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John Themelis, Project Manager
Uranium Mill Tailings Project Office
U.S. Department of Energy
Post Office Box 5400
Albuquerque, New Mexico 87115

Dear Mr. Themelis:

Enclosed are our draft comments on the drafts of the Environmental Assessment, Remedial Action Plan, and Processing Site Characterization Report for remedial actions at the Gunnison UMTRAP site in Gunnison, Colorado. The comments are being forwarded to you in draft form in order to meet your request for receipt of the Gunnison comments by March 1, 1985. The final comments will be sent to you directly from NRC Headquarters by Mr. Mark Haisfield as soon as possible.

Should you require clarification or wish to further discuss these draft comments, we are prepared to discuss them in more detail. If we can be of further assistance, please contact Sandra L. Wastler on FTS 776-2811 or Mark Haisfield on FTS 427-4722.

Sincerely,

SLW Acting
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Edward F. Hawkins, Chief
Licensing Branch 1
Uranium Recovery Field Office
Region IV

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NRC Comments - Gunnison Site

Surface Water Hydrology and Erosion

DRAP

1. Appendix E - PMF Determination

Based on a review of the DOE flood analyses (provided by cover letter from M. Bone to T. Johnson, dated August 17, 1984), we conclude that the Probable Maximum Flood (PMF) for the Gunnison River may not have been adequately or conservatively estimated. Our review of the analyses indicates that several important input parameters to the HEC-1 model have not been properly estimated.

Because the PMF on the Gunnison River determines the riprap size that will be provided to protect the toe of the tailings pile, it is important that an adequate estimate of the flow velocity be determined. Further, because the design must remain functional for a 1000-year period without routine maintenance, it becomes very important to conservatively estimate the flow velocities and shear forces associated with the PMF.

The DOE PMF estimate of 205,000 cfs for the Gunnison River was compared to regional maximum flood (RMF) estimates as presented in Crippen and Rue (1977). Based on this comparison, the RMF value of about 210,000 cfs exceeds the DOE PMF estimate. The NRC staff has concluded that RMF data, in most cases, do not represent conservative PMF values and that any PMF which does not exceed these RMF values has probably been underestimated.

The DOE estimate for the Gunnison River was also compared to the DOE PMF estimate for the Animas River (Durango EIA). The PMF for the Animas River, with a drainage area of 770 square miles was computed to be 271,800 cfs. It is doubtful that the Animas River basin is drastically different from the Gunnison River basin, in terms of flood producing characteristics.

Further examination of the HEC-1 analyses indicate that several parameters in the PMF analyses have not been properly estimated.

1) Areal reduction of PMF. The PMF for the Gunnison River drainage basin (1000 mi^2) was reduced for the combined drainage

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area (2000 mi^2) of the Gunnison River and Tomichi Creek. This reduction should not be applied when dealing with only the peak PMF flow in the Gunnison River.

2) Rainfall Infiltration Rates. The SCS curve numbers that were selected in the HEC-1 model are not considered to be conservative, since little initial saturation of soils is assumed to be present, using these values. For these values to be acceptable, the 24-hour PMF should be preceded by a significant amount of rainfall (e.g., the rearrangement of the last two 24-hour segments of the 72-hour PMP to the first two 24-hour segments), to minimize later infiltration. Alternately, more conservative estimates of the curve numbers (e.g., AMC-III) or saturation of the soils should be used in the analyses.

3) Times of Concentration. The formula used to calculate times of concentration (tc's), and resulting lag times, may not be appropriately reasonable or conservative when dealing with extremely steep mountain streams with very high flow velocities. Based on our examination of topographic maps and portions of the Gunnison River basin, the staff recommends use of the stream hydraulics method (Ref. Design of Small Dams) to estimate tc's and resulting lag times, for streams this steep.

4) Storm Centering. It is noted that the HEC-1 analyses were performed using several sub-basins of the Gunnison River, but using a uniform PMF rainfall amount over the entire basin. A more appropriate method of analysis is to use the procedures outlined in "Hydrometeorological Report No. 49" where varying rainfall depths are centered according to an actual isohyetal pattern over the sub-basins to produce the peak PMF in the entire basin.

Taking the above factors into consideration, a revised PMF analysis should be performed to conservatively determine the upper limit of flooding potential for this site. An acceptable method for addressing the above input paramters and computing the PMF may be found in ANSI N-170, "Standard for Determining Design Basis Flooding of Power Reactor Sites".

