



## Occupational Radiation Epidemiology Based on Central Dose Registry of Japan

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### THE RADIATION DOSE REGISTRATION CENTER FOR WORKERS

*Background of the establishment of the Radiation Dose Registration Center for Workers (RADREC)*

RADIATION EXPOSURE of workers at nuclear facilities is controlled by the managing bodies (nuclear institutions) under the Law for the Regulation of Nuclear Source Material, Nuclear Fuel and Reactor. In many cases, however, periodical inspection and repair work of nuclear facilities are performed by employees or contractors who are engaged in such jobs at several different facilities.

It seemed difficult to obtain accurate information on the lifetime radiation doses of individuals as the number of nuclear facilities increased. In order to overcome this difficulty, a new nationwide system was required.

In May 1965, the Advisory Committee on Nuclear Damage Compensation for Employees in the Atomic Energy Commission pointed out the need for such a system, and the STA proposed a dose registration system covering all radiation workers in radioisotope handling facilities. However, this system had long been left outstanding because of the difficulty of establishing a system covering all radiation facilities. In July 1975, the Advisory Committee again urged the Government to enforce an effective registration system. The Science and Technology Agency (STA) decided that the registration system should be enforced to cover nuclear facilities only, and set up a task group to study the system in the Agency.

In November 1977, the task group reported on the composition and management of the radiation dose registration and control system. The group concluded the system should also use the radiation dose record booklets for workers, with some modification, which had long been used by contractors to control individual doses.

The RADREC was established in November 1977 in the REA to play a central role in the above system [1]. In January 1978, the RADREC was designated by the Government as the central organisation for companies and

booklet-issuing agencies. The relationships between the RADREC and nuclear institutions, and the booklet-issuing agencies and employees are shown in the Figure 1.

### *Methods of information management*

The main activity of the RADREC is to deal with compilation and filing of information supplied from the nuclear facilities throughout the country and to provide quick replies to inquiries. Information is stored mainly in the computer of an external information managing company. A terminal is installed at the RADREC office and necessary data can be retrieved at any time.

Individual workers' radiation dose records are obligated by the Law to be kept permanently. Therefore, the dose records of the workers who have terminated their radiation work at nuclear facilities are submitted to the RADREC for preservation, and then the original records are registered in the computer system with a sequential number and microfilm. A set of microfilm copies is kept at the RADREC and can be referred to upon inquiry. Another set of microfilm copies and original records are stored at different places from the RADREC office so as to prevent them from being lost in case of natural disasters.

A means of communication between the RADREC and nuclear facilities is facsimile or registered mail. Day-to-day registration work is carried out mainly by facsimile.

### *Main functions*

The RADREC's main functions are as follows:

1. Registration of identification items of workers;
2. Registration of engagement and termination records of workers;
3. Registration and preservation of radiation dose records of workers; and
4. Replies to inquiries about the records.

*Registration of workers' IDs.* Workers' ID items have to be registered at the RADREC before they start work at nuclear facilities and they are given unique ID numbers by the RADREC.

