PDR

WM-24

Cyprus Mines Corporation
Uranium Division

1790 30th Street
Suite 200
Boulder, Colorado 80301
Telephone 303) 447-0781

September 12, 1980

80-20.12-892

Mr. Gene Trager
Nuclear Materials Safety and Safeguards
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Trager:

Enclosed are five copies of our responses to the questions and comments on the Hansen Project tailings disposal area that were telecopied to us on August 20, 1980.

The information related to the radiation assessment and construction sequence that was submitted to you on March 19, 1980 and April 29, 1980 is the most recent data. The map (No. 00-21-001) showing the restricted area which was submitted to you on May 4, 1980 is also the most recent information.

If you have additional questions, please contact me.

Very Truly Yours,

MA Thompson

M. A. Thompson
Principal Licensing Engineer

cc: Terry Howard - U. of Idaho - w/ enc.
Mark Jewett - Fred C. Hart - w/ enc.
Richard Gamewell - CDH - w/ enc.

MAT/mb

17339

CYPRUS Add'l info

RESPONSES TO NRC QUESTIONS AND COMMENTS

TELECOPIED TO CYPRUS MINES ON 8/21/80

1. May 12, 1980, response to Cyprus item numbers 5, 8, 9, 10, 13, 14, 15, and.

   Item 8 (re: liner system). More detail is needed concerning the use of "backhoe trenches or auger holes (that) will be used to establish that at least 3 feet of impervious material underlies the bottom of the excavation" and regarding the statement that, "(t)he evaluation and determination of areas to be lined will be based on recognized principles of soil mechanics." For example, what will be the spacing on trenches and/or auger holes, what is maximum permissable permeability of the "impervious" spot liner material, and what can be done in areas in which highly pervious zones are covered by thin layers of "impervious" material.

Response: A thick section of impervious claystone underlies most of the proposed tailings disposal site. It is proposed to line pervious areas of the cells with 3-feet of compacted clay. This clay would be obtained from cell excavations.

The subsurface materials in the disposal area are variable. A gradation summary from more than 20 tests is shown on Figure V-1 of Appendix C-1 of the Project Environmental Report. Most of the exploration performed in the impoundment area was done primarily to evaluate the area as a potential borrow source and did not always extend deeply enough to penetrate what might become the "base" or "final grade" of the cells. However, it is reasonable to assume that the materials within the impoundment are similar to those investigated in more detail in the embankment foundation area and would have similar materials properties.

Materials properties and field and lab permeabilities are presented in detail in the Site and Laboratory Investigation, Definitive Design Report - Hansen Project Volume II - Appendices, by W. A. Wahler Associates, May 1978. Because of the complex and variable distribution of materials at the site, it was, and is, impractical to attempt to define the lateral and vertical extent of each variation of material during design. It has been proposed to utilize the best available form of exploration--the final cell excavations to delineate areas which should be lined.

The field definition of areas to be lined will not be difficult. The claystone areas of the cells can be readily identified by visual examination. The limited areas of sandy gravel and gravelly sand that will require lining can also be readily identified by visual examination. Those areas of the cells where silty sands, clayey sand and sandstone exist will require some field laboratory testing to determine if lining is required. This type of field decision and evaluation is common practice in the design and construction of embankment dams, especially in the area of embankment foundation excavation.

During stripping and borrow excavation in the cells, when the underlying geologic formations are fully exposed, senior design personnel will evaluate and determine those areas of the cells which will require blanketing. These evaluations and determinations will be based on recognized principals of soils mechanics.

The permeability of soils is influenced by the size and shape of the soil particles, density and structure of the soil mass. Since the exposed impoundment excavation surface will be primarily the dense Echo Park Formation, the permeability of the cells will be mostly controlled by the grain-size and density of these materials. The permeability of soils varies significantly with the grain-size and is extremely sensitive to the quantity of the fine fractions. For example, gravelly sands with as little as 7 percent finer than 100 mesh have permeabilities that are as much as 1000 times less than these materials with no material finer than 100 mesh. (Cedergren 1967)

In those areas where sandstones, silty sands, clayey sands and clayey gravels are exposed after excavation and an accurate estimate of the percentage of fines cannot be made by visual examinations, field laboratory tests will be performed on samples of these materials. Gradation tests and the percentage by weight of material passing the No. 200 U.S. Standard Sieve will be determined in accordance with ASTM Designation D422-63 and D1140-54, respectively. The results of these tests will allow evaluation of the permeabilities of these materials. Materials at excavated impoundment surfaces that have greater than 25 percent by weight passing the No. 200 U.S. Standard Sieve are considered to be essentially impervious. Those areas of the impoundment grade that have less than 25 percent by weight passing the No. 200 sieve will be lined with compacted clay. Backhoe trenches and/or shallow auger holes will be used near the margins of mapped pervious areas to determine the depth of the natural impervious cover.