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2. Appendix E - Riprap Toe Protection

A. Calculational Basis for Rock Size

Provide the basis for the determination of D_{50} riprap size of 6 inches for the rock to be placed at the toe of the pile to prevent erosion during a PMF. Based on our review of the HEC-2 analyses, it is difficult to determine what methods were used to compute the required D_{50} rock size. Our independent analyses for a flow velocity of 15 fps and depth of 7 feet indicate that a D_{50} size of approximately 15" will required for an assumed 1^V on 2^H failure slope, using Corps of Engineers formulae (Ref. "Hydraulic Design of Flood Control Channels"). However, DOE calculations indicate a required D_{50} of only 6" (page E-33). The basis for the 6" rock size should be further discussed and/or evaluated.

B. Effect of Revised PMF Analyses

Using the revised PMF estimates (as applicable - See Question 1 above), the riprap for the toe of the pile should be re-evaluated, based on the velocities computed using the revised PMF.

C. Effects of Potential Channel Meandering and Movement

The geomorphic evaluation provided in Appendix B indicates that a potential for channel movement exists at the site. Because of the recognized uncertainty regarding channel stability, and the potential for migration (of unpredictable extent) of the Gunnison River channel toward the pile, we conclude that an additional margin of safety should be applied to the design of the rock toe. This would provide additional protection in the event of a flood which channelizes flow and produces high velocities at the pile, similar to those velocities produced in the existing Gunnison River channel under PMF conditions. We recommend that redesign of the rock be performed, using an additional margin of safety to account for this phenomena.

Taking into consideration the above concerns, the rock toe protection should be re-evaluated.

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3. Appendix E - Erosion Protection for Top and Side of Pile

The NRC staff has concluded that the design for long-term erosion protection for the top slopes of the reclaimed pile may not be adequate to meet EPA long-term stability criteria. We believe that the currently-proposed erosion protection could be damaged by rainfall much less intense than the PMP.

The erosion protection for the pile has been designed to resist only the effects of unconcentrated sheet flow, which may not be an accurate representation of conditions which are likely to exist in the future. We conclude that areas of flow concentration will form due to differential settlement, random flow spreading, and/or uneven grading. We conclude that erosive volocities may be produced by precipitation much less severe than the PMP, if such phenomena occur.

Based on independent analyses performed by the NRC staff, we conclude that rock with a D_{50} of about 1-1/2 inches should be placed on the top at a thickness of two feet. We conclude that the proposed rock with a D_{50} of about 3-1/2 inches is acceptable for the sides of at a thickness of one foot).

Accordingly, either revise the design of the rock for the top of the pile, or provide additional analyses to document that the design adequately accounts for flow concentration due to different settlement and uneven grading.

4. Appendix E - Dam Failures

Identify any upstream dams whose failure could affect the site. If it is determined that there are upstream dams that are not designed for an occurrence of a PMF, provide analyses to determine the effects of failures of such dams on the various site design features. Identify any future efforts that will be undertaken by the dam owners to upgrade the dams or spillways to pass a PMF.

Recognizing that dam failure calculations are difficult to perform and are sensitive to certain assumptions such as time-of-failure, failure mode, etc., you may provide the results of conservative (but less rigorous) calculations used to estimate peak water levels and velocities at the site. Corps of Engineers and U.S. Weather Bureau

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unsteady flow models may be used for such predictions, if a more rigorous approach is taken.

Hydrogeology (Ground-Water Characterization)

DEA

5. The Gunnison UMTRAP site has contaminated ground water hydraulically downgradient from the site in the alluvial aquifer of the Gunnison Valley. Our review concentrates on the seven criteria provided by EPA in Subpart C of 40 CFR Part 192. These seven criteria are used by NRC staff to review the adequacy of hydrogeologic assessments. Of the seven criteria, the hydrogeologic assessment in the Gunnison DEA and DRAP satisfies criterion 1, establishment of background ground-water quality, and criterion 2, identification of ground-water contamination. The other five criteria, however, have not been adequately satisfied.

