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Hydrogeology • Mineral Resources • Waste Management • Geological Engineering • Mine Hydrology  
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Mr. Jeff Pohle  
Division of Waste Management  
Mail Stop 623-SS  
U.S. Nuclear Regulatory Commission  
Washington, D.C. 20555

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Dear Jeff:

Please find enclosed a draft of our paper on the meaning of uncertainty in the prediction of groundwater travel time. I am identifying the paper as a draft because this subject is sufficiently controversial that I believe the very core of the subject should be debated by our other team members in the hydrogeological community before the draft is finalized.

I am confident that we have identified in mathematical format all the sources of uncertainty that are operative in the calculation of groundwater travel time via deterministic and deterministic-stochastic models. I am confident that this paper explains the controversiality of the use of the stochastic method in particular. I am of the opinion that this subject has not been addressed previously in the depth presented in the paper. We have laid out for the first time the true relationship between the geologic environment and the treatment of that environment stochastically. That has not been done in the literature to date. Most of the work that has been done on stochastic modeling has not questioned the true meaning of allowing hydrogeologic coefficients to vary in a model when in fact they are fixed in the geologic environment. The true meaning of correlation structure relative to the realities of the spatial distribution of existing geologic environments has not been addressed sufficiently in the literature. We attempt to address that subject in the paper. Scale of testing is related to this concept also and we attempt to address that issue in the paper.

The NRC is faced with some very challenging questions relative to the validity of treating hydrogeologic coefficients as variable as opposed to fixed. We know they are fixed in space, but all stochastic models treat them as variable from one computer run to the next. It is quite clear under this procedure that the uncertainty inherent in the use of the stochastic method itself will produce cumulative frequency distributions of groundwater travel time that do not include the real groundwater travel time.

We have attempted to present this paper from the point of view of geologists who are experienced in the spatial variability of hydrogeologic properties

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whose values are fixed at each point in space; but we have attempted to present this point of view in mathematical format. Most of the work that has been done has taken the reverse approach; that is the mathematics has been the primary focus and the geologic environment has been manipulated to fit the mathematics. This approach undoubtedly will seem strange to most of the individuals who have worked with stochastic models. Consequently I should warn you that the reaction of persons who have worked with the mathematics as opposed to the geologic environment may be negative. Regardless of that response, this paper explains in detail the essence of the meaning of the manipulation of the fixed hydrogeologic environment by stochastic procedures. Whether or not the NRC accepts the result of stochastic modeling as meaningful will have to be the subject of considerable debate and discussion. Clearly you will be under pressure by persons who have published papers on stochastic modeling to accept the results as meaningful whether they in fact can be shown to include the true groundwater travel time or not.

By way of background, the paper has been prepared by Dr. Kirk Steinhorst, our applied statistician; by Dr. Stan Miller, our geostatistician; by myself (a recognized hydrogeologist); and by Mr. Gerry Winter, a hydrogeologist. I should point out also that we have all learned a great deal through the in depth thought process that was required to produce this paper.

Sincerely,

*Roy Williams*

Roy E. Williams  
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Registered in Idaho

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