

Radiation Dose Registration System for Decontamination Works and Dose Distribution of Workers

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A radiation dose registration system was established for workers engaged in decontamination and related works in areas contaminated by radioactive material discharged during the accident at the Fukushima Daiichi Nuclear Power Plant operated by the Tokyo Electric Power Co., Inc. The system has been operated by the managing body, the Radiation Dose Registration Center of the Radiation Effects Association, which periodically receive radiation dose records from the decontamination contractors. This paper reports an overview of the radiation dose registration system for workers engaged in decontamination and other works; the established work of the dose registration; and the statistics of the radiation dose of the workers based on the registered data.

KEYWORDS: *Radiation dose, Decontamination worker, Dose registration system*

I. Introduction

Decontamination and other related works have been implemented in areas contaminated by radioactive materials discharged during the Fukushima Daiichi Nuclear Power Plant Accident, which occurred after the Great East Japan earthquake. The radiation dose of the workers engaging in decontamination and other related tasks is managed by each contractor responsible for those tasks (hereinafter called “decontamination contractor”) based on laws and ordinances. However, the workers often move from one contractor to another. Therefore, it is necessary to have one organization that centrally manages the radiation dose data recorded by each contractor so that the radiation dose of each worker can be easily controlled. In August 2013, the decontamination contractors established a “Committee for the Establishment of Radiation Dose Registration System for Decontamination and Related Works” and agreed to establish a system for decontamination works, similar to a “Radiation Passbook System” or a “Radiation dose registration system for nuclear workers” (hereinafter called the “nuclear worker registration system”) implemented for the workers such as those in nuclear power plants.¹⁾ As a result, the “Radiation dose registration system for radiation dose of workers

engaged in decontamination and other related works” (hereinafter called the “decontamination worker registration system”) was established on November 15, 2013, to manage the radiation dose of the workers.

An overview of the implementation of the radiation dose registration system and the radiation passbook, which are combined into the nuclear worker registration system and the decontamination worker registration system, is shown in **Figure 1**.

In the decontamination registration system, the Radiation Dose Registration Center of the Radiation Effects Association (hereinafter called “RADREC”) is the operating body. It is used to register the radiation dose and other information related to the workers engaging in decontamination and other related projects in the database, and stores and manages the data over a long term. The registered information is commonly used for inquiries related to the radiation dose and for other purposes by decontamination contractors who participated in the system, the radiation passbook issuing organization, and the nuclear operators (the radiation workers are defined as the workers who have engaged in the decontamination and other related work) to use worker-related radiation dose management.

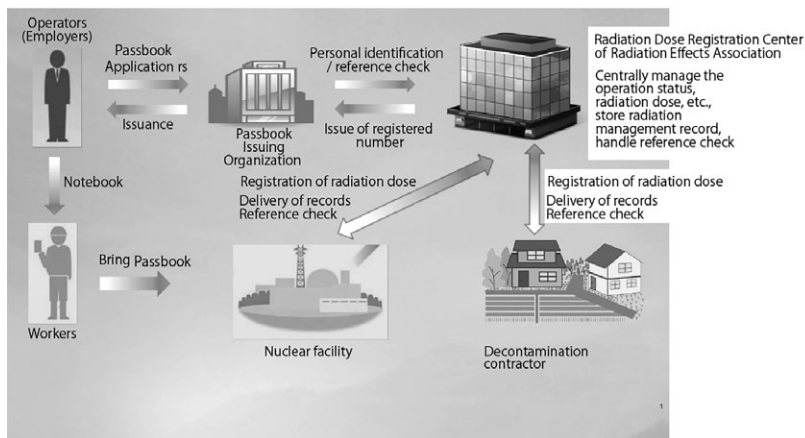


Figure 1 Implementation of the radiation dose registration management system and radiation management notebook

II. Overview of the Decontamination Registration System

To establish the decontamination worker registration system, the existing nuclear worker registration system was used as reference. The following features related to the decontamination and related work were also considered.

- 1) Since the decontamination and related works are performed by the contractors, who have little or no experience in radiation protection, it is important for the contractors to recognize the needs of the system and properly understand the implementation methods of the system.
- 2) Major construction companies have become the primary contractors for the full-scale decontamination projects commissioned by the national government, while small companies and joint ventures, etc., have become the original contractors for the projects ordered by the local government. Therefore, many companies are expected to participate in the system.