   Additional field characterization presently underway should satisfy criterion 3, characterization of the extent of ground-water contamination, including relative concentrations of contaminants within contaminant plumes, and criterion 4, characterization of the rate and direction of contaminated ground-water migration. Once these assessments are completed, DOE should be able to satisfy criteria 5, 6, and 7 and select appropriate actions for the Gunnison UMTRAP site. The NRC would recommend that new data and analysis derived from on-going investigations be submitted prior to issuance of a final EA to allow the NRC to review the data to assure EPA's seven criteria have been satified and to avoid schedule delays

   The following paragraphs reiterate the NRC's concerns as originally expressed in our comments on the PDEA. Ground-water quality information in the DEA, DRAP, and SCR indicates that shallow ground water hydraulically downgradient from the site is contaminated, and that water from this same aquifer is being consumed by residents of the Gunnison Valley. As reported in these documents, concentrations of uranium, arsenic, and selenium in ground water consumed by the residents are below maximum allowable concentrations for drinking water (e.g., MCL's under 40 CFR Part 141). Additional characterization of the extent of ground-water contamination is warranted, however, because these concentrations may increase as the contaminated ground water beneath the site migrates downgradient toward the domestic users of the shallow aquifer. We recommended

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that DOE characterize the variation of ground-water quality with depth, the lateral extent of ground-water contamination, and the fate of contaminated ground water near the confluence of the Gunnison River and Tomichi Creek (i.e., does the contaminated ground water completely discharge into the surface water or does it migrate beyond the confluence).

Under criterion 4, the DEA, DRAP, and SCR should characterize the stratigraphy of sediments that conduct the contaminated ground water because stratigraphic heterogeneities may significantly affect rates and directions of contaminant migration. In addition, the documents should characterize the distribution of hydraulic head in the alluvial aquifer in the valley by measuring water levels in shallow monitoring and domestic wells in this aquifer. This information is necessary to (1) predict the rates and directions of contaminant migration, and (2) characterize recharge-discharge relationships of the alluvial aquifer with the Gunnison River, Tomichi Creek, and other surface water bodies in the valley (e.g., gravel pits, irrigation canals, ponds, etc.). This information will also aid in characterizing the potential for migration of contaminated ground water toward a municipal well in the alluvial aquifer, which is located several thousand feet north of the site.

Once this information is developed, we recommend that you pursue the strategy for selecting appropriate remedial actions for ground water as described in the DEA and DRAP, which includes characterization of the extent of contamination, identification of remedial action alternatives, and evaluation and optimization of these alternative actions. By pursuing this strategy and satisfying the EPA guidance provided for such decisions in Subpart C of 40 CFR Part 192, DOE should be able to support its decisions.

6. More explanation is needed to adequately justify that the proposed stabilized embankment and liner system will protect ground water after remedial actions are completed at the site. As presently described and evaluated, the proposed design does not demonstrate adequate protection of ground water beneath the site. Future versions of the RAP should include conservative predictions of post-remedial action performance to demonstrate compliance with the EPA standards in 40 CFR Part 192.

7. The hydrologic characterization of the Gunnison site alluvial aquifer provided in Appendix D of the DEA is inadequate. The Theis

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method used to analyze the test data is not valid because many of the assumptions made by Theis in developing the method are violated. Additionally, neither the early or late time/drawdown plots provided as Figures D.2.6 and D.2.7 fit the Theis type curve. Until a more detailed lithologic description of this unit is provided, one must assume that the aquifer is unconfined, poorly sorted, very course-grained and poorly compacted. Use of the Jacob straight line method on the late time drawdown data or the Theis method as modified for thick unconfined aquifers would have resulted in more representive hydraulic properties. Taking the above facts into consideration, a revised analysis of the pump test data should be performed to provide representative hydraulic properties of the alluvial aquifer.

8. Page D-55; It is stated that the difference in hydraulic head between the shallow and deep observation wells indicates that confining layers or lenses are present within the aquifer making it "semi-confined." This observation by itself does not prove or disprove the existance of silt and clay lenses within the aquifer. All it says is that there is vertical flow within the aquifer. Unless additional geologic evidence proves the existance of confining layers, this paragraph should be deleted.

9. Page D-55; It is stated that there are higher concentrations of uranium and iron present in the shallow wells than in the deep wells. The authors attribute this to sorption by clay layers present between the shallow and deep wells. It should be noted that uranium is a fairly mobile species and would not be expected to be significantly sorbed by clay fractions. It is possibly more reasonable to attribute this to a redox phenomena, pH change or the fact that the shallow wells are closer to the contaminant source (bottom of the pile) than are the deep wells. Also, according to the authors, high concentrations of Fe are present in the natural ground water anyway. The text should be modified to reflect the possibility that other natural mechanisms may be responsible for this phenomenon.

10. Page D-51; It is stated that the pump test data indicate the presence of a layer or zone which acts like a confining layer. The data presented in Figure D.2.6 may indicate a boundary condition. However, this may also represent a no-flow boundary similar to the bedrock/channel boundaries depicted in Figure D.2.5. Unless

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additional geologic evaluation proves the presence of confining layers, this inference should not be used as proof of confinement.

