

Report: Good Practice in Radiation Exposure Control at the Fukushima Daiichi NPP

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2016 ISOE Asian ALARA Symposium
7th to 8th September 2016, Iwaki, Fukushima, Japan
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Nuclear Safety Research Association



The government-commissioned project by the Ministry of Health, Labour and Welfare (MHLW) of Japan has been implemented since 2013.

The purpose of this project is to provide “correct” information on the radiation workers who are or were engaged in works relating to the TEPCO Fukushima Daiichi NPP accident.

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Ri  or

Misund  standing

With the purpose to contribute to better understanding on health status and work environment of the workers, the MHLW decided to provide “accurate” and the “latest” information to the world in a timely manner.

Make a Website

Send an email

Hold a Workshop

Implemented by
NSRA (2013, 2015,
and 2016)

“Workshop on Radiation Exposure Control at Fukushima Daiichi NPP”

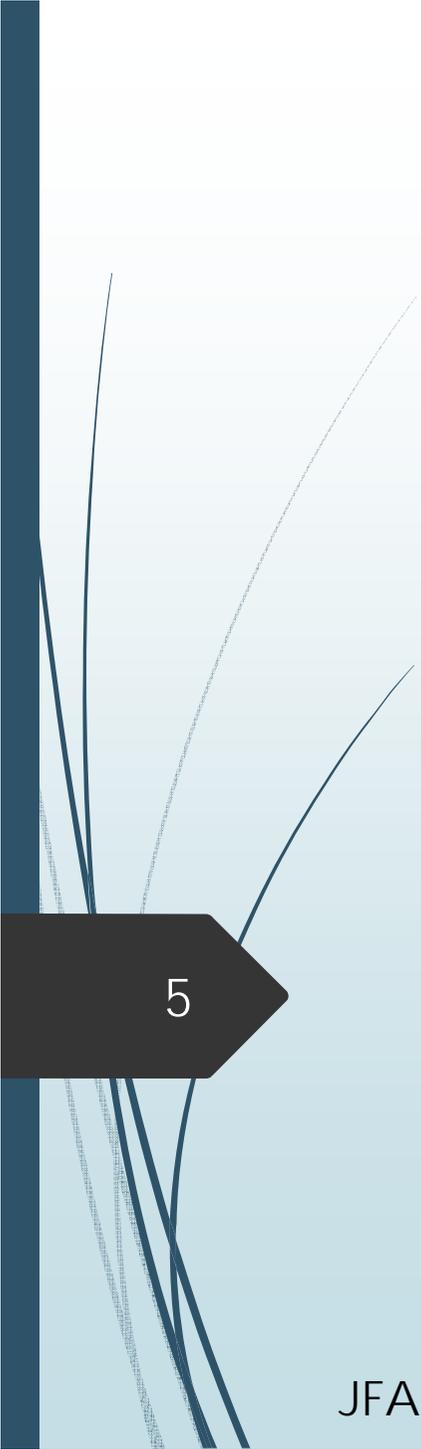
Date: 10th November 2015

Participants: **77**

Tokyo Electric Power Company Incorporated.
(TEPCO), and primary contractors.

(Hitachi-GE Nuclear Energy, Ltd.
Mitsubishi Heavy Industries Ltd.
Toshiba Corporation
Kajima Corporation
Taisei Corporation
Shimizu Corporation)

+ Foreign media



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JFA National Training Center J-Village Convention Hall

Program

Session1

"Improving working environment activities at the Fukushima Daiichi NPP"

"Measures for improving the work environment in the Fukushima Daiichi nuclear power station" (TEPCO)

"Present State & Future Response to TEPCO's Fukushima Daiichi Nuclear Power Station" (TEPCO)

Session2 and 3

"Good activities in radiation exposure reduction, technological research and development"

"Activities concerning radiation control for the treatment of accumulated water at the Fukushima Daiichi NPP" (Hitachi-GE)