Cedergren, Harry R., Seepage, Drainage, and Flow Nets, John Wiley & Sons, Inc. (1967)

Items 9, 10, and 14 (re: water sheet erosion/flood protection for 3-cell system). In the April 17, 1980 meeting, Cyprus agreed to provide a topographic map of the final reclamation cover which was to have included areas which will be protected by riprap. Of particular concern are areas on the cover which will be subject to the concentrated, higher-velocity flow of runoff from tributary drainage areas. In general discussion at the April meeting, Cyprus stated that flow conditions on the tailings cover would be of a low-velocity, depositional nature. However, from inspection of Figure III-4 (Conceptual Reclamation Plan) it appears as though the transition from erosional to depositional flow may occur on the cover and that some riprap or rock cover protection is called for at these points. The conceptual design for hardening these areas, if required, should be provided.

Response: High velocity flow may occur in the natural drainage channels above the reclaimed cells. The transition from erosional to depositional flow would occur near the outer boundary of the cells. The conceptual design for hardening these areas consists of placing a rock cover along selected portions of the boundary of the reclaimed cells and the steep slopes, where defined drainage channels exist. The specific locations and areal extent of the rock cover would be defined during final design.

Item 11 (re: 3-cell water balance). What is the estimated evaporation from the raffinate pond and by what amount could this evaporative capacity be increased? What additional quantity of tailings liquid could be recycled if it were removed from the tailings impoundment?

Response: The estimated evaporation from the raffinate pond is estimated to be 13 gpm. Since the water in the raffinate pond is recycled to the mill, it would not be desirable to increase the evaporative capacity of this pond. Any additional loss by evaporation would have to be made-up by an increase in the mill water supply. Any additional tailings liquid that could be removed from the tailings impoundment could be recycled to the mill. The amount indicated for recycle from the tailings disposal area (389 gpm) is considered to be the practical maximum.

Item 13 (re: documentation of heaving). The documentation provided shows that heaving can occur, although under conditions which appear to be dissimilar to those at the B-2 site. Is there documentation available of heaving under conditions similar to those at B-2 site?

Response: We are not aware of specific documentation describing heaving under conditions similar to those at the B-2 site. A literature review was performed for the response to NRC Item 13. That response contained a list of references documenting heaving and blowout. However, the same engineering principles apply to the B-2 site as for the documented cases, regardless of whether the physical conditions are exactly the same or not. Lenses or pockets with artesian pressures not overlain by sufficient thickness of confining material will heave.

2. May 29, 1980, response to Cyprus item numbers 4, 7, and 17.

Item 4 (re: characterization of landslide potential). The study of varying cell geometries to be provided by Cyprus by the end of August 1980 will include a parametric study of slope stability and should resolve questions on this item.

Response: The study characterizing the landslide potential was provided on August 29, 1980.

Item 7 (re: dewatering of tailings). It is stated that attempts to dewater using a subdrain system during disposal operations would merely result in recycling of fluid through the tailings. This is misleading because it does not consider that a lower liquid level in the tailings results in a lower driving head and potential for seepage, nor does it consider that removal of liquid during operations should result in earlier settlement and consolidation of tailings and an earlier reclamation. It is also stated that there are a number of possible ways of reducing liquid in the tailings by increasing the recycle of liquid to the mill and by increasing evaporative capacity outside of the impoundment. Please discuss and quantify the following elements which would potentially enable the removal and disposal of liquids in operating tailings cells: (1) recycle of liquid to the mill, (2) increasing the areal extent of the raffinate pond and/or use of an additional evaporation pond, (3) use of tailing liquid in surficial wetting to surpass tailings dusting. Please quantify and account for the disposal of evaporation pond residues in the tailings cell(s). Finally, please estimate the increase in recovery that might be possible with increased recycle of liquids from an underdrain system.

Response: There is apparently some misunderstanding regarding the potential for reducing the liquid in the tailings by increasing the recycle of liquid to the mill and by increasing the evaporative capacity outside of the impoundment. All of the liquid that can be removed from the tailings will be recycled to the mill. The amount of liquid to be recycled to the mill does not limit the amount that can be removed from the tailings. . The evaporative capacity outside the impoundment area was considered for use during the final drying of the tailings just prior to reclamation and not during operations. Increased outside evaporative capacity would not increase the potential for removal and disposal of liquid from the tailings disposal area.

Tailings liquid will be used to surpress dusting on the beach areas of the impoundment. The estimated evaporation rate from the tailings area (77.8 gpm) as shown in the water balance in our May 12, 1980 response includes evaporation due to use of the tailings liquid for dust suppression. This method of dust suppression will provide the maximum practical evaporation.

The volume of residues in the raffinate pond requiring disposal in the tailings area is estimated to be less than 10 acre feet.

Underdrains would be expected to rapidly plug during operations due to the precipitation of dissolved solids. (See also Item 7 in May 29, 1980 response.) Impervious claystone underlies most of the tailings disposal site. Pervious areas of the cells would be lined with 3 feet of compacted clay. It is not anticipated that seepage from the cells will present any significant adverse affects. For these reasons, the use of underdrains is unwarranted.

Item 17 (re: optimizing cell geometry to increase below-grade storage volume). The study of varying cell geometries (see Item 4 above) should resolve questions on this item.

