JUN 26 1980

NOTE TO: Document Control
Room 016

FROM: Thomas J. Nicholson
SSSB/SHSS/OSD NL-5650

Please place the attached document in the PDR using the following file and file points:

PDR File (Select One)		Related Documents (Enter if appropriate)	
Proposed Rule (PR)	10 CFR Part 60	ACRS Minutes No.	
Reg. Guide		Proposed Rule (PR)	10 CFR Part 60
Draft Reg. Guide		Draft Reg. Guide	
Petition (PRM)		Reg. Guide	
Effective Rule (RM)		Petition (PRM)	
		Effective Rule (RM)	
		Federal Register Notice	May 13, 1980
		SD Task No.	SS 809-1
		NUREG Report	
		Contract No.	

Subject: Public Comment on Hydrologic Criteria in the Technical Support Documentation for the Siting Requirements in USNRC 10 CFR Part 60 - Disposal of High-Level Radioactive Waste in Geologic Repositories.

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JUN 26 1980

MEMORANDUM FOR: Patricia Comella, Chief
Site Designation Standards Branch

THRU: Leon L. Beratan, Chief
Site Safety Standards Branch, SD

FROM: Thomas J. Nicholson, Hydrogeologist
Site Safety Standards Branch, SD

SUBJECT: TRANSMITTAL OF PUBLIC COMMENT LETTER ON THE "TECHNICAL SUPPORT DOCUMENTATION FOR THE SITING REQUIREMENTS IN USNRC 10 CFR PART 60"

I have received a copy of a letter from Professor Irwin Remson of Stanford University to Mr. L. B. Myers of ONWI-Battelle dealing with his technical comments on the "Technical Support Documentation for the Siting Requirements in US NRC 10 CFR Part 60 - Disposal of High-Level Radioactive Wastes in Geologic Repositories." Please find attached a copy of that letter. Professor Remson's comments have been noted and will be forwarded by this memorandum to the Division of Waste Management and the Public Document Room. The comments will be retained for review during the rewriting of the Technical Criteria of 10 CFR Part 60.

POOR ORIGINAL

Thomas J. Nicholson, Hydrogeologist
Site Safety Standards Branch
Office of Standards Development

Attachment:
As stated

cc: I. C. Roberts, SD
J. Martin, NMSS
M. Bell, NMSS
L. White, NMSS
G. Robbins, NMSS

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SD Task No. SS 809-1

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June 18, 1980

Mr. L.B. Myers
ONWI
Battelle
505 King Avenue
Columbus, Ohio 43201

Dear Mr. Myers:

Some very serious hydrologic errors in the "Technical Support Documentation for the Siting Requirements in USNRC 10 CFR Part 60 - Disposal of High-Level Radioactive Wastes in Geologic Repositories" overshadow all other aspects of the document. These errors have resulted in the preparation of an "Advance Notice of Proposed Rulemaking" that sets up unnecessary requirements and misses the essential requirements.

It should be emphasized that this erroneous information did not come from the regular refereed hydrologic literature. Rather, it came from inexcusable verbage that has been allowed to creep into print in sources other than the regular refereed hydrologic literature as referenced on page 3-6.

First let me describe the erroneous information and erroneous thought trends in these documents:

Page 6-9 discusses "permeability" values as low as 10^{-10}cm/sec. I have seen even lower values in non-refereed literature. First of all, if the units are cm/sec, the correct terminology should be "hydraulic conductivity". When such numbers are substituted into the flow equations at normal groundwater gradients over very long periods of time, they can predict objectionable radionuclide transport to the biosphere. Therefore, it appears to the uninitiated that "Regardless of host rock permeability and depth, there is sufficient time for groundwater to penetrate the repository and return biologically significant radionuclides to the accessible environment." (Page 1-4). As a cnsequence, groundwater containment cannot be counted on and "Performance studies and sensitivity analyses indicate, over the long term under reasonable conditions, it is primarily the geochemical system that will determine the rate of release of radionuclides to the accessible environment,. . ." (Page 3-6). Because of uncertainties about the geochemical system, it is therefore essentially impossible to prove containment. The result has been the specification of unnecessary testing and requirements while the truly important ones are not mentioned. Fortunately, this is completely wrong!

When there is a linear relationship between groundwater discharge and gradient, the flow regime is said to be "Darcian". Hydraulic conductivity is the constant of proportionality, and the relationship is Darcy's Law. Darcy's Law and the commonly-used transport equations apply only when the flow is Darcian. In the case of a nuclear repository site, the fluid flow regime will be non-Darcian because of the low permeabilities of the host rocks. In fact, if Darcian flow can occur in a geologic material, that material is too permeable for use as a repository host rock.

As mentioned, "hydraulic conductivity" values of 10^{-10}cm/sec and smaller are reported from studies of potential repository host rocks. If very large time frames are used, solution of the transport equations may predict objectionable radionuclide transport to the biosphere even for these low values of "hydraulic conductivity." However, such low values of "hydraulic conductivity" indicate the presence of materials sufficiently impermeable to preclude Darcian flow. Therefore, these computations are completely without meaning. They are not even approximations. They are totally worthless.

I have read of laboratory experiments in which the ends of cores of dense unfractured granite or salt are subjected to pressure differences of 250,000 psi. After some time, water is driven through the core. Using Darcy's law, "hydraulic gradients" of 10^{-10}cm/sec or there about are computed and reported. Subsequently, people use such "hydraulic conductivities" under normal groundwater gradients of say 0.001 to predict significant groundwater transport over long periods of time. Again, this is completely wrong.

The water that passed through the core was not subject to Darcian flow. A value of 10^{-10}cm/sec is not hydraulic conductivity. Because Darcy's law does not apply, there is no linear relationship between flow and gradient. Therefore, that number can only be used at the experimental head gradient of 250,000 psi per core length. If it takes 250,000 psi differential to move water through the core, the water is not moving through capillary cores. It must be moving through spaces of subcapillary size and against tremendous adsorptive force fields. Almost certainly a large threshold gradient is needed to move water molecules against such forces. In short, it is likely that a rock that tests at 10^{-10}cm/sec under such huge gradients will have a zero transport rate under a field gradient of 0.001.

The other problem with the laboratory core is that it is likely to miss joints and faults. Thus, for fractured impermeable rocks, the laboratory tests can seriously underestimate transport. Fortunately, the answer to this is simple. Before emplacement of canisters in repository cored holes, the cored holes can be pressure tested at non-destructive pressures. If a test results in a "hydraulic conductivity" of say 10^{-10}cm/sec, two things are apparent. First, there are no open fractures that are conducting significant amounts of fluid. Second, the transport to the biosphere under normal field gradients over the 1,000 year specified transport period is zero because the flow is "sub-Darcian".

In conclusion, the hydrology can do the containment job especially for a period as short as 1,000 years. Second, with the geochemistry as a backup, the transport problem is tractable over the short design periods now specified.

Sincerely yours,

Irwin Remson

Irwin Remson
Professor

IR:rh

cc: Dr. R.B. Laughan
Mr. Thomas Nicholson
GRG Committee
Professor Krauskopf