WSRC-RP-89-647

**RESPONSE TO REQUESTS BY FMF AND DWPF
CONCERNING DISPOSAL OF FMF SALTSTONE DRUMS IN
Z-AREA VAULTS (U)**

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July 25, 1989

RESPONSE TO REQUESTS BY FMF AND DWPF CONCERNING
DISPOSAL OF FMF SALTSTONE DRUMS IN Z-AREA VAULTS (U)

TO: W. E. Stevens, 773-43A

FR: C. A. Langton & J. R. Cook, 773-43A

Introduction

Disposal of FMF saltstone in 55 gallon drums in the Z-Area Industrial Waste Landfill requires modification of the landfill permit. Approximately 5000 drums of FMF saltstone are currently stored on SC DHEC-permitted concrete storage pads adjacent to the burial ground. At a meeting with DWPF, FMF, and EPS on July 18, 1989, IWT agreed to supply the following information:

- 1) Consequence of disposal of CCA (Cu, Cr, As) treated wood pallets in the Z-Area vaults. (Four drums of FMF saltstone are currently banded to each pallet.)
- 2) Consequence of placing partially filled FMF drums in the Z-Area vaults.
- 3) Formulation for clean grout back-fill. Grout will be emplaced around and over the drums, thereby iso-

lating them from environment (rainwater) prior to vault capping.

4) Maximum loading of FMF saltstone drums in the Z-Area vaults.

5) Consequence of void volume in drums, in clean grout, or both on groundwater modeling results.

This document is a response to the above requests.

Discussion & Recommendations

Recommendations addressing these requests are summarized as follows:

TREATED WOOD PALLETS

Treated wood is exempt from hazardous waste classification, as summarized by W. J. Maloney, Attachment 1. Disposal of treated wood pallets in the Z-Area vaults will likely require groundwater modeling studies and approval of groundwater impact by SC DHEC. As discussed in the July 18 meeting, inclusion of treated wood pallets in the permit modification would delay resolution of drum disposal.

PARTIALLY FILLED DRUMS

Do not place partially filled drums in a vertical, closely packed arrangement. Such an arrangement will result in an unsupported area over 73% of the cell. This is unacceptable from the standpoint of providing load-bearing support for the overlying drums, grout, etc.

An engineering study to evaluate drum emplacement options with respect to preventing subsidence, cost, and operational constraints is outside the scope of this report, and is not necessary for the permit modification. However, such a study should be carried out prior to placing the FMF drums in the Z-Area vaults unless voids in the drums and clean grout backfill can be eliminated

BACK-FILL GROUT

Basic data for specifying the clean grout backfill includes the following design criteria: 1) pumpable, 2) minimum compressive strength of 2000 psi, 3) flow up to 35 ft with vibration. (The assumption was made that a single discharge point would be used to grout 1/4 of the cell area [i.e., 50 X 50 ft section]. The maximum distance in this area is the diagonal length of 71 ft. One centrally located discharge point per 1/4 section results in a maximum flow distance of about 35 ft.), 4) no aggregate greater

than 1/2 inch, 5) D effective $\leq 5 \times 10^{-10}$ cm²/sec for U;
D effective , 1×10^{-8} cm²/sec for NO₃, Cr, Hg, all
others.

The clean grout mix design shown below or an
equivalent/improved mix design meets the basic data
requirements and is recommended for backfilling the FMF
drums. This is a standard construction grout with the
following, SRS approved design:

Type II cement	940 lbs	Pozzoian	164 lbs
Water	61	No aggregate	
Sand	1987	+/- water reducing admixture	
		air entrainer	

(Reference: Approved SRS Concrete Mix Designs 3/22/89,
Project 9S2295).

MAXIMUM FMF SALTSTONE LOADING

The limiting case for the number of drums in a cell or
vault is the maximum number which can be physically
placed in a cell, assuming the effective diffusion
coefficients for clean grout backfill specified above.
Several cases were modeled in which the relative
volumes occupied by drums and clean grout backfill
were varied. Diffusion coefficients of the clean grout
backfill were also varied. For all cases considered,
concentration of ²³⁴U in the drinking water is the
limiting case. As shown in Attachment 2, uranium
concentrations in the groundwater are much more sen-
sitive to the D_{eff} for U (backfill grout) than to the
relative volumes of FMF saltstone and backfill grout.

CONSEQUENCE OF VOID VOLUME

Void volume in either the FMF saltstone drums or in the
clean backfill grout does not adversely impact modeled
groundwater concentrations. As shown in Attachment 2,
void volume in the drums decreases the amount of waste
per cell. Void space in the clean grout due to pallets
decreases the number of drums per cell by one layer.
This again has the effect of reducing the volume of
waste per cell. The worst case modeled was the ref-
erence case with drums completely full of FMF salt-
stone and stacked with no pallets or grout between
layers of drums. (This discussion of void space is
based only on modeled groundwater results. Void space
must also be addressed with respect to preventing
subsidence.)