"Evaluation of the total exposure reduction measures during construction of the land-side impermeable walls using the frozen soil method" (Kajima)

"Introduction of examples for reducing exposure dose during the decontamination at the reactor building (Fukushima Daiichi NPP unit 3)" (Mitsubishi)

"Dose rate reduction by decontamination of the reactor building at the Fukushima Daiichi NPP Unit 2" (Toshiba)

"Activities to reduce exposure doses during disassembling bolted type tanks" (Taisei)

"Efforts for reducing radiation exposure during facing construction of slope areas" (Shimizu)

“Activities concerning radiation control for the treatment of accumulated water at the Fukushima Daiichi NPP” (Hitachi-GE)

(Construction of facilities for treatment of the accumulated radionuclide-contaminated water)

1) Individual dose control (for key persons).

- Set a target value of the control for each of the workers.
- Allocation of workers considering the dose rate of the work place, etc.

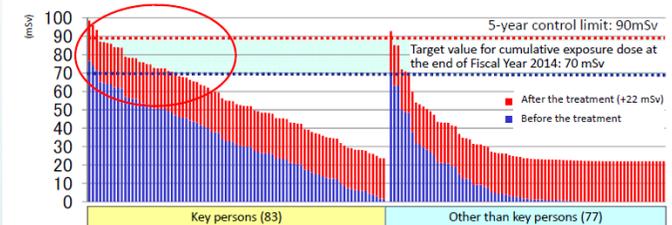
2) Exposure dose reduction with respect to the environment.

- Reduction by modifying design of the constructed facilities (e.g. change of piping routes).
- Reduction by improving methods (e.g. employing a remote monitoring method).
- Reduction by utilizing shielding (e.g. installing shielding).
- Other measures (e.g. visualization).

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4. Exposure dose reduction measures for key persons HITACHI

Cumulative exposure dose by workers: After the treatment (expected for group leaders)
Assuming that all workers uniformly receive dose from the treatment (+22 mSv/worker)



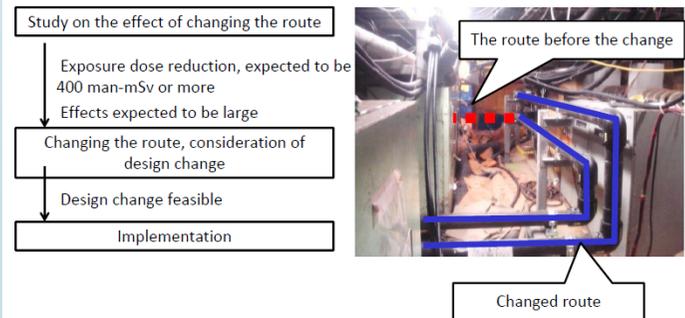
	Key persons	Other than key persons
No. of workers	83	77
90 mSv <	3	1
70 mSv <	24	6

Cumulative exposure dose, exceeding 70 mSv for many group leaders as well.

4.2 Measures for exposure dose reduction HITACHI

① Implementation of exposure reduction measures (Reduction by design modification)

Change of piping routes at the Matsuno-roka (corridor) in T/B of Unit 1



Significant exposure dose reduction. Reduced by about 510 man-mSv.

“Evaluation of the total exposure reduction measures during construction of the land-side impermeable walls using the frozen soil method” (Kajima)

(Construction of the land-side impermeable walls using the frozen soil method)

- 1) Implementation of the measure for radiation exposure reduction.
 - Measures to reduce the air dose rate.
 - Measures to shorten working ours by improvement of the construction methods.

