ENVIROCARE OF UTAH, INC.
THE SAFE ALTERNATIVE

40-8989

February 4, 1994

Ms. Sandra Wastler
Mr. Daniel Rom
U.S. Nuclear Regulatory Commission
5E2-ORTEN USNRC
11555 Rockville Pike
Rockville, MD 20852

Subject: Revised Filter Zone Design

Dear Ms. Wastle/Mr. Rom:

Envirocare of Utah, Inc. (Envirocare) is submitting for your consideration, a proposed redesign of the filter zone. Enclosed is a summary of the proposed changes with the associated calculations. The changes are in response to the need to develop a cover design which satisfy both the NRC and the State of Utah requirements.

If you have any question or require further information, please contact me at your convenience at (801) 532-0920.

Sincerely,

Steven J. Peterson
Site Engineer

Enclosure

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NMSS/RGN4
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REVISED FILTER ZONE DESIGN

BACKGROUND:

Under Envirocare's current cover design, the filter zone material has been designed by use of strict filter criteria for bedding materials. This type of design has two disadvantages: 1) If often requires multiple layers of filter zone increasing the complexity of the cap, and 2) the multiple layers of filter zone which include fine grained materials such as sand, impede the water runoff from the cap; thus, increasing the water flux through the embankment. By increasing the permeability of the filter zone while providing adequate erosion protection for the radon barrier, the water flux through the embankment can be decreased.

OBJECTS:

Increase the permeability of the filter zone while providing adequate protection for the radon barrier.

PROPOSED CHANGE:

1. Replace the two and three layer filter zones with a single 12 inch thick filter zone, and

2. Increase the thickness of top slope rip-rap to 18 inch.

PROPOSED DESIGN:

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18 inches of Rip-Rap

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12 inches of Filter Zone

Radon Barrier

Top-Slope Rip-Rap Gradation:

SIZE:	% PASSING
6"	100%
3"	30-70%
1-1/2"	0-30%

Side-Slope Rip-Rap Gradation:

SIZE:	% PASSING
16"	100%
8"	30-70%
3"	0-30%

Proposed Filter Zone Gradation

SIZE:	% PASSING
6"	100%
3"	95-100%
1-1/2"	70-100%
1/2"	20-60%
No. 10	0-10%

CALCULATIONS:

Use critical velocity approach.

Assume a maximum permissible velocity of 0.5 ft/sec from Figure 7-3 of Open-Channel Hydraulics.

$V_s = (k * i) / n$

Where V_s = Velocity

k = Permeability

i = gradient

n = porosity

Because the path through the filter zone is a tortuous path, V_s should be increased by a factor of $\sqrt{2}$ which applies to a porous media of approximately uniform pore size. Therefore:

$V_s = (k * i * \sqrt{2}) / n$

Assume $n \approx 0.3$

Find k for top slope with a maximum slope of 3.6%.

$k = (V_s * n)/(i * \sqrt{2})$

$= (0.5 * 0.3)/(0.036 * \sqrt{2})$

$= 2.95$ ft/sec

$= 90$ cm/sec

Therefore, for the top slope, a permeability of 90 cm/sec or less will limit flow to less than 0.5 ft/sec.

Find k for side slope with a slope of 20%.

$$k = (V_a * n)/(i * \sqrt{2})$$

$$= (0.5 * 0.3)/(0.2 * \sqrt{2})$$

$$= 0.53 \text{ ft/sec}$$

$$= 16 \text{ cm/sec}$$

Therefore, for the side slope, a permeability of 16 cm/sec or less will limit flow to less than 0.5 ft/sec.

Find the maximum grain size for the lower band (Use Hazen's formula).

$$k \text{ (cm/sec)} = (D_{10} \text{ (mm)})^2$$

$$D_{10} = \sqrt{k}$$

$$= \sqrt{16}$$

$$= 4 \text{ mm}$$

$$= 1.57"$$

The D_{10} for the proposed gradation is less than the maximum allowable grain size for the lower band; therefore, the gradation provides acceptable protection against erosion of the radon barrier.

CONCLUSIONS:

The proposed change in rip-rap will provide adequate erosion protection for the radon barrier and will decrease the water flux through the embankment.

REFERENCES:

(Chow, V. T., 1959, Open-Channel Hydraulics, McGraw-Hill Book Co., New York, p. 166)