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Originated by:
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NOV 13 1986

Ralph Stein, Director of Engineering and Geotechnology Division, DOE/HQ
(RW-24), FORS

NEVADA NUCLEAR WASTE STORAGE INVESTIGATIONS PROJECT COMMENTS ON "DRAFT GENERIC TECHNICAL POSITION, INTERPRETATION AND IDENTIFICATION OF THE EXTENT OF THE DISTURBED ZONE IN THE HIGH-LEVEL WASTE RULE (10 CFR 60)" (JUNE 10, 1986)

Your August 26, 1986, letter requested comments on the subject Generic Technical Position (GTP). Our comments are enclosed (Enclosure 1). Alan Jelacic also requested that we comment on proposed Office of Geologic Repositories (OGR) responses to the GTP. Victor Montenyohl (Weston) discussed the responses at the Geosciences Coordinating Group Executive Committee meeting held in Denver, Colorado, on October 1-2, 1986. Our comments on the responses (Enclosure 2) generally repeat the concerns we expressed at the meeting.

Like the previous draft, this GTP will not significantly affect the work presently planned for our program. The GTP basically directs us to determine the extent of the disturbed zone on a site-specific basis, which we plan to do. However, we have reviewed this draft more thoroughly than the previous one and identified some problems that you may want to discuss with the Nuclear Regulatory Commission (NRC).

The GTP is well written; its points are stated clearly and concisely. However, in our view, the GTP seriously departs from 10 CFR 60 and support for its conclusion that the disturbed zone extends, at the minimum, 50 meters from the repository, is weak.

The definition of the disturbed zone in the GTP departs from the definition in 10 CFR 60.2. The departure is so significant that we doubt that NRC could justify a 50 meter disturbed zone if it had based the GTP upon the 10 CFR 60 definition of disturbed zone. The GTP defines disturbed zone as the zone where physical and chemical changes significantly affect the intrinsic properties of the rock. In contrast, 10 CFR 60 defines disturbed zone as the zone where physical and chemical changes significantly affect repository performance. Effects on rock properties are all relative and not well-defined. Effects on the repository's performance are absolute because the level of performance is well-defined in the regulations. We prefer to gauge a disturbed zone against well-defined criteria and suggest that you request that NRC use the 10 CFR 60 definition. Unlike regulations, compliance with technical positions issued by the NRC is not mandatory. We recognize that failure to incorporate the guidance found in technical positions will complicate our demonstration of compliance. When faced with apparent inconsistencies between a regulatory

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requirement and its associated guidance; however, we feel we must rely on the regulation itself, and the documented considerations supporting the regulatory requirement.

Consequently, our comments, as outlined below, address both what we feel to be a lack of logic in the regulation itself, and the departure of the "Disturbed Zone GTP" from the provisions of the regulation as it now exists.

The GTP repeats some old arguments from the NRC's for having a disturbed zone. We, in turn, have repeated our arguments for not having a disturbed zone. The GTP contemplates extensive studies within the disturbed zone. We question the value of these studies when we cannot use the information to assess ground-water travel time or predict the repository's performance. Our basic argument however, is with 10 CFR 60. The "Disturbed Zone" GTP, and the GTP about Pre-emplacement Ground-Water Travel Time, further compound what we believe to be a mistake in logic by the NRC in linking the Disturbed Zone to the Pre-Waste Emplacement Ground-Water Travel Time. We urge you to continue trying to get NRC to consider correcting this illogical linkage. Although the Disturbed Zone is defined in terms of performance assessment (i.e., releases of radionuclides to the accessible environment) it is only used for one thing - a starting place for calculating the pre emplacement Ground-Water Travel Time. For this calculation to be meaningful it should represent the rock conditions applicable at the time for which the calculations are meant to be representative. During this time period those rock conditions that have been disturbed only result from excavation, not heat from canisters, etc. Rock features that are likely to change during excavation that could impact Pre-Waste Emplacement Ground-Water Travel Time include porosity, permeability, and stress. The rock that will be studied during the testing phase of the exploratory shaft will be the best characterized and most understood rock anywhere within, or beyond, the repository. If we measure changes in rock properties that are limited to within only a few centimeters from the drift wall by these tests, then we will have ample evidence that the changes are minor, or nonexistent, farther out.

