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The Japan Power Demonstration Reactor Decommissioning Program
- decontamination and radioactivity measurement on building surfaces -

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ABSTRACT

After dismantling the components in the facilities of Japan Power Demonstration Reactor (JPDR), decontamination on concrete surfaces and final survey of radioactivity have been started as the last step in the JPDR dismantling activities.

At the first step for the decontamination on concrete surfaces and the final survey of radioactivity is as follows; The contamination on the concrete surfaces in the JPDR facility was characterized on the basis of radioactivity measurements of samples taken from the buildings. The contamination in the JPDR facility was categorized into two groups: fixed or removable; deep penetrative contamination was not found in the JPDR facility. The distribution map of the contamination was made based on the characterization. Decontamination activities were planed according to the distribution map of the contamination.

The all buildings will be demolished and the site will be landscaped after finishing the final survey of radioactivity by March 1996.

INTRODUCTION

The Japan Power Demonstration Reactor (JPDR) decommissioning program is underway. This program has two phases; Phase-I is to develop reactor decommissioning techniques, Phase-II is to demonstrate the techniques developed and to obtain experience and data on actual dismantling of the JPDR. The scope of the JPDR dismantling project (Phase-II) activity is to remove all radioactive materials from the facility.

The decontamination of the concrete surfaces in the JPDR facilities was successfully performed by a scabbler, a shot-blaster, a sand-blaster and a needle gun. Data on actual use of these tools were also collected through the decontamination activities.

This report describes the JPDR dismantling activities focusing on the procedures of decontamination and measurement of radioactivity on the concrete surfaces.

JPDR DECOMMISSIONING PROGRAM

JPDR

The JPDR, which was the first reactor to generate electricity in Japan, is a boiling water reactor that began generating electricity in 1963 and ceased the operation in 1976. The total operation time and the output of electricity during this period were approximately 17,000 hours and 1.4 x 10^6 kWh, respectively. The thermal power was initially 45 MW (JPDR-I), which was later increased to 90 MW (JPDR-II) for the

enhancement of its neutron irradiation capability.

Overview of JPDR decommissioning

The JPDR decommissioning program was initiated in 1981 under contract with the Science and Technology Agency (STA) in Japan[1]. It consists of two major phases: Phase-I began in 1981, aiming at developing technologies necessary for reactor decommissioning[2],[3]. Phase-II began in 1986, actual dismantling of the JPDR to reach green field condition. The objectives of the program are (1) to gain actual experience of nuclear power reactor dismantling, (2) to verify and confirm the developed techniques and (3) to collect the data on the dismantling activities.

Actual dismantling of the JPDR has been progressing since 1986, aiming at making green field condition as the final goal. The main parts of JPDR facilities including the reactor pressure vessel[4] and the biological shield[5] were dismantled by January 1994.

The JPDR decommissioning program is in final stage; the major activities in the stage are decontamination and survey of radioactivity for cancellation of radiation controlled areas.

PROCEDURE OF JPDR SITE RELEASE

Figure 1 shows flow of site release procedure on the JPDR decommissioning activities. The procedure of the site release was divided into 4 steps. At the first step, contamination on concrete surfaces of the buildings was characterized by sampling and measurements. On the basis of the measurements, contamination map was created, then the contaminated concrete surfaces were removed according to the plan which was made by reflecting the contamination map. The building surface has been decontaminated in each area, then the radioactivity on the decontaminated areas has been surveyed to confirm that the radioactivity is less than the planed value. After all the activities will be finished, the site on the JPDR will be released.

Characterization of contaminated areas

At the first step toward releasing the facilities for unrestricted use, the characteristics of the contaminated areas on the facilities were evaluated by the procedures shown in Fig.2. About 1,800 samples were taken from every 2 m by 2 m area of the buildings; the size of the samples were 1 cm in depth and 4 cm in diameter[6]. Gross gamma-ray of each sample was measured by a NaI (Tl) detector with a single channel analyzer. Figure 3 shows sampling points and results of measurement. In addition to the measurement, previous records of contamination during the JPDR operation were surveyed using the log book. The contamination on the concrete surfaces in the JPDR facilities was roughly characterized on the basis of the radioactivity measurements and the previous records. The map of the contaminated areas was made from the data. Figure 4 shows distribution of radioactivity contamination in the JPDR

facilities. It was found that about 47 % of total radioactivities of contamination (1.3×10^8 Bq) in the JPDR facilities was existed in the rad-waste building, and that about 37 % of total areas (20,000 m^2) was contaminated.

