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DRAFT 40-8907

10/20/87

RETURN ORIGINAL TO PDR, HQ.

EPA Comments on UNC Reclamation Plan

1. Examination of possible remedies for groundwater quickly reveals the interconnection between reclamation and plans for dealing with seepage. Since capping of source areas is one of the principal methods for mitigating future groundwater degradation by infiltration of surface waters through the tailings, the design of the cap and the basic decision that capping alone is adequate are of concern to EPA. Capping serves two purposes: limiting radon releases and reducing infiltration to the tailings. One or both of these functions will determine the design of the cap over all or portions of the tailings. With no documented basis, UNC has reached the decision to design the cap for radon attenuation alone. While comments in attachment C also deal with the adequacy of radon attenuation modeling, the principal concern is UNC's seemingly unilateral decision that this function determines the cap specifications. In the past, liquids associated with tailings have provided a strong source of contamination, the potential exists for dewatered tailings, to contaminate infiltrating surface water and pose a continuing problem.

   The possible control of groundwater protection purposes on the cap design needs to be addressed prior to starting construction of the cap.

2. The eventual fate of the contaminated body of groundwater is not addressed. UNC's contention that dissipation of the groundwater mounds eliminates health hazards is oversimplistic and incorrect. The existing seepage won't evaporate or simply disappear. Instead, dissipation of the mounds is accomplished by downgradient movement of the contaminated waters.

   UNC clearly states that its modeling is a strict hydraulic analysis, that makes no effort to account for the attenuation and dispersion of contaminants. The later processes are in fact the primary concern. The hydraulics of the mounds dissipation are relatively unimportant, since constituents levels may be reduced to background or other acceptable levels either prior to or long after water levels have stabilized.

   Projections of the fate and transport rates for the existing body of contaminated groundwater need to be made. Until that is done, UNC's statements on how far seepage will travel and the off-site impacts it may cause are mere speculation.

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3. UNC's report commonly arrives at numerical values or critical conclusions without adequate information on how it was derived. Specific examples include:

   a) dissipation calculations for the groundwater mounds;
   b) the opinion that alluvium rapidly neutralizes tailings seepage;
   c) application rates for spraying water onto the tailings piles; and
   d) water balance calculations

   Without knowing what data conclusions are based on, or the calculations employed, it is impossible to verify many of the report's conclusions.

4. The groundwater system beneath the site is termed a "temporary system" by UNC. This conclusion is based on an extremely limited amount of data (the NECR mineshaft and one pre-mill boring). More documentation needs to be included in the report concerning the degree of saturation of the Alluvium, Dilco, and Upper Gallup, at the tailings pile, mill, and surrounding areas prior to mining and milling. The logs for the NECR mine shaft, boring HL-5, and borehole No. 76SHB-2W, should be included with this report along with the logs of other boreholes drilled prior to 1977. NMEID recently stated that other wells were drilled at the same time as those cited in the report. If that is true, then why doesn't UNC present that data too?

   In addition to the limited data, UNC presents a water balance to demonstrate that the zones could have been saturated by mine water and tailings seepage. The number of assumptions and unknowns make it very difficult to determine the validity of the water balance. In addition, outflow both up and down valley from the section evaluated are neglected. This might be valid in the middle of a long and consistent stretch of stream, but it probably isn't here.

   Water levels may have increased due to mine water infiltration and tailings seepage. However, UNC's position that the formations were dry in extreme and very likely wrong.

5. The areal extent of contaminated groundwater is significantly understated. This is accomplished through use of an inadequate indicator (lab pH) and the selective use or ignorance of certain wells. EPA believes that the farthest down-gradient well in the Gallup zone 3, EPA-1, may have been affected by seepage. In addition, UNC's conclusions on natural water quality in alluvium directly below and south of the south cell may not be correct. In particular, nitratel levels in alluvial monitoring wells are well in excess of normal background values, even if he alluvium were a newly saturated zone.

