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Dose Assessment for Hand Emplacement of MgO Sacks Around CH Waste 7 Packs at the Waste Isolation Pilot Plant

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INTRODUCTION

This paper provides an estimate of the worker dose associated with the hand emplacement of magnesium oxide sacks (MOS) around the perimeter of contact-handled (CH) waste 7-packs. This estimate provides a means of evaluating the dose impact of this procedure in terms of administrative and ALARA goals at the WIPP and of comparing this procedure to any alternative approaches which may be developed in the future. Although the decision to backfill waste barrels with magnesium oxide is a sound decision that provides an added barrier to long term migration of buried waste, the hand emplacement method chosen to emplace the backfill is to be evaluated in terms of costs, manpower, time, ergonomics, and dose. This paper provides the dose element of that evaluation.

DISCUSSION

The approach taken to evaluate the dose impact of MOS emplacement was to video tape two trial runs of the emplacement operation. This allows for careful review of and analysis of time and distance values associated with the work and provides a referenceable basis for reviewing the dose estimate. One trial run was performed above ground and was limited to MOS emplacement on a 7-pack. The second trial run was a real life simulation to demonstrate emplacement and MOS backfill of two 14-packs in an underground waste room. Although more practice may result in actual doses that will be less than those estimated in this paper, the dose estimates cited in this paper will serve as a conservative upper limit of expected doses for the hand emplacement procedure that can be linearly adjusted as more information is obtained regarding actual CH waste radiation fields.

In determining the dose impacts of the hand emplacement procedure, time and distance information of the workers in the vicinity of the waste was transcribed to Table 1. Then previous dose rate estimates[1] in Attachment 1 are multiplied by the time and distance information to arrive at the dose estimates in Table 1.

The results of both trials are averaged for both the MOS retrieval and the approach-to and depart-from steps in the emplacement process. However, one of the two 7-Packs in trial 2 was wrapped in plastic that covered the top half of the 7-Pack. This resulted in a more difficult and slower emplacement process and nearly doubled the associated worker dose estimate. This doubling was too great an increase to justify averaging the values for the hand emplacement step. Therefore, doses for both trials have been distinquished as sufficiently different steps. If an effort is made to ensure that plastic wrapping is applied

[1] Figure 4 of the WIPP Radiological Control position paper 96-01 titled Dose Estimations, Radiological Area Posting, and Access Control Policy for Initial Waste Receipt.

Trial / Step Description	Avg. Time of Each Step	Avg. Distance from 7-Pack	Dose Rate for Each Step (mR/h)	6 Steps per 7-Pack	Dose Estimate per 7-Pack (μrem)
Trial 1: Receiving MOSs from Helper	2.0 seconds	>3 feet	1		3.3
Trial 1: Both Approaching and Departing 7-Pack	2.5 seconds	3 Feet	3		12.5
Trial 1: Fitting MOS Between Barrels	2.5 seconds	1 foot	5		20.8
Trial 2: Grabbing MOSs from pallet	10.0 seconds	>7 feet	0.5		8.3
Trial 2: Approaching and Departing 7-Pack	2.0 seconds	3 Feet	3		1.7
Trial 2: Fitting MOS Between Upper Barrels (Obstructive plastic wrap)	5.0 seconds	1 foot	5		41.7
Trial 2: Fitting MOS Between Lower Barrels	3.0 seconds	1 foot	5		25
Estimated Average Dose for MOS emplacement underground per 7-Pack					8.3 + 1.7 + 22.9 **32.9**
Estimated Average Dose for MOS emplacement underground per 7-Pack (with obstructive plastic wrap)					8.3 + 1.7 + (41.7 **51.7**
Estimated Average Dose for MOS emplacement underground per **14-Pack**					(2 x 8.3) + (2 x 1.7) + (41.7 + 22.9) **86.7**

Table 1. *Time-distance-dose table for MOS emplacement simulation. The value 22.9 is the average of the two values 20.8 and 25 which are the two emplacement values for the 7-Packs that were setting on the ground in both trials. The different value of 41.7 is for the stacked 7-Pack in the underground which had plastic wrap which was wrapped farther down on the 7-Pack, making it more difficult to insert the MOSs and added an average two seconds to the insertion time of each MOS.*

so that it is not obstructive, the average dose estimate could be lowered to around 30 μrem per 7-Pack.

In addition to the emplacement of MgO sacks around the perimeter of the 7-Packs, a large 'supersack' was placed on top of a 14-Pack using a fork lift. The use of the forklift eliminated any significant dose to workers and the step was not included in Table 1. Plans are being developed to use a 'pancake' backfill approach where flat sheets of MgO are placed on top of individual 7-packs as they are stacked three high. This system will use a forklift to emplace the backfill pancakes thereby minimizing the dose impact to workers.