The following two sampling methods were applied to getting more exact data, especially on contaminated depth at the points where contamination was detected. In the areas where only surface contamination was found, surface layer (2 mm in depth) was removed until contamination was not detected. In the areas where penetrated contamination was found, cores (10 cm in depth) were taken from concrete surface. Samples were made in such a way that every 1 mm thickness layer was taken from the surface to 10 mm in depth, and 5 mm thickness layer below 10 mm in depth. Gamma-ray spectrum of each sample was measured by a Ge-detector with a multichannel pulse height analyzer.

Figure 5 shows characteristics of the contamination in the JPDR facilities. About 86 % of contaminated area of the JPDR facilities was the surface contamination in which the radioactivity existed within a very thin surface layer of only 2 mm in depth. It is therefore enough to remove thin surface layer slightly for decontamination of the building surfaces. Plans for decontamination on the contaminated areas were made based on the above data. Figure 6 shows a sample of the plan for decontamination in the precoat charge tank 1A and the control room of the rad-waste building.

Decontamination on buildings

As described above most contamination in the JPDR facilities was of two types, surface and penetrated contamination. For this reason, the decontamination procedures were roughly divided into two groups. Figure 7 shows the decontamination procedures on the JPDR.

The penetrated contamination was removed in the following procedures. First, holes were drilled in every 1 m by 1 m area to a specified depth. Then the holes were colored by paint. The concrete surface in each 1m by 1m area was decontarminated until the color disappeared.

Decontamination of surface contamination was performed as follows. Contaminated concrete surface areas were colored by paint. The concrete surfaces were removed until no color remained on the concrete surfaces. Decontamination was performed by a sand-blaster, a shot-blaster, a scabbler and so on. Photo 1 shows decontamination tools.

Final survey of radioactivity

After finishing the decontamination, the final survey of radioactivity was conducted with the procedures shown in Fig.8. At first, the radioactivity was directly measurement at each room in the JPDR facilities using gas flow counter type and scintillation counter type survey meters, which has 160 cm^2 or 1,800 cm^2 and 900 cm^2 of the sensitive window area, respectively. These survey meters are capable of 0.4 Bq/cm^2 for beta-emitters under normal background conditions. The final survey is performed on every 0.8

m x 0.8 m square blocks moving the survey meters, and the highest counting rate in each block was recorded.

Furthermore, after the decontamination activities some concrete samples were taken from the decontaminated areas. The gamma-ray spectra of the samples were measured by a Ge-detector with a multichannel pulse height analyzer to confirm that there was no contamination in the concrete samples.

After finishing the final survey by workers, the survey was conducted by the personal in the department of health physics of JAERI.

Site release

Based on the report of site release procedure, which was submitted to the STA, the confirmatory survey will be conducted by the STA. Then the site on the JPDR will be released. The turbine building, the control building, the fuel building, the reactor building, the rad-waste building and the fan building will be demolished. The site on the JPDR will be landscaped.

CONCLUDING REMARKS

On the basis of the procedures of site release on the JPDR, the decontamination of the contaminated concrete surfaces was performed efficiently and safely. It was very useful for making the decontamination plans to evaluate the characteristics of the contaminated areas.

REFERENCES

(1)M. Ishikawa, M. Kawasaki, and M. Yokota; JPDR decommissioning program - plan and experience, Nucl. Eng. Vol.122, pp.358-364, 1990

(2)S. Yanagihara, Y. Seiki, and H. Nakamura; Dismantling techniques for reactor steel structures, Nuclear Technology, Vol.86, pp.148-158, August 1989

(3)S. Yanagihara, F. Hiraga, and H. Nakamura; Dismantling techniques for reactor steel piping, Nuclear Technology, Vol.86, pp.159-167, August 1989

(4)M. Tachibana, T. Hoshi, and I. Miki; Underwater cutting of JPDR reactor pressure vessel and core internals, Proceedings of the 1st ASME/JSME Nuclear Engineering Conference, pp.81-84, November 1991

