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MEMORANDUM FOR: Malcolm R. Knapp, Chief
Geotechnical Branch
Division of Waste Management

FROM: Richard Codell
Hydrology Section
Geotechnical Branch
Division of Waste Management

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SUBJECT: TRIP REPORT FOR NCRP, COLORADO STATE UNIVERSITY, AND URFO MEETINGS

I took part in a meeting of Task Group 6, Scientific Committee 64 of the National Council on Radiation Protection and Measurements (NCRP), held in Jackson Lake, Wyoming on July 9 through 11, 1985. The purpose of the meeting was to work on the guide for screening models which can be used by layman to assess the acceptability of very-low-level releases to the atmosphere, surface water and groundwater. The report emphasizes simple generally conservative models using tables and graphs wherever possible in order to minimize the amount of calculations. My section on groundwater is nearly final, but most of the committee members were tied up with the section on atmospheric pathways in order to complete a commentary for the Clean Air Act (PL-95-95). I therefore came prepared to significantly rewrite the section on surface water with Dr. Yasuo Onishi of PNL. We spent most of the three days completely rewriting the procedures to better comply with the groundwater section and also simplify them considerably. We were quite successful in this effort. The COMPAC portable computer which I carried to the meeting proved to be of great utility. I was able to recompute tables of factors needed for the screening models. I also used it as a word processor for revising the work sheets of the screening model. All expenses for my attendance at this meeting were paid for by NCRP.

On July 23, I attended a meeting at Colorado State University concerning flume experiment for flow through and over rock armor. This research is sponsored under contract A9350 through ORNL, and was designed to gather data on flow friction relationships and failure modes for rock armor layers on uranium mill tailings embankments. The meeting was attended by Ted Johnson, Dan Gillen, Ed Hawkins and myself from NRC, members of the CSU staff, and representatives of the DOE TAC and RAC.

The meeting began with a review of the program, then proceeded to tour the test facilities. There are two flumes; the first is an indoor flume, 8 ft. wide and about 200 ft. long. A 6 inch layer of 2 inch crushed rock was placed on a sand layer covered with filter fabric. The slope of the test section was variable

from zero to about 5 percent. Upstream of the test section of the flume is a identical section, covered with chicken wire to maintain the stability of the layer. Stripes were spray painted on the rocks of the test section to aid in the direct observation of the movement of rocks. The purpose of the indoor flume is mainly to study flow phenomena for small rock placed on the less-steep top slopes of the tailings embankments.

The indoor flume was run for the benefit of the observers, but no data were yet being taken. The slope of the flume had been set to 2 percent. I observed the flow of the water over the rock and took several photographs. I also watched the operation of the instruments used to measure the mean water velocity through the rock layer. The demonstration was run at two flowrates. The first flowrate was too low to directly measure with the pressure gage, but I asked three different CSU staff personnel to estimate the flow and got a range from 3 to 10 CFS. The second flowrate was about double the first, and was measured at 2.5 CFS. This substantial error in the estimate of the first case by trained engineers used to working with the flume points to the danger of speculating on these phenomena without direct measurements from instruments. The higher flowrate corresponded to approximately the maximum flowrate likely on a typical embankment top slope without any flow concentration phenomena. There was no large failure of the rock layer, but movement of individual rocks was observed. There was also some evidence of movement of small particles out of the test area, but this was freshly-placed rock and probably had an abundance of fines.

The tour then moved to the larger outdoor flume which was designed to study flow and failure phenomena on the steeper side slope. This flume had a width of about 20 feet and was set up for a fixed slope of 2 percent on the top slope, changing abruptly to a 20 percent side slope. Work on the outdoor flume was not nearly as complete as that on the indoor flume, but all major parts of the experiment were in place except the final grading of the rock, which will consist of a layer of 6-inch crushed granite on a 2 1/2 inch crushed rock bedding layer.

While at the laboratory, the group was fortunate to observe a test of direct precipitation on a simulated unvegetated watershed. This work had no direct connection to the NRC project but it was interesting to observe the many gullies which formed on the mild slope within a period of hours, emphasizing the need for slope protection.

The meeting reconvened after the tour. Ted Johnson suggested that the large outdoor flume could be run with only the 2 1/2 inch bedding layer present in order to get more data on the smaller rock on a 2 percent and 20 percent slope at little extra cost. The large rip-rap could be placed on the filter layer

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upon completion of this experiment. I brought up several points. The first was that there is a need for redundant experiments since there is a certain degree of randomness in the tests, and the variance of the test results cannot be determined from a single test as planned. Secondly, the experiments use only crushed angular rock, whereas some of the armor layers will employ rounded alluvial rock where available. CSU is perfectly willing to address these issues, but further experiments might be limited by the availability of funds from NRC.

On July 24, I met with Ed Hawkins, Ted Johnson, Dan Gillen and representatives of DOE at the URFO offices to discuss design methodology for rock armor. The first topic discussed was flow concentration caused by differential settlement of the slope. I presented some results of my computational experiments showing that slopes as small as 1/2 percent perpendicular to the fall line caused by differential settlement can have a marked effect on flow concentration. DOE allowed that slopes can be overbuilt with a convex crown, and engineering measures such as overloading can be used to reduce settlement to very low amounts. They suggested that my experiments be repeated with very small settlements to determine the feasibility of defining a cutoff such as 0.1 percent, below which the flow concentration effect would not need to be considered.

We next considered the use of the Probable Maximum Precipitation (PMP) as the basis for the hydrologic design. DOE, of course, urged that a less-severe flood be adopted, but the outcome of this argument is unclear. I had found it to be necessary to use very-intense rainfall for very short periods of time. This was dictated by the very short transients in the simulated system (one to two minutes) determined from the mathematical model. Since rainfall tables rarely go below 5 minute durations, and in some cases 15 minutes, it was necessary for me to extrapolate the PMP down to intervals shorter than that reported in the references. DOE questioned my extrapolation procedure, proposing a less stringent, but no better justified one. We agreed to follow up on this question by consulting with the National Weather Service on rainfall intensities for very short durations.

I also agreed to rerun the models in order to determine their sensitivity to these very short duration events. The DOE representatives expressed great interest in the NRC models and wanted to know when they would be available for public use.

Lastly, we discussed the use of the "Safety Factor" and "Stephenson" methods for rock design and the discrepancy between rock diameters calculated by the two methods. We reached no conclusion but agreed that the results of the CSU flume tests on the failure of the rock slopes should shed light on the problem.

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At this point I left the meeting because I was not directly involved in the remaining points of discussion. Additional meeting notes may be found in Ted Johnson's summary, which will be finished soon.

I would be happy to brief you further on any of the above meetings.

Original Signed By

Richard Codell
Hydrology Section
Geotechnical Branch
Division of Waste Management

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