In summary, to start the Pre-Waste Emplacement Ground-Water Travel Time from the edge of a Disturbed Zone which is defined in terms of performance (i.e., "such that the...change of properties may have significant effect in the performance of the...repository") is highly illogical. If 10 CFR 60.113(2) is to have any true meaning, then the Pre-Waste Emplacement Ground-Water Travel Time calculation should start from a boundary established by pre-waste emplacement conditions which have been verified by in situ experiments during the exploratory shaft phase of the program. The definition of the Disturbed Zone should be revised to delete the reference to performance.

If you have any questions on these comments, please contact Jerry S. Szymanski of my office.

Original Signed By
M. B. Blanchard

for Donald L. Vieth, Director
Waste Management Project Office

WMPO:JSS-155

NOV 13 1986

Enclosures:
1. Comments on GTP
2. Comments on UTCG

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NNWSI Project Comments on

Draft Generic Technical Position (GTP):

Interpretation and Identification of the Extent of the Disturbed Zone in the High-Level Waste Rule (10 CFR 60)

1. Page 4, 2.0 Rationale behind the "disturbed zone," paragraph 3

The GTP states,

"The staff considers that the natural geologic barriers at a given site should not be permitted to depend exclusively or predominately on the favorable properties of the host rock directly adjacent to the underground facility."

The GTP makes a similar statement on page 6,

"...the zone directly adjacent to the underground facility should not be depended upon to provide the major portion of natural barrier protection from HLW releases to the accessible environment."

We assume that the zone immediately adjacent to the underground facility (adjacent rock) is not the same as the disturbed zone. If we are wrong, NRC should explain why it distinguishes the adjacent rock from the disturbed zone. The quotations state that we cannot depend exclusively or predominately on the adjacent rock to reduce releases. As a corollary, we assume that we can take some credit for the adjacent rock as long as it is not exclusive or predominate. In any event, the adjacent rock or as we view it the underground structure is by definition in 10 CFR 60.2, part of the underground facility. Thus, it is not clear how we could remove the adjacent rock from the underground facility...for the purpose of calculating releases...when NRC regulations treat them as one. We suggest that NRC clearly state whether we can take credit for some portion of the adjacent rock when calculating the release rate from the engineered barrier system (EBS). (The EBS, according to 10 CFR 60.2, includes the waste package and the underground facility.)

2. Pages 6-7, 3.0 Interpretation of the "disturbed zone" definition

In its regulation, 10 CFR 60, NRC describes the disturbed zone as the zone where changes in physical or chemical properties, "...have a significant effect on the performance of the geologic repository" (10 CFR 60.2).

In the GTP, however, NRC defines the disturbed zone as,

"...the zone of significant changes in intrinsic permeability and effective porosity..." (page 7, last paragraph).

The GTP goes on to discuss (1) the processes that could cause significant changes in rock properties and (2) the changes in rock properties that could be considered significant.

The GTP does not discuss the rock property changes with regard to the performance of the repository. That is, 10 CFR 60 states that the disturbed zone is "that portion of the controlled area the physical or chemical properties may have a significant effect on the performance of the repository." This GTP assumes that, for defining the disturbed zone, the "performance of the repository" has to do primarily with ground water travel time. Two questions then arise in determining when the hydrologic properties have been significantly altered: Should significant changes in the hydrologic properties be identified only along the fastest path of likely radionuclide travel? Or should the calculation of significance be based on the average hydrologic properties of the rock through which which ground water could travel to the accessible environment?

We also see a disconnect between the definitions of disturbed zone in 10 CFR 60 and in the GTP. 10 CFR 60 describes disturbance in an effective sense i.e., its influence on the performance of the repository. The GTP describes disturbance in a relative sense i.e., changes in the intrinsic rock properties of a particular amount. The repository's performance is well defined in the regulations, but changes in rock properties are not. In fact, changes in rock properties are all relative and may never be clearly defined. Thus, we believe that 10 CFR 60 offers a more concrete definition of the disturbed zone.