(5)K. Kozawa, M. Kan, S. Yanagihara, and K. Fujiki; The progress of the Japan Power Demonstration Reactor (JPDR) Dismantling Activities: Dismantling the Biological Shield Concrete by controlled Blasting, Proceedings of the 2nd ASME/JSME Nuclear Engineering Conference, pp.821-826

(6)H. Yasunaka, M. Hatakeyama, T. Sukegawa, T. Kozaki, S. Yamashita, and T. Hoshi; Evaluation of contamination on concrete of JPDR building, Proceedings of the 1989 joint international waste management conference, pp.183-187, October, 1989

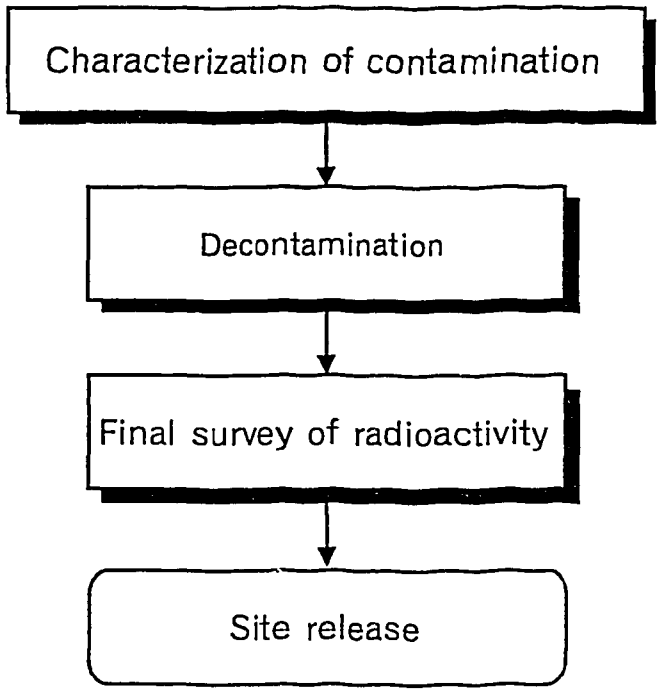


Fig. 1 Flow of site release on JPDR

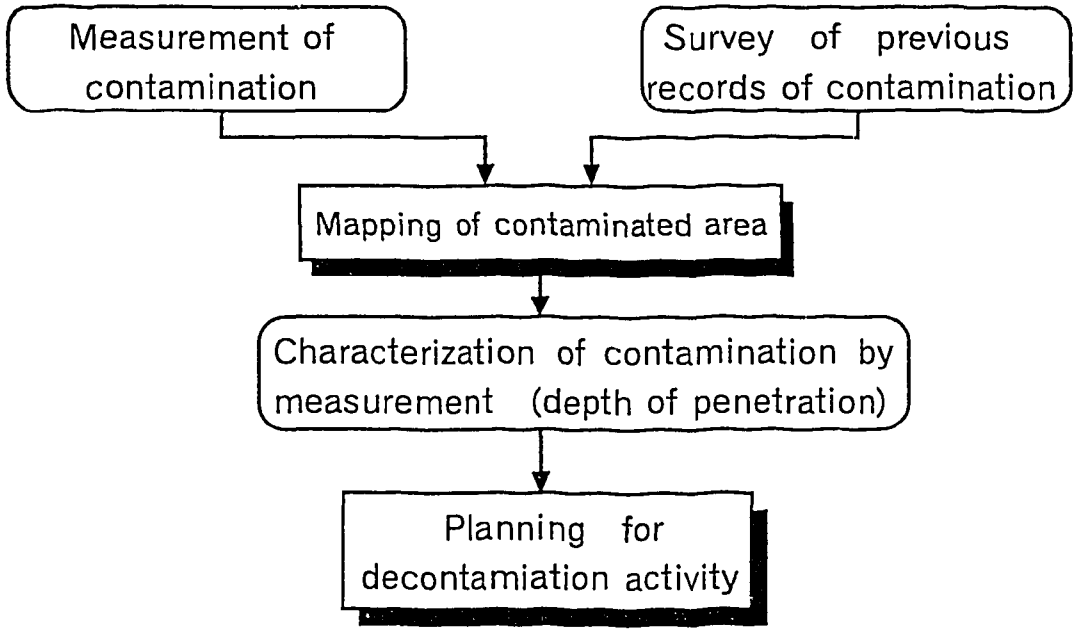


Fig.2 Procedure for characterization of contamination

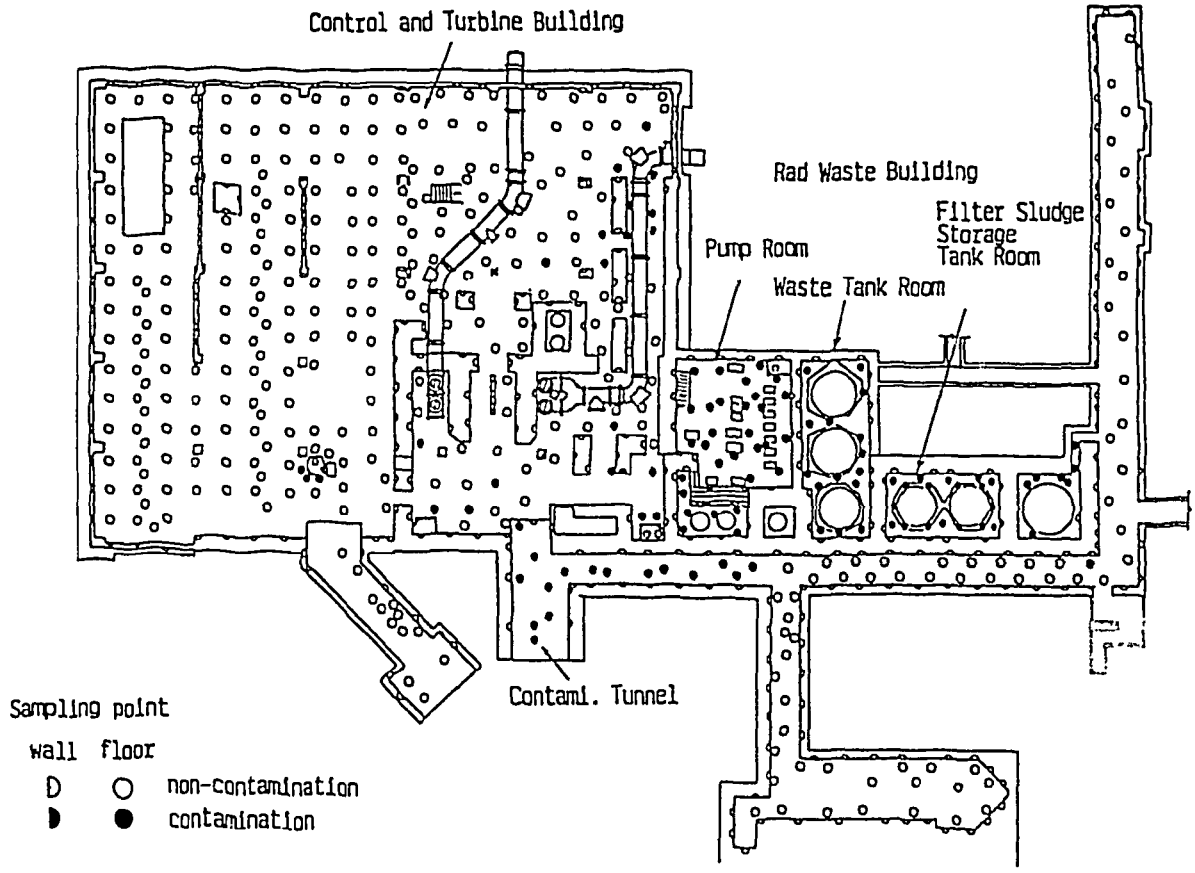


Fig.3 Sampling points and results of measurement