6. The level of contamination present in the groundwater is not addressed. Instead, laboratory pH is used to define the extent of the contaminant plume. Lab pH is an inappropriate indicator for several reasons:

   a) "Lab" pH is not a valid test parameter due to the ease with which a samples pH can change between collection and measurements (it must be measured in the field);

   b) A pH greater than 7 does not assure that an area has not been impacted by some acidic seepage since the initial pH was apparently above 7 and significant buffering of the acid is possible depending on initial water quality;

   c) Water quality can be significantly degraded by primary and secondary contaminants with no accompanying change in pH or alkalinity if the seepage has already been neutralized.

   d) Some UNC wells have been reportedly completed with limestone gravel packs which would tend to neutralize acidic seepage;

   e) Side by side comparison of field vs. lab pH in UNC's own samples shows a uniform increase of 0.3 to 0.5 units from field to lab; and

   f) UNC fails to demonstrate a correlation between pH and other constituents in the groundwater.

   The mere fact that more measurements exist for one parameter (lab pH) than any other does not make it the best or most appropriate way of identifying the extent of the plume. The use of pH as an indicator underestimates the affected and threatened areas and gives the false impression that the alluvium is unaffected. The selection of a small group of anion and cation indicators (e.g. sulfate, nitrate/ammonia, chloride, ~~as RSA~~) would be much more appropriate for outlining the areal extent and water quality of the plume. Without such an approach, the plume cannot even be identified, let alone evaluated for possible remediation or health threats.

and TDS

The plan's overall failure to examine the level of contaminants present precludes both the comparison of these levels to drinking water MCLs or background and the evaluation of potential effects on health or the environment. Such an evaluation of water quality with respect to MCLs and background in existing aquifers affected or threatened by seepage is explicitly required by 40 CFR Section 192.32(a)(2), Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings-Subpart D. These EPA regulations were promulgated under authority of Section 275 of the Atomic Energy Act of 1954, 42 U.S.C. 2022, as added by the Uranium Mill Tailings Radiation Control Act of 1978, P.L. 95-604, as amended.

Indicator parameters need to be selected and utilized in evaluating existing and future groundwater conditions as well as in future monitoring. An analysis of water quality with respect to the requirements of 40 CFR 192 is also required.

7. Contrary to UNC's conclusions, it appears that significant areas of the alluvium may be affected by seepage. The explanation of low pH observed in wells south of the impoundments as being a result of normal quality of the "rubble zone" at the Mancos Shale surface is questionable. The "anomaly" is explained based on the completion depths of the wells. In fact, using Table 4.8, it is apparent that the six wells with depressed pH are a closely spaced group with surrounding wells, regardless of depth, showing near normal pH. The explanation of other constituents being part of normal background is also questionable. Even if geochemical properties of the alluvium underlying most of the tailings have prevented migration of contamination to the south and west of the site, the questions arise: for predicted future seepage from the tailings, how long will the alluvium continue to neutralize the leachate? What is the neutralization capacity to the alluvium, and under proposed reclamation conditions, how long can it continue to operate? The extent of contamination and levels present in the alluvium need to be addressed.

8. The past, present, and future sources of groundwater contamination are not addressed in any detail. Tailings disposed in various portions of the impoundments have varied in chemical make up over time. Other sources such as raffinate pits and periodic spills, in addition to that in 1979, are not even mentioned. Are any of these significant? The future potential of rainfall to leach tailings is not addressed, as was discussed previously.

   A figure identifying the sources of groundwater contamination and some discussion of when they were active and how strong a source they provided are needed. This is particullarly critical where tailings were disposed directly over outcrops or shallow subcrops of the Gallup formation.

9. Gross transport rates are evaluated based on aquifer tests. For the most part, this does not account for the more transmissive lineament or fracture zones or permeable channels in the alluvium. These are the most rapid mechanisms for off-site transport. Therefore evaluation of the transport rates and capacities of such zones is appropriate.