One note regarding the emplacement process is that the most dose intensive aspect of the emplacement exercise involved removing the restraints that hold the 14-Packs to the transporter. This step took around two and a half minutes at an average of two feet from the drums, resulting in doses to the workers equal to that of the MOS emplacement. If any effort were made to reduce dose, this step would deserve attention. However, restraint-removal dose is not the focus of this paper and has not been included in Table 1.

CONCLUSION

Worker dose associated with the emplacement of MgO sacks around the perimeter of a 7-Pack was evaluated and found to be in the range of 30-50 μrem per 7-Pack depending on whether the plastic wrap around the 7-Pack was obstructive or not. This dose estimate is based on a time-distance analysis of a video tape of an emplacement simulation and on the radiation field estimates for an average 7-Pack.

In looking at the proposed throughput schedules, these values could begin to adversely impact WIPP administrative and ALARA goals in the year 2001 when the anticipated throughput will be 45 14-Packs a week. This volume of waste translates to 390 person mrem associated with hand emplacement of MgO sacks. When this is added to the estimated restraint release dose, the total person mrem for the two steps approach 800. Add to this a restraint-attachment-dose equal to or greater than 400 mrem, incurred in preparing the 14-packs for transport to the underground, and the total person mrems for a single waste shift approach WIPP administrative limit goals. Whether a limit is exceeded may depend on how evenly dose is incurred between workers. These results suggest that some effort may be needed to reduce these anticipated exposures if the present WIPP administrative or ALARA goals are to be accomplished.

Alternative plans are being developed where MgO pancakes will be placed between stacked 7-packs using a forklift. This approach is seen as having the most favorable cost/benefit analysis based on numerous factors including worker dose, facility costs, and operational considerations.

