

REVISED WORKER EXPOSURE ESTIMATES FOR
TMI-2 RADIOACTIVE WASTE PROCESSING
AND DECONTAMINATION

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ABSTRACT

As progress in the cleanup from the accident at TMI-2 has been made, more information has become available to improve estimates of worker exposure. Recently revised estimates by the U.S. Nuclear Regulatory Commission have been made which are higher by about a factor of 6 over estimates made in early 1981 prior to any manned entries into the reactor building.

BACKGROUND

As a result of the March 1979 accident at TMI-2, large scale contamination of the facility occurred. The radioisotopes of primary concern (Cesium and Strontium) are unique to the nuclear power industry, being more characteristic of the isotopes encountered at a fuel reprocessing facility. Because of the long-lived (roughly 30 year half life) high energy gamma and beta sources, special technologies were necessary (e.g., new TLD's, protective clothing).

Cleanup Accomplishments

The current inventory of radioactivity has decreased to about 5×10^6 Ci from a level of about 30×10^{10} Ci at the time of the accident. About 4×10^5 Ci of the dominant gamma sources (Cs-134 and 137) remain after cleanup operations to date. Progress so far at TMI-2 has included:¹ processing over one million gallons of highly contaminated water which was released to the building sumps during the accident; offsite shipment of ion exchange media with specific activities over 1,000 times higher than resins from normal reactor plant operations; large scale decontamination of the buildings and equipment; and removal of the reactor vessel head. Management of the unique radioactive wastes has been previously reported.²

Estimates of Worker Exposures

The Nuclear Regulatory Commission has, from the onset of the TMI-2 cleanup program, been concerned about the radiation exposures which the workers will receive. Estimates of person-REM made early in the program³ have proven to be too low. As a result of obtaining new information, the NRC has revised its estimates of TMI-2 worker exposures.⁴ In the past four years since the original estimates were made, considerable new information and experience have been obtained at TMI-2. The early 1981 worker exposure estimates were made without any data about conditions in the reactor building which had not been entered at that time. The most recent estimates were made after more than 500 manned entries. The conditions in the reactor building and in the fuel handling/auxiliary building are now reasonably well characterized. In addition, the effectiveness of various decontamination approaches is better known. Table I summarizes the current and previous estimates of

worker exposures. The range of estimates is due to the uncertainty in the degree of complexity of each job. The initial estimates of about 2 - 8,000 person-REM have now been increased by about a factor of 6, to 13 - 46,000 person-REM.

Although the revised estimates of worker dose are significantly higher than NRC previously estimated, these estimates must be viewed in the proper perspective. First, there is no feasible alternative to concentrating and offsite removal and safe disposal of the major amounts of long-lived radioactivity, including the entire damaged core. Second, NRC oversight and regulation of the work, coupled with an aggressive licensee radiation control and ALARA program should ensure that no individual worker comes close to the legal exposure limits.⁵ Third, experience to date at TMI-2 confirms that this unique cleanup program has not resulted in extraordinary worker exposures. In fact, exposures to date show TMI-2 to be significantly below the average for all other U.S. reactors (see Fig. 1). Actual total exposures through 1984 are only slightly over 2,000 person-REM. The total person-REM at TMI-2 in 1984 was 513, compared to the latest (1983) industry average of 1,150 person-REM for all U.S. reactors. Fourth, the cleanup is expected to not only remove the long-term potential public risk, but also will provide valuable information for management of radioactive wastes, as well as information from the accident to increase safety margins at other nuclear power plants.

Radiation Level Reductions

Significant progress has been made over the past five years in reducing the general radiation levels in the reactor building where most of the manpower intensive activities will be taking place over the next few years. An aggressive program of surface decontamination and shielding after removal of the accident water from the basement has resulted in marked reductions in radiation levels. Table II provides data based on measured worker exposures from personal dosimeters and man hours spent on the two accessible levels of the reactor building. Starting with average readings of 430 and 240 mr/hr on these two levels in 1980, decontamination and shielding had reduced the radiation to 67 and 34 mr/hr respectively by the end of 1984.

