HOMESTAKE MINING COMPANY
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TO: DCS

May 18, 1994

U.S. Nuclear Regulatory Commission
Division of Waste Management, MS5E2
Attn: Mr. Joseph J. Holonich, Chief
High Level Waste and Uranium
Recovery Projects Branch
11555 Rockville Pike
Rockville, MD 20850

Re: License SUA-1471 Docket No. 40-8903
Response to Questions Dealing With Reclamation Plan Amendment Dated January 1994

Dear Mr. Holonich:

Attached is a letter from Homestake Mining Company consultant Water, Waste & Land, Inc., addressing issues discussed with Homestake personnel and Nuclear Regulatory Commission personnel. Ongoing test work dealing with radon flux rates and tailing pile characterization will be forthcoming. Estimated time for completion of the additional work is mid-June 1994.

Should you have any questions please contact me at (505) 287-4456.

Sincerely,

HOMESTAKE MINING COMPANY

F. R. Craft
Resident Manager

FRC:jg

Attachment (1)

xc: Mr. Pete Garcia, NRC
H. Barnes

NL05

WATER
WASTE
& LAND INC.

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April 7, 1994

WWL #310

Homestake Mining Company
650 California Street, Tenth Floor
San Francisco, California 94108-2788

Attention: Luke Russell, Corporate Manager, Environmental Affairs

Subject: Radon Barrier Material, Homestake Grants Site

Dear Luke,

This letter outlines a modification to the design of Homestake Mining Company's (HMC's) radon barrier for the large tailings impoundment at the Grants site. This modification reflects recent construction and borrow area identification work, which shows that clays farther from the large tailings impoundment are the preferred borrow material source. The use of this clay would result in a radon barrier with better characteristics than the clayey sand currently specified in HMC's NRC license.

This letter has been prepared to expedite NRC review of HMC's license amendment application and to notify NRC about this change in the radon barrier concept as soon as possible. This letter outlines the implications that the use of clay (rather than clayey sand) would have on the radon barrier design.

RADON BARRIER DESIGN BACKGROUND

The initial radon barrier design for the large and small tailings impoundments at the Grants site consisted of compacted clay from borrow areas north and west of the large tailings impoundment, as outlined in the 1991 Reclamation Plan (AK Geoconsult et al., 1991). This material was described as a moderate plasticity clay (USCS classification of CL/CH) with approximately 50 percent clay-sized material.

In review of the reclamation plan, the NRC expressed concerns about the availability of sufficient clay in these borrow areas and the ability for an earthmoving contractor to selectively excavate these interbedded clays from the borrow area. As a result, the radon barrier was modified to consist of a mixture of the clays and sands in the borrow area producing a compacted clayey sand radon barrier. This revised radon barrier design was presented as an alternative in the December 1992 submittal to the NRC (HMC, 1992) and the June 30, 1993 submittal to NRC (WWL, 1993). This design was included in NRC's revised license conditions in 1993 and was the focus of the 1994 license amendment application (WWL, 1994).

RESULTS FROM RECENT FIELD WORK

The clayey sand radon barrier was based on being able to mix the clay layers and sands in the borrow area to produce a mixture with at least 25 percent fines (passing the No. 200 sieve). This mixing was planned to prevent lenses of relatively clean sands from being used for the radon barrier.

From initial borrow area preparation, the earthmoving contractor has found that the clays in the borrow area have residual moisture. This moisture along with the plasticity of the clays prevents successful mixing of the clays with the sands. From an earthmoving cost standpoint, it is less expensive to excavate clays farther from the tailings impoundment than use additional equipment to appropriately mix the sands and clays.

Borrow area exploration work conducted for HMC has identified a large zone of clay north of the current designated borrow area (immediately north of the large tailings impoundment). Backhoe trenching and logging on a grid pattern in this new area has identified sufficient clay for 4.7 feet of radon barrier over the top surface and side slopes of the large tailings impoundment. Test work is ongoing to verify the suitability of this material.

CLAY BORROW MATERIAL DATA

Previous data from clays in the site area have been documented in Appendix D of the 1991 Reclamation Plan (AK Geoconsult et al., 1991), and in the December 1992 submittal to NRC (HMC, 1992). Clay samples were collected in 1986, 1987, and 1992. Hydrometer testing showed 40 to 70 percent clay-sized material, and Atterberg limit testing showed material plotting above the "A" line, with a CL to CH USCS classification.

Moisture content of the clays was evaluated in several ways. First, measured moisture contents at 15 bars tension ranged from approximately 23 to 35 percent. Natural moisture contents from samples collected at 120 to 500 cm depth, as recommended in NRC Regulatory Guide 3.64 (NRC, 1989), ranged from approximately 8 to 23 percent. Standard Proctor test optimum moisture contents (representing the moisture content at which the clays would be compacted) are primarily 20 percent.

Using the Rawls and Brakensiek equation to estimate long-term moisture content (NRC, 1989), the input parameters are organic matter and clay content. Using average organic matter and clay content values from the data above (2.4 percent and 50 percent, respectively) the estimated long-term moisture content is 20 percent. Using lower limit values (2 percent and 40 percent, respectively), the estimated long-term moisture content is 17 percent.

