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December 27, 1979

Ross A. Scarano, Chief
Uranium Recovery Licensing Branch
Division of Waste Management
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Mr. Scarano,

Transmitted herewith is a copy of Bokum Resources Corporation letter dated December 26, 1979 relative to the Bokum application.

By copy of this letter, a copy of the enclosure has been sent to:

John D. Nelson, Ph.D.
707 Boltz Drive
Fort Collins, CO 80521

Please acknowledge receipt.

Sincerely,

Alphonso A. Topp, Jr.

Alphonso A. Topp, Jr.
Program Manager
Licensing & Registration Unit

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Enclosure: as stated

cc: Dr. Nelson - w 1 cy
G. Wayne Kerr, NRC (w/o enc)

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EXEMPT 8001240537

BOKUM RESOURCES CORPORATION

December 26, 1979

P. O. Box 1833
142 W. Palace Avenue
Santa Fe, New Mexico 87501
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Mr. Alphonso A. Topp,
Program Manager
Radiation Protection Section
ENVIRONMENTAL IMPROVEMENT DIVISION
P. O. Box 968
Santa Fe, New Mexico 87501

Dear Mr. Topp:

This letter provides answers to those questions raised by the NRC in various presentations cited below. They are submitted as further clarification to our Discharge Plan. In regard to the telecopy of Dr. John Nelson's letter to Madonna Krug, dated November 30, 1979, we submit:

1. Regarding the moisture content of the tailings material after disposal within the trench, a conflicting estimate exists in both Designer's Memorandum (D.M.) No. 2 and D.M. No. 4 in which a value for the moisture content of 40% was quoted. This value was assumed because it was thought at that time these two memoranda were prepared that the uranium tailings would consist of essentially silt-size material. Subsequent review of laboratory data for the various ores to be processed by the Marquez Mill, however, indicated that the Marquez tailings will consist of fine sand with between 10 and 30% fines (i.e. passing No. 200 sieve). Such a gradation suggests that the final moisture content of the saturated portion of the tailings will probably average about 33% by weight. A moisture content of 33%, as indicated in D.M. No. 8 and D.M. No. 11, was assumed for computing the required size for all trenches and evaporation ponds. It should also be noted that we plan to monitor actual tailings depositional characteristics achieved within Trench 1 with regard to settled density, rate of fluid generation and final variation in moisture content within the settled tailings. When these field data become available, we will reassess our sizing and scheduling requirements accordingly.

2. Regarding a schedule showing the sequencing of operations, it is necessary to evaluate both trench and evaporation requirements over the planned 20-year life of the mill. As indicated in D.M. No. 8, Trench No. 1 is designed to store six (6) months of total mill production (both liquid and solid) at a rate of 2,000 tons of ore per day. During this period of time, the first major trench (Trench No. 6) and the first of several evaporation ponds will be constructed.

The basic design concepts for the disposal trenches is presented in D.M. No. 11. The following information relates to the duration of operation for each trench assuming the previously stated rate of mill production:

Order of Trench Excavation	Surface Area (Acres)	Percentage[1] of Total Storage Volume	Estimated Life of Trench (years)	Years in Service from Mill Start-up
6	32.2	24.4	4.8	0.5 - 5.3
5	27.7	21.0	4.1	5.3 - 9.4
4	31.6	23.9	4.7	9.4 - 14.1
3	24.4	18.5	3.6	14.1 - 17.7
2	15.9	12.1	2.3	17.7 - 20.0

1. Assumes a constant depth for all trenches.

As shown above, Trench No. 6 will be the first trench to be excavated after Trench No. 1. A portion of the excavated material from this trench will be used to construct the embankment fills for Evaporation Ponds 1 and 2. These two embankments will require approximately two million cubic yards of material and between 120 and 150 days for construction.

It should be noted that Pond 3 cannot be constructed until Trench No. 1 is reclaimed because a portion of the embankment fill for this pond will be placed over the trench. We have assumed that Pond 3 will, most likely, be constructed by the end of the second year of plant operation. This implies that Trench No. 1. would not have to be reclamed for almost one year after it has been filled. Concurrently with the construction of Ponds 1 and 2, we will construct about 30 acres of additional evaporation ponds within the area of Trench Nos. 2 and 3.

