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December 7, 1988

Mr. John J. Linehan
Project Management and
Quality Assurance Branch
Division of High-Level
Waste Management
U.S. Nuclear Regulatory Commission
Mail Stop 4-H-3
Washington, D.C. 20555

Dear Mr. Linehan:

This office has completed its review of the NRC Draft Generic Technical Position titled "Draft Technical Position on Postclosure Seals in an Unsaturated Medium". Our general and specific comments are attached.

In general, it is our opinion that this GTP is an unnecessary exercise, as the performance objectives regarding postclosure repository seals, as contained in 10 CFR Part 60, appear to constitute adequate, guidance to an applicant for a repository license. Furthermore, the Draft GTP does little more than review the relevant sections of 10 CFR Part 60, and respond to the fact that the potential applicant is considering a drainage system, intended to function in association with postclosure seals. It should be the applicant's responsibility to apply the NRC's performance objectives to the specific conditions of the site and any design approaches it chooses to employ.

This Office would be pleased to meet with the NRC to discuss, clarify, or amplify any of our comments.

Sincerely,

Robert R. Loux
Executive Director

RRL:CAJ:ps

cc: Mr. Paul Prestholt, U.S. NRC

enc.

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STATE OF NEVADA
COMMENTS

ON

UNITED STATES NUCLEAR REGULATORY COMMISSION

DRAFT GENERIC

"TECHNICAL POSITION

ON

POSTCLOSURE SEALS IN AN UNSATURATED MEDIUM"

DECEMBER 7, 1988

GENERAL COMMENTS

1. The GTP provides little guidance or insight into how the NRC will review the performance assessment and design of the borehole, shaft, ramp and underground facility seals at Yucca Mountain. The entire document could be summarized as follows: "The seals should be designed and analyzed such that the performance objectives of 10 CFR Part 60 will be met, and the portions of 10 CFR Part 60 that the staff considers relevant to the topic of seals are appended." It might be most efficient to announce this position to the potential applicant in a memo which could include the additional points described below.

2. The regulations, 10 CFR Part 60, provide performance objectives for the design of seals, but they do not contemplate the need of additional performance objectives for the design of an effective drainage system. The GTP, and DOE reports on seals for the Yucca Mountain site, emphasize incorporation of a drainage system in the repository. In reviewing the GTP, one gets the impression that the NRC staff considers seals and drainage systems to act together as a barrier, protecting against loss of waste isolation. If the belief is that the regulations are deficient, perhaps the GTP should include any additional guidance, in the form of criteria and objectives the staff believes necessary if a drainage system is to be considered part of the engineered barrier.

3. While the GTP is presented as a generic document, it is quite obviously written within the context of a potential license review of the Yucca Mountain site, and is responsive, at this early date, to the potential applicants apparent interest in incorporating a drainage system in conjunction with postclosure seals. Having gone this far, it would seem reasonable that the GTP recognize the matter of known fault and fracture zones transecting the repository block, serving as potential pathways for waste migration, and attempt to address this situation in relation to postclosure repository sealing.

4. The concept of regionally sealing (and draining) the repository as a contribution to waste isolation is disturbing, in the limited context of what is currently known about Yucca Mountain geohydrology. Nevada recommends that seals for shafts, ramps, and the underground facility (and drainage systems) not be relied upon for any contribution to waste isolation, but rather, if appropriate, be considered as a factor of safety if they are to be installed in the repository. It should also be emphasized that there is a real possibility that, for a number of reasons, emplacement of postclosure seals (and drainage systems) may create conditions adverse to waste isolation assessment. For this reason, any proposed sealing (or drainage) approach must be fully evaluated during the site characterization period, and addressed as an element affecting system performance in a license

application review.

5. All boreholes must be plugged prior to being abandoned, however, borehole sealing for purpose of meeting waste isolation objectives is essentially an untried technology. It is probably inevitable that, during site characterization, some boreholes will be drilled in locations and to depths that result in the requirement that they be effectively and permanently sealed. The GTP should clearly address this issue and announce the expectation that it be fully resolved by the DOE prior to the time a license application is submitted Do the NRC for its evaluation.