10. The conclusion as to evaluation of the geochemical make up of groundwater are in some cases highly questionable. Further discussion is provided in Attachment D, relating to UNC's "Geochemical Background Study."

11. No pilot tests were conducted in order to optimize cap performance with respect to radon attenuation and infiltration reduction. Such relatively simple tests would clearly be appropriate for a cap of such size to prevent over-design and reduce costs. From a regulatory standpoint, it should be requested that UNC either prove the design works, or overbuild it to such a degree its success would be beyond questions. Such over-design on a 200 acre cap wold be extremely bad judgement on UNC's part. The lack of such tests raises concerns as to whether the cap really was over-designed or if it is even adequate.

ATTACHMENT A

CH2M HILL
Engineers
Planners
Economists
Scientists

August 31, 1987

W08761.ED

Mr. Alan Tavenner
U. S. Environmental Protection Agency
10th Floor
Allied Bank Tower
1455 Ross Avenue
Dallas, Texas 75202-2733

Dear Mr. Tavenner:

Subject: Review of United Nuclear Corporation
Geohydrologic Report

As follow up to our meeting of August 20, 1987, I am enclosing our formalized response to the above referenced report. I have grouped the comments into general and specific. The specific comments list the page number and the portion of the page to which we refer.

GENERAL COMMENTS

The hydrogeologic report has several shortcomings. Generally speaking, most report conclusions could be valid, however, we find that the backup and support for these conclusions are missing. It will be a more credible report if more calculations and data are included to support the conclusions that are made.

The use of laboratory pH as an indicator of contamination is not a good parameter. Lab pH could have changed significantly from when the sample was collected. Total dissolved solids, nitrate, chloride or other drinking water parameters should be used. In many wells significant contamination can be found outside the pH plume. Good examples include EPA Nos. 10 and 21 (Zone 3), EPA Nos. 2 and 8 (Zone 1), and EPA Nos. 20, 26 and 28 (alluvium). There is a considerable amount of high TDS water in the junction of Pipeline Canyon and the stream valley where NECR mine shaft discharged. Much of this water could infiltrate into Zone 3.

The report gives conclusions based on a particular remedial action. This action is presented with no alternative analysis. If other alternatives were evaluated, they should be presented. If not, the study does not parallel CERCLA guidance.

There are several portions of data that are needed to evaluate the hydrogeologic conditions that were not found in the report. How much volume of tailings are present? What is the total volume of liquids that could be available for recovery, if necessary, at the site? What is the tailings chemistry, pore water chemistry, and hydraulic properties of the tailings?

There is no discussion of what happens to this and other alluvial water after closure. Does it migrate downstream? Does postclosure water in Zones 1 and 3 just stop, disappear, become adsorbed after closure? In contrast to Canonie, we feel that the head in the tailings, tailings dewatering, and precipitation will continue to drive the contaminants downgradient.

Upgradient wells in Pipeline Canyon above the influence of Quivera and UNC would be useful in determining if a pre-UNC aquifer system existed in the alluvium.

SPECIFIC COMMENTS

Page 7 — First Bullet - Zone 2 is considered an aquiclude in the site area and acts as a hydraulic barrier between Zones 1 and 3. Yet in the cross-sections through the site, displacement along faults have been in excess of the thickness of Zone 2. In some areas (Figure 2-5), the Zones 3 and 1 aquifers are juxtaposed. Therefore, Zone 2 cannot be assumed to be a true aquiclude.

Page 13 — Last Paragraph - The argument addressed in this paragraph is that no near surface groundwater was present prior to the tailings operation. This may be true, however, the supporting data is not in the text. The mine shaft log should be presented. In what formation was the water found? Also, when considering the dip of the rocks at the site,

the mine shaft would be on strike with cross-section B-B. In this cross-section, Zone 1 has a bottom elevation of 6,700, which is similar to the elevation of the first water reportedly encountered in the mine shaft log.

