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February 3, 1988

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Scott Grace
U.S. Nuclear Regulatory Commission
730 Simms St., Suite 100A
P. O. Box 25325
Golden, CO 80225

RE: L-Bar Mine Reclamation and Closure Plan

Dear Scott:

Pleased find attached 5 sets of replacement pages (seven pages per set) for those which had typographical errors in the L-Bar Mine Reclamation and Closure Plan revisions which were submitted on January 29, 1988. I apologize for the inconvenience.

Sincerely,

G.E. Grisak
Vice President

GEG:lli

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Groundwater quality data for parameters (Cl, SO_4, and pH) from the groundwater monitoring system which existed prior to the Phase II well installation program are presented in Figure R4.2 through Figure R4.41, and supplemented in detail in Appendix C. The current tailings pond water quality is provided in Table 4-6. The tailings pond is clearly a source of ionic constituents with respect to the ground water and the following groundwater chemistry evaluation is based on that premise. Ground-water chemistry modeling and equilibrium calculations were performed using the aqueous speciation code PHREEQE (Appendix D). From chemical analyses of water samples the code calculates the distribution of aqueous species and mineral saturation indices based on an ion pairing aqueous model.

4.5.1 Background Ground-Water Quality

Chloride has been adopted as the most appropriate general indicator of background water quality in the First Tres Hermanos Sandstone. In addition, general indicators such as trends (increasing concentrations), pH, and constituent ratios (Cl/SO_4) are also considered in evaluating background concentrations vs. seepage-contaminated levels.

First Tres Hermanos Sandstone

Based on the location, parameter stabilization with time and the length of record, monitor wells MW-6, MW-7, MW-9, MW-12, MW-12A, MW-17 and MW-21 are considered to provide a reasonably representative range of background ground-water quality in the 1st Tres Hermanos sandstone. (Under natural circumstances the alluvial material in the tailings area is most likely unsaturated, therefore there is no discussion provided of background water quality in the alluvium). Further background data are provided by the first few years of recorded water quality in wells MW-1A and MW-2A. The lower concentrations of the first few samples taken from MW-6 and MW-7 appear to reflect either a precipitation infiltration pulse (see Section 4.5.2) or drill water and drilling disturbances. From the discussions between NRC and Kennecott over the delineation of background chemistry at the site, monitoring well MW-29 has been designated as an

4.5.2 Ground Water Impacts From the Tailings

The alluvium and the 1st Tres Hermanos Sandstone are the primary zones within which offsite transport in the ground-water system would occur. Although the alluvium is likely unsaturated under natural conditions, the tailings pond has clearly provided a water source and resulted in at least partial saturation of the alluvium after commencement of disposal operations. Ground-water impacts will be discussed by addressing the water quality data for the monitor wells shown in Figures R4.2 through R4.41.

<u>1st Tres Hermanos Sandstone</u>

Wells MW-1A and MW-2A show background ground-water quality through 1976 and most of 1977. Sulfate concentrations decrease through the latter part of 1977 and early 1978. The decrease may be related to a pulse of infiltration captured in the tailings area during and after construction but prior to commencement of tailings disposal. Wells MW-4A, MW-6, MW-7 and MW-8 also show some evidence of such a pulse. Chloride and sulfate concentrations in MW-1A, MW-2A, MW-3A, MW-4A, MW-5 and MW-8 show a distinct increase between 1978 and 1980. The increase is clearly due to seepage from the pond to the 1st Tres Hermanos Sandstone. Well MW-2A shows eventual saturation with respect to gypsum (Table 4-7) while MW-1A remains undersaturated, suggesting somewhat less contamination. Based on the arrival of the conservative constituents sulfate and chloride, the velocity of ground-water movement from the starter dam to the monitor wells is about 150 feet/year (0.4 ft/day). This magnitude of velocity would be expected to be reduced to the range presented in Table 4-5 once the ground water migrates further away from the relatively high gradients between the tailings and the front of the starter dam. The general sulfate and chloride concentrations to the west of the tailings area are contoured in Figure 4.34.

It should be noted that all the high sulfate waters are just at saturation with respect to gypsum rather than being grossly oversaturated. Even at

If we assume the distance of interest is approximately 10,000 feet (i.e., Rio Moquino), the longitudinal dispersivity (α_L) is 10% of the travel distance, the transverse dispersivity is $.05\alpha_L$, the ground-water velocity is 0.1 ft/day (Table 4-5) (yielding an undispersed travel time of 100,000 days) the theoretical plume width is:

$$W = 2\sqrt{2 \times 50 \text{ ft} \times 0.1 \frac{\text{ft}}{\text{day}} \times 100{,}000 \text{ days}} + \text{pond width (ft)}$$

$$= 2{,}000 \text{ ft} + 2{,}000 \text{ ft}$$

$$= 4{,}000 \text{ ft}$$

If it is assumed that the entire 4,000 foot wide plume is completely mixed, the dilution due to transverse dispersion would result in a maximum concentration reduction to 1/2 C_o (C_o = input concentration). However, precipitation infiltration would also add to the dilution as the plume migrated.

For instance,

Infiltration = 10% of precipitation (0.954" = .0795 ft)

Annual infiltration area = 1 ft x 2,500 ft (average) = 2,500 ft^2
(per unit length)

Annual infiltration = 1 ft x 2,500 ft x .0795 ft
= 199 ft^3

Volume of water in 1 ft of 1st Tres Hermanos
1 ft x 2,500 ft x 20 ft x .10 (porosity)
= 5,000 ft^3

The dilution due to infiltration yields a further 4 percent (199 ft^3/5000 ft^3) per year. If the travel time is in fact 10,000 days, or 27 years, then the total dilution due to infiltration would be of the order of 100% or a factor of 2.