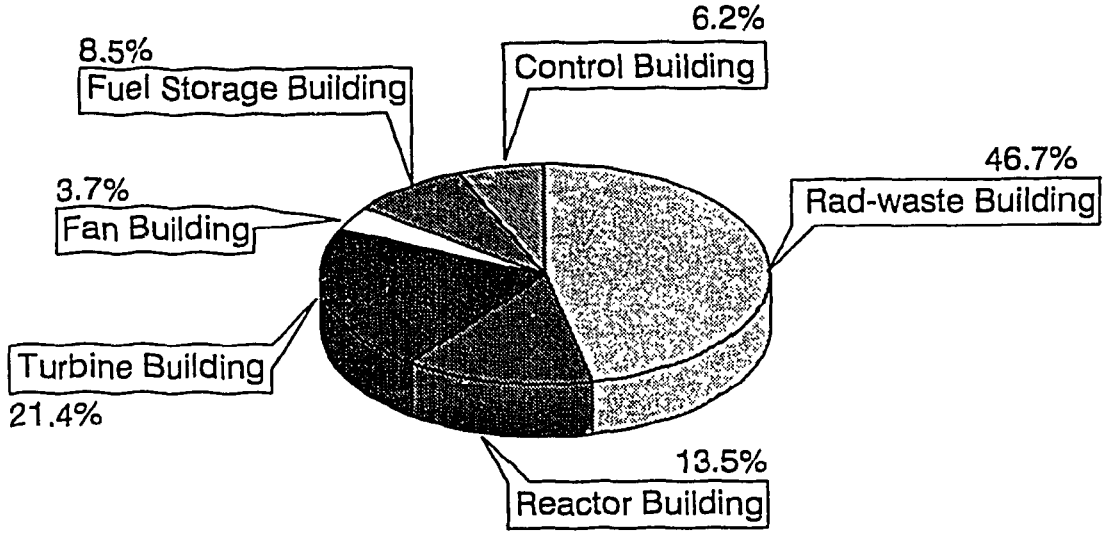


Fig.4 Distribution of contamination

(Total activities of contamination 1.3×10^{8} Bq)

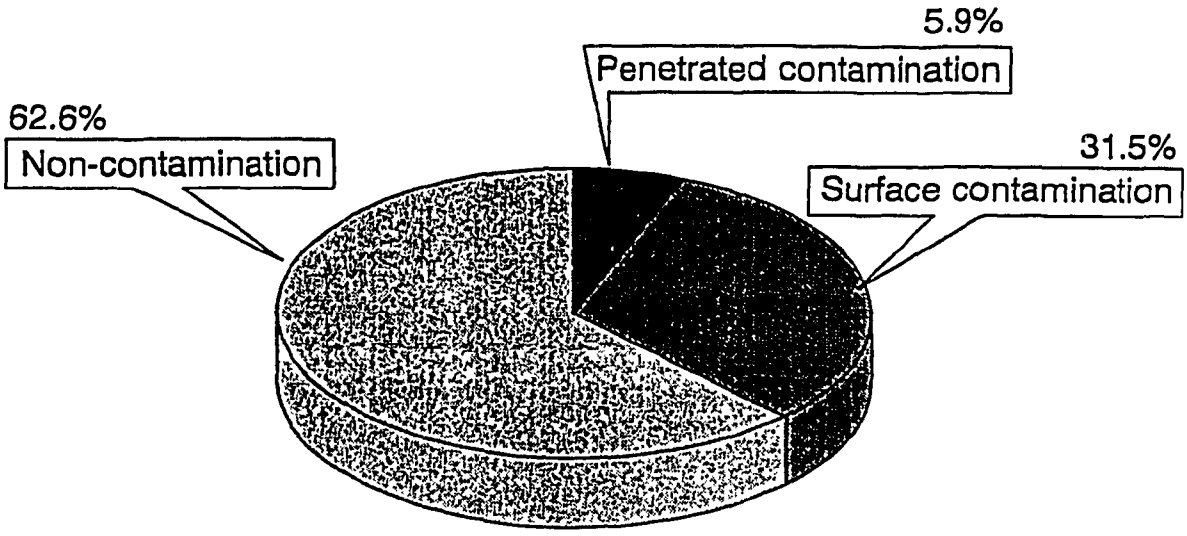


Fig.5 Characteristic of contamination
(Gross areas of buildings: 20,000m^2)

Room	Precoat charge tank1A and control room	
	Decontaminated area	Decontaminated depth
Floor−1	7m^2	1.5cm
Floor−2	63m^2	Surface

