TMI-2 EQUIPMENT DECONTAMINATION FACILITIES EVALUATION

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ABSTRACT

Two principal facilities--the 328' decon facility (which is located in the radiological controlled area of the TMI-2 auxiliary building) and the 7000 square-foot, stand-alone waste handling and packaging facility (WHPF)--provide the wide variety of equipment decontamination services necessary to support the Three Mile Island Unit 2 (TMI-2) cleanup program. Each facility was designed, and is operated, to achieve the maximum amount of onsite waste reduction while improving the overall ability of the plant operations staff to control large volumes of contaminated material.

In mid-1987, decontamination personnel at TMI-2 began collecting data on equipment decontaminated by these two facilities since January 1987(1). The data was then used to evaluate the performance of each individual decontamination process, and to assess the relative effectiveness of each facility.

EVALUATION CRITERIA AND RESULTS

Two indicators were considered for evaluating the effectiveness of each decontamination method. The decontamination factor (DF), which is the ratio of as-received to after-processed contamination levels, was selected since DFs are commonly used to describe radwaste process efficiency and were easily quantified using available data. The minimum, average, and maximum fixed beta-gamma, total beta, and loose surface contamination DFs for each process were calculated. A second indicator of decontamination performance was a comparison of ultimate disposition, in which the percentage of items cleaned to below releasable limits was determined. For this indicator, all items released, whether for "clean" reuse or disposal as "clean" non-radioactive trash, were combined. Similarly, all items remaining contaminated, regardless of the reason, were combined into one category.

Results of the decontamination efficiency evaluation are summarized in Tables I and II and discussed below. The DFs (Table I) are the average experienced for items processed via each method during 1987. The number of identifiable items processed during this time period are listed for each process method.

328' Facility Decontamination Summary

Contaminated items brought to the 328' decon facility are generally processed by a combination of techniques, in order to take advantage of the relative strengths of each method. While only 31% of the items were releasable (compared to 69% from the WHPF), many of the items processed in the 328' facility originated in the reactor building (RB) and were only intended for gross decontamination and return back to the RB for reuse.

The vibratory finisher has been demonstrated to be very good for gross decontamination of items removed from the reactor building. Because this device is not labor intensive, it is used considerably for gross decon of items intended for recycle back to the RB via the "hot tool crib."

The ultrasonic decon unit is good for low level gross decon but is generally applied to items in combination with one or another of the various 328' facility process techniques. The high pressure freon decontamination unit has been used extensively for the gross decon of electrical equipment with low levels of contamination.

The labor requirements for the process techniques in the 328' facility are relatively similar. The vibratory finisher is the least labor intensive, averaging 2.7 manhours per item, while the ultrasonic cleaner is the highest, requiring an average of 5.0 manhours per item. Labor requirements for multiple decon processes in the 328' facility (4.5 manhours average per item decontaminated) are considerably lower than in the WHPF.

WHPF Decontamination Summary

For the WHPF, the paint digester appears to be the most effective in removing fixed beta-gamma activity. The DF for this decontamination process is nearly twice that of the other WHPF methods for removing fixed contamination. At the same time, paint digestion was successful in fully decontaminating for unrestricted release 83% of the items processed. Overall, the paint digester has proven to be highly effective at gross decontamination of tools and equipment, particularly those coated with epoxy or enamel paints. This process has also been demonstrated to remove contamination fixed to loosely adherent rust oxides, although activity fixed within base metal is not removed.

The only method with a higher unrestricted release percentage than the paint digester was the electro polisher. This, however, is based on only five items which were processed exclusively by the electro polisher. The electro polisher was originally intended (and is currently being used) for final decontamination to below releasable limits of items previously processed for gross activity removal by

TABLE I

Average Decontamination Factors.

Decon Method	mR/Hr	mRad	DPM	Qty. No.
WHPF				
Electro Polisher	3.4	--	2.3	5
Paint Digester	15.7	--	9.1	47
Abrasive Blast	8.5	10.0	141.0	11
Combined	5.7	0.5	19.8	33
328' Facility				
Vibratory Finisher	17.4	0.6	25.8	49
Ultra Sonic	17.0	19.6	6.0	4
HP Freon	75.0	0.1	0.5	4
Combined	10.6	5.7	34.5	140
Both Facilities				
Hands-on Decon	10.2	4.0	19.0	63

Note: (1) There was insufficient data to determine average mRad decontamination factors for the electro polisher and paint digester

TABLE II

Percentage Disposition Summary.