Response: As indicated in the August 1980 Wahler Associates report on Cell Stability, the proposed three-cell geometry of typically 50% below grade is nearly optimum. Some small modifications in geometry might be achieved during final cell design, but any additional optimization would not be expected to significantly increase the amount of below-grade disposal or decrease the surface area of the disposal area. The additional cost and risks associated with significantly increased below grade disposal cannot be tolerated by the Project.

3. May 29, 1980, response to Cyprus item numbers 2 and 3.

Items 2 and 3 (re: drill and test plan, countour map of saturation zone, etc.) The statement is made that any piezometric map for the site would not be meaningful because this would oversimplify the actual subsurface conditions. Because of the importance of this information in evaluating the potential for blowout and impacts to groundwater please estimate/approximate volumetric extent(s) and capacity of the water bearing zones. Does the term "aquifer" accurately describe these zones? Please comment on the origin of the confined water. If the water is "connate" and there is no recharge, please account for the high pressures observed. Although it would be difficult to precisely quantify the amount of heave and quantity of inflow into the excavations, please bound what would be expected given what is known about the subsurface conditions. What is the "conventional dewatering" plan that would be used during excavation?

Response: The results of the additional groundwater investigations are summarized in the Wahler Associates report titled "Hansen Project, Groundwater Investigation, Proposed Tailings Disposal Area", May 1980. The results of this investigation confirmed that the water bearing zones within the Echo Park Formation and Precambrian basement complex occur randomly with no apparent physical or hydraulic connection between zones. Therefore, the term "aquifer" does not accurately describe these zones. A more accurate description would be "perched water zones". Because of the random nature of these zones (both in location and extent) it would be meaningless to attempt to estimate the volumetric extent and capacity of these zones.

The water zones probably originated over geologic time periods during which the water accumulated in zones of higher permeability. The recharge of the zones would be extremely slow because of the low permeability of the Echo Park material surrounding the zones. The piezometric pressure within the zones would remain high because the water, once accumulated within the zones, would be confined by the low permeability of the Echo Park Formation.

Also, because of the random nature of the water bearing zones, it would be meaningless to attempt to quantify the amount of heave and quantity of inflow that could occur into the excavation. However, based on the limited number of test wells, a "typical" flow rate into the excavation might range between 2 and 50 gpm with an unrestricted flow for days before the piezometric pressures is relieved. "Typical" heaving might be a few feet. Both the inflow and heaving would be manageable.

Because of the random nature of the water bearing zones and the low permeability of both the zones and the Echo Park formation, "conventional dewatering" (i.e. installation of dewatering wells before starting excavation) would not be possible. What would be required would be control and disposal of inflow water into the excavation. The water could be controlled by a series of small ditches and sumps within the excavation. These ditches and sumps would be constructed as the inflow water is encountered. The inflow water could be disposed of by piping to the mine dewatering, water treatment plant for treatment and discharge, by use in construction, by recycling to the mill (after mill startup), by evaporation, or by discharge (if the quality is suitable). The proposed treatment plant will have adequate capacity to treat additional water from the tailings disposal area. The water from the tailings area has a higher quality than the water from the mine area; therefore, the treatment process would be adequate to achieve the water discharge limits. Because of the amount and quality of water that might be encountered is unknown, a detailed water management plan cannot be developed; however, prior to excavation a conceptual plan, including contingency actions, would be generated.

4. June 2 and 9, 1980 response to Cyprus item number 1

<u>Item 1</u> (re: large excavation separated with tailings embankments). In connection with the study of feasible excavation geometries and cut slope stability it is important to note that there was a misunderstanding of what would be involved in the concept of this alternative. The NRC's intent was to examine a large, single excavation in the location of the 3-cell alternatives. The two

"ridges" which separate the cells and which support the earthfill embankments in the 3-cell system would be excavated and would be replaced by a series of embankments constructed of tailings sands. The floor of such an excavation would gradually dip from the point nearest the head-of-the-valley and would connect the three deepest points in the 3-cell system design. Tailings sand embankments would be constructed as storage capacity was needed and excavation proceeded. The earthfill embankment at the mouth of the valley might be constructed in stages with excavation material. The overall stability of the embankments in this sytem would appear to be improved because they would be located largely below grade.

Response: This is generally the scheme described in the Wahler Associates report titled "Summary Evaluation of Tailings Disposal Methods, Hansen Project", July 1980, page III-6. Because of geotechnical and hydrological considerations, this method of tailings disposal would be no better (and would be less stable) than the three cell system using earth embankments.

As shown in Figures 1 and 2 of the Response to NRC Item 1, the tailings embankments would be about 60 and 90 feet high. With this alternative, the tailings level would be as much as 40 feet higher in elevation than the crest of the downstream zoned earthfill embankment. The tailings embankments would be loose silty sands. Because of the physical arrangements of the 3 cell scheme, (i.e., ponds on both sides of the tailings embankments), both the upstream and downstream sides of the silty sand tailings embankments would be saturated. This type of construction would be inconsistent with recommendations in Section B.3 of U.S. Nuclear Regulatory Commission Regulatory Guide 3.11, December, 1977.

In addition, little additional tailings burial is obtained with this scheme (Response to NRC Item 1, June 2, and 9, 1980), and this scheme would increase the problems associated with excavation at the site.

17330