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TENNESSEE VALLEY AUTHORITY

CHATTANOOGA, TENNESSEE 37401
1630 Chestnut Street Tower II

RETURN ORIGINAL TO PDR, HQ.

June 19, 1985

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RECEIVED JUN 25 1985 U.S. Nuclear Regulatory Commission Mail Section

Mr. R. Dale Smith
U.S. Nuclear Regulatory Commission
Uranium Recovery Field Office
P.O. Box 25325
Denver, Colorado 80225

Dear Mr. Smith:

In the Matter of)
Tennessee Valley Authority (TVA))

Docket No. 40-1341

On March 5, 1985, TVA submitted information to you which addressed actions taken to eliminate the perched water at the Edgemont Decommissioning Project disposal site. In your March 22, 1985 response to our submittal, you indicated that our data was insufficient to allow a determination that "the existing unconfined water within the weathered shale in the disposal basin has been eliminated to the extent practicable." In addition, we were asked to respond to three specific questions directed at producing responses that would contain the necessary information to fulfill TVA's commitment to License Condition Number 36.

Enclosed for your review is a copy of a McLaren Engineers' report submitted as TVA's response to your questions.

If you have any questions or comments concerning this matter, please get in touch with W. M. Belvin of my staff at FTS 858-2693 in Chattanooga.

Very truly yours,

TENNESSEE VALLEY AUTHORITY

J. A. Domer

J. W. Hufham, Manager
Licensing and Regulations

Enclosure

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Add Info
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MacLaren Engineers

42497-1000-0008

May 17, 1985

Mr. G. Cummings
Resident Manager
Silver King Mines Inc.
P.O. Box 49
Edgemont, South Dakota
U.S.A. 57735

Dear Mr. Cummings:

Re: Edgemont Mill Decommissioning
NRC Questions Concerning Disposal
Site "Trapped" Water

At your request, we have undertaken to respond to the questions raised by NRC with regard to the drainage of "the existing unconfined water within the weathered shale in the disposal basin". These questions addressed the following specific points:

1. The total amount of water entrained in the weathered shale within the disposal site.

2. A discussion of any further measures that could be taken to eliminate this water.

3. If the water could not be eliminated, the potential for this water, containing hazardous constituents leached from the tailings, to migrate laterally through the clay perimeter liner and the subsequent environmental consequences.

Before undertaking a response to these questions, perhaps a brief review of the basin design philosophy is in order.

Detailed geotechnical investigation of the proposed disposal basin undertaken during the design studies (Report 7, MacLaren 1983), confirmed the presence of low permeability shale ($K<1 \times 10^{-7}$ cm/s) underlying the disposal basin. However, this work revealed that the proposed impoundment excavation contours contained in the Final Environmental Statement (FES) related to the decommissioning of the Edgemont Uranium Mill (USNRC 1982), would terminate in overburden or weathered shale and in some areas not meet the requirement of the FES that "the permeability of the materials in the bottom and sides of the proposed impoundment excavation will be uniformly about 1×10^{-7} cm/s (0.1 ft./year) across the entire site (FES Section 2.2.3.7, Item 5).

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Also, it was revealed that the unconfined groundwater conditions that occur in the surficial materials at the proposed disposal site noted in the FES (Section 3.6.2.2) did indeed exist in the lower portion of the relatively "pervious" weathered shale above the more "impervious" unweathered shale (Report 7, Figure 10).

In consideration of these findings, two alternatives were considered for the design of the containment system for the basin:

1. Development of the basin utilizing a relatively shallow excavation scheme generally to the contours proposed in the FES and lining the bottom and sides of the basin with a three-foot layer of clay compacted to achieve a permeability of 1×10^{-7} cm/s. Under this alternative, the liner would have been placed above the unconfined groundwater layer in the weathered shale zone.

2. Excavation of the sides of the basin into the "impervious" competent shale and lining the perimeter walls above the level of the competent shale with a minimum three-foot clay layer thus isolating or sealing off the basin from the surrounding more pervious strata.

   This latter alternative was recommended because it:

   i) utilizes relatively steep slopes on the side walls (two horizontal to one vertical), thus minimizing the contact area between the more pervious strata forming the basin walls and also provides for diversion of groundwater around the basin perimeter;

   ii) maximizes the volume of the basin relative to the surface area and minimizes the potential for infiltration of surface water into the wastes; (The surface area is reduced by 44% over the area of the basin proposed in the FES.)

   iii) provides for a staged development of the basin (annual cells) which allows for adjustments to be made in the volume of the basin as the decommissioning proceeds. This aspect is of particular significance as the exact extent of the contamination at the mill site will not be known until excavation of the tailings sands and slimes is undertaken. By modifying the bottom contours within each annual cell, the volume of the basin can be adjusted thus avoiding redesign of the surface contours which could ultimately affect surface runoff and/or the erosion rate of the final cover.

With regard to the first question raised by NRC, the total volume of saturated weathered shale which will remain is calculated to be about 250,000 cu. yds. This calculation is based on the inferred perched groundwater contours and top of competent shale contours (Report No. 7, Figures 9 and 10) and the design excavation contours developed for an estimated contaminated material volume of 2.65 x 10^6 cu. yds. (Report 10, MacLaren 1983, Drawing No. 1).