These ponds (probably two ponds with a surface area of about 15 acres each) will be incised and similar in design to that presented in D.M. No. 10. They will also be lined with a five foot thick layer of compacted Mancos shale. A more precise acreage requirement and location for these ponds will be determined during the final design for Evaporation Pond Nos. 1 and 2. It should be noted from the data regarding the estimated life of each trench presented above, that the evaporation ponds within the Trench Nos. 2 and 3 area will be operational for about 14 years after mill start-up. After these ponds are taken out of service, because of the need to excavate Trench Nos. 2 and 3, the evaporation pond acreage required to replace these ponds will be developed over Trench No. 6.

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Further, additional evaporative area, if needed, becomes available after Trench 5 and subsequently Trench 4 are reclaimed. In summary, therefore, the total evaporation pond acreage to be provided and the approximate sequencing is as follows:

Evaporation Pond No.	Approximate Pond Area (Acres)	Planned Date of Construction	Location
1	20	1980	S. of Canyon de Marquez
2	19	1980	S. of Canyon de Marquez
3	24	1982	S. of Canyon de Marquez
4	15	1980	Within area of Trench 2 or 3
5	15	1980	Within area of Trench 2 or 3
6	15	1994	Within area of Trench 6
7	15	1994	Within area of Trench 6

From the schedule presented above, it is apparent that approximately 69 acres will be available for evaporation ponds within the first year of plant operation. Assuming a rate of liquid generation from plant operations equal to approximately 275 gpm as discussed in D.M. No. 10, a total volume of fluid (neglecting any evaporation) equal to 444 acre-feet will be produced within the first year. Assuming the maximum design fluid depth within each pond equal to seven feet, this volume of fluid would fill approximately 63 acres of pond.

By the end of the second year of plant operations, Pond 3 will be completed thereby bringing the total evaporation surface to approximately 93 acres. As shown on Figure No. 1. of D.M. No. 10, which presents storage vs. aggregate pond area as a function of time assuming continuous plant operation with 275 gpm raffinate, an aggregate pond size of 93 acres would accommodate approximately 12.6 years of plant operation.

Based on the above information, ample evaporation pond acreage will be provided within the first two years of plant operation to accomodate the required evaporative potential for over 12 years of plant operation. During this period, actual rates of fluid generation and separation, along with actual rates of evaporation, will have been determined with sufficient refinement to enable a water balance to be derived. Based on these actual data, the requirement for additional evaporative area can be assured. It should be noted that after ten years of plant operation both Trench Nos. 6 and 5 will have been filled and reclaimed. This area, which amounts to almost 60 acres, would be available for evaporation pond construction.

3. The question relates to the influence of soil suction on the rate of liner saturation and improved estimates of seepage losses from the ponds. We agree that soil suction acting within the fine grained compacted Mancos shale, which was not considered in our preliminary design, will increase the rate at which the liner becomes saturated. However, even if one considers that the liner and some thickness of the foundation becomes saturated, it would not appear, considering the low coefficient of permeability of the compacted or insitu Mancos shale, that significant seepage losses will occur from the evaporation ponds. Nevertheless, during final design we intend to perform a seepage analysis depicting the unsaturated flow beneath the ponds to determine what, if any, seepage control measures appear warranted.

4. The question relates to potential segregation of the tailings within the trench and its influence on capillary rise within the tailings. Also, the question is raised regarding osmotic potential and the effects of salt concentration within the tailings fluid. Both of these questions relate to the resulting impact that a rise in salts through the tailings could have on the ability to establish a self-sustaining vegetative cover. As pointed out in the response to Question 1, the actual distribution of tailings gradation, density and moisture content will be evaluated after completing Trench No. 1. Based on these results and a careful observation of the reclamation performance, the need for alternative reclamation plans can be evaluated. (Further elaboration has been presented in our 12/5/79 letter to the EID).