SPECIFIC COMMENTS

Notwithstanding Nevada's position that this GTP on Postclosure Seals in an Unsaturated Medium is unnecessary in relation to the stated performance objectives of 10 CFR Part 60, the following are some specific comments we have regarding the draft text.

Page 1. 3rd paragraph

There is a basic dichotomy between the requirement that the seals and drainage design should ensure that drainage pathways for uncontaminated water would not enhance flow of contaminated water towards the water table and the last sentence in Pg. 1 par. 4 which state uncertainties should be considered. To ensure means to make certain, i.e. without the possibility of failure. Although a change in wording might appear to help this situation there is still the fundamental problem of reasonably demonstrating how any drainage design will function over the entire postclosure period. The problem is compounded when any engineered drainage design is superimposed upon the extensive natural drainage from the active faults that the system already possesses. Likely perturbations in the stress field during the next 10,000 years makes the problem even more complicated. Furthermore, the identification of water that flows through the repository horizon as contaminated and uncontaminated will become more and more speculative through time during the postclosure period.

Page 2. 2nd paragraph

It is stated that "the staff has recognized that large uncertainties are likely to persist in evaluating the longevity and long-term effectiveness of seals and drainage for the postclosure period." This statement again conflicts with the position that the DOE should ensure that drainage pathways for uncontaminated water would not enhance flow of contaminated water toward the water table as stated on pg. 1, par. 3.

Page 2. 5th paragraph

Statement: "This technical position does not explicitly address the implications of potential changes in water level during the postclosure period. However, it is expected that sealing performance analyses and requirements will include adequate consideration of credible future tectonic, geologic, geomorphological, and geochemical processes and events that could affect seal performance".

Performance analyses of the thermal effects of HLW on the seals should also be emphasized.

Page 3. Paragraphs 2
Page 5. Section 4.1(1)

The GTP should not even speculate as to whether or not site sealing is important to waste isolation. It should assume that to be the case, and shaft, ramp, borehole and underground facility sealing should be included on the DOE Q-list, without question, from the outset.

Page 3. Section 3.1(3)
Page 6. Section 4.1(3)

In reading the NRC's technical paper, concern is raised with respect to the proposed "drainage" design at the site. If the paper is referring to surface drainage design, then it can be agreed without question that the mine openings (shafts and ramps) should be designed to prevent or greatly hinder water intrusion via surface flooding or infiltration. But to expect to greatly control or manipulate the groundwater migration pathways is not prudent from an engineering standpoint.

Page 3. Section 3.1(5)

Evaluation of seal materials and placement methods will require the same level, of experimentation and testing as required for evaluation of the native rock material. This should be an extensive program if one is to consider coupled systems whose performance is to be evaluated over a 10,000-year time frame.

Page 3. Section 3.1(5)
Page 7. Section 4.1(5)

The placement of seals and plugs within the repository proposed at Yucca Mountain can have both positive and negative impacts. In some cases, seals may hinder hydraulic transport where desired (i.e. waste emplacement areas); but due to the extremely fractured heterogeneous environment, water may simply travel through zones around the seals, rendering then virtually useless. Another aspect of seal placement that should be addressed is the

blockage of existing water pathways that may, in turn, cause a pressure head to form at the point of blockage. Over time, this head can cause structural damage to the seals or force new pathways of transport around the seals.

Page 3. Section 3.1(5)
Page 7. Section 4.1(5)

Since it is very difficult, if not impossible, to accurately predict the very long-term behavior of seal materials and because, as previously discussed, it may not be possible to confirm the performance of a seal during the allotted assessment period, it would seem prudent not to rely on seals for any contribution to waste isolation.

Page 4. Section 3.1(6)

It is implied that an analytical solution without any empirical data can be used to demonstrate that the performance objectives can be met for any unsealed boreholes. Such a means of demonstration should not be acceptable.

Page 4. Section 3.2(1)

It should not be too difficult to place the shaft or ramp and associated structures so that surface runoff is essentially eliminated as a potential source of water into the repository.

Page 4. Section 3.2(1)

Ramps are not currently considered part of the site characterization process.

Page 4. Section 3.2(2)

Limitation of boreholes is a two-edged sword. The more boreholes, the higher the potential to compromise the site, however, it will be necessary to have a sufficient number of boreholes to obtain spatial resolution for characterizing the repository block.