Assuming no drawdown of the water level in the saturated zone as a result of construction operations and assuming an average total porosity of the weathered shale of about 30 per cent, the total volume of isolated or "trapped" groundwater within the basin is estimated to be 2.0 x 10^6 cu. ft. With regard to the trapped water, it should be noted that:

i) It will be isolated from the perched groundwater table outside the basin by the perimeter liner which will be keyed into the underlying "impermeable" ($K<1 \times 10^{-7}$ cm/s) shale;

ii) Only a relatively small percentage, probably less than 5%, of the total water volume noted above can be drained out of the weathered shale by gravity; the remainder comprises interstatial water which is bound into the shale matrix and can only be removed by such measures as oven drying.

With respect to drainage of the weathered shale, it is our opinion that with the exception of a few isolated more permeable zones, which have been observed in the current excavation of the basin, the permeability of the majority of the weathered shale is too low to permit any level of practical drainage beyond the measures provided in the design. As an example, the majority of the existing exposed cut slopes below the zone of saturation in both the perimeter cut-off trench and the centerline drainage ditch are currently baked dry (by exposure) yet local excavation into the face of the slopes will expose "wet" shale within a few inches of the dry surface.

To intercept and drain the isolated more permeable zones within the weathered shale, the basin design called for the construction of a center-line drainage trench and excavation of the perimeter and embankment cut-off trenches. These excavations have and will continue to provide drainage for the isolated, more permeable zones as the development of the basin proceeds until the source of recharge is cut off by placement of the perimeter clay liner.

It is also worth noting that assuming a volume of 2.65 x 10^6 cu. yds. of contaminated material is placed in the basin approximately 200,000 cu. yds. of saturated weathered shale will be excavated from the basin, along with approximately 1.7 x 10^6 cu. ft. of "trapped" water. The excavated weathered

shale will either be placed in stockpile for future use in construction of the final cap or utilized directly for construction of the downstream portion of the embankment structure (Report 10, Table 5.1). It was anticipated in the design, as noted above, that much of the "trapped" water in the excavated weathered shale would remain and when mixed with drier soils provide a substantial portion of the compaction water (optimum moisture content for compaction of the weathered shale ~ 20%) required to place the material and achieve the desired density. When the weathered shale is placed as part of the cap, it would be expected that "trapped" water, when replaced by precipitation infiltrating through the cover, would eventually percolate into the tailings.

A discussion of the completed basin steady-state seepage considerations and rate of contaminant migration was presented in the disposal site design report (Report 10). This analysis was reviewed by Oak Ridge National Laboratory in a letter to NRC (August 1984). The conclusion from these studies was that the contaminants of interest will require time periods in the order of hundreds of years in the case of uranium and at least a thousand years in the case of radium 226 to migrate through the perimeter liner.

It is our opinion that the presence or absence of the "trapped" water in the weathered shale within the basin has no significance with respect to the above conclusion.

This opinion is based on the following rationale: if we ignore for the moment surface water infiltration into the basin, there will be essentially no gradient causing seepage of the "trapped" water in the weathered shale to migrate through the liner:

i) because the weathered shale itself will not drain;

ii) because initially the "perched" water level outside the basin will be above the "trapped" water level inside the basin.

If we further assume that the "trapped" water could be removed from the weathered shale prior to placement of the tailings, then the weathered shale would effectively have a capacity to contain or trap approximately 2.0×10^6 cu. ft. of water. Ignoring the field capacity and transit time through the tailings mass and assuming that all replacement moisture would come from infiltration through the cap (0.8 gals/min., Report 10, Section 4.5.2.1), then it would require approximately 36 years for conditions in the weathered shale to reach the saturated state noted above.

Since there is no practical method of removing the "trapped" water from the weathered shale, the only other alternative available is to remove the weathered shale containing the "trapped" water. Under this condition

the tailings mass would be placed directly on the unweathered shale and the seepage conditions in the basin in our opinion would be equivalent to the case where the saturated weathered shale was left in place.

However, leaving the weathered shale in the basin would appear to have some definite environmental advantages. Under the original assumption, as the water level in the basin rises due to surface water infiltration (Report 10, Section 4.5.2), the increased head may have a tendency to drive the "trapped" groundwater out of the basin. In our opinion, there will be little or no advective mixing of the contaminated leachate (surface water infiltration migrating through the tailings) and the "trapped" water within the weathered shale (mixing will be restricted to diffusion). Under these circumstances, the 250,000 cu. yds. of weathered shale which represent approximately four times the volume of material to be placed as liner, may well tend to retard rather than encourage the rate of contaminant migration out of the basin.

In summary, it is our opinion that there is no practical method other than what has been incorporated into the basin development plans for removing the "trapped" water within the weathered shale matrix. Also, it is our opinion that the presence of this water in the weathered shale will not affect the conclusions reached regarding the containment efficiency of the basin design and action taken to remove the "trapped" water by excavation of the weathered shale may indeed have an adverse effect on the overall rate of contaminant migration from the basin.

We trust that the above discussion satisfies your immediate purposes. Should you have any questions or require our further services on this matter, please do not hesitate to contact us.

Yours very truly,

MacLAREN ENGINEERS INC.

E.J. Chart, P.Eng.
General Manager
Waste Management

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