3. Page 8, 4.0 Calculation of the Extent of the Disturbed Zone, First Paragraph

The GTP states the disturbed zone could be determined,

"...through evaluation of the spatial extent of changes in the intrinsic rock hydraulic properties caused by:

1) stress redistribution
2) construction and excavation
3) thermomechanical effects, and
4) thermochemical effects."

Three of the four processes (stress redistribution, construction and excavation, and thermomechanical processes) are processes that mainly affect the hydrologic properties of fractures. In the unsaturated environment at Yucca Mountain the possibility exists that the average flow path to the water table will be a matrix-dominated path. In this situation, the changes in fracture properties are not expected to be important. The NRC needs to recognize this possibility in determining the extent of changes in intrinsic permeability and effective porosity. In general, the NRC should more clearly state throughout the GTP that the hydrologic properties most affected by stress redistribution, construction and excavation, and the thermomechanical processes are the fracture properties.

4. Page 9, 4.1 Stress redistribution, first paragraph

The GTP states,

"A generic relationship between stress change and permeability change can be established by considering that, for all practical purposes, permeability will not change in the volume of rock beyond the surface of no stress change."

This statement is true; however, it is impossible to delineate "the surface of no stress change." We note that NRC refers to stress studies (Hoek and

Brown, 1980) that assume the medium behaves in a linearly elastic fashion. In an absolute sense, the surface of no stress change does not exist in elastic analyses. We point this out simply to emphasize the point that relative changes based upon arbitrary, absolute constraints can be unworkable and thus, provide no useful guidance.

The only viable approach to examining the effects of stress redistribution and permeability changes is to assess the significance of these effects on the repository's performance. This is what NRC regulations require, and if we must choose between a regulation and a GTP, we select the regulation.

5. Page 10, 4.1 Stress redistribution, third paragraph

The GTP states,

> "...the no-stress-change-contour could be somewhat conservatively estimated in many cases to be about 5 diameters for circular openings or 5 times the opening height for noncircular openings."

As stated previously, the no-stress-change-contour does not exist in elastic analyses i.e., the disturbed zone would be limitless. However, the distance to a contour of no significant changes in permeability is more likely to be on the order of 2 to 3 diameters. The distance to a contour of no significant change in permeability such that it affects performance is more likely to be less than one diameter.

6. Page 11, 4.1 Stress redistribution, fourth paragraph

The GTP states,

> "The opening sizes discussed above mean those of the final completed excavation, and not the design dimensions."

We must determine the size of the disturbed zone before we excavate a

repository. How then should we determine the opening size (which, in turn, determines the size of the disturbed zone) without a "final completed excavation"?

7. Page 17, 5.0 Statement of Technical Position

The GTP instructs DOE to calculate the extent of the disturbed zone on a site-specific basis, and states,

> "These site-specific analyses should account for the effects of heterogeneities in the geologic system, local geologic anomalies, the magnitude of likely groundwater flux, magnitude of areal thermal loading of the repository, the geochemical and hydrochemical characteristics of the site, and changes in the facility configuration through time."

It seems absurd that NRC requires such detailed information on a zone of rock that cannot contribute to the repository's performance. We are directed to present logical and defensible calculations to support the extent of a disturbed zone. Then, we are not allowed to use this information to calculate ground water travel time. Instead, we must use information on rock that is beyond the disturbed zone and perhaps beyond reach from the exploratory shaft. Clearly, we will know more about rock that is accessible (i.e., within the disturbed zone) than rock that is far away (i.e., beyond the disturbed zone). Yet we cannot take advantage of this knowledge.

NNWSI Project Comments

on

The Underground Testing Coordinating Group (UTCG) Comments

on

Draft Generic Technical Position (GTP): Interpretation and Identification of the Extent of the Disturbed Zone in the High-Level Waste Rule (10 CFR 60)

Except where noted, we agree with all comments.

