30 December 1980

MEMORANDUM FOR: ENVIRONMENTAL IMPROVEMENT DIVISION

SUBJECT: Initial Comments on Ground Water Discharge Plan, UNC Church Rock Mill, and Final Design Report Southeast Evaporation Ponds

This memorandum provides initial comments from a review of the following documents:

1. "Seepage Study, UNC - Church Rock Operations, Volume V, Phase I - PMF Determinations," Science Applications, Inc., Natural Resources Division, 5 August 1980.

2. "Ground Water Discharge Plan for United Nuclear Corporation N.E. Church Rock Mill," Science Applications, Inc., 1 December 1980.

3. "Final Design Report Southeast Evaporation Ponds," Civil Systems, Inc., August 1980.

Comments on reference 3 were provided by telephone to Joe Pierce, Richard Raymondi, and Ron Conrad. Comments on references 1 and 2 were discussed with Bruce Gallaher on 18 December 1980 at EID. This memorandum provides a written summary of these comments and indicates aspects of the hydrologic investigations and hydraulic engineering design that should be examined in more detail in preparation for a public hearing.

The Seepage Study - PMF Determinations (reference 1) applies a sophisticated physical process computer model developed by Simons, Li and Associates (SLA) to the derivation of design hydrographs for Pipeline Canyon. This represents a significant improvement over standard techniques used in hydrologic and hydraulic design (for example, the "Design of Small Dams" approach applied at Canyon Marquez by SAI for BRC). However, as with any physical or computer model of natural processes there are certain assumptions and limitations inherent in the approach. In applying the SLA MULTSED model the following assumptions are made:

- Subwatersheds may be represented by an "open book" approximation.

- Soil characteristics are isotropic and homogeneous.

- Canopy cover and ground cover are homogeneous.

- Rainstorm events are spatially homogeneous and cover the entire plane or subwatershed unit.

- Initial conditions such as soil moisture are uniform.

- Evaporation processes are neglected for a single runoff event.

- Streams within the watershed are ephemeral, and the movement of subsurface flow and groundwater flow are negligible.

- The kinematic-wave approximation for flow routing is valid, i.e., the gradients due to local and convective accelerations are negligible and the water surface slope is nearly equal to the bed slope.

- Water and sediment yield simulation is based on a single storm.

Additional assumptions are required in formulating the various components of the model. In the hands of an experienced modeller who is aware of these limitations and the details of the mathematics involved in restructuring the physical process equations for computer solution, the MULTSED model will produce reliable results. The 87000 CFS hydrograph with a runoff volume of 6000 AF recommended as a PMF would result in a very conservative design.

In regard to the UNC Ground Water Discharge Plan (reference 2) my comments relate primarily to Section 5.0 "Flooding Potential" and the 2 SLA reports contained in that section. The first report dated 12 November 1980 (pp 5-6 to 5-60) concerns the stability of the existing UNC tailings site under PMF conditions and is based on the design PMF developed in item 1 above. It is interesting to note that the Bokum hearing has had an impact on the design approach at other sites. The SLA report touches on essentially every item of site hydraulics and geomorphology brought out by EID staff and consultants at the BRC hearing. As the conclusions and recommendations of pages 5-58 thru 5-60 emphasize, it would be impractical to provide protection for the existing tailings site against PMF flows. The 15 to 20 million dollar estimate (page 5-2) for hydraulic engineering to protect the site for a 30 year operational period is probably low. There are numerous major problems, including: overtopping of the embankment at the north end of the site, overtopping of the dam that forms the west boundary of the tailings site and supercritical flow along several sections of the dam, and the stability of the eastern boundary of the tailings site. In the constricted channel to the west of the tailings site aggradation, degradation, bank stability, and lateral migration would present additional problems and require major engineering effort to insure site stability under PMF conditions. The SLA report documents and quantifies most of the potential surface water problems of the Pipeline Canyon site.