11. Page D-67; According to DOE's plan for implemeting EPA standards for UMTRAP sites, ground water and contaminant modeling will use existing data from each site to explain historic contaminant transport and predict post-remedial action concentrations and rates of migration. The DOE modeling plan is predicated on two invalid assumptions; (1) that sufficient data exists to adequately model the sites, and (2) that the model can be used as a prediction tool.

In the case of Gunnison, we recommend that chemical and transport models not be used in a predictive manner because there is not enough data concerning:

a) Dispersivity and scale dependence of dispersivity. Also, TRUMP uses finite-difference approximation to advection-dispersion equations. The validity of this equation is questionable at the travel distances involved in this problem.

b) Uranium and heavy metals are the only contaminants of concern (SO_4 does not appear to be a health hazard at the site). The reduction in concentrations of these species is governed by complex adsorption-coprecipitation reactions that are not adequately understood. No kinetic or thermodynamic data exist on these reactions. A source term for trace elements computed by PHREEQE would be meaningless.

c) The method of computing the source term via PHREEQE and the equation on page D-70 is over simplified.

One alternative might be to model moisture flow and possibly mass transport in one dimension through two hypothetical columns of tailings: 1) existing profile, and 2) remedial action profile. Solute flux into the water table for the proposed remedial action would be compared to that of the original profile. In this way, the effectiveness of the remedial action in isolating contaminants from the ground water system could be evaluated. The flux of contaminants into the ground water would be lowered by a factor equal to the ratio of the two fluxes. Due to the existence of retardation and removal processes associated with uranium and other heavy metals, this evaluation could be considered conservative.

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12. Page D-67, 68; FEMFLO, TRUST, and TRUMP are extremely expensive models to utilize. DOE does not have sufficient data to adequately describe the site complexities that would justify the use of such models. We recommend that DOE use any analytical models which may provide valuable information at a fraction of the cost.

DRAP

13. Pages D-51 - D-55; The authors attempt to present a case to justify "semi-confinement of the alluvial aquifer underlying the Gunnison site." However, on page 14 of the draft RAP, the authors are calling the aquifer unconfined. This inconsistency should be clarified.

14. Page 17; (DRAP) The alluvial aquifer is being defined as unconfined, which is inconsistent with data presented in the draft EA. Also, it is unclear as to the basis for determining that the depth of the aquifer is 130 feet. Data presented in the DEA indicated that the aquifer may be 200 feet thick under the site and cited literature sources as saying it could be as much as 400 feet thick.

Geology

DEA

15. More regional information is needed to adequately evaluate the geology of the site. Supporting regional physiographic, geomorphological, sedimentological, stratigraphic, and structural information is needed. Evaluation of site-specific data alone (even when adequate local information is provided) cannot result in a proper assessment of the long-term suitability of a site in relation to the EPA requirements (40 CFR 192). Given the nature of geological processes, past, present and future geologic conditions at any given localized site are inextricably linked to the geologic character of the larger region (geologic province) in which it is located.

Standard professional methods and procedures require that adequate geologic investigations of a site include complementary information to describe:

1. The geomorphic conditions at the site and their relation to the regional geomorphic setting.

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2. The site stratigraphy and its relationship and [illegible]ation with the regional stratigraphy.

3. The structural geology of the site and the relationship of site structure to regional tectonics.

4. The geologic history of the site as it relates to the regional geologic history.

5. The hydrocarbon, metallic and non-metallic mineral resources of the site as they relate to regional or analogous trends.

The regional information required usually can be derived primarily from a review of the existing, pertinent geologic literature. The information should be documented by references to all relevant published and unpublished material. The UMTRAP document review process will be expedited if the DOE submittals contain sufficient information for the reviewer to make an independent assessment of the conclusions regarding the geologic suitability of the site.

16. With regard to the terrace at the level of the site, the location of the terrace scarps and the projected duration of the terrace relative to the 200- to 1,000-year stability requirement for the pile should be identified.

Geotechnical

DEA

17. Page 20; Reference is made to a [illegible] foot thick "clay filter" layer. This term is ambiguous as to whether the layer is to function as a liner or as a filter for the capillary break layer. Please clarify the term and indicate the purpose of the clay.

18. Pages 31 and 37; The construction activities listed for the two alternative sites include placement of "clay filter" and capillary break layers. We are not convinced that it is appropirate to assume that these design aspects are necessary without further characterization of the ground-water regime at the sites. In addition, there is insufficient data to support conclusions related to the availability of site soils for use in liner or cover layers. Some basic site characterization work at the two alternative sites is needed to enable a more representative cost comparison.