5. The shear strength parameters used in the preliminary assessment for the stability of the side slopes for the disposal trenches were based on what is believed to be a conservative assessment of unconsolidated-undrained (UU) and unconfined shear strength test results of the Mancos shale. More laboratory tests to determine the long-term shear strength characteristics of both compacted and in situ Mancos shale are planned in association with the final design of the embankment fills and Trench No. 6. Also, the stability analysis completed during final design will incorporate appropriate seepage conditions expected to occur within the trench side wall.

6. This question relates to obtaining samples prior to design of the embankment fills for laboratory testing purposes. Samples of the weathered Mancos material have already been obtained and a laboratory testing program is underway to provide design data regarding compaction, compressibility, permeability, and shear strength. As suggested in the letter, however, it is not possible at this time to recover samples of the unweathered Mancos shale because it is too deep (average depth of 30-40 feet) to be reached by a conventional backhoe. We, therefore, plan to obtain samples of the unweathered Mancos shale during the

excavation of Trench No. 1. A laboratory testing program will be performed at that time similar in scope to the one currently being performed for the weathered Mancos shale.

Concerning those questions of Mr. Bill Bivins, telecopied directly to the company from the NRC on December 5, 1979, we submit:

1. The general storm PMP 6-hour point value for the Bokum Resources Corporation uranium mill and tailings disposal site near Marquez, New Mexico, is about 4.0 inches (USBR, 1973, page 50, figure 17). The thunderstorm PMP 1-hour point value is abour 11.0 inches (USBR, 1973, page 53, figure 20). Following the USBR suggestion, we finally selected the 1-hour thunderstorm PMP for all subsequent design considerations because it was more conservative than the 6-hour general storm. The 6-hour PMP of 15.5 inches suggested by Mr. Bivins appears higher than the USBR estimates. As a matter of fact, the USBR reference only shows two geographical areas in the continental U.S. west of the 105^{0} meridian with a 15.5 inches or higher PMP; these areas are located near Denver, Colorado, and northcentral Montana. Evaluation of PMF series pooling for the ground water discharge plan was based on Regulatory Guide 3.11 (U.S. Nuclear Regulatory Commission, 1977). Specifically, pages 3.11-2 to 3.11-3 set forth that, "The maximum runoff used in the design. . . .is equal to that of the Probable Maximum Flood at the site of the dam. Methodology to estimate the Probable Maximum Flood is available in Regulatory Guide 1.59, Design Basis Floods for Nuclear Power Plants, and other publications." One of the "other publications" referred to on page 3.11-3 is the USBR (1973). Thus the USBR design guidelines were used by us in compliance with specific NRC regulations.

2. The shot-crete toe ditches, drain culverts, corrugated pipe, and spillway surrounding parts of Evaporation Ponds 1 and 2 are sized to carry the 100-year peak flow estimates. Where any discharges from these conveyances enter the drainage structure, rip-rap protection is provided for the pond embankments (see D.M. 12). This drainage structure is designed to carry the PMP peak flow to Canon de Marquez upstream of the secondary catchment dam. This channel, located between ponds 1 and 2, has 1:1 sideslope, 5-foot bottom width and a 4-foot depth being trapezoidal in cross section. If this structure is constructed with a slope of 1.5% over its length and completed in unfinished shot-crete a channel capacity of 800 cfs can be achieved. Calculation of the 1-hour PMP peak discharge for the drainage area south of the evaporation ponds indicates that the peak flow is 785 cfs. Final design specifications for all of these structures along with those for the Evaporation Ponds will be submitted to the EID for review.

3. The discharge monitoring questions were previously addressed in the ground water discharge plan (see pages 77-99, and the summary on page 98). Preliminary chemical analyses of solvent extract and ground water

quality samples are given in Tables 11.2 and 11.4, respectively.

4. This question is addressed in item No. 2 on page 5 of this letter.

5. Mr. Bivins has expressed concern for embankment protection subject to erosion by wave action. His concern is in regard to the location of evaporation ponds in relation to the secondary catchment dam and the PMF series pool (see D.M. 9 and D.M. 12). Rip-rap protection has not been considered for the upstream side of the secondary catchment dam because of the State Engineer's requirement to evacuate any collected flood flows. It should be noted, however, that rip-rap will be provided adjacent to the right groin of the secondary catchment dam, the extreme northwest end of Pond 1, and at the spillway between Ponds 2 and 3. Design and placement conditions will be presented to the EID for review and addressed in the final design for Evaporation Pond Nos. 1, 2, and 3.

