WILLIAMS & ASSOCIATES, INC.

P.O. Box 48, Viola, Idaho 83872 (208) 883-0153 (208) 875-0147

Hydrogeology • Mineral Resources Waste Management • Geological Engineering • Mine Hydrology

September 30, 1987
Contract No. NRC-02-85-008
Fin No. D-1020
Communication No. 150

Mr. Jeff Pohle
Division of Waste Management
Mail Stop 623-SS
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

RE: TASK 5

Dear Jeff:

We have studied your letter of September 15, 1987. Your letter describes the draft Task Descriptive Summary for simulating the testing and analysis of a hypothetical high-level waste disposal site in saturated media. This letter outlines our views on implementing this task; we present an outline of those options of the task which we suggest should be conducted by Daniel B. Stephens and Associates and by Williams and Associates, Inc. We have not contacted Nuclear Waste Consultants at this time regarding the content of this Task Descriptive Summary.

We have three basic questions which guide our response to deciding whether or not Williams and Associates, Inc. or Daniel B. Stephens and Associates, Inc. should conduct various parts of the task. Our first set of questions concerns the computer system at INEL. Do you know what type of computer system will be employed for this task if the task is initiated? Do you know what operating system will be used? How large a mesh will the computer handle?

Our second set of questions concerns the discussion in the Task Descriptive Summary about the calculation of groundwater travel times. Does the NRC intend to use an aquifer simulation code or a solute transport code? The selection of the code is an important factor that will influence the outcome.

Our third question pertains to the analytical analysis of the test data generated using the aquifer simulation model and the synthetic data base. Will the evaluators (using analytical techniques) operate in a "blind" mode? We believe it is important for the evaluator to operate in this mode so that their evaluation will not be prejudiced by knowledge of input to the simulation model. However, it is important that the evaluator know

something about the basic boundary conditions that may be inferred from the geology as you note in your letter. Your answer to this third question is required before we can suggest which contractor should undertake Task 2, Subtasks A and B.

We foresee some basic problems in setting up this synthetic data base and in simulating the synthetic aquifer for subsequent evaluation. We believe that the selection of the model and the method in which the model will be run will influence heavily the success of this effort or the lack thereof. It is entirely possible that the model that is selected or the mode of simulation that is selected can make it impossible to evaluate the data using available state of the art, analytical techniques. In addition, the grid used for assigning aquifer coefficients (random or judgmental) must be conducive to simulating data that is amenable to the analytical techniques that must be used to interpret the drawdown test results. The time increments chosen for simulating test data must be compatible with the state of the art analytical techniques. The time increments are governed by the initial time and the multiplier used to increase the time steps in the model for transient conditions. The grid spacing near the test well and the observation well locations must be small enough to produce usable early time data for the analytical analysis of the simulated test data. Because of the above reasons, Williams and Associates, Inc. believe it is imperative that the selection of the model and the model setup for test simulation must be carried out jointly. The model(s) selected for conducting the study must be capable of producing early time drawdown data from simulated tests that are realistic with respect to field and theoretical conditions. The use of too coarse a grid, too large a time step, or a late time initiation of the simulation could create simulated data that are not conducive to evaluation by state of the art qualitative or quantitative methods. The coarseness of the grid and the length of the time step could eliminate the possibility of evaluating the data by any analytical or numerical inverse modeling techniques.

We have prepared a table of our recommendations for the completion of Tasks and Subtasks discussed in the following paragraphs. The table is appended to this letter. We believe that the investigation of the relationship of heterogeneity and anisotropy in a two-dimensional aquifer can be carried out by either Williams and Associates, Inc. or Daniel B. Stephens and Associates, Inc. We believe that Subtask 1A should be a joint effort in the determination of the parameters (coefficients) and boundaries, and the variability of the synthetic data base at the site. We believe that the selection of a computer code(s) (Subtask 1B) also should be a joint effort. We believe that Williams and Associates should prepare the test plan (Subtask 1C) using our knowledge of the geology and our professional judgment based on the basic information supplied by the creator of the synthetic data base. We concur with your assessment that Daniel B. Stephens and Associates, Inc. should create the field spatially correlated random properties of the hydrogeologic system in Subtask 1D. However the created field must be constrained to some extent so that it does not exceed the capability of available analytical testing methods.