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19. Page 24; The discussion on cover construction indicates that long-term moisture contents of 5 percent (top 1 foot) and 10 percent (bottom 4 feet) were assumed for radon barrier calculations. However, the test data on the silty-clay borrow material (DSCR) indicates in-situ moisture contents ranging from 4 to 9 percent (5.8 percent average). Justify your use of 10 percent. In addition, Item 4 of E-17 states that long-term moisture contents are based on calculations using site-specific data. The method used for estimating long-term moisture contents should be clarified.

20. Page E-35; The rock durability criterion of less than 10 percent loss after 12 cycles of freeze/thaw appears to be too low. In addition, the criterion for the Schmidt Hammer test appears to be in error. (Reference: NUREG/CR-2642, Table 6.2.) Provide the basis used to determine the rock durability criteria and verify the criteria for the Schmidt Hammer test.

21. Page E-39; The determination of the need for a waste water treatment plant could significantly impact the cost comparisons presented in the DEA. The determination should be included in future versions of the EA and RAP.

SCR

22. The DSCR does not adequately characterize the subsurface materials at the site. Provide the results of the 22 borings performed by Ford, Bacon and Davis (GC series) and any other new or historical data to characterize these materials. This information is necessary to evaluate the liquefaction potential of underlying foundation soils.

Radiological

DEA

26. Page 77; Because of seasonal fluctuations in radon concentrations, the average outdoor background should be an annual average radon concentration. The average outdoor background radon concentration provided in the DEA may not be representative of actual background. In order to provide a representative average outdoor background radon concentration an annual average should be determined by taking three or four 24-hour samples at the five sampling locations in different seasons of the year.

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24. Page 79; Uranium, Pb-210, Th-232 and Th-230 concentrations in the tailings should be provided along with a discussion on why these radionuclides are or are not included for health effect considerations. A comparison of these values with natural background should also be made. The DEA should be modified accordingly in order to provide a complete analysis of the radiological health effects from radioactive particulates.

25. Page 97; Ra226 is a bone seeker and whole body risk estimates should include this fact rather than assigning a whole body risk factor on the basis of a dose to the bronchi only.

26. Page 101. Paragraph one refers to "airborne radioactive particulate concentrations yet the DEA only addresses Ra-226. Therefore the analysis as presented in the DEA is incomplete. The effects of airborne Th-230 and Pb-210 should also be addressed. This lack of information affects the assumptions in the second paragraph as well.

27. Page H-6;

a. The risk factor for excess fatal lung cancer, which in this DEA is 100 X 10^{-6} deaths per person - WLM, is used for the general population and for the remedial action worker. The Evans et al (1981) reference, which gives the primary justification for using this risk factor, states that workers are a higher risk than the general population for equal exposures to radon daughters. A higher risk factor comparable to those recommended by UNSCEAR and used by the NRC should be applied to the remedial action worker.

b. Comparing total organ doses over 50 and 100 years for both workers and the general population would help to clarify the difference when compared to expected background exposures rather than comparing only relative risk.

28. Page H-7; Second paragraph. The dose conversion factor for 1 WLM in BEIR III has been superceded by NCRP #77 (1984) which lists 14 REM/WLM.

29. Page H-9; The average wind speed of 2.1 meters per second from the Isbill Associates source should be used rather than the average 2.7 meters per second from the Fercheau reference. The Isbill wind data was collected over a 5-year period, whereas the Fercheau data

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was collected over a 2-year period. Also, because the Isbill data is a product of NOAA's Environmental Data Service, it is probably a better data source. With the Isbill average wind speed, a 30 percent greater on-pile radon concentration remedial action worker health effect is obtained.

30. Page H15; Equation at top should list 730 hours/WLM for a member of the public.

DRAP

31. Page 8, Section 2.5 and Page A9; states that, when working levels are between 0.02 WL and 0.03 WL, the government will have the flexibility to decide if measures should be taken to reduce working levels. This is inconsistent with the EPA standard in 40 CFR 192.12(b)(1). The standard requires that a reasonable effort be made to reduce working levels to below 0.02 WL. A decision to take no action would constitute the application of supplemental standards. The DRAP should be modified to reflect compliance with the EPA standards.

32. Page 36; It appears that dust control will depend exclusively on spraying The DRAP should recognize the possibility of extreme dust conditions and require more restrictive controls when warranted. Controls such as reduction or stoppage of work should be considered. The DRAP should be modidied accordingly.