ATTACHMENT 1

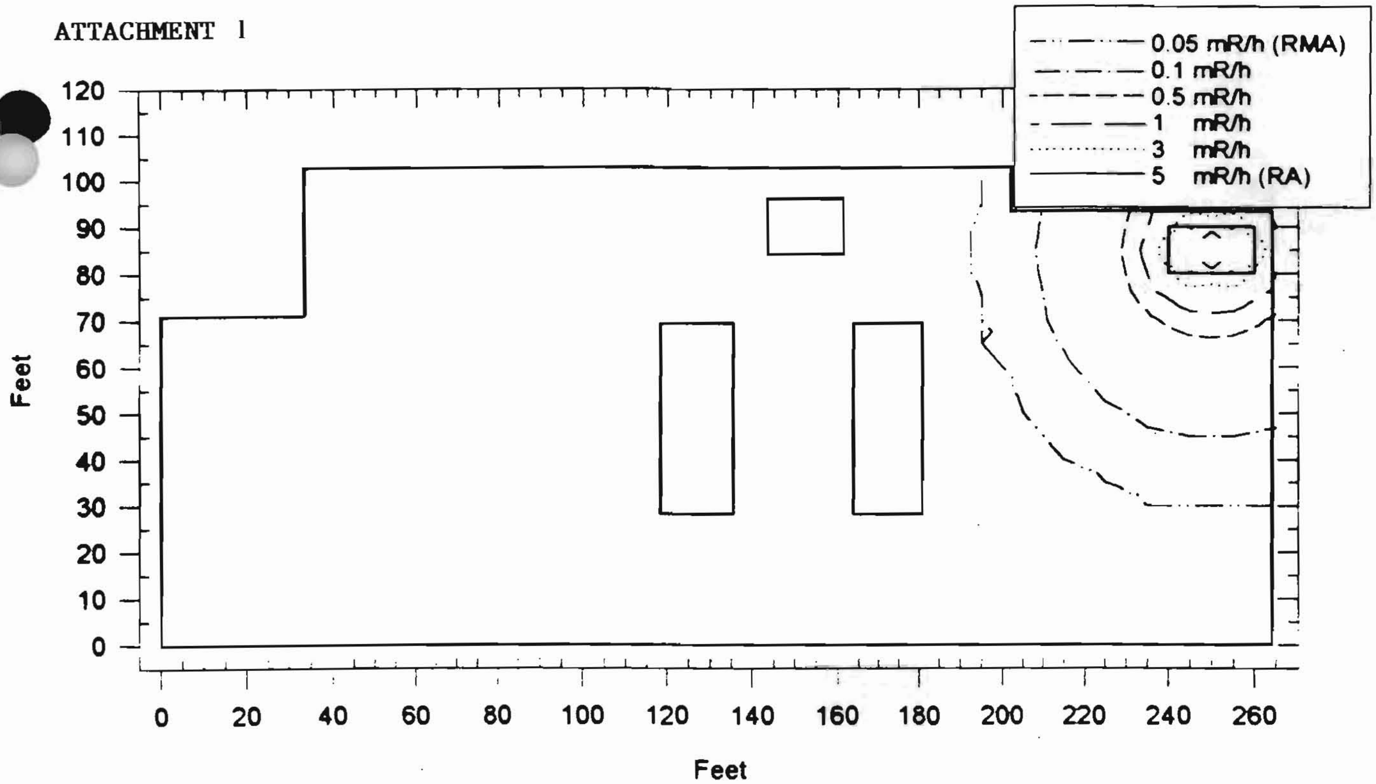

Fig. 3. Projected dose rates from "average" contact handled TRU waste for 1 facility pallet in staging area.

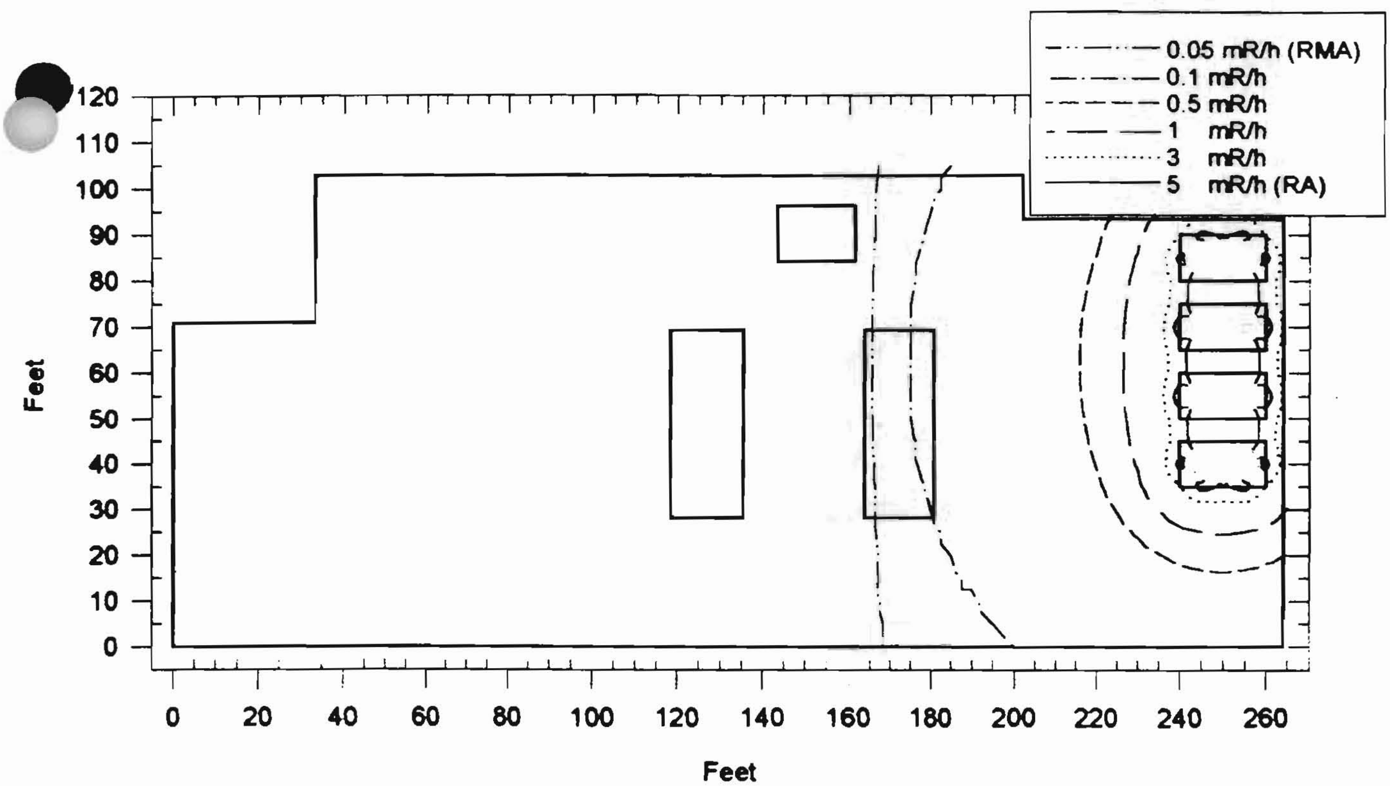

Fig. 4. Projected dose rates from "average" contact handled TRU waste for 4 facility pallets in staging area.