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JUL 11 1984

Mr. Samuel J. Chilk
Secretary of the Commission
Attention: Docketing and Service
Branch
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Chilk:

The Department of Energy submitted comments on the proposed amendment to 10 CFR Part 60 for disposal in the unsaturated zone in a letter to you dated April 16, 1984. In that letter, the Department indicated it would provide a suggested alternative performance objective, related to the geologic setting for sites located in the unsaturated zone, by separate letter after the close of the public comment period.

This letter transmits the proposed alternative performance objective and the Department's rationale for the proposed performance objective.

As indicated in the Department's letter dated April 16, 1984, we are available to meet with the NRC concerning the previously transmitted comments or the enclosed material.

Sincerely,

Ben C. Rusche, Director
Office of Civilian Radioactive
Waste Management

Enclosures

Acknowledged by card.....

RATIONALE FOR PROPOSED ALTERNATIVE PERFORMANCE OBJECTIVE

As noted in the DOE comment letter to the NRC dated April 16, 1984, Dames & Moore concluded in NUREG/CR-3130 that the flux and the frequency of wetting events were the primary factors in determining releases from wastes disposed in the unsaturated zone. DOE stated that ground-water travel time does not represent an appropriate measure of performance for a site within the unsaturated zone and that the flux through the repository, both in the unsaturated and saturated zones, is a more appropriate and direct measure of potential cumulative releases to the accessible environment.

Accordingly, DOE has given considerable effort toward developing a proposed performance objective based on flux through a repository located in the unsaturated zone. Although this effort has reinforced the understanding that flux is the primary factor in determining releases from wastes disposed in the unsaturated zone, DOE has concluded that it is impractical to specify a minimum amount of flux or to otherwise define a performance objective for the geologic settings based on the flux through the repository. A determination of flux will be necessary, however, to demonstrate compliance with the EPA Standard.

As a result, DOE reviewed the NRC rationale for the performance objective specifying that the fastest likely path of radionuclide travel to the accessible environment shall be at least 1000 years or such other travel time

as may be approved or specified by the Commission. This performance objective can be interpreted as specifying a minimum time before release of radionuclides to the accessible environment. DOE concludes, based on this review and interactions between NNWSI Project staff and the NRC staff, that satisfying this performance objective is meant to provide an independent and redundant barrier to the engineered barrier system during that period of time when the wastes are most hazardous (46 FR 130, p. 35281). DOE notes that, for sites located in the unsaturated zone, this same effect may be derived, either in whole or to a large extent, from the creation of a drying zone around the underground facility during the period of the heat pulse. Therefore, the concept of a minimum time for release of radionuclides to the accessible environment forms a reasonable basis for a site performance objective for the unsaturated zone and is a more appropriate performance objective than ground-water travel time for the unsaturated zone.

The emplacement of radioactive waste canisters within an unsaturated zone repository leads to a situation wherein the heat generated by the wastes as they decay causes the moisture in the rock surrounding the waste canisters to migrate away from the waste canisters. Preliminary numerical modeling of this phenomenon[1] indicates that this migration creates a zone around the

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[1]B. Travis, H. Hudson, T. Nuttall, T. Cook, and R. Rundberg, 1984, "Preliminary Estimates of Water Flow and Radionuclide Transport in Yucca Mountain," LA-UR-84-40 (in Review), Los Alamos National Laboratory, Los Alamos, New Mexico.

canisters, extending for a few tens of meters in which there is no water available to either corrode the canisters, dissolve the wastes, or transport any radioactive material. The drying phase for a saturated zone repository is expected to last several hundred years before resaturation is complete (NUREG-0804). In an unsaturated zone repository, the time required for moisture to return to the waste packages is expected to be even longer because the rock will return to initial conditions primarily through capillary effects.

A site performance objective for the unsaturated zone, based upon the minimum time for release of radionuclides to the accessible environment, must consider four separate physical events. The first event is the creation of the drying zone. The second event, which is closely related to the creation of the drying zone, is the subsequent return of moisture to the rock surrounding the waste canisters. These two events encompass a time during which no water is available to either corrode the waste canisters, dissolve the waste material, or transport radionuclides to the accessible environment. The third event important to the release of radionuclides to the accessible environment is the transport of radionuclides in the unsaturated zone. Finally, the radionuclides are transported to the accessible environment by ground water movement in the saturated zone.

The minimum time for release of radionuclides to the accessible environment is the sum of times required for each of the four events because they are temporally sequential. The minimum time for release of radionuclides to the accessible environment for an unsaturated zone repository is thus the

sum of the time during which a drying zone exists around the waste canisters, the time it takes for the dry rock to return to initial moisture conditions, the time for ground water to travel through the unsaturated zone and the time for ground water to travel through the saturated zone to the accessible environment.

It is not inconceivable that the time for drying added to the time for return to initial moisture conditions could encompass the total 1000 year period required for fission products to decay to insignificant levels. When all four time components are added together, significantly higher confidence in protection of public health and safety is obtained than if only the time when radionuclides are actually moving were considered.

The NNWSI Project site characterization activities include studies of the drying phenomenon. In addition to the previously mentioned study of radionuclide transport and the formation of the drying zone, other numerical studies which model the physical responses, in the unsaturated zone, to the emplacement of waste canisters and heat are underway. In situ tests to obtain information about moisture migration in response to thermal loads are planned for the exploratory shaft. These tests include bulk permeability tests, canister scale heater experiments and waste package tests. The waste package tests are reduced scale but are designed to specifically investigate moisture conditions, particularly moisture movement during thermal and post thermal periods of storage. High frequency electromagnetic, ultrasonic and neutron methods are to be used to establish the moisture content in the area

surrounding the simulated canister before and after thermal cycling and to monitor fluid movement during the experiments. These activities should provide the necessary and sufficient information to support demonstration of compliance with the proposed alternative performance objective.

PROPOSED ALTERNATIVE PERFORMANCE OBJECTIVE

DOE proposes that Section 60.113(a)(2) be revised to Section 60.113(a)(2)(i) and a Section 60.113 (a)(2)(ii) be added as follows:

For a geologic repository located in the unsaturated zone, the minimum 1000 year travel time to the accessible environment shall include the time of existence of the drying zone around the emplaced wastes, the time required for rewetting to initial moisture conditions, the time of travel through the unsaturated zone, and the time of travel through the saturated zone.