Implementation of the measure for radiation exposure reduction (1): 3-Block Areas

Reduction measure: Crushed stone pavement and installation of L-shaped protective walls



Before the measure (Radiation sources: Ground surface/left side building)

Air dose rate:
1.0 - 2.0 mSv/h



After the measure (At the work area protected by the L-shaped protective walls)

Air dose rate:
0.2 - 0.3mSv/h
(Reduced to 1/5 - 1/6)

Measures for improvement in work efficiency (3)

Amount of reduced exposure dose by automated welding of freezing pipes

Data for Calculation	Values	Note
Dose rate (mSv/h)	a 0.13	•Reduction of work hours, attempted by automated welding for connecting freezing pipes. (Reduction of Work Hours per One Freezing Pipe) •Welding by humans: 30 min/joint; Automated welding: 20 min/joint •No. of joints: 2 joints/pipe; Reduction of hours: (30 min - 20 min)*2=20 min/pipe
Reduction of hours (min./pipe)	b 20	
Number of workers (man/day)	d 100	
No. of pipes	c 1500	
Rate (pipe/day)	e 8	
Reduced amt. of exp. rate(man*mSv)	Eq.: $0.13 \text{ mSv/h} \times 20/60 \text{ h} \times 100 \text{ man/day} \times 1500 \div 8/\text{day} = 813 \text{ man}^* \text{ mSv}$	



2) Evaluation.

- Evaluation of the reduction of the total exposure dose (based on a quantitative analysis of the trade-off between “exposure dose” and “prevented potential exposure dose”.

“Introduction of examples for reducing exposure dose during the decontamination at the reactor building (Fukushima Daiichi NPP unit 3)” (Mitsubishi)

(Decontamination of the reactor buildings)

1) Development of remote decontamination technology in the reactor building.

- Reduction of the work load of the workers for the cables and hoses.
- Development and utilization of wheeled platforms.

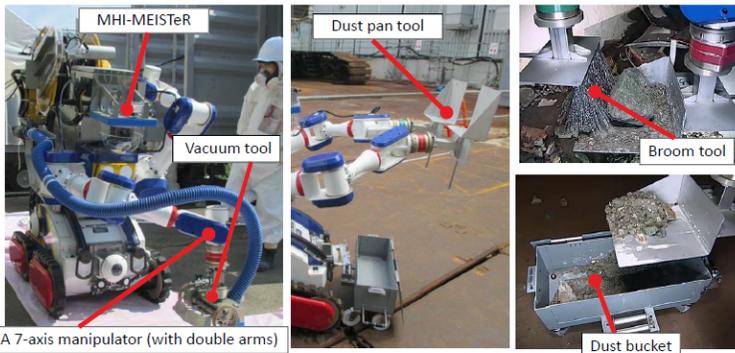
Overview of the work [Tools]



MHI Technical Document: Class B

MHI-MEISTeR

Developed as a work robot with double arms, utilized in both [the contamination survey](#) and [decontamination](#) in 1F (at the reactor building).



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Causes of and measures against radiation exposure ① 3/3



MHI Technical Document: Class B

Supporting hoses



A suction hose and the wheeled platform

Supporting hoses required during the work is a cause of radiation exposure.



Development and utilization of wheeled platforms to relieve the work load for workers supporting the hoses, etc.

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2) Information exchange.

- information on the rest facilities and areas of low radiation was mutually shared.

“Dose rate reduction by decontamination of the reactor building at the Fukushima Daiichi NPP Unit 2” (Toshiba)

(Decontamination of the reactor buildings)

1) Decontamination of the reactor building using a remote handled decontamination machine.

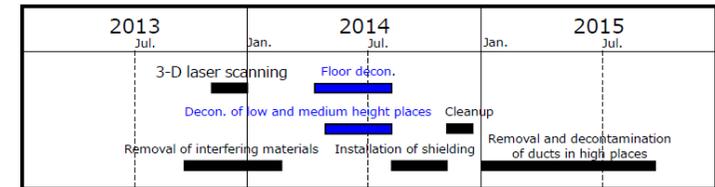
- Removal of interfering objects.
- 3D laser scanning.
- Decontamination of floor, and low and medium height places.
- Installation of shielding
- Cleanup
- Removal of ducts in high places

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2) Confirmation of the decontamination results.

- The dose rate at the floor has been reduced by 40% or more.