Page 14 — Second Paragraph - There is no backup for saying that Zone 1 is unsaturated in the areas at well Nos. EPA-1 and EPA-17. Both of these wells did not intercept the Zone 1 aquifer.

Page 16 — First Paragraph - Calculates infiltration loss for a 6-year period (1969 through 1977). This is actually an 8-year period. Also March through May is actually 3 months and not 5 months.

Therefore, infiltration may be as high as 1 billion gallons.

Page 16 — Second Paragraph - Calculations should be shown to support the pore volumes for each strata.

Page 17 — Last Paragraph - The conclusion that all the water in the "artificial" system is attributable to mining and milling is premature. There is a 200-million-gallon mistake in the infiltration calculation.

Page 17 — Last Paragraph, last sentence - This sentence appears to be a critical sentence in the argument for the artificial system. The sentence is vague and the assumptions and basis for calculations need to be presented.

Page 19 — Last Paragraph - What is the basis of determining that 5 million gallons are available for seepage? What are the assumptions and where are the calculations?

Page 20 — 1st Paragraph - Again, where are calculations to support the 14-million-gallon value?

Page 20 — 2nd Paragraph - The alluvium may have "favorable" geochemical properties to stop seepage, but it does not have properties to stop flow. What is the seepage volume available here?

Page 24 — Last Paragraph - How was underflow calculated in the alluvium? Was cross-sectional analysis used? Where were the cross-sections? The method of getting to all flux calculation results is unclear. More support data and calculations need to be provided.

Page 25 — Last Paragraph - In contrast with the report. There is a clear mound of groundwater in excess of 10 feet thick in the north cell of the tailings area. This is clearly shown in Figure 3-1. Seepage will continue to contribute to the alluvial system.

Page 26 — 1st Paragraph - The logarithmical extrapolation needs to be shown. Between what data points (wells or contours) were the gradients determined, what years?

Page 26 — 2nd Paragraph - Regarding the gradients in the area of borrow pit No. 2; shouldn't the gradients have increased with the operation of the east pump-back system because of an increased drawdown at the pumped wells? What will be the impact on the gradients once the wells have stopped pumping? Review of the potentiometric surface maps for Zone 1 and 3 indicate little existing influence (depressions) caused by the pumping. Is this really true?

Page 26

Last Paragraph - The rate of dissipation of the mound at the borrow pit area was extrapolated from the historical gradient changes. The data should be shown, but more importantly these data were probably determined under the effect of pumping and nonpumping conditions. If the wells are shutoff, the hydrodynamics of the system are completely changed. Therefore, the conclusions derived in this paragraph as to the time to dissipate the mound may be invalid.

If the water level in the borrow pit is rising, why is the gradient declining? August 1987 field work indicated that water levels are rising in the bedrock aquifers.

Page 29

1st Paragraph - The inference that the high nitrate levels in alluvial waters is from dissolution of salts in the soils is unlikely. Rather, the nitrate levels are more likely the result of oxidized ammonia from the mine and mill waters.

Page 30 — Last Paragraph - How does organic carbon content and cation exchange capacity neutralize acidity?

Page 31 — Section 4.2 - Cite examples of the locations of thick acid and thick alluvium and thin alluvium/thick tailings to prove premise of this section.

Page 32 — 2nd Paragraph - The report states that the alluvium can neutralize tailings leachate and effluent within several feet. If this is true, why do we still see low pH values in Zones 1 and 3 after tailings should have been neutralized by the alluvium?

Page 33 — 3rd Paragraph - Again, the term alluvium derived nitrate is used. This is highly improbable. The concentrations of nitrate could not have been solubilized from the natural alluvium.

Page 33 — Section 4.2.2 - This section has numerous errors. First of all, there is no good correlation between pH and the constituents in Figures 4-2 through 4-6. Correlation coefficients for these data are poor. Laboratory pH was used because it has extensive data not because it detects the limit of the plume. These are numerous places where the pH is neutral but the TDS is more than the drinking water standard. If we solely look at pH, we ignore any contamination (dissolved solids) that was introduced by the mine waters which were neutral.