6. The stage capacity curves and the associated PMF and 100 year impoundment contours (Figures 2 and 3, D.M. 9) were based on approximately 30 acres of evaporation ponds located east of the diversion system. Subsequently, the design was modified such that no ponds will be placed in this area. Current planning now includes a total of 63 acres of evaporation ponds to be located south of Canon de Marquez between the diversion system and the secondary catchment dam. Two factors indicate that the previously calculated stage-capacity relations will not be affected: (1) the evaporation ponds are designed with sufficient freeboard to contain the PMF series precipitation events so that their area within the secondary catchment drainage may be considered non-contributing with concomitant reduction in the PMF series volume impoundment, behind the secondary catchment dam; and (2) the encroachment of evaporation pond earth fill into the previously available area for storage of the PMF series flood pool will not markedly decrease the overall storage available behind the secondary catchment dam.

7. The hydrologic design basis, including embankment protection and slope stability analyses, will be evaluated to reflect the currently anticipated location of Evaporation Ponds 1, 2 and 3. These analyses will form part of the design basis of these ponds, and will be submitted to the EID for review prior to construction.

8. This question has already been addressed in part in my letter to you of December 5, 1979. The Arroyo Hondo will not be returned to its original course upon cessation of operations. Doing so would introduce natural surface drainage into closer proximity to the reclaimed trench areas than utilizing Canon de Marquez. This recommendation was suggested by Dr. Peter Lagasse, a consultant to the EID.

9. The evaporation estimate is based on an annual lake evaporation rate of 50 inches per year as summarized in Tuan, et. al (1973). As stated in the answer to question 2, page 1 of this letter, Evaporation Ponds 1, 2, and 3 are not intended to provide all of the necessary evaporative surface for the mill. Further ponds as required will be constructed on the area of Trenches 2-6.

10. This information is provided in item 9 immediately above and item 2, page 1 of this letter.

11. In D.M. 12 the "minimum construction width" shown in Figure 1 should read "minimum construction width of 5 feet".

REFERENCE CITED

Bokum Resources Corp., 1979, A Ground Water Discharge Plan Using Below Grade Tailings Disposal, Marquez, N.M., private consulting report prepared by Science Applications, Inc., and Civil Systems, Inc., and submitted to the New Mexico Environmental Improvement Division, Santa Fe.

Tuan, Yi-Fu, et. al, 1973, The Climate of New Mexico, New Mexico State Planning Office, Santa Fe.

U.S. Bureau of Reclamation, 1973, Design of Small Dams, U.S. Dept. of the Interior, Washington, D.C., 816 p.

U.S. Nuclear Regulatory Commission, 1977, Regulatory Guide 3.11: Design Construction, and Inspection of Embankment Retention Systems for Uranium Mills, Revision 2, December 1977, Washington, D.C. 9 p.

Regarding those questions referenced in a letter dated December 4, 1979, from the NRC to the EID, we submit:

1. Default values for XRHO and KRHO will be used in subsequent UDAD calculations.

2. It is believed that a value of 2.4 g/cm^3 more accurately reflects the fact that the material released from the drying/packaging facility and subsequently inhaled is an agglomeration of particles rather than single particles. The value of 0.0 m/sec for the settling velocity is calculated by the UDAD code based upon particle size/mass distributions. It is not an input value.

3. Less than one-tenth of one percent of the Ra 226 originally in the ore is carried over into the yellow cake. Because of the effects of the various chemical separative processes involved, secular equilibrium between Ra 226 and its decay products cannot be assumed.

4. This is due to the subdivision of the area sources by the computer code. An attempt will be made to manipulate the position specification of the area sources to avoid this.

This completes our responses to these questions. If, after reviewing this presentation, you wish to discuss anything further, please call me.

Very truly yours,
BOKUM RESOURCES CORPORATION

Raymond R. Waggoner
Environmental Manager

RRW:ks

cc: Dr. Gale K. Billings
Science Applications, Inc.

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