3. Decontamination results (decontamination of the floor and low and medium height places)



Floor decontamination with a remote handled decontamination machine, decontamination by mechanical wiping and suction for medium height places. Decontamination by wiping by workers for narrow areas, walls, and other structural components.



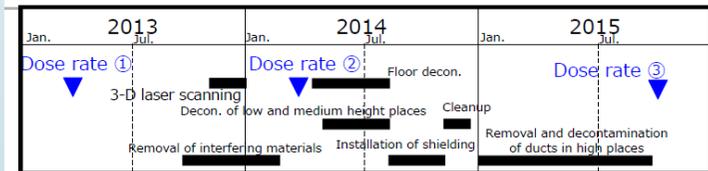
Developed by ATOX, Ltd. Remote handled decontamination machines (for floors, and low and medium height places).

Wiping by workers

TOSHIBA
Leading Innovation >>>

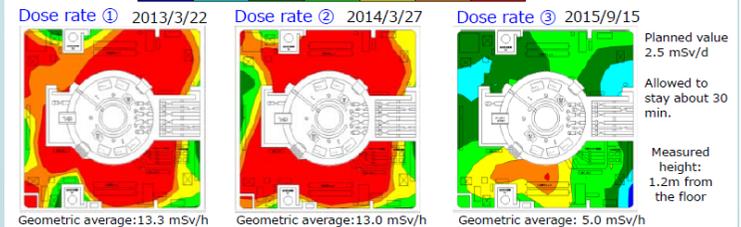
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4. Confirmation of the decontamination results



The dose rate at the floor has been reduced by 40% or more even when considering the radioactive decay of the radiation source.

0 2 4 6 8 10 12 mSv/h



TOSHIBA
Leading Innovation >>>

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“Activities to reduce exposure doses during disassembling bolted type tanks” (Taisei)

(Development of the balloon-type temporary roof)

1) Shortening of working hours by development of a balloon-type temporary roof.

-Development and installation of balloon-type temporary roof which can be put into place immediately using a crane.

1. Shortening of working hours by the development of a balloon-type temporary roof

A light weighted balloon type temporary roof allowed lifting a whole roof at once using a crane, leading to the significant shortening of the roof installation/removal working hours, resulting in the reduction of the exposure dose of workers.



Weight of a roof = 300 kg/unit

Balloon blower (Pressurizer)



2) Installation of shielding materials for work inside the tank.

-Installation of rubber mat on the floor and composite panels on the wall.

3. Installation of shielding materials for the work inside the tank

Shielding materials are provided (mainly against beta rays) before workers enter inside of the tank because the inner surface of the tank is severely contaminated .

Shielded conditions (Whole view)



A rubber sheet (to shield radiation from the bottom)



Composite panels (to shield from radiation from the wall)



“Efforts for reducing radiation exposure during facing construction of slope areas” (Shimizu)

(Weeding, topsoil stripping, shotcrete for facing construction of slope area)

1) Remote recovery of debris using a large magnet.

-Collection of debris using a lifting magnet equipped with a strong magnet.

2) Automated RCM (Rock Climbing Machine).

-Topsoil stripping conducted by a remotely operated RCM in high radiation areas.

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3.1 Outline of exposure reduction measures - Engineering measures - 8

Engineering measures ③ Improving efficiency

■ Removal of debris using lifting magnets

Efficient removal of high radiation debris left on the slope using lifting magnets

Debris

- Consist of many steel outer wall of buildings including those highly contaminated
- Distributed widely on the slope near the buildings of Unit 1 to Unit 2 (Zone③-⑤)

Attempted to increase efficiency in the collection of the widely distributed debris using a magnet lifted by a crane. Moreover, remote recovery contributed to radiation exposure reduction.

* The lifting magnets are used in general for transporting iron scrap at the iron-making factories, etc.