Page 34 — Section 4.3 - The conclusion that a seepage plume does not exist in the alluvium totally contradicts that mine water and the tailings liquids have saturated this reportedly "artificial" system. EPA well Nos. 24, 25, 26, and 28 all have neutral pH values; however, their nitrate concentrations are 5.8, 190, 127, and 69, respectively, to say that these alluvial wells are not affected by a

contaminant plume as suggested by this report is false.

Page 36

Section 4.3.2 - Reference is made to Appendix C as the source of data to determine the velocity of the plume at 0.2 to 0.3 ft/day. The data is there but the method or discussion is missing. How was it done?

Using the permeability of 5×10^{-3} cm/sec (Table 2.2), a porosity of 0.005 (Table 2.2), and a gradient of 0.20 ft/ft (page 36), the velocity is 11 ft/day and not 0.3 ft/day.

The report also fails to address the transmissivity and flow velocity.

Page 38

1st Paragraph - Reference is made to the fact that the Zone 1 aquifer has been neutralized or diluted. If well Nos. 516A and 604 have a pH of 4, how could they be considered neutralized?

Page 38

Last Paragraph - How can the hydraulic gradient stabilize in these dipping strata? Gravity flow will continue to cause a gradient.

Page 39

1st Paragraph - The effect of dewatering and resultant reversal of gradient is negligible. As seen in cross-section D-D, if the pit was dewatered, the localized effect of a temporary groundwater reversal to the east would be less then 200 feet east of B.P. No. 2. In fact, what may occur as the result of dewatering is that a groundwater reversal will occur in the tailings west of the pit.

Seepage of these tailings may cause acidic discharges that will migrate eastward.

Page 39-42 — Section 4.4 - This section attempts to explain anomolous pH values on native properties of the Mancos shale. Yet, several contradictions are presented. As seen in this section, high concentrations of magnesium is used as an indicator of Mancos Shale groundwater. However, why does well No. 664 which is completed on 100 percent Mancos only have 270 mg/L of magnesium while well No. 631 has a concentration of 3,112 mg/L and is only completed in 40 percent of the Mancos. Furthermore, wells east and north of the borrow pit have magnesium concentrations in excess of well No. 644. These wells are completed in the Zones 1 and 3 formations Canonie refers to these as relatively nonreactive formations. Since the report concludes that there was no groundwater at the site in Zones 1 and 3, there was no magnesium in the tailings, and Zones 1 and 3 are relatively unreactive; then where is the magnesium coming from?

Table 3.2 — What is the basis of assigning a value of zero gpm seepage rate to the tailings? The report states in several places that the tailings are seeping. Also, it is difficult to comprehend that a 100-acre unlined tailings site is contributing zero discharge into the system.

Table 4.4 and 4.5 — Is the term "acid neutralization potential" referring to the commonly used acid-base potential which is obtained by conducting neutralization potential and acid potential tests or is it a different type of test?

Figure 2-8 — Structural lineaments should be placed on the map with cross-section locations Figure 2-3. This will facilitate the study of fractures and groundwater flow.

Figure 2-5 — Is the potentiometric surface near 78SHB-13E correct? It appears something is missing in this area.

Figure 2-6 — In the area of HL-6, the Zone 1 water level is concave upward and suggests a strong vertical gradient in this area. If this is correct, it suggests leakage into the Mancos shale.

Figure 3-2 — Potentiometric lines for Zone 3 should not be drawn in Pipeline Canyon where the formation has been eroded and does not exist.

Figure 4-1 — The pH for EPA well No. 27 is most likely contaminated by the cement backfill used construction. A pH value of 11.7 is rare in natural conditions. This well, because of its problems, is the worst possible choice for postclosure monitoring of the alluvium. Canonie, in their design report, chose this well to monitor pH changes below 7. If a slug of acid passed by this well it would be difficult to detect the acid front.