RADON BARRIER THICKNESS USING CLAY

The radon barrier thickness calculations were reviewed for the use of clay. The material properties for the tailings and interim cover were kept the same as used in the license amendment application (WWL, 1994). For the radon barrier, radon diffusion coefficient was calculated from the empirical relationship with density and moisture content in RAEC (1984).

For average conditions (50 percent clay), the diffusion coefficient was 0.0047 cm^2/sec. For lower limit conditions (40 percent clay), the diffusion coefficient was 0.0088 cm^2/sec. Radon emanation coefficient was conservatively set a 0.35, and radium activity was 5 pCi/g.

The RADON model calculations show that for average conditions (50 percent clay), the radon barrier thickness required to reduce the radon emanation rate to below 20 pCi/m^2-sec is less than 3 feet on both the top surface and side slopes of the large tailings impoundment. For a 3-foot thick radon barrier, the calculated weighted average radon emanation rate over the entire large tailings impoundment is 16.9 pCi/m^2-sec. For lower limit conditions (40 percent clay), the radon barrier thickness required to reduce the radon emanation rate to below 20 pCi/m^2-sec is less than 4.7 feet on both the top surface and side slopes of the large tailings impoundment. For a 5-foot thick radon barrier, the calculated weighted average radon emanation rate over the entire large tailings impoundment is 16.6 pCi/m^2-sec.

REVISED RADON BARRIER MATERIAL SPECIFICATIONS

The material specifications for the radon barrier in Condition 37 of the current NRC license (25 percent passing the No. 200 sieve, Atterberg limits above the "A" line) would apply to the clays from the new borrow area. However, these specifications should be amended to better represent the clay characteristics. Likely amendments would consist of increasing the minimum percent passing the No. 200 sieve and including a minimum plasticity index specification (such as 10). Specification revision would be done particularly if the radon barrier thickness is reduced to reflect use of the clay.

ADDITIONAL TESTING FOR CONFIRMATION OF RADON BARRIER THICKNESS

Additional testing currently underway under the direction of HMC is listed below.

Relationship of clay content with Atterberg limits. Backhoe trench samples collected to identify clays in the new borrow area are currently being tested for percent passing the No. 200 sieve and Atterberg limits. Additional tests will include hydrometer testing (for clay-size percentage) and Standard Proctor tests (for compaction control).

Radon emanation measurements. Radon emanation will be measured from the regraded tailings surface and areas of compacted radon barrier on the large tailings impoundment. Selected emanation measurement locations will be drilled and sampled for current moisture content and radium activity measurement. Selected samples will be tested for radon diffusion coefficient and radon emanation coefficient.

Radon emanation modeling. The measured radon emanation rates and measured values will be used in RADON model calculations to adjust radon attenuation parameters. Using these adjusted parameters and long-term moisture contents, revised radon barrier thickness calculations will be made.

SUMMARY

HMC is therefore planning to use a clay borrow source for the radon barrier for the large tailings impoundment. This clay source is easier for the earthmoving contractor to condition for compaction than the previously planned clayey sand mixture. The use of this clay also creates a radon barrier with radon attenuation characteristics superior to the clayey sand mixture.

Calculations based on previous test data show that a radon barrier comprised of this clay is as thick as (or less than) the 4.7-foot thick barrier currently proposed by HMC for the large tailings impoundment. Additional testing outlined above will be used to more clearly identify acceptable clays and quantify the clay radon barrier thickness.

I trust that this letter adequately outlines HMC's current strategy for initiation of radon barrier construction and additional on-site testing. If you have questions concerning the information in this letter, please call me.

Yours sincerely,

WATER, WASTE & LAND, INC.

Clint Strachan

Clint Strachan, P.E.
Manager, Geotechnical/Mining Division

cc: Fred Craft

ATTACHMENT – REFERENCES CITED IN LETTER

AK Geoconsult, Inc., Applied Environmental Consulting, Inc., Jenkins Environmental, Inc., and Radiant Energy Management, 1991. "Reclamation Plan, Homestake Mining Company, Grants Operation," Two Volumes, prepared for Homestake Mining Company, January.

Homestake Mining Company (HMC) 1992. "Response to NRC Questions About Soil Cover and Rock Toe Apron, Homestake Grants Operation," December 21.

Rogers and Associates Engineering Corporation (RAEC), 1984. Radon Attenuation Handbook for Uranium Mill Tailings Cover Design, NUREG/CR-3533, prepared for U.S. Nuclear Regulatory Commission, April.

U.S. Nuclear Regulatory Commission (NRC), 1989. "Calculation of Radon Flux Attenuation By Earthen Uranium Mill Tailings Covers," Regulatory Guide 3.64, U.S. Nuclear Regulatory Commission, Office of Nuclear Regulatory Research, June.

Water, Waste and Land, Inc. (WWL), 1993. "Description of the Radon Barrier Design for the Large Tailings Impoundment at the Grants Uranium Mill," prepared for Homestake Mining Company, June 30.

Water, Waste and Land, Inc. (WWL), 1994. "Evaluation of Radon Barrier Design for the Large and Small Tailings Impoundments at the Grants Uranium Mill, NRC License No. SUA-1471," prepared for Homestake Mining Company of California, January.