ACNWC-0033

APR 11 1995

PM

George M. Hornberger
308 Farm Lane
Charlottesville, VA 22902

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Dear Lynn and Bill,

Sorry that I'm a day late with my comments. I forgot to bring your FAX numbers home from the office last evening so wound up unable to send the FAXes last night.

I did one sheet with what I consider to be the three main points that I took from the discussions at the meeting last week. I did these in "bullet" form as requested and tried to keep them concise. Nothing earth shattering here and the points may not be of tremendous help, but I present them for what they are worth to you.

I had a few other observations. These are more "rambling" thoughts. I lsit these under "general comments" which you may or may not want to peruse. Let me know if there is anything else that I can do that might be of help.

Best regards,

George

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x 102.5

RSOZ
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Main points.

- In terms of the "defense-in-depth" strategy, the aim of NRC for licensing a repository for spent fuel and for high-level radioactive waste must be to provide a reasonable assurance that the geological barrier will be "effective" as judged ultimately by the performance of the repository. The aim should not be an absolute guarantee (which cannot be provided for *any* site) that *some* flow path, under *some* (extreme) assumptions will not have a ground-water travel time (GWTT) less than 1000 years.

- Uncertainties mandate that probabilistic calculations be made to define the GWTT. The 1000-year condition should not be applied to the tails of the distribution resulting from such a probabilistic calculation. The tails of these distributions are ill defined. Some measure related to central tendency of the distribution (the median?) should be used in the interpretation of the regulation. If the NRC determines that the 1000-year travel time is not acceptable under these conditions, the limiting GWTT should be increased until the median is an acceptable criterion, but a "worst-case" analysis that uses the tails of the distribution should not be accepted under any circumstance.

- The modelling efforts related to assessing the GWTT for Yucca Mountain must aim to address field observations -- residence times associated with measurements of concentrations of stable isotopes, in particular -- and not merely be hypothetical computations aimed at meeting the letter of the regulations. Calculations for long-term conditions involving geological repositories such as Yucca Mountain will always be highly uncertain. Reliance on calculations alone will remain an unconvincing stance to scientists and the public alike. It is imperative that the characterization and evaluation procedure for Yucca Mountain be integrated across disciplines and across modelling, laboratory and field studies.

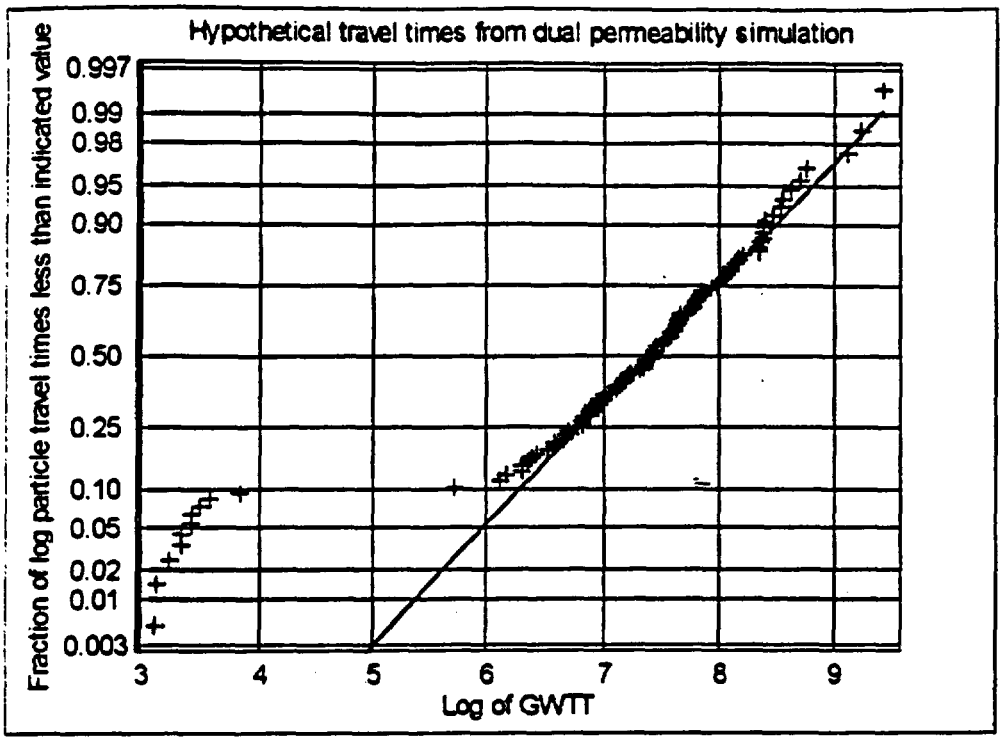
GENERAL COMMENTS

The GWTT provision for licensing (and for disqualification of the site as per DOE) is unfortunate. Now that we have the regulation, however, I believe that it is best to let it be and to deal with developing an acceptable interpretation of it. [This is similar to the experience in Sweden where the law demanded "absolute assurance" that a safe method of disposal be found before continuing in the 1970's. Although "absolute assurance" is a nonsense according to commonly accepted scientific philosophy, the Swedes proceeded with their program, making a working definition of "absolute" that was acceptable.] I do not see that removing the GWTT regulation now, or changing it explicitly to a flux-based standard would be beneficial.