Alan, we hope that the information in this letter is useful in your review on this document. If you have any questions, please call me.

Sincerely,

Rich Petrus, C.P.G.S.

cls/DFW6E/026

ATTACHMENT B:

Comments prepared by CH_2M Hill (Bill Bluck and Peter Binney) on "Reclamation" portions of the UNC plan. The following is a partial list of comments provided to EPA. Comments not included were duplicated elsewhere in the EPA comment package.

iv-3rd P	States the outflow from the artificial system and seepage mound is approximately 570 GPM. Where is this measured? What is the flow gradient.
25-1st P	The logs from the lithological and geophysical wells should have been included.
30-3.5	"No groundwater has been, or will be, affected by the mining and milling activities" should be removed from the text.
34-4.2	What were the other physical characteristics that the soil was tested for?
64-7.3.5	HEC-2 assumes clear-water hydraulics. The PMF should be considered as a slurry flow with bulking potential. San Bernardino County guidelines indicate an increase of up to 50 percent when mudflows can occur. We suggest t hat SCS Tech Memo No. 25 which addresses a "Moveable Bed" design rather than rigid boundary design be investigated.
79-82	Calculations for Radon flux should have been included in the report.

Without the background information there is very little evidence there was no aquifer prior to the artificial system. We do not disagree that the uranium mine and mill has contributed to the aquifiers; however, we are not convinced that the alluvium and bedrock formations were completely dry prior to mining and milling. Rather, a partially saturated condition probably existed as evidenced by wells in the Gallup formation downgradient of UNC and a windmill east of the site.

The radiation study has two main data gaps. First, no readings were taken on Tribal Lands. These are required to determine the volume of soils to be placed in the pits. Also, many of the asphalted areas, such aS below the ore pads, were not analyzed. These areas have the potential of being contaminated. Samples should be tested below the asphalt to determine contamination levels and waste volumes.

ATTACHMENT C

Comments prepared by Jacobs Engineering (Duane Truitt, Jack Caldwell, Paul Clements, David Gonzales, and Jere Millard). Further comments were submitted by Jacobs but are duplicate elsewhere in the EPA comment package.

Geology & Groundwater

1. Cross Section EE shows no aquitard between the alluvium and Zone 3 beneath the North Cell; therefore, why will most of the liquid migrate into the alluvium and not Zone 3?

2. ~~The presence of a thick sequence of alluvium is not a barrier to seepage beneath the south cell. Ground water contamination is evident in wells completed in the alluvium downgradient from the South Cell.~~

2 8. Instead of saying that Zone 1 and Zone 3 approaches unsaturated flow conditions to the northeast, state what the saturated thicknesses ~~s.~~ is. How far down dip do Zone 1 and 3 of the upper Gallup Sandstone become full saturated? At what distance down dip do they become partially saturated and thus a potential water source?

3 8. What evidence is there that the water quality in the 600 series alluvial wells, located alo the northern boundary, is characteristic of infiltrated mine dewater[illegible] The high nitrate levels, for example, almost certainly are not natural to the alluvium and did not come from mine dewatering. Are there other sources of alluvial contamination or did the contamination come from the tailings pile?

4 8. The data in Table 4.1 are suspect. Several analyses of the mine water discharge should be included in this report. The indicated quality of the alluvial water does not appear reasonable, especially the TDS and nitrate values.

5 8. Several complete analyses of tailings fluids should be included in this report. The constituents Al, Mn, NH_4 and NO_3 in the acidic seepage should be represented by a range of concentrations. The indicated chemistry of the impacted Alluvium and Gallup Sandstone water does not seem reasonable.

6 7. Apparently, no measurement of the saturated hydraulic conductivity of the soils, either in the natural state or compacted, was made.

