

PRESENT STATE OF THE MONITORING FOR INTERNAL CONTAMINATION  
AT TOKAI RESEARCH ESTABLISHMENT, JAPAN ATOMIC ENERGY  
RESEARCH INSTITUTE

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The Japan Atomic Energy Research Institute (JAERI) was established in 1956. Activities at Tokai Research Establishment (Tokai R.E., JAERI) were started in 1958. Research and development of bioassay and whole body counting was started in 1958 and 1959, respectively. As for the internal monitoring, preliminary monitoring by bioassay and whole body counting were started in 1961, and routine monitoring were started in 1964. In 1967, research activities at Oarai Research Establishment (Oarai R.E., JAERI; not so far from Tokai R.E.) were started, and routine monitoring have been carried out from this year.

At present, Tokai and Oarai R.Es. have about 2,000 and 500 employees, respectively. Among these employees, the number of workers who are registered as a occupational radiation worker are about 2,000 (Fig. 1). Main facilities at both Tokai and Oarai R.Es. are; 5 research and testing reactors, 4 accelerators, 3 high level hot laboratories, radioisotope production plant, 2 radioactive wastes treatment plants and many other hot laboratories.

The Bioassay Section, Tokai R.E. is responsible for the monitoring of the internal contamination for both Tokai and Oarai R.Es. The Bioassay Section has three groups as shown below:

Bioassay Sec.	{	Bioassay Group; 2 stuffs and 1 technician, Chief, 1
		External Counting Group; 3 stuffs,
Secretary, 1	{	R&D Group; 3 stuffs

Main equipments and facilities belong to the Section are; 160 m<sup>2</sup> of chemical laboratory (Bioassay Group), 90 m<sup>2</sup> of laboratory equiped with a heavy shield (20 cm Fe + 5 mm Pb) whole body counter and chair type counter, and 125 m<sup>2</sup> of experimental rooms (R&D Group).

LEGAL LIMIT AND AUTHORIZED DOSE LIMIT OF JAERI

Japanese legal limit and authorized limit of JAERI is presented in Table 1. These limits are applied for both external and internal exposures. Legal limit is based on ICRP Recommendation: 1962 (Pub. 6). If the exposure dose exceeds the authorized limit (JAERI), then restriction of radiation work and medical care should be taken based on JAERI's manual on radiation safety.

Table 1. Dose limits applied in JAERI

Organ	Legal limit	Authorized limit(JAERI)
Whole body	3rem/3 months	3rem/3 months and 5rem/year
Skin	8rem/3 months	8rem/3 months and 30rem/year
Hand, Foot	20rem/3 months	20rem/3 months and 75rem/year
Bone, Thyroid	—	8rem/3 months and 30rem/year
Other single organ	—	4rem/3 months and 15rem/year

## MONITORING OF INTERNAL CONTAMINATION

In JAERI, as to the exposure level, there are no workers who might exceeds 3/10 of the anual dose limit, and also as to the kinds of work, we have no radiation work such as described in ICRP Pub.12, Para.105. Therefore, the internal monitoring is not required routinely related to ICRP Recommendation. Internal monitoring is also not absolutely required by Japanese legal regulation, however it is required by JAERI's manual on radiation safety.

Two kinds of monitorings, that is, a Routine Monitoring and a Special Monitoring are carried out. The main purpose of the routine monitoring is to check a presence of significant contamination for the selected workers who are engaging an ordinary(routine) radiation work. The purpose of the special monitoring is to estimate of body burden, and committed dose equivalent, if necessary. Special monitoring is applied in the following cases for all of the workers who are suspicious for internal contamination; (1) a significant contamination is found by the routine monitoring, (2) an accidental contamination is occurred, (3) after the work which internal contamination is suspicious.

As for the routine monitoring, methods of the monitoring are shown in Table 2.

TABLE 2. Method of routine monitoring

Method	Subject
External counting	
Whole body counting (Chair type counter)	Workers who are treating $\gamma$ -emitters ( $>100$ KeV)
Chest counting (Lung monitor)	Workers who are treating $\gamma(x)$ -emitters ( $<100$ KeV)
Bioassay	
Gross $\alpha$ activity (Radiochemically)	Workers who are treating soluble $\alpha$ -emitters
Gross $\beta$ activity (Radiochemically)	Workers who are treating $\beta$ -emitters (Except low $\beta$ -energy nuclides)
Uranium	Workers who are treating uranium
Tritium(Liquid scintillation counting)	Workers who are treating tritium and low energy $\beta$ -nuclides

As for the special monitoring, various methods are used according to the contaminated nuclides, a heavy shield whole body counter is generally used when the external counting is applied.