Decon Method	Releasable	Contaminated	Unspecified	Qty. No.
WHPF				
Electro Polisher	100%	0%	0%	5
Paint Digester	83%	4%	13%	47
Abrasive Blast	9%	82%	9%	11
Hands-on	78%	0%	22%	9
Combined	61%	27%	12%	33
Total WHPF	69%	19%	12%	105
328' Facility				
Vibratory Finisher	4%	94%	2%	49
Ultra Sonic	0%	100%	0%	4
HP Freon	0%	100%	0%	4
Hands-on	61%	39%	0%	54
Combined	31%	69%	0%	140
Total 328'	31%	69%	0%	251

the paint digester or abrasive blast units. Consequently, most of the 33 items listed under the "Combined" category in Tables I and II received final processing through the electro polisher, with an overall release percentage of 61%.

The abrasive blast equipment has demonstrated an ability to remove surface contamination, however, the majority (82%) of items processed via this method have remained above unrestricted release limits. The apparent reason for this is that while the method is successful in removing loosely adherent surface contamination (DF of 141), fixed contamination is not as effectively removed (DF of only 8.5). In addition, the abrasion medium (glass beads appear to be better than aluminum oxide) is generally reused many times, and has a tendency to deposit contamination. A possible solution to this would be to replace the abrasion media more frequently, however, this is likely to result in more radioactive waste than is saved by the decontamination process. TMI-2 decon personnel have limited the use of the abrasive blast equipment to items with high initial levels of loose surface contamination and those items which are intended for reuse within the plant in contaminated applications.

Hands-on decontamination techniques (e.g., wiping, washing) have also demonstrated not only high decontamination factors but also a very high release percentage. Nearly two-thirds of all items processed via hand methods (40 out of 63 items from both facilities) were successfully decontaminated to below unrestricted release limits.

Multiple WHPF decon methods have proven to be particularly successful in removing loose surface contamination. In general, items coated with epoxy or enamel paint are first processed though the paint digester for gross decontamination, followed by the electro polisher for final decon to releasable limits. Non-painted items with high activity levels are first processed by the abrasive blast unit followed by the electro polisher, or solely by the electro polisher if initial contamination levels are relatively low.

With respect to the labor time expended for each item processed, the abrasive blast unit requires over twice the number of manhours as the other individual processing techniques. This method averages 5.5 manhours per item processed, compared to 2.0 for hands-on decon. Items undergoing multiple decon processes require an average of 19.6 manhours, although some of this time was likely spent in transferring the items between processes.

Benefits From WHPF Operation

An estimate of the benefits (in both direct cost savings and reduced disposal volume) resulting from operation of the TMI-2 WHPF during the first seven months of 1987 was made to confirm the economic justification developed prior to facility construction. Three elements were considered: (1) the cost savings associated with the release of decontaminated "clean" material from the facility, (2) the cost savings associated with improved packaging efficiency for non-compacted material in boxes, and (3) the cost savings associated with improved packaging efficiency for compacted material in drums(2).

To calculate the effective annual cost savings from use of the WHPF, actual packaging efficiencies for drums and boxes in 1986 (before WHPF operation) and from February through August in 1987 (after WHPF operation) were used, as well as actual GPUN costs for containers, transportation, disposal, and labor in 1987. Two cases, with and without the inclusion of GPUN labor, were determined. Table III summarizes the results of the cost and volume savings from use of the WHPF. All values have been normalized for an effective annual savings.

CONCLUSION

Considerable experience in equipment decontamination at TMI-2 as a result of the recovery cleanup operations confirms the benefits of an integrated decontamination facility containing a wide variety of compatible process techniques. By having several process alternatives available, waste management personnel are able to selectively utilize the method most appropriate for each specific item, and its

TABLE III

WHPF Benefits.

Element	$ Savings(1)	$ Savings(2)	Volume Savings
Improved Box Packaging	$162,729	$471,839	3,638 ft^3
Improved Drum Packaging	29,995	87,740	649 ft^3
"Clean" Material Released	114,783	332,816	2,566 ft^3
Total	$307,507		

(1) Cost savings, without including GPUN labor
(2) Cost savings, including GPUN labor
(3) Effective annual

associated contamination, without compromising the overall objectives for effective contamination.