~~The~~ Hydraulic conductivity is an essential parameter in defining infiltration through the cover to the pile. Additional information should be obtained; ~~this should~~ include the relationship between the moisture content and the soil moisture negative (suction) pore pressure. ~~The parameters are commonly employed on Title I sites to calculate infiltration.~~

~~(See also Page 47). The hydraulic conductivity of the soil cover~~ should also be ~~characterized.~~

7 ~~8.~~ What wells and what chemical constituents were used to determine that the rate of migration of the plume has slowed over time? ~~pH is not an acceptable indicator of plume extent.~~ How can acidic seepage that is migrating in Zone 1 from past discharges be neutralized by seepage from present discharge? The calculation showing a plume extending 1,200 feet east of its present location should be included in the report.

~~8.~~ This section should be reconsidered. The southwest area appears to be ~~one of most~~ contaminated ~~areas~~ and it ~~is unlikely~~ that this contamination ~~is attributable to contact with the~~ Mancos. If 63% of the total ~~outflow~~ leaves through the alluvium to the ~~southwest then~~ this area is critical.

6 ~~10.~~ The statement that "no ground water has been, or will be, affected by the mining and milling activities" is questionable and should be deleted. Whether or not the ground water was artificially created fails to address the issue of present contamination at the site and its potential impacts.

Surface Reclamation

9 ~~11.~~ Slopes as flat as one percent are too flat to assure continued run off and prevent ponding. The minimum practical slope that does provide for continued run off and eliminate ponding is about two and preferably four percent. The consolidation and settlement potential of the tailings should be considered in establishing minimum acceptable slopes.

10 ~~12.~~ We do not believe a 5:1 soil covered slope required by 40 CFR 192. on the embankment will prevent significant erosion. This slope probably will not meet long term stabilization requirements as ~~accepted by the NRC.~~ Gully erosion will probably expose tailings. Calculations and a discussion of the gully formation potential should be provided to support the choice of a 5:1 slopes, or should be flattened. A typical design may include 10:1 slopes with a much-thicker soil cover, or else the use of rock erosion protection on 5:1 slopes.

11
13. We do not believe a 4-foot cover will provide adequate erosion resistance for the design life. Calculations involving the use of the Universal Soil Loss Equation (USLE) are given in the body of the report to justify this cover thickness. However, recent work by NRC, EPA, and consultants to this item, in particular, Steve Abt of Oakridge, has shown that significant gully erosion can occur in situations like that proposed for Churchrock. We would recommend an evaluation of the potential for gully formation and hence its effect on pile integrity and the proposed approach to groundwater improvement.

12
14. We question the use of the ~~Universal Soil Loss Equation~~ (USLE) as proof of the adequacy of the cover integrity. This approach is ~~not the standard approach in Title I sites (i.e. the UMTRA Project), it has been rejected by the NRC as~~ unrepresentative and unconservative. The shortcomings of the USLE approach are that it does not account for flow concentrations which may cause gullying, nor does it account for the erosion from infrequent but large-magnitude rainfall events such as the PMP.

13
15. ~~Disposal of building debris in Borrow Pit No. 2~~ There does not appear to be a stated criteria for release of contaminated building materials and equipment. Presumably NRC guidelines will apply. Consolidation of building materials and other debris in Borrow Pit No. 2 may not meet compaction requirements to prevent water infiltration and seepage. Disposal of wooden beams and tank staves in this borrow pit would ultimately result in their decay and consequent degradation of the cover.

14
16. Because of the potential voids (due to the nature of materials placed in Borrow Pit No. 2), and because of the "moderate compaction" planned, consolidation and surface settlement are distinct possibilities. Such consolidation would affect the integrity of the cover and possibly result in increased and seepage of contaminants to subsurface soils. The plan should discuss in detail how detrimental affects will be avoided or why they will not occur.

15
17. While it may be correct that the rock from the Todilto Limestone quarry would be suitable for "occasionally to seldom" saturated areas, the Pipeline Arroyo may be saturated more frequently than "occasionally to seldom". Therefore, it may be necessary to obtain rock of better quality as a significant feature of the long-term ~~stabilization scheme~~. The radiological characteristics of the Todilto limestone should be assessed and documented prior to use of this material.