- 3) The duration of the decontamination projects is relatively short (1 to 2 years), and there are cases in which the workplace is closed after the projects are completed. Taking this into consideration, it is necessary that the registration of radiation dose during the projects and the delivery of records after the decontamination and related work are securely performed.
- 4) Some workers engage in the decontamination and related projects while moving around to multiple contractors or workplaces, and some others go to, and come from, nuclear facilities and decontamination and related workplaces within a short period. Therefore, it is necessary to check the past records of the radiation doses at each movement.

1. Scope of the System

The decontamination registration system is intended for primary contractors engaging in the following work: “decontamination,” “collection of the waste,” and “handling designated contaminated soil and waste,” as specified in paragraph 7 of Article 2 of the Ionizing Radiation Ordinance for Decontamination²⁾; “works under the designated dose rate” in paragraph 8 of the Ionizing Radiation Ordinance for Decontamination; and the projects concerning the disposal of accident-derived waste, which is included in the “Radiation work” in paragraph 3 of Article 2 of the Ionizing Radiation Ordinance³⁾ (These operations are collectively known as “decontamination-related projects.” The workers engaging in the decontamination-related projects are called “workers engaging in decontamination-related work.”).

In the guidelines for the prevention of radiation hazard for workers engaging in decontamination projects,^{4,5)} the primary contractors shall designate a radiation protection manager and compile the radiation dose of the workers with the subcontractors (the employers working under the primary contractors). As the subcontractors are not always familiar with radiation works, the primary contractors are expected to participate in the radiation dose registration system for decontamination projects.

In the decontamination worker registration system, the primary contractors participating in the system shall perform the items listed in the right column of **Table 1** depending on the classification of the project.

The following provision was specified for primary contractors in the aforementioned guidelines in accordance with the establishment of the decontamination worker registration system; “Participate in the Organization for Registration Control of Radiation Exposure Doses for Decontamination and Related Works to accurately determine the accumulated exposure

Table 1 Items to be implemented depending on the project classification

Classification of decontamination operations, etc.	Items for participation in decontamination worker registration system
Decontamination-related projects in the special decontamination area	i) Acquisition and use of radiation passbook ii) Project site registration, periodical dose registration (quarterly) iii) Reference check (past radiation dose records, etc.) iv) Submission of radiation dose and medical examination records for ionizing radiation work (at the time of project completion)
Decontamination-related projects other than the special decontamination area	i) Submission of radiation dose and medical examination records for ionizing radiation work (at the time of project completion)
Projects regarding the disposal, etc., of waste originating from an accident (inside and outside of the special decontamination area)	i) Acquisition and use of radiation passbook ii) Project site registration, periodical dose registration (every quarter) iii) Reference check (past radiation dose record, etc.) iv) Submission of radiation dose and medical examination records for ionizing radiation work (at the time of project completion)

doses of workers and prevent exposure dose records from getting scattered or lost.

2. Framework of the Decontamination Registration System

(1) Acquisition of Radiation Passbook

The primary contractor of the decontamination projects and the subcontractor in charge of the management of radiation work shall implement the following: applying for issuance of radiation passbooks for workers engaging in decontamination work and recording the radiation dose on the radiation passbook.

(2) Registration of Work Site and Periodical Dose

The primary contractor shall register the name of the work site established for decontamination projects, the operation job name, and other such details into the decontamination worker registration system for each work site.

The primary contractor shall also register, on a quarterly basis, the following information (periodical dose registration) in the decontamination worker registration system within three months of the last day of the quarter:

- a. Personal identification
- b. Information about the project (the name of the project, start and end date of work, etc.)
- c. Radiation dose (effective dose)

(3) Submission of the Legal Record

The primary contractors shall submit the radiation dose records and the ionizing medical examination records for the workers engaging in decontamination work, in accordance with laws and ordinances, to the decontamination worker registration system within three months of the end of the term of the decontamination projects.

The decontamination worker registration system stores the delivered records on the microfilm for a long time.

(4) Personal History Inquiry and Disclosure Request

The primary contractor can inquire about the radiation dose of the workers engaging in the decontamination work registered in the decontamination worker registration system and the content of the stored records. In this case, for data sharing, the primary contractor can also inquire about data and records regarding the radiation dose, etc., that other primary contractors participating in the decontamination worker registration system have registered.

