

CHARACTERISTICS OF INTERNAL AND EXTERNAL EXPOSURES TO WORKERS BY JOB IN JAPAN ATOMIC ENERGY RESEARCH INSTITUTE

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INTRODUCTION

It is useful to investigate the characteristics of exposure to radiation workers by job category for the reassessment of the appropriateness and effectiveness of monitoring method and radiation protection practice. As a first step, we have analyzed annual collective dose to workers in JAERI by job category and type of exposure for the years of 1969-1986.

INDIVIDUAL MONITORING IN JAERI

For external exposure, film badge is issued every 3 months to all radiation workers. For internal exposure, monitoring is carried out by bioassay and external counting as follows [1]:

- Routine or confirmatory monitoring: for subjects selected from specific worker groups according to the possibility of internal contamination, by an annual survey on working condition,
- Special monitoring: including internal dose assessment, for workers supposed to be contaminated or exposed, as a rule, above 0.1 mSv of committed dose equivalent in any organ.

CLASSIFICATION OF WORKERS BY JOB

Workers are classified into 8 categories as follows:

- a) Reactor operation: operation, utilization and maintenance of nuclear reactors,
- b) Hot laboratory management,
- c) Waste treatment: including the workers attended to decontamination of instruments, equipments and hot laboratories,
- d) Radiation control,
- e) Radioisotope production,
- f) Research and development: relating nuclear reactor, accelerator, safety engineering, materials, nuclear fuel, radiation chemistry, physics, chemistry, fusion, etc.
- g) Others: administrative and engineering services, trainees, etc.

YEARLY VARIATION OF THE NUMBERS OF WORKERS IN JOB CATEGORIES

The number of workers tends to increase, mainly due to development of fusion research, nuclear safety research, reactor fuel examination and decommissioning of a power demonstration reactor, that reflects in the increase of workers in categories c) and f). The numbers of workers are shown in Fig.1.

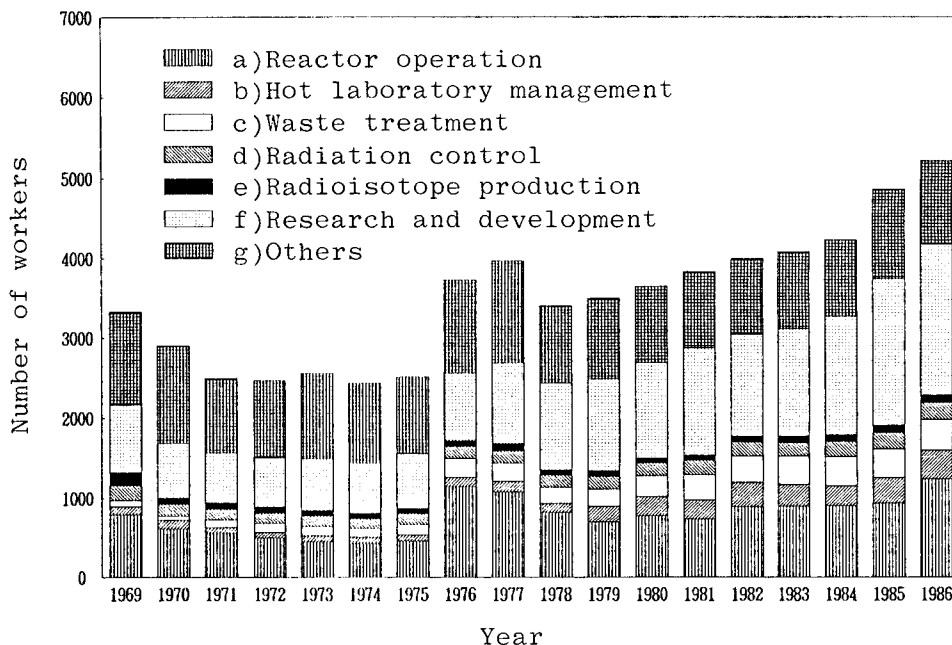


Fig.1 Yearly number of radiation workers.