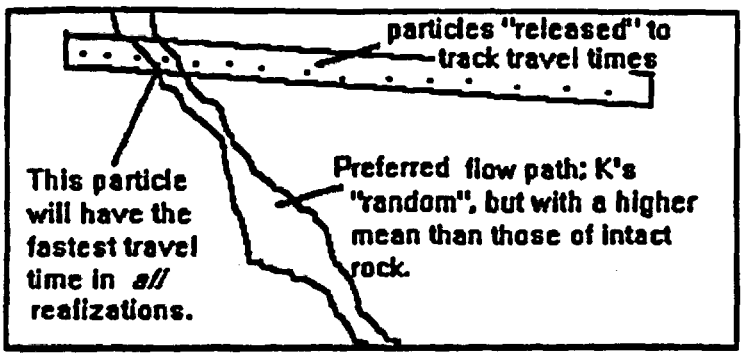
There are several technical issues that were presented by DOE that need to be evaluated. The proposal to fit a lognormal distribution to computational results for travel times and to extrapolate to a 1000-year GWTT should be scrapped. Extrapolation to the tail of a distribution is no more reassuring than the approach suggested by the NRC staff (as I understand it) to choose the absolute least GWTT from any given simulation and use the distribution of these values for a host of simulations. In any case, the use of the very uncertain values from extremes of a distribution is not a good idea.

I interpreted something that Jeff Pohle said at the meeting to be eminently sensible. (Of course, I'm not certain that my interpretation of what Jeff said is correct, but .....) My take on it is the following. The flow paths at Yucca Mountain are likely to fall into two categories: "fast" and "slow". The slow paths are all those for which a significant part of the flow occurs in the matrix. The fast paths are those for which a good part of the flow occurs through fractures. Barnard's presentation of (hypothetical) calculational results at the meeting illustrate this. Essentially, he had the "slow" particles with a GWTT of $6x10^6$ years and the "fast" particles having times lognormally distributed across 10^3-10^4 years. If we consider the "slow" times to be distributed across $5x10^5$-$5x10^6$ years, Barnard's probability plot (assuming 100 particles with 10 in the "fast" path and 90 in the "slow" path) would look something like the graph on the following page.

The essential point is that all of the "fast" GWTT's are "the same"; that is, the fast times are all much larger than the bulk of the times. This is the critical point that (I think) Jeff was making. [Note that the scale that I use stretches the "slow" times out to what they should be. This explicit recognition that the "slow" times are indeed very slow (and variable) helps illustrate (I think) that the fast times are all equivalent; Raleigh plotted all of the "slow" times at $6x10^6$ years so the "fast" times showed up as much more variable than the others when just the reverse is true.] Taking all of the fast GWTT's to be equivalent leads naturally to an interpretation of the GWTT requirement that the median (say) of all of the fast paths be less than 1000 years. This seems to me to be a sensible interpretation, to a large extent avoiding the problems of looking at the extremes of the distribution.



Having tentatively adopted the above interpretation, I must admit that there are some lingering concerns. First, suppose that the GWTT's for Yucca Mountain do not segregate into two classes. How can we identify the "fast" paths? In this case, Jeff's idea would not be easy to implement unambiguously. Perhaps the fastest 10% of the particle travel times could be used. This case would need more thought. Second, the travel-time distribution for a single realization (a single run of the model with a fixed set of parameter values) is not equivalent to a sample from some probability distribution; that is, the spatial distribution of conductivities is not random so the position from which a particle is released will have a deterministic component to its calculated trevel time. For example, suppose a fault zone cut through the repository as shown schematically below.



Hydraulic parameters for any realization would be chosen from probability distributions (conditional on position) and GWTT's for each particle would vary from one realization to the next. The fastest path in *any* realization, however, would always be through the fracture zone. In this case, one could argue that the NRC regulation should be interpreted as pertaining to the absolute fastest travel time. I would modify this argument, however, that DOE should circumvent this case with judicious engineering. Once the repository is constructed, fault zones can be identified and emplacement of waste in these zones can be avoided. In this way, such fault zones (or other preferred flow paths) are not "credible" paths for transport of nuclides. Nevertheless, NRC needs to be able to evaluate the fastest paths from a sequence of realizations, even though these values -- in and of themselves -- will not form the basis for the GWTT regulation.