The worker can also make a disclosure request about his or her own data and the record of the radiation dose, etc.

(5) System Used for Registration

In the beginning, when the decontamination worker registration system was established, a stand-alone PC was tentatively used to register the work site name, the project name, the periodical dose, and other related information. Starting on December 8, 2014, it is now possible to make, for example, online inquiries about the radiation dose of the workers engaging in decontamination work via the Internet from the exclusive terminal of the participating contractors using the system developed for the decontamination registration system.

3. Cross Referencing with the Nuclear Worker Registration System

The radiation dose registration system intended for workers engaging in radiation work

in nuclear facilities started in November 1977, and the radiation dose has been centrally managed for more than 35 years along with the radiation passbook system.

Some workers often move between both nuclear facilities and decontamination project sites to engage in radiation work. Therefore, every time they start working in nuclear facilities or decontamination project sites, the radiation dose until that point (past dose record) and other related information should be confirmed.

For this reason, in order for the participating contractors in the decontamination worker registration system and the nuclear worker registration system to be able to confirm each respective information regarding the radiation dose and other such related information related to the workers, the following systems were established.

- a. Using the terminal, nuclear operators can make inquiries about the information such as the radiation dose and other related information registered in the decontamination registration system, providing the information only about the workers engaging in radiation work in own nuclear facilities.
- b. Using the terminal, decontamination contractors can enquire about the radiation dose and other related information registered in the nuclear worker registration system, providing the information only about workers engaging in radiation work at their own work sites.
- c. The radiation passbook issuing organization can make inquiries, using the terminal, about the information registered in the nuclear worker registration system and the decontamination worker registration system.

The relations between the decontamination worker registration system and the nuclear worker registration system are shown in **Figure 2**.

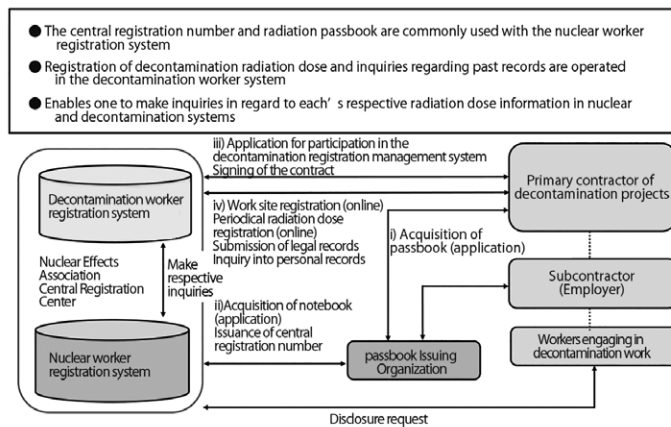


Figure 2 Relations between the decontamination worker registration system and the nuclear worker registration system

III. Implementation of the Registration System

The status of each registration and submission of the records in the decontamination worker registration system is shown in **Table 2**.

As of the end of March 2015, there were 160 operators participating in the decontamination worker registration system (operators registering the periodical doses and submitting the

records: 49; operators performing submission only: 111).

In addition, the registration of the periodical dose is conducted on a quarterly basis in the decontamination worker registration system and the cumulative registration by the end of March 2015 was 132,306 records.

Further, there were 11,226 submitted records, which were sequentially microfilmed from electronic images (records in paper-form were scanned to create the electronic image). These microfilms are stored as the original.

The information registered in the decontamination worker registration system and the nuclear worker registration system can be mutually inquired into, and there were 6,809 inquiries as of the end of March 2015.

Table 2 Status of each registration, etc., in the decontamination registration management system

	Item	Number of registrations, etc.
Number of participating contractors	Periodical dose registration and submission of records	49 ⁱ
	Submission of records only	111 ⁱ
Project site registration		154 ⁱ
Registration of the name of operation		281 ⁱ
Registration of periodical dose (quarterly basis)		132,306 ⁱⁱ
Submission of the records		11,226 ⁱⁱ

i Number of enrollments or registrations at the end of March 2015.

ii Cumulative number by the end of March 2015.