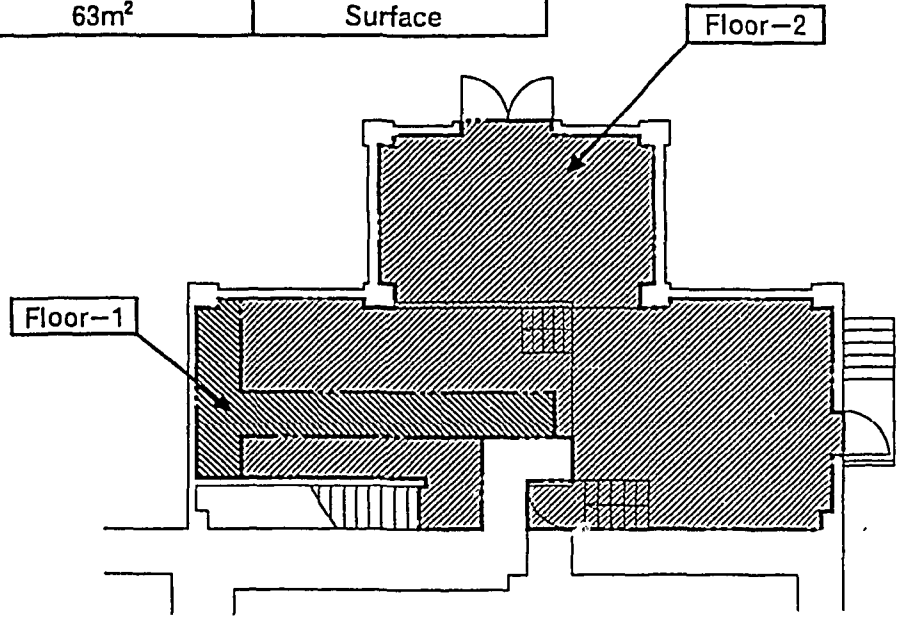


Fig.6 Sample of plan for decontamination
(Rad−waste building)

