

**Enclosure 6**

**Excerpt from Vieth, D.L., Letter to J. William Bennett on the subject of the NNWSI Project's response to the proposed 10 CFR 60 Unsaturated Zone Amendment (49 FR 5934); April 2, 1984.**

## ENCLOSURE 6

### QUESTION POSED BY THE NRC IN 49FR5937:

"Does groundwater travel time represent an appropriate measure of performance for a site within the unsaturated zone, or would an alternative performance objective... (e.g. maximum likely volumetric flow rate of groundwater through the geologic repository) be more appropriate?"

Because of the presumed greater uncertainties for unsaturated flow-time predictions, the NRC argues that this measure may have "questionable value in estimating the capability of the geologic setting to isolate HLW from the accessible environment." The conclusion is acceptable, but perhaps for a different reason.

Flow time, whether saturated or unsaturated, is a poor surrogate for measuring repository performance, which is evaluated according to limits to be set in 40 CFR 191 in terms of total curies released over 10,000 years. The amount of water moving past the waste sets a limit, independent of the flow velocity or flow path, on the maximum amount of curies that can be released from a repository and subsequently transported by water moving at any velocity toward the accessible environment. Thus flux is a much more direct, and therefore a much more satisfactory measure of the overall performance standard. The time required for a given number of curies to be released to the accessible environment depends more directly on the flux past the waste than on the flow time, and is independent of whether disposal is in the saturated or unsaturated zone. This is especially true considering that flow velocity also depends to a large extent on the flux through the flow system.

Thus, the answer to the question posed by the NRC on 49FR5937 is yes! Flux (volumetric flow rate of groundwater through the geologic repository) is a more appropriate measure of performance than flow time for a repository in the unsaturated zone. Further, it is a more appropriate measure for a repository in the saturated zone as well. It is recommended that the flow time requirement in the published final rule be modified to account for flux and that no distinction be made between saturated and unsaturated disposal.

If the NRC persists in retaining flow time as a surrogate measure for system performance, then the only possible logical conclusion is that such a measure is equally applicable to saturated and unsaturated disposal. If different measures are set for the two disposal regimes, the NRC will commit an error in logic that cannot be defended in terms of the reason for the requirement. The NRC has already justified the 1000 year flow time requirement on the basis that such a flow time will provide an independent barrier to ensure that no releases occur until the fission products have decayed to insignificant levels. This barrier is intended to supplement the requirement for a 300 to 1000 year waste package, thus providing two redundant and independent approaches to ensuring complete isolation during the time when the fission products are dominant. A presumed difficulty (i.e., higher uncertainty) in characterizing this measure in the unsaturated zone (a questionable assumption as pointed out above) is not a logical reason for abrogating that requirement for unsaturated zone disposal. The espoused performance objective (an independent site barrier to ensure complete isolation until the fission products have decayed) is independent of the disposal concept, thus the surrogate measure for that objective should also be independent of the disposal concept.

In summary, flow time should be replaced by flux as a more direct and appropriate measure of system performance, both for saturated and unsaturated disposal environments. If flow time is retained as a performance measure for saturated disposal, it should also be retained for unsaturated disposal to maintain logical equivalence for both regimes. For the unsaturated zone, total travel time must include travel times for both the unsaturated and saturated portions of the flow path to the accessible environment. In drawing these conclusions, it is recognized that it might jeopardize the opportunity to at least modify the NRC's regulations toward a more rational approach for unsaturated zones while leaving saturated zone disposal to cope with the 1000 year flow time requirement. However, there is no discernable, defensible reason to treat the two zones differently in terms of overall performance objectives. Flow time is flow time and flux is flux; the percent saturation in the rocks in which they occur is not important.