IV. Radiation Dose of the Workers Engaging in Decontamination Work

The radiation dose distribution and relevance to dose limit of workers engaging in decontamination work can be confirmed by statistical data using the periodical dose registered in the decontamination worker registration system.

1. Data Processing Method

(1) Personal Data Processing

The dose of each worker was processed based on their personal identification number (central registration number).

(2) Dose Processing Method

The radiation dose in 2011 was added to the 2012 statistics to create a dose distribution table in accordance with the treatment of the dose stipulated in the guideline by the Ministry of Health, Labor and Welfare⁴⁾ (The dosages received from March 11 to December 1, 2011, were considered as those received on January 1, 2012, and added) to compare with the dose limits prescribed in the Ionizing Radiation Ordinance for Decontamination.

(3) Period of the Annual Dose

The period of the annual radiation dose is from January 1 to December 31 of the corresponding year (calendar year).

2. Statistical Data

The distribution of the annual radiation dose of the workers engaging in decontamination work from 2012 and 2013 is shown in **Table 3**.

In the 2012 statistical data, the total number of workers was 11,058, the average radiation dose was 0.5 mSv, the maximum dose of individual was 13.9 mSv, and the total dose was 5,226.0 man-mSv.

The radiation dose administered during the decontamination pilot project for the period of 2011–2012 is included in the dose statistics⁶⁾. Note that 90.3% of workers' radiation doses were 1 mSv or less.

In 2013, the total number of workers was 20,564, the average radiation dose was 0.5 mSv, the maximum dose of individuals was 6.7 mSv, and the total dose was 10,719.8 man-mSv. Note that 85.4% of workers' radiation doses were 1 mSv or less.

Note that the annual radiation dose of the workers engaging in decontamination work in 2012 and 2013 was less than the dose limit (50m Sv/year) specified in the Ionizing Radiation Ordinance for Decontamination. Furthermore, the annual average dose was 0.5 mSv, which is less than half the average dose of the radiation workers in nuclear facilities in 2009 (1.1 mSv⁷⁾) before the accident at the Tokyo Electric Power Co., Fukushima Daiichi Nuclear Power Plant.

Table 3 Radiation Dose Distribution of workers engaging in decontamination work (Number of Workers and Percentage)

Year	≤1 mSv	1 < and ≤3 mSv	3 < and ≤5 mSv	5 < and ≤10 mSv	10 < and ≤15 mSv	15 < and ≤20 mSv	20 mSv <	Total (Number of Workers)	Total Dose (man-mSv)	Average Dose (mSv)	Max Dose (mSv)
2012	9,989	738	169	130	32	0	0	11,058	5,226.0	0.5	13.9
	90.3%	6.7%	1.5%	1.2%	0.3%	0%	0%				
2013	17,569	2,787	168	40	0	0	0	20,564	10,719.8	0.5	6.7
	85.4%	13.6%	0.8%	0.2%	0%	0%	0%				

(Data registered by March 30, 2015)

V. Summary

Through the establishment of the decontamination registration system, the information that was previously managed by each primary contractors and subcontractor of the decontamination projects, such as the radiation dose of workers engaging in decontamination work, is now centrally registered and maintained in the RADREC database. The system has also made it possible to centrally manage each person's radiation dose together with the dose received in nuclear facilities and to handle inquiries. It is also possible to store and manage the radiation dose records and ionizing medical examination records for a significant period, which can prevent the loss of records.

To properly operate the decontamination registration system, it is necessary to spread awareness regarding the importance of the system, not only among the primary contractors participating in the system but also among the many subcontractors. It is also necessary to try to refine and improve the functionality and operability of the registration system so that the dose registration and delivery of records from the participating contractors are promptly and reliably performed. It is further necessary to make efforts to reliably operate the radiation passbook (issuance of the passbook; entry to the passbook; and return of the passbook to the

worker when the project is completed, or he or she leaves the job).

In the decontamination projects, the radiation dose of the workers is managed based on the operational plan and the management regime of each project. However, the radiation dose of the workers in decontamination projects changes depending on the plan and goal of the project (reducing the dose), the form and the method of the operation, and environmental conditions (ambient dose rate). The statistical data regarding the radiation dose distribution and other parameters of the workers engaging in decontamination works will continue to be published in the future. The authors expect that the results will be reflected in the radiation management in the decontamination projects.

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