#### FREQUENCY OF ROUTINE MONITORING AND LEVEL OF SIGNIFICANT CONTAMINATION

As a basic principle, we adopt the "investigation level" or "derived investigation level" defined by ICRP. However, regardless of internal contamination level, if the observed value exceeds the detection limit, then the fact is informed to Radiation Control Office. This information will be contribute to improvement of the working conditions. Thus, at present, we are taking the detection limit as the significant contamination level.

TABLE 3. Frequency of routine monitoring and detection limit

Kind of monitoring		Frequency	Detection limit*
External counting	WBC(Chair type)	Every 3 months	$\sim 17\text{nCi}(^{137}\text{Cs, whole body})$
	Chest counter	Once a year	$10\text{--}15\text{nCi}(^{239}\text{Pu, lung})$
Bioassay	Gross $\alpha$ activity	Twice a year	$\sim 0.2\text{pCi/l}(^{239}\text{Pu, urine})$
	Gross $\beta$ activity	Every 3 months	$\sim 10\text{pCi/l}(^{90}\text{Sr, urine})$
	Uranium	Every 3 months	$\sim 5\mu\text{g/l}(\text{nat.U, urine})$
	Tritium	Every 3 months	$\sim 50\text{nCi/l}(^3\text{H, urine})$

\*Detection limit: The value of  $\text{mean} + 3\sigma$  obtained from non radiation workers.

In the routine bioassay, only urine is taken as a sample, but in the special monitoring, both urine and feces are taken as sample.

#### SELECTION OF SUBJECTS FOR ROUTINE MONITORING

As provided by the JAERI's manual on radiation safety, the subjects for routine monitoring are selected by the chief of each working group(Section or Laboratory), and a request for routine monitoring is presented to Bioassay Section. However, to hold the same views about the selection of subjects is very difficult because there are nearly 100 working group in JAERI. Therefore, the following procedures are taken as a practice.

1. Bioassay Section; Survey the working condition:  
a questionnaire about the working condition is send to each working group.
2. Working Group; Fill up the questionnaire for each worker.
3. Bioassay Section; Investigate the results of the survey, discuss with Radiation Control Office, and make an original plan about the number of subjects for each working group.
4. Bioassay Section; Present the original plan about the number of subjects to each working

group, revise the number is made if necessary.

5. Working Group; Select the subjects according to the plan. Request of routine monitoring is send to Bioassay Section.

Main items of the questionnaire are; kind of nuclides, amounts, chemical form, degree of air contamination due to the work, ways and means for protection from the air contamination.

## RESULTS OF INTERNAL MONITORING

The number of subjects of routine monitoring after 1969 are presented in figure 1. By routine monitoring, the significant internal contamination is sometimes found for the worker who are treating tritium, but it is almost never found for the other workers.

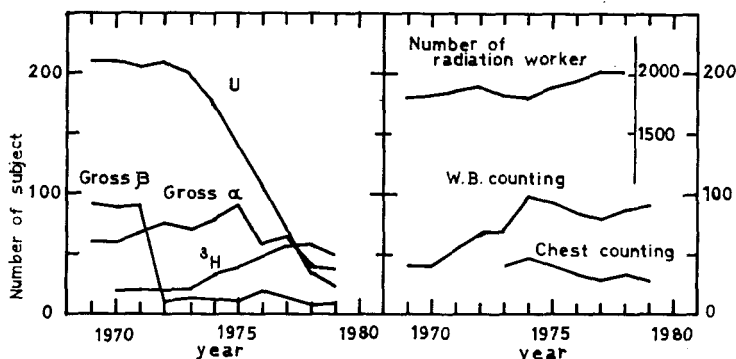


Figure 1. Numbers of subjects of routine monitoring

As for the special monitoring, a number of subjects are largely varied depended on the activities in JAERI. In 1965, the number of subjects who received the special monitoring reached to nearly 300 because a repaire of research reactor was carried out in this year. In the recent few years, the number of the subjects for special monitoring is several tens or so.

As for the special monitoring, the workers who found the significant internal contamination are less than 50%. Moreover, the internal dose (50 years) estimated are mrem order for the most of all subjects. During past 15 years, only a several cases of exposure of rem order were found. The highest dose we had experienced was about 4 rems ( $^{131}\text{I}$ , thyroid).

## RECORDING LEVEL

As regards to a formal recording level, we adopt 10 mrem (usually 50 years dose). When the estimated dose is less than this level, the value is treated as zero.