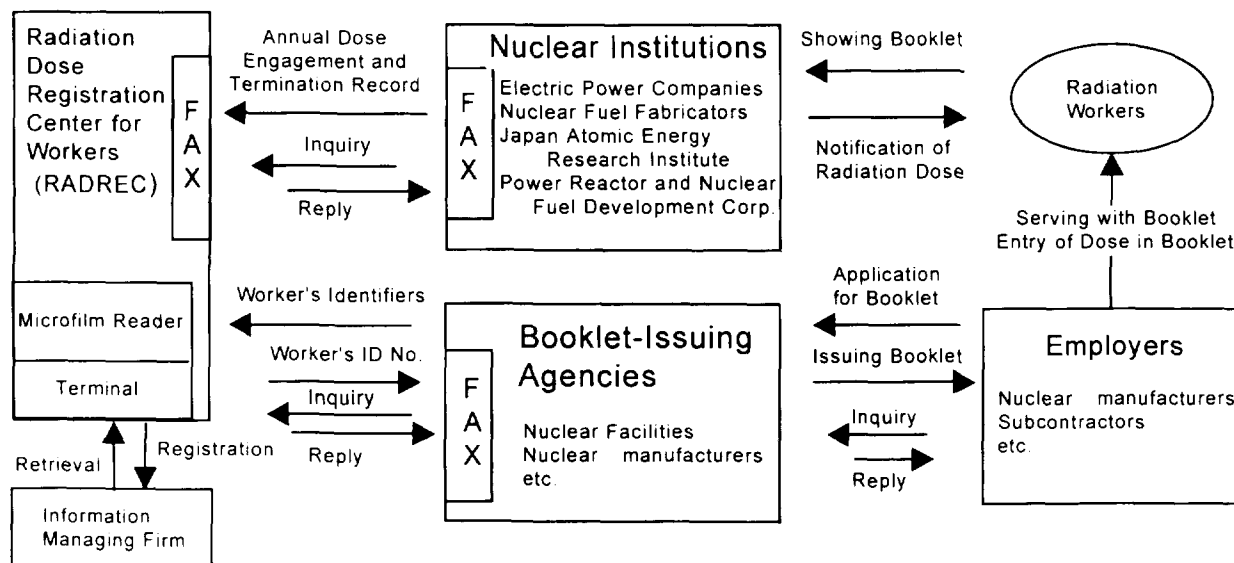


Figure 1. Flow diagram of radiation dose registration systems.

*Registration of engagement and termination records of workers.* All nuclear institutions are required to register at the RADREC the dates when a worker starts and terminates radiation work. The date of the worker's termination and the radiation dose record for the working period is registered in the computer. This registration gives information on the engagement of workers in radiation work and changes of their workplaces.

*Registration of annual doses.* Annual radiation doses of all workers are reported by the facilities and registered at the RADREC once a year. The media of the report is magnetic tapes or floppy disks. An example of annual dose distribution of workers by the number of workplaces is shown in Table 1.

*Replies to inquiries.* Collected information is available when necessary, but it is provided only for the purpose of radiation exposure control in order to protect the workers' privacy.

#### *The radiation dose record booklet system*

Any radiation worker who wishes to work at a nuclear facility must show his or her radiation dose record booklet. This system enables the facility to identify the bearer of the booklet, and to obtain information on previous records as a

radiation worker. Further, this booklet makes it possible for a worker to confirm his or her own radiation dose. The form of the booklet is nationally unified, as designated by the RADREC. Items included in the booklet are 'Certificate of radiation work by employer', 'Records of exposure to radiation', 'Records of work done outside of employer's main workplaces', 'Results of medical checkup' and 'Radiation protection training'.

The booklet is issued by a booklet-issuing agency after the worker's identification items are registered at the RADREC and identification number is notified.

#### *Management costs*

Funds for the management of the RADREC were partially met by the Government for the initial three years. Now, the system is operated by contributions from nuclear institutions according to the principle that the users should bear the cost.

#### *Registration system for radioisotope users*

This is the system of radiation dose registration for licensed users of radioisotopes and/or radiation. In October 1984, the RADREC was designated by the Government as an organisation to preserve the records of exposure dose for

Table 1. Annual dose distribution of workers by the number of workplaces (April 1990 – March 1991)

Range: mSv/y	No. of workplaces						Total (%)
	1	2	3	4	5	Over 6	
≤5	36,775	5940	1812	552	140	52	45,271 (88.7)
5 ~ 20	2542	1640	732	247	58	25	5244 (10.3)
20 ~ 30	144	202	107	41	10	0	504 (1.0)
30 ~ 50	0	0	0	0	0	0	0 (0.0)
50 <	0	0	0	0	0	0	0 (0.0)
Total							
no. of workers (%)	39,461 (77.3)	7782 (15.3)	2651 (5.2)	840 (1.6)	208 (0.4)	77 (0.2)	51,019 (100.0)
Average dose per worker (mSv/y: person)	1.1	3.5	4.8	5.3	5.0	4.0	1.8

Values in parentheses: the percentage of the total number of workers.

radiation workers who have worked as the licensed users of radioisotopes etc.

The features of such radiation workers are as follows:

- (a) migration of workers is rare; and
- (b) exposure dose of most workers is below detectable levels.

The main purpose of this system is preservation of the records of radiation doses and medical examinations of workers at the facilities that discontinued to use radioisotopes etc. The following services are provided for the radioisotope users who voluntarily have contracts with the RADREC: (a) registration and preservation of radiation dose records of workers; and (b) replies to inquiries about records.

Communication with the users is done mostly through the mail. At present, the total number of participating users is 31, which is comprised mostly of non-destructive testing companies, several research institutes and a few foundations.