TABLE I
Estimates of TMI-2 Worker Exposures
(In Person-REM)

<u>Job Category</u>	<u>Early 1981 (Ref. 3) Estimate</u>	<u>Current Estimate (Ref. 4)</u>
Reactor Bld. Decon	660 - 3,000	5,900 - 21,000
Reactor Disassembly and Defueling	782 - 2,380	2,600 - 15,000
Dose Reduction in Reactor Bld.	Not Included	2,500 - 5,100
Primary System Decon	108 - 1,740	56 - 970
Aux. & Fuel Bld. Decon	375 - 550	500 - 1,400
Others*	127 - 653	200 - 690
Dose Incurred to Date of Estimate	**	1,700
Total Estimate	2,052 - 8,323	13,000 - 46,000

*Including waste management and transport and system maintenance

**Dose incurred distributed in job categories

TABLE II
TMI-2 Reactor Building Radiological Status

	<u>Mean Man-Millirem/Man-Hour</u>	
	<u>1st Floor</u>	<u>2nd Floor</u>
Fall 1980 (Initial Entries)	430	240
Fall 1981	390	200
Fall 1982	350	146
Summer 1983	140	106
Fall 1983	145	71
Summer 1984	109	72
Winter 1984	67	34

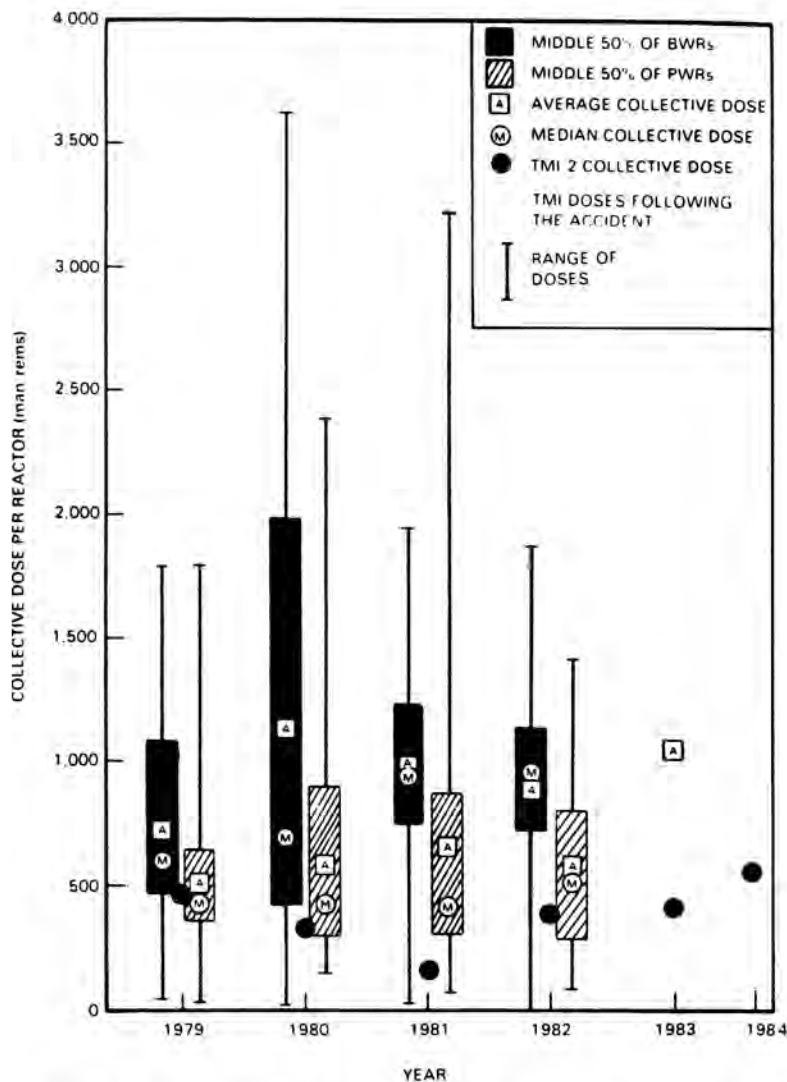


Fig. 1. Doses at TMI-2 compared with doses per reactor at all commercial nuclear plants in the United States.

REFERENCES

1. G. KALMAN and R. WELLER, "Progress in the Recovery Operations at Three Mile Island Unit 2," *Nuclear Safety*, Vol. 25, No. 1, January - February 1984.
2. B. J. SNYDER, "Management of Solid Radioactive Wastes from the TMI-2 Accident; A Regulatory Perspective," Waste Management '84 Conference, March 1984.
3. NUREG-0683, "Final Programmatic Environmental Impact Statement Related to Decontamination and Disposal of Radioactive Wastes Resulting from the March 28, 1979 Accident TMI-2," March 1981, USNRC.
4. NUREG-0683, Supplement 1, "Final Programmatic Environmental Impact Statement Related to Decontamination and Disposal of Radioactive Wastes Resulting from the March 28, 1979 Accident TMI-2," October 1984, USNRC.
5. Code of Federal Regulations, 10 CFR 20, Standards for Protection Against Radiation.