It can be seen from these simplified calculations that dilution due to dispersion and infiltrating recharge over a 10,000 foot travel distance would probably reduce input concentrations of conservative species such as sulfate and chloride by a factor of 4.

With respect to the metals such as uranium, thorium, lead, zinc, etc., most of these are characterized by either solubility controls or sorption onto clays such that the extent of their migration offsite will likely be negligible. The variety of thermodynamic reactions likely to affect the concentrations of multivalent species such as uranium, and the sensitivity of these to the in-situ redox conditions indicate that detailed thermodynamic calculations would not be supported by the data base. It is expected that retardation coefficients between 10 and 100 would be assigned to most of the metals and radionuclides. The retardation would result from solubility controls as well as ion exchange. This order of retardation yields travel times to the property boundary of the order of hundreds to thousands of years. However, solubility controls and coprecipitation with carbonate and sulfate minerals whose solubilities are exceeded may in fact provide the more significant concentration control of the radionuclides.

With continued enhanced evaporation the majority of the salts in the tailings pond water will be left as a relatively thin layer on the beaches. In fact, the salt 'crust' as well as the moisture is currently serving to stabilize the sandy tails and windblown material.

The salts (primarily sodium, iron, and aluminium sulfates: see Appendix RIII) deposited on the beaches beyond the 6198' contour will be scraped and placed in the pond area prior to placement of the windblown scrapings and the radon barrier.

6.5.2 Pumpback Wells and Evaporation

Two additional pumpback wells have been installed in the 1st Tres Hermanos sandstone between pumping well MW-5 and the alluvial trench. The hydraulic conductivity of the 1st Tres Hermanos in this area is quite low (about 0.5 ft/day; Section 4.2) therefore two equally spaced wells rather than one were installed. Continued monitoring of MW-14 and MW-27 will indicate if more pumpback wells will be required in this area. A third additional well was installed between MW-15 and MW-4A to insure that there was no bypass in the 1st Tres Hermanos on the southern side of the natural draw in which the alluvial trench is located. The first samples from the well do not show elevated chloride or sulfate levels. The extent of influence of pumping wells MW-10, MW-8 and MW-2A suggests that additional pumpback wells are not likely to be required in this area. Continued monitoring of MW-6, MW-7, MW-12 and MW-12A will indicate whether or not additional pumpback wells will be required in this area.

The pumpback water and the water collected in the drainage sump for the horizontal drains will be pumped to the below-grade evaporation lagoon at the east side of the tailings area. The pumpback collection system will continue until monitoring data indicate the relatively high sulfate water in the First Tres Hermanos is reduced to residual values (of the order of 5,000 mg/L SO_4).

section through the tailings area (Figures R6.6.3.2-1 and R6.6.3.2-2) illustrates the basic cover design, comprising slimes overlain by 10 to 20 feet of waste rock or tailings sand, overlain by the excavated diversion channel material.

The design parameters used in the RAECOM radon barrier calculations are provided in Table R6.6.3.2-1. A minimum tailings sand or waste rock thickness of 10 feet over the slimes was selected as the most conservative case, which yields a cover thickness of 2.29 feet of Mancos Shale from the diversion channel excavations. A total of 836,000 cubic yards of Mancos Shale will be excavated from the diversion channels, with 88,000 cubic yards used to place a final 2 foot lift over the mill area, yielding a final cover thickness of 4.6 feet over the 113 acres of final tailings radon barrier cover outlined on Plate R6.6.2-1. The final radon barrier cover thickness of 4.6 feet is a factor of 2 greater than the required cover thickness indicated in the design calculation in Table R6.6.3.2-1. The radon barrier and additional cover over the mill area will be seeded following the final recontouring and encouraged to return to natural vegetation cover. The vegetation cover which has returned without seeding to both the tailings dam and the saddle dam show that natural vegetation cover can be readily established on reworked Mancos Shale.

6.7 Environmental Monitoring Program

The environmental monitoring program at L-Bar is conducted in accordance with NRC license conditions 29 and 30 and with New Mexico State Discharge Plan DP-150. Sampling of air quality monitors is executed by trained site personnel and analyses are performed by TMA Eberline, Albuquerque. Quarterly ground water monitoring, and annual soil, vegetation and surface water sampling is conducted by the site contractor (INTERA) and laboratory analyses are performed by Radian. Sampling and analytical protocols and instrument calibration documents are currently being updated. A complete set of operating procedures will be on site by

February 29, 1988. Radiation Safety Officer services are provided by TMA Eberline. The tailings area and dam are inspected daily by the site maintenance operator and quarterly by the dam engineer of record, A.K. Kuhn. Piezometers (approximately 25) near the dam and in the tailings area are monitored biweekly (Appendix R.II).

Due to numerous corporate reorganizations over the past 12 months, complete semi-annual environmental monitoring reports, in accordance with license condition 12 and 40CFR40.65, have not been collated and submitted within the required time period. The environmental monitoring report due at the end of February will include all outstanding data.

6.8 Reclamation Schedule

The quantities Table R6.8-1 summarize the reclamation construction work at the L-Bar site. The entire reclamation activities have been taken to the preliminary design stage and summarized in this plan. The overall construction schedule, from preparation of detailed design drawings and tender documents to completion of the placement of the radon barrier, is 15 months. License condition 28 requires completion of interim stabilization by June 30, 1989. Resolution of technical issues and approval of the preliminary design is required by March 1, 1987 to complete the construction by June 30, 1989.

6.9 Costs

The final cost estimate for the Reclamation Plan will be submitted by February 15, 1988, following review by the licensee, B. P. America.