### EPIDEMIOLOGIC HEALTH STUDY OF RADIATION WORKERS IN THE JAPANESE NUCLEAR INDUSTRY

#### *Purpose of the study*

The objectives of the study are to investigate mortality rates and causes of death among nuclear industry workers in order to reveal the health effects of low-level radiation [2, 3]. For this purpose, the Institute of Radiation Epidemiology (IRE) was established in November 1990 as an organisation in the Radiation Effects Association (REA), a non-profit organisation that conducts research into the effects of radiation exposure and runs a radiation dose registration service (RADREC). The study is funded by the government on a contract with the Science and Technology Agency (STA).

#### *Subjects of the study*

During the first five-year period, the survey will focus upon a mortality study of a group of 230,000 workers registered at the RADREC up to the end of the 1988 fiscal year (March 1989).

#### *Method of the follow-up*

With the co-operation of relevant government bodies and nuclear facilities, an attempt has been made to integrate the following information, which has been stored separately:

1. individual names, dates of birth and annual exposure doses collected by the RADREC from nuclear power stations and other nuclear facilities throughout Japan;
2. present addresses of the workers available at the facility where they work or have worked;
3. vital status information of workers from the local government office in the area where they have registered residence;
4. individual causes of death from the national vital statistics of the population; and
5. radiation doses registered at the RADREC.

As of the end of the 1988 fiscal year (March 1989), a total of approximately 230,000 workers have been registered at the RADREC. When the registration system was estab-

lished in 1978, all the data concerning radiation exposure of workers kept at nuclear power stations, etc., including such data monitored prior to that date (the oldest exposure dated back to 1957), were transferred to the RADREC. Only 1% of the group proved to have been exposed to a cumulative dose larger than 100 mSv. The exposure data up to the end of the 1988 fiscal year are supposed to be used in this study.

*Vital statistics data.* Vital statistics data are compiled in accordance with the Statistics Act, as a means of investigating population change caused by births, deaths, marriages and divorces. All the results of the surveys have been stored in the computer database since 1972. In the case of deaths, underlying causes of death (ICD codes) are recorded.

*Procedures of data collection.* The details of this are given below.

1. To obtain workers' current or last known addresses available at the nuclear facilities where they work or have worked. (The names of the relevant facilities and most of the start dates of engagement of the workers can be identified by the RADREC computer file.)
2. To obtain copies of resident cards of workers from public offices of villages, towns or cities where they have registered their addresses in order to determine the workers' vital status: whether they are still living or dead, or have moved anywhere else. If a person has moved in the last five years, the local authorities in the former place of residence can provide the person's new address.
3. To obtain copies of resident cards of the workers who have moved from public offices of the local communities to which they have moved.
4. To obtain underlying causes of death by matching sex, date of birth, date of death and place of death on the magnetic tapes of vital statistics.

*Protection of privacy.* The privacy of information of these employees and former employees is protected in accordance with Law No.95, 1988. In addition, the IRE Human Rights Committee is closely supervising the activities of the IRE from such a standpoint.