Task 2 describes the use of the synthetic data base for performing a variety of steady-state and transient tests typical of those which might be performed at a site. Subtask 2A discusses the simulation of a number of single hole hydraulic tests while Subtask 2B describes the simulation of one or more large scale transient tests. We believe the assignment of these subtasks should be dependent upon whether the work is conducted in a "blind" mode. That is, should the evaluators using analytical techniques know before hand what distribution of hydrogeologic coefficients exists at the simulated site?

Task 3 describes the interpretation of the results of the pumping tests using the synthetic data base. We believe that Williams and Associates, Inc. should be assigned the subtask of analyzing the results of the small scale tests (Subtask 3A). We also believe that Williams and Associates, Inc. should be assigned Subtask 3B which involves the analysis of the results of the simulated large scale tests. We believe that it is very important that the group that analyzes the simulated data is the same group involved in Subtask 1C. These two critical parts of this investigation should not be separated by having one group perform one task while the other group completes the other Task. We believe that Subtask 3C should be assigned to Williams and Associates, Inc.; Subtask 3C involves the comparison of the results from the large scale and the small scale tests. We believe that Subtask 3D should be a joint effort wherein the attempt will be made to combine the fine grid data with large scale data for the purposes of simulating the large scale pumping test. We believe that Subtask 3E should be a joint effort. This subtask explores methods that will be used to test ways in which effective porosity can be measured from synthetic experiments.

Task 4 outlines the work involved in determining the paths of likely radionuclide travel and groundwater travel times based on data collected at the scale simulated using the synthetic data base. Subtask 4A describes the effort involved in the prediction of groundwater flow paths and travel times using a deterministic analysis based on professional assessment of the distributions of coefficients. We believe Subtask 4A should be conducted by Williams and Associates, Inc. Subtask 4B describes the prediction of groundwater travel paths and groundwater travel times using a stochastic Monte Carlo approach using completely random fields. We believe this subtask should be undertaken by Daniel B. Stephens and Associates, Inc. Subtask 4C calculates the "true" groundwater travel time using the synthetic data base. We believe that this effort could be conducted by Williams and Associates, Inc. although it also could be a joint effort. Subtask 4D describes the comparison of the deterministic groundwater travel times with the distribution of stochastically determined groundwater travel times and the true groundwater travel time. We believe this effort should be a joint product produced by Daniel B. Stephens and Associates, Inc. and Williams and Associates, Inc. A great deal of judgment will be required at this step because many of the groundwater travel times generated in the stochastic

distribution will not be realistic or defensible from a geologic point of view.

Task 5 describes the scoping of a continuation of this study for a three-dimensional case. We believe that Task 5 should be a joint effort conducted by Daniel B. Stephens and Associates, Inc. and Williams and Associates, Inc.

Please call if you have any questions regarding this letter. We have raised some questions as to the approach that will be used if this task is implemented. This is a complicated subject area; consequently early time subjective decisions will influence the outcome to a great extent. Please respond as soon as possible to these questions should you wish to pursue this task in a timely fashion. We will await your answer to these questions prior to contacting Nuclear Waste consultants and Daniel B. Stephens and Associates, Inc. regarding this task and subtasks.

Sincerely,

Roy E Williams/pl

Roy E. Williams

REW:sl

Table Listing Recommendations for the Completion of Tasks and Subtasks Related to the Simulation of a Hypothetical High-Level Waste Site

TASK	SUBTASK	W.&A.	D.B.S.&A.	Joint	?
1	A			X	
	B			X	
	C	X			
	D		X		
2	A				X
	B				X
3	A	X			
	B	X			
	C	X			
	D			X	
	E			X	
4	A	X			
	B		X		
	C	X	or	X	
	D			X	
5				X	

WM-RES

WM Record File 51020

WM Project 10, 11, 16

Docket No.

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