1. Page A-1, second bullet

This comment compares the differing concepts of performance in the disturbed zone (DZ) GTP as opposed to the ground water travel time (GWTT) GTP. We agree with your comparison, but suggest you add a third concept of performance that appears in 10 CFR 60. The definition of disturbed zone in 10 CFR 60.2 is concerned with whether or not the included rock has a significant affect on repository performance not solely permeability (GWTT/GTP) or stress redistribution (DZ/GTP). We believe that both GTPs seriously depart from 10 CFR 60 (see our cover letter and our comment on the disturbed zone GTP, page 1, comment 2).

2. Page B-1, comment 2

Your comment states,

> "In general, it is a good idea to relate the disturbed zone to quantitative bounds on estimated significant increases in permeability and porosity."

We agree that it is a good idea to place quantitative bounds on any subjective term; in this case, "significant." However, we think it is a bad idea to relate the disturbed zone to increases in permeability and porosity. As noted previously, 10 CFR 60 states that the disturbed zone may significantly affect repository performance, and the GTP does not prove that increases in permeability and porosity can significantly affect repository performance. We note that you have made several comments on NRCs failure to make a cause and effect connection between stress redistribution and increases in permeability/porosity. We suggest that you take these comments a step further.

3. Page B-1, comment 3

The comment states,

"...the disturbed zone may be assumed to extend either further or less than the arbitrary fifty meters or five opening heights..."

and concludes,

"With this view, the document [GTP] is flexible and hence acceptable."

As we read it, the GTP does not give us the option of selecting a disturbed zone that is less than fifty meters. The GTP states,

"NRC considers that ... a disturbed zone of five diameters for circular openings, 5 opening heights for noncircular openings, or fifty meters, whichever is largest, from any underground opening, excluding shafts and boreholes, may be the minimum appropriate distance..." (page 17)

Elsewhere, you make similar comments (page B-1, comment 1 and page C-2, comment 5) and then tell NRC to delete the term "minimum" (page B-8, Section 4.2). If the GTP is indeed "flexible and hence acceptable," as this comment states, why must the term "minimum" be deleted? We suggest that you delete the comment and revise related comments, or restate the comment to say that the GTP is inflexible and unacceptable because the 50 meter distance should not be a minimum.

4. Page B-2, comment 6

The GTP states that the applicant should not depend exclusively or predominately on the host rock directly adjacent to the underground facility. Here, and on page B-5, Section 2.0, you suggest that NRC delete this statement because it is objectionable and irrelevant. We suggest that NRC retain the

statement and elaborate on it (see our comments on the disturbed zone GTP, page 1, comment 1).

We believe that NRC is recognizing some of our previous concerns. It appears that NRC will allow us to depend on the adjacent rock as long as the dependence is not exclusive or predominate. Although the adjacent rock is irrelevant to calculating ground water travel time...the disturbed zone, which is the origin of the calculation, is much larger...the adjacent rock is extremely relevant to calculating the release rate from the engineered barrier system. We have asked NRC to clarify whether we could include the adjacent rock as part of the engineered barrier system.

5. Page B-7, Section 4.1

You state that salt is not amendable to relating the disturbed zone boundary to the surface of the no stress change boundary. We agree, but suggest you add that the relationship is purely theoretical and has no practical application to any geologic media (see our comments on the disturbed zone GTP, pages 3 and 4, comments 4 and 5). The linear elastic theory underlies the NRC rationale for telling us where to draw the contour where stress does not change. This contour does not exist in elastic analyses. In other words, the disturbed zone would be limitless.

We suggest that NRC delineate the outer boundary of the disturbed zone as the contour where no significant changes in permeability occur. If NRC takes this approach, it should discover that the disturbed zone will extend no more than 3 opening diameters rather than 5. NRC should then explain what constitutes a significant change in permeability. If NRC is consistent with its regulations, this change must significantly affect the repository's performance.

ROUTING AND TRANSMITTAL SLIP

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2. NRC		
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