Future Work

IWT/SRL will measure diffusion coefficients of the clean backfill grout to ensure that the specified grout meets the requirements determined by the groundwater modeling.

ATTACHMENT 1

WESTINGHOUSE SAVANNAH RIVER COMPANY
INTER-OFFICE MEMORANDUM

ESH-FSG-89-0172

July 21, 1989

TO: D. G. MURDOCH, 247-F
K. Z. WOLF, 703-S
C. A. LANGTON, 773-43A

FROM: W. J. MALONEY, 703-A *WJM*

DISPOSAL OF PRESSURE TREATED WOOD

On 7/18/89 we met to discuss the disposal of the FMF saltcrete drums in the Z Area vaults with the pallets. At that time it was thought that these pressure treated pallets would fail an EP Toxicity test, therefore they would be considered a hazardous waste when disposed of.

This memo is to correct any misunderstandings that may have risen during the meeting. I agree that pressure treated pallets would probably fail an EP Toxicity test, but this wood would not be considered a hazardous waste when disposed of. SCHWMMR 261.4 (b) (9) specifically excludes discarded wood or wood products which fail an EP Toxicity test from the definition of a hazardous waste. This includes arsenical-treated wood.

I should point out, however, that this exclusion does not release us from our need to manage our waste in an environmentally sound manner. This includes being assured that arsenic would not migrate to the groundwater if we were to dispose of pressure treated wood pallets in the Z Area vaults. If you do contaminate the groundwater, RCRA 3004 (u) will force the facility back into the RCRA program (most likely as an RFI site and possibly as a CERCLA site) and corrective action will be required. To avoid this, we need to be sure that arsenic from pressure treated wood could not create a groundwater contamination problem before any pressure treated wood pallets are disposed of in the Z Area vaults.

Questions from your staff should be directed to W. J. Maloney (X5-1086).

WJM:sdm

ATTACHMENT 2

GROUNDWATER MODELING CASE STUDY FOR FMF DRUM LOADING IN Z AREA VAULTS

Attached are work sheets which calculate potential groundwater impacts resulting from the disposal of FMF waste in vaults surrounded by clean grout. The "Method of Ratios" developed by E. L. Wilhite (DPST-88-322) and applied to the Intera model used in the Z Area permits was used for these calculations. A number of scenarios were calculated based on various combinations of vault loading and drum filling cases. The assumptions used are listed in front. The underlying assumption in all cases is that the concentration of material in groundwater will be directly proportional to the ratio of FMF waste to total grout (FMF plus clean).

For each case the results are presented as the fraction of the Drinking Water Standard as a function of the effective diffusion coefficient of the grout. In all cases the most limiting constituent is ^{234}U .

Effective diffusion coefficients of $5 \times 10^{-10} \text{ cm}^2/\text{sec}$ for uranium and $1 \times 10^{-8} \text{ cm}^2/\text{sec}$ for nitrate in the clean grout will allow the maximum amount of drummed FMF waste to be placed in the vaults without exceeding drinking water standards.

Assumptions:

Vault divided into cells 100'x100'x24'.

Vault cell volume is 240,000 ft³.

Drums are 22"x36" and hold 7.5 ft³.

Pallets are 6" of solid material and will decompose to void space.

Drums can have 6" void in top.

U D_{eff} = Effective diffusion coefficient for uranium in clean grout

U %DWS = $\frac{\text{uranium concentration} * 100\%}{\text{uranium Drinking Water Standard}}$

Case 1: Drums completely full, no pallets.

100 ft/side / (22 in/drum / 12 in/ft) = 54 drums/side

54 * 54 = 2916 drums/layer

2916 drums/layer * 8 layers/cell = 23,344 drums/cell

23,344 drums/cell * 7.5 ft³/drum = 174,960 ft³ waste/cell

240,000 ft³ - 174,960 ft³ = 65,040 ft³ grout/cell

174,960 ft³ / (174,960 ft³ + 65,040 ft³) * 100% = 73% waste

U D _{eff}	1E-07	1E-08	1E-09	1E-10
U % DWS	1200%	390%	120%	39%

Case 2: Drums have 6 inch void in top, no pallets

$\pi * (11 \text{ in} / 12 \text{ in/ft})^2 * (3.0 \text{ ft} - 0.5 \text{ ft}) = 6.3 \text{ ft}^3 \text{ waste/drum}$