Efforts for Reducing Radiation Exposure during the Facing Construction of Slope Areas

子どもたちに誇れることを。清水建設

3.1 Outline of exposure reduction measures - Engineering measures - 9

Engineering measures ④ Automation

■ Topsoil stripping by remotely operated RCM(Rock Climbing Machine)

Topsoil stripping was conducted by remotely operated RCM in the high radiation areas. (west side from the buildings Unit 1 to Unit 2).

Radiation exposure dose of the RCM operator is high in the high radiation areas.

Remote operation of the RCM. The operator handled the RCM remotely from a low radiation area with the assistance of a camera installed at the driving seat of the RCM, which contributed to radiation exposure reduction.



Efforts for Reducing Radiation Exposure during the Facing Construction of Slope Areas

子どもたちに誇れることを。清水建設

In Focus: Radiation Protection at Works Relating to TEPCO's Fukushima Daiichi Nuclear Power Plant Accident (IRPW)



What's New

- Jun 30, '16 [Exposure Dose Distribution of the Workers at Fukushima Daiichi Nuclear Power Plant \(Updated on 30 Jun 2016\)](#)
- Jun 24, '16 [Start of a weekly on-site consultation desk to address health matters of decommissioning workers, etc.](#)
- Apr 22, '16 [Dose distribution among workers engaged in decontamination and related works, etc., per quarter \(Flash report\) \[From January 2015 to December 2015\] \(by Radiation Effects Association\)](#)
- Apr 13, '16 [Results of supervision and instruction activities for employers of decommissioning and decontamination workers at the TEPCO Fukushima Daiichi Nuclear Power Plant \(in 2015\)](#)

TEPCO Fukushima Daiichi NPP

The status on the exposure dose, health care management and radiation protection of the workers at Fukushima Daiichi Nuclear Power Plant are shown.

- [Status of Radiation Exposure](#)
- [Radiation Protection](#)

Decontamination/Remediation

The status on radiation protection of the workers engaged in decontamination and remediation of contaminated materials derived from Fukushima Daiichi NPP Accident are shown.

- [Decontamination/Remediation](#)

Links

- ▶ **Japanese Government**
 - [Prime Minister of Japan and His Cabinet](#)
 - [Ministry of the Environment](#)
 - [Reconstruction Agency](#)
 - [Agency for Natural Resources and Energy](#)
 - [Nuclear Regulation Authority](#)
- ▶ **International Organization**
 - [ILO:International Labour Organization](#)
 - [WHO:World Health Organization](#)
 - [UNSCEAR:United Nations Scientific Committee on the Effects of Atomic Radiation](#)
 - [IAEA:International Atomic Energy Agency](#)

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Good Practices in Radiation Exposure Control at the Fukushima Daiichi NPP

This page introduces good practices implemented by TEPCO and primary contractors related to radiation exposure dose management, exposure reduction and health management at TEPCO's Fukushima Daiichi NPP.

To collect and facilitate the sharing of information about good practices, the Workshop on Radiation Exposure Control at the Fukushima Daiichi NPP was held in cooperation with TEPCO and primary contractors at J-Village in Futaba County, Fukushima Prefecture on 10 November 2015.

The workshop consisted of three sessions: (i) improving working environment activities, (ii) radiation exposure reduction, and (iii) technological research and development. Presentations were given by TEPCO and primary contractors, followed by an exchange of opinions between participants and experts.

The details of the presentations are compiled and introduced below.

Session1: Improving working environment activities at the Fukushima Daiichi NPP

Initiatives for improving the working environment in the Fukushima Daiichi NPP
Tokyo Electric Power Company, Incorporated.

Abstract PDF 18KB

Presentation material 1 PDF 4537KB

Presentation material 2 PDF 5017KB

Session2: Good practices in radiation exposure reduction.

Activities concerning radiation control for the treatment of accumulated water at the Fukushima Daiichi NPP
Hitachi-GE Nuclear Energy, Ltd.

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http://www.mhlw.go.jp/english/topics/2011eq/workers/tepco/gre/gre_151111.html

http://www.mhlw.go.jp/english/topics/2011eq/workers/ri/gr/gr_160131.pdf