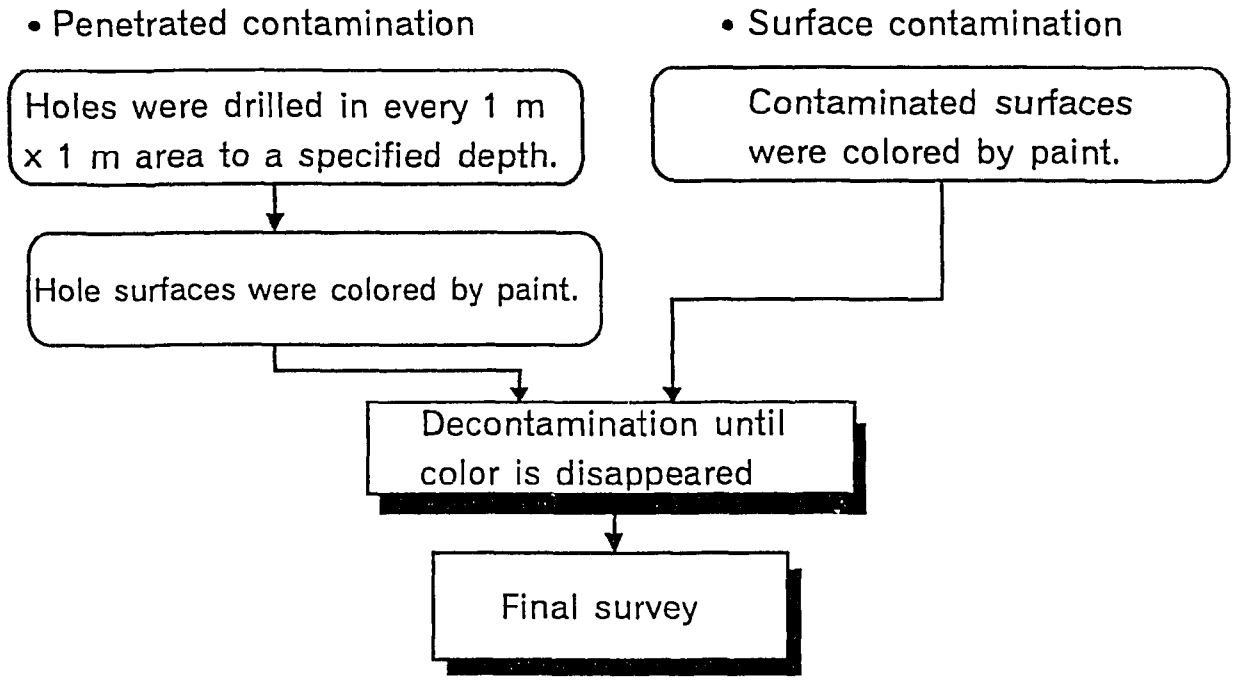


Fig.7 Decontamination procedure

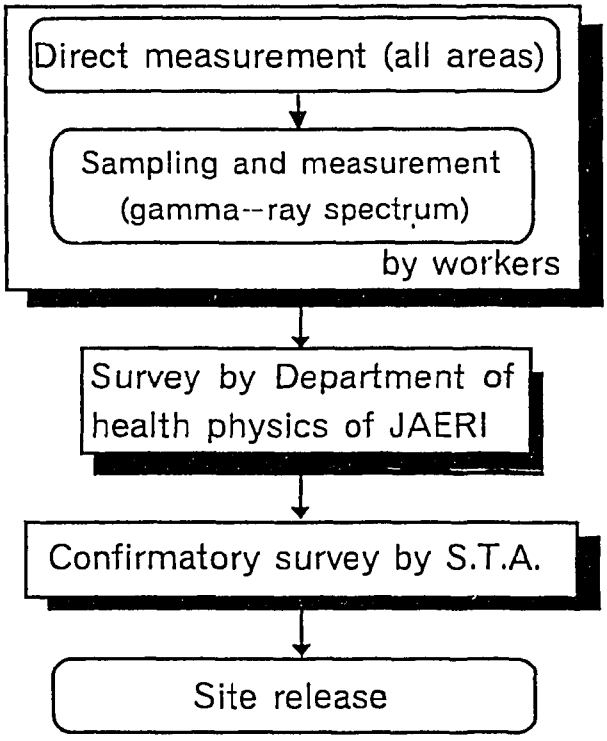
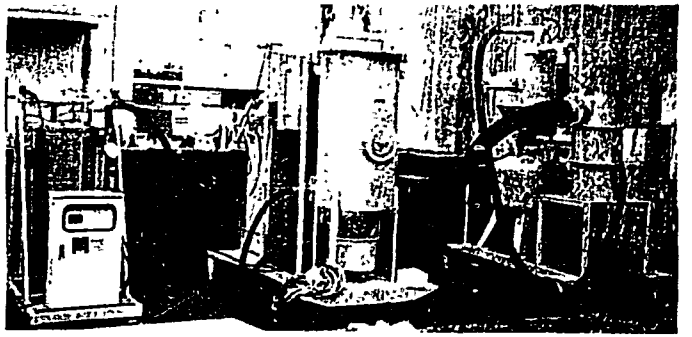
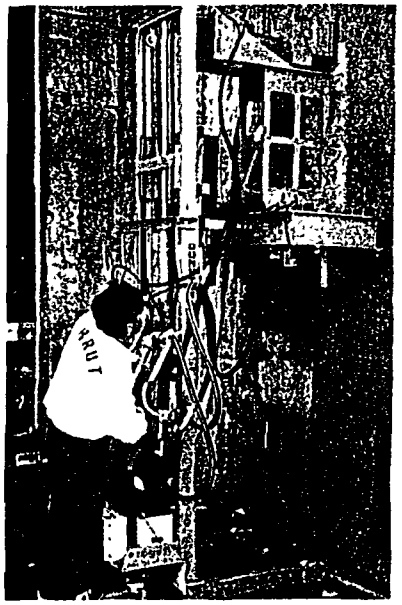


Fig.8 Final survey of radioactivity

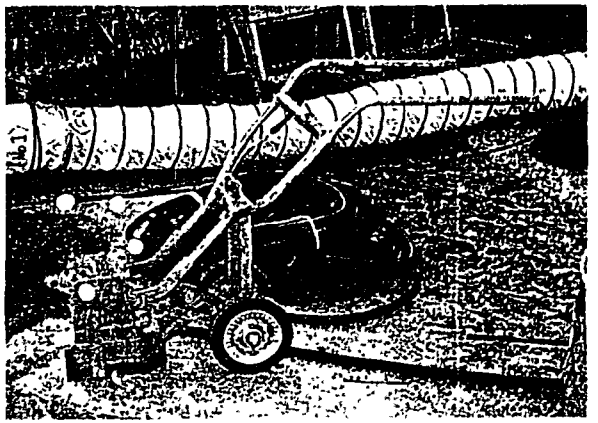
a. Shot−blaster



b. Sand−blaster



c. Wall Scabbler



d. Floor Scabbler

Photo 1 Decontamination tools