100 ft/side / (22 in/drum / 12 in/ft) = 54 drums/side

54 * 54 = 2916 drums/layer

2916 drums/layer * 8 layers/cell = 23,344 drums/cell

23,344 drums/cell * 6.3 ft³ waste/drum = 147,067 ft³ waste/cell

240,000 ft³ - 174,960 ft³ = 65,040 ft³ grout/cell

147,067 ft³ / (147,067 ft³ + 65,040 ft³) * 100% = 69% waste

U D _{eff}	1E-07	1E-08	1E-09	1E-10
U % DWS	1200%	370%	120%	37%

ATTACHMENT 2

Case 3: Drums have no void in top, 6 in thick pallets create voids

$$3 \text{ ft/drum} + 0.5 \text{ ft/pallet} = 3.5 \text{ ft/layer}$$

$$100 \text{ ft/side} / (22 \text{ in/drum} / 12 \text{ in/ft}) = 54 \text{ drums/side}$$

$$54 * 54 = 2916 \text{ drums/layer}$$

$$24 \text{ ft/cell} / 3.5 \text{ ft/layer} = 6 \text{ layers/cell}$$

$$2916 \text{ drums/layer} * 6 \text{ layers/cell} = 17,496 \text{ drums/cell}$$

$$17,496 \text{ drums/cell} * 7.5 \text{ ft}^3 \text{ waste/drum} = 131,220 \text{ ft}^3 \text{ waste/cell}$$

$$240,000 \text{ ft}^3 - 131,220 \text{ ft}^3 - [6 \text{ layers} * 0.5 \text{ ft/layer} * 100 \text{ ft} * 100 \text{ ft}] = 78,780 \text{ ft}^3 \text{ grout}$$

$$131,220 \text{ ft}^3 / (131,220 \text{ ft}^3 + 78,780) * 100\% = 62\% \text{ waste}$$

U D _{eff}	1E-07	1E-08	1E-09	1E-10
U % DWS	1000%	330%	104%	33%

Case 4: Drums have no void in top, 6 in thick grout layer between drums

$$3 \text{ ft/drum} + 0.5 \text{ ft/cover} = 3.5 \text{ ft/layer}$$

$$100 \text{ ft/side} / (22 \text{ in/drum} / 12 \text{ in/ft}) = 54 \text{ drums/side}$$

$$54 * 54 = 2916 \text{ drums/layer}$$

$$24 \text{ ft/cell} / 3.5 \text{ ft/layer} + 3 \text{ ft/top layer} = 7 \text{ layers/cell}$$

$$2916 \text{ drums/layer} * 7 \text{ layers/cell} = 20,412 \text{ drums/cell}$$

$$17,496 \text{ drums/cell} * 7.5 \text{ ft}^3 \text{ waste/drum} = 153,090 \text{ ft}^3 \text{ waste/cell}$$

$$240,000 \text{ ft}^3 - 153,090 \text{ ft}^3 = 86,910 \text{ ft}^3 \text{ grout}$$

$$153,090 \text{ ft}^3 / (153,090 \text{ ft}^3 - 86,910 \text{ ft}^3) * 100\% = 64\% \text{ waste}$$

U D _{eff}	1E-07	1E-08	1E-09	1E-10
U % DWS	1100%	340%	110%	34%

Case 5: Drums have no voids in top, 6 inch pallets and 6 in thick grout layer between drums

$$3 \text{ ft/drum} + 0.5 \text{ ft pallet} + 0.5 \text{ ft/cover} = 4.0 \text{ ft/layer}$$

$$100 \text{ ft/side} / (22 \text{ in/drum} / 12 \text{ in/ft}) = 54 \text{ drums/side}$$

$$54 * 54 = 2916 \text{ drums/layer}$$

$$24 \text{ ft/cell} / 4.0 \text{ ft/layer} = 6 \text{ layers/cell}$$

$$2916 \text{ drums/layer} * 6 \text{ layers/cell} = 17,496 \text{ drums/cell}$$

$$17,496 \text{ drums/cell} * 7.5 \text{ ft}^3 \text{ waste/drum} = 131,220 \text{ ft}^3 \text{ waste/cell}$$

$$240,000 \text{ ft}^3 - 131,220 \text{ ft}^3 - 30,000 \text{ ft}^3 = 78,780 \text{ ft}^3 \text{ grout}$$

$$131,220 \text{ ft}^3 / (131,220 \text{ ft}^3 - 78,780 \text{ ft}^3) * 100\% = 62\% \text{ waste}$$