Page 4. Section 3.3(1)

The requirement for real data for the minimum seal design is absolutely necessary if any of the overall system performance assessment evaluation is to be seriously considered in the license application. Inherent in the performance assessment is the basic concept that the seals will not provide accelerated pathways to the accessible environment. If DOE is relying on the repository design and characteristics of the tuff to provide long travel times, then they must be able to demonstrate that the seals will function as designed.

Page 5. Section 3.4(1)

This paragraph raises the question as to when the methodology for predicting long-term behavior has to be developed. If performance confirmation is required prior to license application as suggested by the previous paragraph then the methodology should be required to be in place before initiating any construction on any kind of opening that will require sealing.

Page 5. Section 3.4(1)

Water has a surprising ability to move through low-permeability rocks, especially at slightly elevated temperatures, above 100 °C, at which the viscosity of water is low. Examining accomplished work in published literature would reveal the kinds and intensities of water penetration under shallow crustal conditions.

A reservoir of information is in engineering records, particularly of dams and undersea tunnels. For example, flow takes place at low temperature (20-40 °C) and low pressure gradients (deltaP = 1-20 atmosphere) in grouted rocks of the Seikan undersea tunnel situated 100 meters below the sea bottom.

Page 5. Section 3.4(2)

Consideration should include the disturbed zone around all openings.

Page 5. Section 3.4(2)

There is a high probability that seals would be affected by expectable physical geologic processes, such as strong seismic shaking, which could pull seals apart from rock surfaces.

The possibility that groundwater will be able to penetrate the repository must be faced in a worst-case scenario. The flow could affect the seals physically (washing out clays at boundaries) or chemically (dissolving seal constituents, reacting with repository components and with released waste elements).

Page 5. Section 3.4(4)

Sealing by backfill, packing, and grouting might work on a short time basis, that is, for one hundred years or less (engineering time scale), but should not be relied upon for 1,000 to 100,000 years (geological times).

Page 6. Section 4.1(2)

Any selected construction method that can cause excessive damage to the surrounding rock should not be used unless there is no

alternative and then only if there is acceptable technology available to define the physical extent of the disturbed zone.

Page 6. Section 4.1(3)

In an active tectonic environment such as Yucca Mountain it will be extremely difficult to develop a long-term drainage system that would always allow the water to drain away from the waste emplacement area.

Page 6. Section 4.1(3)

Statement: "Drainage through the rock mass may initially be sufficient to prevent and adverse effect on waste isolation. To assess if the drainage will remain sufficient to meet the long-term design criteria, the drainage capacity over an extended period should be evaluated. Experimental as well as analytical methods should be used to assess the long-term effectiveness of the drainage system in meeting the design criteria."

The DOE should be compelled to describe the experiments pertaining to the assessment of the drainage system in the SCP. The current version, the CD-SCP, does not mention any experiments that assess the drainage from the repository horizon.

Page 8. Section 4.2(2)

The statement is made that only the number of boreholes required for obtaining information needed for site characterization should be planned. This is a nice policy statement but it needs to be more specific. How is the determination made? By whom and when? What constitutes too many boreholes or too few?

Page 9. Section 4.2(3)

A statement needs to be added to the effect that the program for seal design and testing should be developed and in place prior to shaft sinking or borehole emplacement in the immediate repository vicinity.

Page 9. section 4.3(1)

There is no basis at this time for the statement that data available when the license application is submitted are likely to reduce uncertainties in predicting the performance of seals during the postclosure period.

Page 9. Section 4.3(1)

Where is the testing to take place relative to the repository? If the evaluation is supposed to provide reasonable assurance of functionality in the anticipated range of seal environments then

a good share of the data must come directly from the repository block.

Page 9. Section 4.3(3)

The effectiveness of any engineered system cannot be ensured (guaranteed not to fail) particularly if a major part of the system is natural. Therefore, the requirement should be to demonstrate that the performance requirements can be met without taking into consideration the long-term effectiveness of seals.

Page 10. Section 4.4(1)

Confirmation testing of seal performance needs to be initiated at the earliest possible time after an acceptable site characterization plan has been developed.