CALCULATION OF COLLECTIVE DOSE

(1) External exposure

Effective dose equivalent was assumed to be equal to the dose estimated from the film badge reading. Collective dose to workers of each category was calculated by summation of individual doses above the minimum detectable dose of 0.2 mSv.

(2) Internal exposure

Intake of radionuclides of workers was estimated by bioassay and/or external counting. Annual collective dose was calculated by summation of committed effective dose equivalents above 0.1 mSv.

VARIATION OF ANNUAL COLLECTIVE DOSES

(1) External exposure

Variation of annual collective doses by job for years 1969-1986 is shown in Fig.2. The collective dose was the largest in category a), and the second largest in category f). The collective doses were larger before 1973 because of special jobs of maintenance of heavy water research reactors. After 1973, the annual collective dose has been relatively constant. In 1986, the annual collective dose is nearly equally shared by 4 categories: a), b), c) and f).

(2) Internal exposure

Fig.3 shows the annual collective committed dose equivalent to 38 workers among the total of 1,500 subjects of special monitoring. As for the result of routine monitoring of 18,300 measurements, only 7 subjects were found to be exposed to above 0.1 mSv

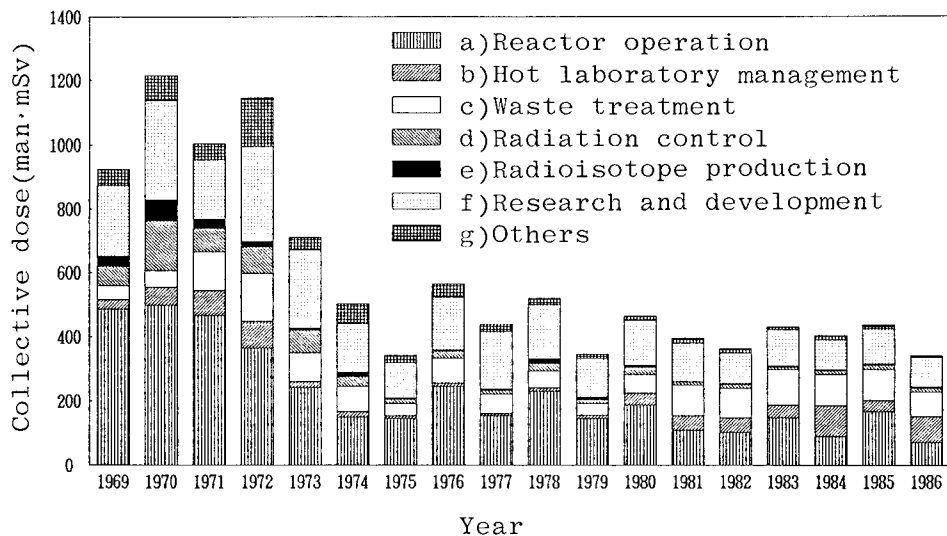


Fig.2 Variation of annual collective dose for external exposure.

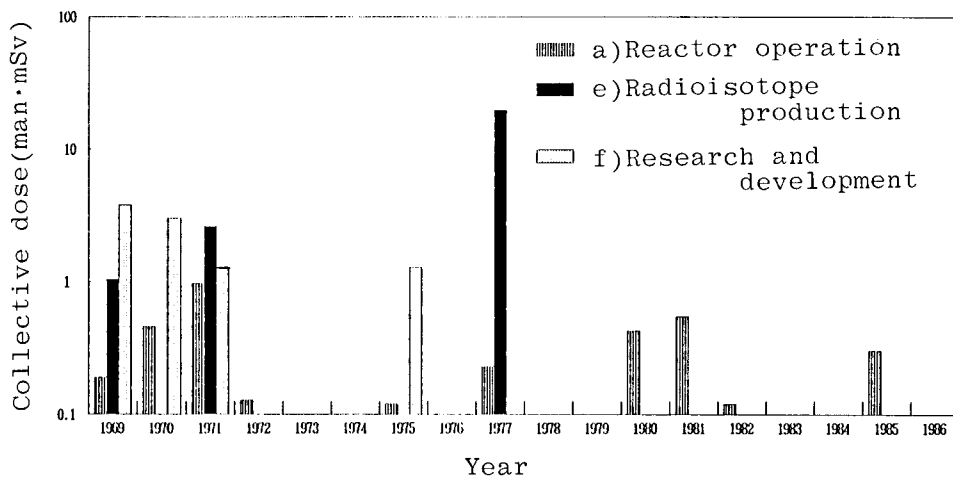


Fig.3 Annual internal collective doses for job category.