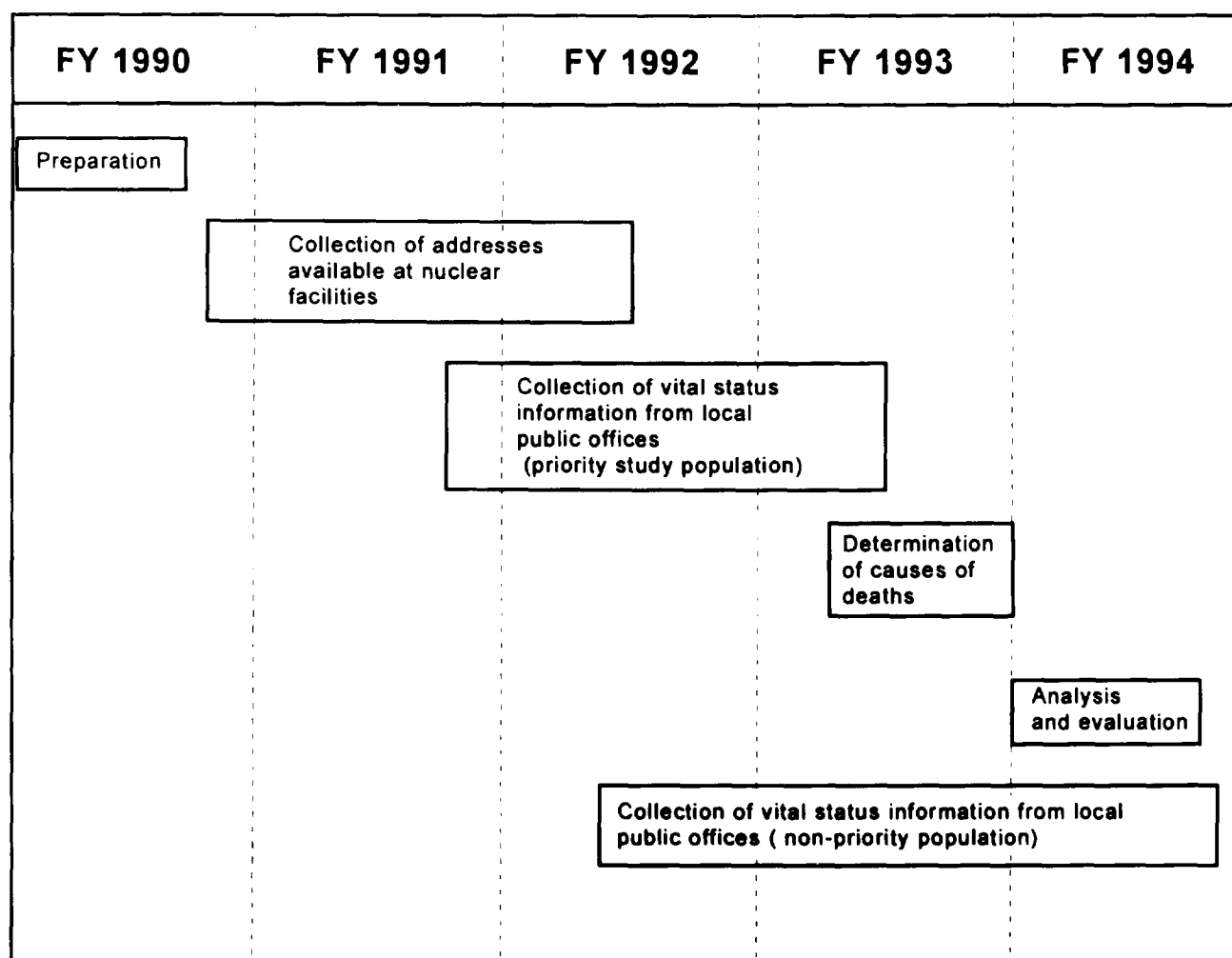
#### *Analysis of data*

*Set up of 'priority study population'.* It is not statistically cost-effective to investigate all study workers in a limited time period of five years. Therefore, we have defined 'priority study population' and will give priority to the members of this population in collecting vital status information.

The priority study population consists of four groups of Japanese male workers with different ranges of accumulated occupational exposures. Group 1 consists of all the workers having accumulated doses higher than 100 mSv. Group 2–Group 4 consist of randomly sampled workers so as to have

Table 2. The priority study population

Group	Accumulated dose (mSv)	Number of workers
1	≥100	~2500
2	10–99	~10,000
3	<10	~10,000
4	Less than detectable	~10,000
Total		~32,500



**FY (A Fiscal Year): April of a year to March of the following year**

Figure 2. Timetable for the study.

almost the same distribution of calendar years of work and the range of birth years as Group 1 subjects. The dose ranges and approximate number of workers for the four groups are as shown in Table 2.

*Method of evaluation.* The data thus collected will be analysed at the IRE in close contact with the IRE Steering Committee and the Evaluation Committee. Mortality rates of the subjects of the priority population will be evaluated in two ways.

The primary method of evaluation will be an internal comparison of cause-specific mortality rates among worker groups of different ranges of accumulated exposure. Secondly, study workers with the number expected based on Japanese male rates adjusted for age and calendar year.

*Release of the results.* The results will be released to the public through the STA.

#### *Timetable for the study*

The timetable for the first five-year period of the study is scheduled as shown in Figure 2. Collecting copies of resident cards to local community offices began in November 1991, based on the information on the addresses of workers received so far from nuclear power stations and other nuclear facilities.

1. Radiation Effects Association. Hou-eikyo News No. 3, January 1992 (in Japanese).
2. Cardis E, Esteve J. International Collaborative study of Cancer Risk among Nuclear Industry Workers II — Protocol. IARC Internal Report 92/001, 1992.
3. Cardis E, Gilbert ES, Carpenter L, *et al.* Effects of low doses and low doses rates of external ionizing radiation: cancer mortality among nuclear industry workers in three countries. *Radiat Res* 1995; **142**, 117-132.