The second SLA report, dated 20 November 1980, (pp 5-62 to 5-119) presents an alternate approach for temporary use of the existing site by providing an "equivalent" PMF protection for a 5-year period. The assumptions required for the risk analysis to determine the design flood to provide PMF level protection for a shorter period should be evaluated closely prior to a public hearing on the discharge plan. As a minimum, consultation with Bill Bivens of NRC is recommended. A few quick calculations using various assumptions in Eq s 5 & 6 (page 5-72) indicate the sensitivity of the resulting design flood to the input parameters. If the half-life of common uranium wastes ranges from 10,000 to 100,000 years (page 5-70) one could argue that the longer half-life should be used as a project life in the calculations. Applying Eqn 5 with $n = 10^5$ and $T = 10^6$ yields a probability of failure of .095 and from Eqn 6 the design flood would have a return period of 50 years. One could also argue that a PMF is about a 10,000 year event. With $T = 10^4$ and $n = 10^4$ in Eqn 5, P_f becomes .632 and the design flood from Eqn 6 is the 5 year event. Or combining these assumptions, with $T = 10^4$ and $n = 10^5$ in Eqn 5, P_f becomes .999 and the design flood would be the 1.2 year event. The assumptions used in the risk analysis should be evaluated closely prior to a public hearing on the discharge plan. In the final analysis the question to be answered is "for the short-term use of the site what level of risk is acceptable to EID?" If the probability of failure of .01 is acceptable to EID then a design based on the 500 year event should be adequate.

The commitment by UNC to use the existing tailings area for only five years is rather indefinite (pages 1-2 and 1-3 - the third "special consideration"). In addition, the tailings will not be removed from the existing site to a new location until 10 years after initial operation of a new site (page 1-3), i.e., the Pipeline Canyon site will actually be used for 15 years. Perhaps the temporary use of the site should consider a 15 year period as apposed to a 5 year period in the hydraulic design. Using n = 15 years and $P_f = .00995$ in Eqn 6 (page 5-73), the design flood would be a 1500 year event which presents a significantly greater challenge for engineering design than the 500 year flood used in the second SLA report.

Given the input parameters for the 5 year temporary use of the existing site I would concur in the recommendation of alternative II as presented in the report. However, the details of the hydraulic design have not been provided and should be evaluated carefully by EID before approving this approach. In particular, the size, location, and extent of rip rap protection will be critical to the acceptability of the approach. Given the geomorphic characteristics of Pipeline Canyon above and below the tailings site, there will be a strong tendency to "break out" of a straight channel along the west edge of the tailings area during an extreme event. Guiding the flows into the channelized reach will also be critical to the success of the approach.

Although the Discharge Plan (page 2-5) notes that the design for the Southeast Evaporation Ponds (reference 3) is being considered separately, the evaporation pond approach is closely linked to the stability of the existing tailings area. An integral part of the evaporation pond design is the diversion and conveyance of fluid realeases to the South Pond of the existing tailings area as a secondary catchment (pages 2-2 and 2-3). Insuring the stability of the existing tailings area for only 5 years of temporary use under the Discharge Plan, yet relying on the integrity of that same area as a secondary catchment during an estimated 30 year useful life of the mill appears inconsistent. If provision of secondary catchment is critical to EID approval of the evaporation pond plan, then this is a point that needs to be addressed.

The surface water hydrology investigation (Appendix C) was completed by SAI technical staff using the SLA MULTSED model. To my knowledge the results were not reviewed by SLA personnel. For reasons cited earlier in the memorandum there is a danger in the use of a mathematical model "off the shelf" by inexperienced personnel. The assumptions used in this application of the model should be checked carefully before it is accepted by EID as a valid basis for design. For example, in the SLA application of the model (reference 1, Table 1, Page 8) the greatest subwatershed unit slope used was 34.3% and only 3 units had slopes in excess of 30%. In the SAI application (reference 3, Table C-1, Page C-3) slopes in excess of 60% are used and 6 units had slopes in excess of 40%. The validity of the underlying assumptions of the model at these slopes needs to be checked.

The diversion system around the evaporation ponds is intended to restrain surface water from entering the site from the east, and contain and safely direct potential evaporation pond spills to the existing tailings area. The hydraulic characteristics of the diversion and conveyance system should be checked in detail prior to EID approval of the approach. This includes the capacity of conveyance channels and adequacy of shotcrete linings under PMF and pond-spill conditions. Critical features such as the alignment of arroyos that impact the low diversion embankment and rip rap protection should also be evaluated. However, the most critical question to be addressed is the linking of the evaporation pond scheme with the existing tailings area as a secondary catchment.

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