of effective dose equivalent, which are included in the collective dose. Before 1973, internal exposure occurred almost every year in 3 categories a), b) and f). After 1973, internal exposure occurred less frequently. The exposure of the year 1977 in category e) was an Am-241 inhalation case, 20 mSv received by a subject.

COMPARISON

Fig.4 shows yearly variation and ratio of internal and external

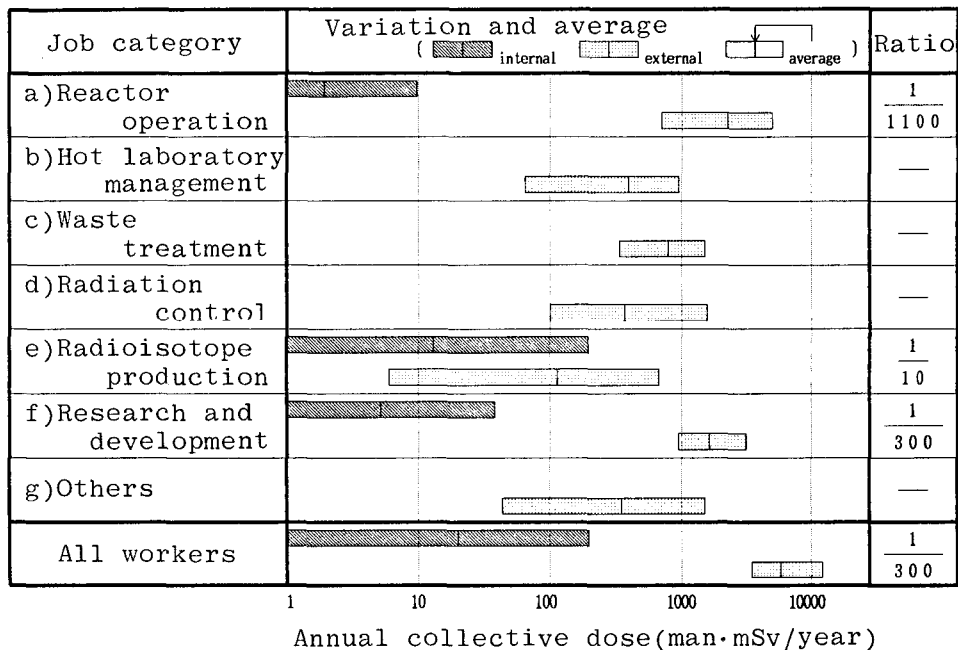


Fig. 4 Comparison of internal and external annual collective doses for job categories.

annual collective doses in each category. Each box represents the range of annual collective dose variation. The left and right ends of the box are minimum and maximum, respectively, and the average is shown with an interposed line. As shown in the figure, the ratio of internal to external collective doses in category e) was the largest, that was 1:10, to which the Am-241 case in 1977 made a dominant contribution. Internal collective dose was by 300 times smaller than external collective dose for all radiation workers in JAERI for years 1969-1986.

CONCLUSION

We presented a retrospective analysis of annual collective dose with special emphasis on comparison of internal and external exposures. We could characterize the working condition by job more clearly, that may be of some use in planning a monitoring program. A small proportion of internal exposure to external exposure in collective dose can be interpreted as a result of radiation protection practice in JAERI, that is, unsealed radioactivity is enclosed as far as possible to minimize contamination of workers and work places.

Reference

- [1] J.Akaishi, H.Fukuda, S.Mizushita: "Present State of the Monitoring for Internal Contamination, Tokai Research Establishment, JAERI", IRPA5, Jerusalem, III, 197-200 (1980).