(A)

to next page

4 — Flood potential

18. To the drainage canal for the South Cell which is designed to remain stable in the event of a PMF.

15. It appears that the lower reaches of the channel are in bedrock, which may resist erosion by PMF flows. The PMF flows, however, may cause erosion of the channel sideslopes where it is cut into the tailings. What is to be done to prevent this?

16 19. Examination of contours of the area prior to construction of the tailings impoundment indicate the possibility that the impoundments have obliterated the pre-existing drainage channels, (see Page 61). The present "arroyo" appears to represent an erosional feature resulting from discharge of mine water. The "nick point" therefore would be a very young feature and may not be stable. Site examination indicates that the rock forming the nickpoint dips to the east and if the arroyo moves in that direction no nickpoint-forming rock will be encountered (this is noted on page 60). Futhermore, the nickpoint rock does not appear to be that sound. The potential for long-term integrity of the nickpoint must be questioned.

17 20. The reason given for Interim stabilization is "to provide an opportunity for monitoring the success of the program allowing for necessary adjustments prior to initiation of final reclamation" appears inadequate.

As demonstrated on UMTRA and other Title II sites the technology for final reclamation exists, and has and is being implemented. There are no technical reasons at all why further "study" is required to complete reclamation at Church Rock.

18 21. The interim stabilization plan may reduce infiltration; it is, however, unlikely to "minimize infiltration" as claimed. If the need and desire is to control infiltration, a more substantial cover than proposed is required.

19 22. Do the large storage tanks near the mill buildings still contain contaminated solvent solutions? If so, how will this liquid be disposed of? Spraying it over the tailings pile does not seem advisable without an assessment of contaminant levels as well as infiltration characteristics.

20 23. The source term units of pCi/cm^3-sec need to be clarified since the RAECOM model normally uses pCi/g of Ra-226.

(A) → 21 from previous page

24. Uranium-238/Ra-226 ratios in surface soils of 1.7 and 0.92 both indicate the presence of ore.

25. The radiological site characterization is inadequate for the following reasons:

    a. - The characterization relys heavily on the prediction of Ra-226 soil concentrations from measured exposure rates. However, no data on the relationship between these two parameters is discussed.

    b. - The radial sampling grid resulted in widely dispersed sampling points with increasing distance which may not be adequate to estimate volumes of contaminated materials.

    c. - Th-230, the major groundwater contaminant, was not sampled in overlying soils.

    d. - The spatial extent of the ground water plume was only characterized by pH and TDS by assuming, for example, that Th-230 would have an identical spatial distribution. Data on radio nuclide distributions in ground water need to be presented and discussed.

    e. - No mention of verification sampling is made in the reclamation plan.

    f. - Tribal lands adjacent to the mill were not surveyed.

In general, an inadequate site characterization could adversely affect groundwater following and during reclamation.

26. Text statement page 79, Volume 1 indicates that fine tailings (slimes) constitute 20% of the total quantity of tailings. However, RAECOM calculations use a 500 cm layer for t his material. This implies that the slimes comprise nearly 75% of the total.

27. The proposed spray evaporation requires additional supportive data to justify implementing this procedure as follows:

    a - Conduct radiological and non-radiological characterization of all liquids to be sprayed.

    b - Conduct a hazard evaluation using predicted air concentrations of hazardous materials during spraying operations and potential health effects.

- Estimate effects of infiltration of sprayed liquids through the tailings pile and their subsequent impact on the shallow ground water present.

- Determine the volume of contaminated equipment used to spray liquids and methodologies to either decontaminate or implement their eventual disposal.

If non-radiological constituents present in sprayed liquids exceed EP toxicity criteria or are listed in subpart D of 40 CFR 261, an evaluation must be conducted to determine if RCRA limits would be met.