U D _{eff}	1E-07	1E-08	1E-09	1E-10
U % DWS	1000%	330%	104%	33%

Case 6: Drums have voids in top, 6 in thick pallets create voids

$$\pi * (11 \text{ in} / 12 \text{ in/ft})^2 * (3.0 \text{ ft} - 0.5 \text{ ft}) = 6.3 \text{ ft}^3 \text{ waste/drum}$$

$$3 \text{ ft/drum} + 0.5 \text{ ft/pallet} = 3.5 \text{ ft/layer}$$

$$100 \text{ ft/side} / (22 \text{ in/drum} / 12 \text{ in/ft}) = 54 \text{ drums/side}$$

$$54 * 54 = 2916 \text{ drums/layer}$$

$$24 \text{ ft/cell} / 3.5 \text{ ft/layer} = 6 \text{ layers/cell}$$

$$2916 \text{ drums/layer} * 6 \text{ layers/cell} = 17,496 \text{ drums/cell}$$

$$17,496 \text{ drums/cell} * 6.3 \text{ ft}^3 \text{ waste/drum} = 110,224 \text{ ft}^3 \text{ waste/cell}$$

$$240,000 \text{ ft}^3 - 131,220 \text{ ft}^3 - [6 \text{ layers} * 0.5 \text{ ft/layer} * 100 \text{ ft} * 100 \text{ ft}] = 78,780 \text{ ft}^3 \text{ grout}$$

$$110,224 \text{ ft}^3 / (110,224 \text{ ft}^3 + 78,780) * 100\% = 58\% \text{ waste}$$

U D _{eff}	1E-07	1E-08	1E-09	1E-10
U % DWS	970%	310%	97%	33%

ATTACHMENT 2

Case 7: Drums have voids in top, 6 in thick grout layer between drums

$$3 \text{ ft/drum} + 0.5 \text{ ft/cover} = 3.5 \text{ ft/layer}$$

$$\pi * (11 \text{ in} / 12 \text{ in/ft})^2 * (3.0 \text{ ft} - 0.5 \text{ ft}) = 6.3 \text{ ft}^3 \text{ waste/drum}$$

$$100 \text{ ft/side} / (22 \text{ in/drum} / 12 \text{ in/ft}) = 54 \text{ drums/side}$$

$$54 * 54 = 2916 \text{ drums/layer}$$

$$24 \text{ ft/cell} / 3.5 \text{ ft/layer} + 3 \text{ ft/top layer} = 7 \text{ layers/cell}$$

$$2916 \text{ drums/layer} * 7 \text{ layers/cell} = 20,412 \text{ drums/cell}$$

$$17,496 \text{ drums/cell} * 6.3 \text{ ft}^3 \text{ waste/drum} = 110,224 \text{ ft}^3 \text{ waste/cell}$$

$$240,000 \text{ ft}^3 - 153,090 \text{ ft}^3 = 86,910 \text{ ft}^3 \text{ grout}$$

$$110,224 \text{ ft}^3 / (110,224 \text{ ft}^3 - 86,910 \text{ ft}^3) * 100\% = 56\% \text{ waste}$$

U D _{eff}	1E-07	1E-08	1E-09	1E-10
U % DWS	940%	300%	94%	30%

Case 8: Drums have voids in top, 6 inch pallets and 6 in thick grout layer between drums

$$3 \text{ ft/drum} + 0.5 \text{ ft pallet} + 0.5 \text{ ft/cover} = 4.0 \text{ ft/layer}$$

$$\pi * (11 \text{ in} / 12 \text{ in/ft})^2 * (3.0 \text{ ft} - 0.5 \text{ ft}) = 6.3 \text{ ft}^3 \text{ waste/drum}$$

$$100 \text{ ft/side} / (22 \text{ in/drum} / 12 \text{ in/ft}) = 54 \text{ drums/side}$$

$$54 * 54 = 2916 \text{ drums/layer}$$

$$24 \text{ ft/cell} / 4.0 \text{ ft/layer} = 6 \text{ layers/cell}$$

$$2916 \text{ drums/layer} * 6 \text{ layers/cell} = 17,496 \text{ drums/cell}$$

$$17,496 \text{ drums/cell} * 6.3 \text{ ft}^3 \text{ waste/drum} = 110,224 \text{ ft}^3 \text{ waste/cell}$$

$$240,000 \text{ ft}^3 - 131,220 \text{ ft}^3 - 30,000 \text{ ft}^3 = 78,780 \text{ ft}^3 \text{ grout}$$

$$110,224 \text{ ft}^3 / (110,224 \text{ ft}^3 - 78,780 \text{ ft}^3) * 100\% = 58\% \text{ waste}$$

U D _{eff}	1E-07	1E-08	1E-09	1E-10
U % DWS	970%	310%	97%	31%

END

**DATE
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4 / 29 / 93