See Docket 6 forencl.

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NOV 25 1985

Dr. Donald L. Vieth
Director
Waste Management Project Office
U. S. Department of Energy
Nevada Operations Office
P. O. Box 14100
Las Vegas, NV 89114-4105

Dear Dr. Vieth:

The NRC staff has reviewed both the DOE June 7, 1985, letter and the supporting reference documents that provide information on exploratory shaft construction and sealing. This information was provided in response to our letter of April 14, 1983 (Coplan to Vieth).

The two broad areas of concern considered in our review are: 1) that the site characterization activities (e.g., construction of an exploratory shaft) will not compromise subsequent long-term isolation and containment capabilities of the repository; and 2) that plans for construction of the exploratory shafts will not preclude the acquisition of adequate information for site characterization. These two concerns are raised so that DOE commitments to construction techniques can be thoroughly examined prior to implementation.

Our April 14, 1983 letter identified NRC information needs pertaining to six broad areas associated with exploratory shaft construction and sealing: 1) shaft and seal design considerations; 2) construction plans and procedures; 3) sealing and grouting plans and procedures; 4) construction testing and inspection plans and procedures; 5) plans and procedures for gathering specific information related to site characterization; and 6) quality assurance for all of the above. Specific NRC staff comments representing the official NRC position on the DOE's letter response associated with each of the above six areas are addressed in Enclosure 1. Additional comments from NRC contractors which are provided for information only can be found in Enclosure 2.

In the subject letter dated June 7, 1985, the DOE has proposed construction methods (ES-1, drill and blast, ES-2, raise bore) for the two exploratory shafts. The NRC has no objection to the use of the proposed construction methods, provided that the shafts are properly constructed and construction is controlled with an adequate quality assurance program.

After reviewing the other information provided in the DOE letter of June 7, 1985, and the supporting references, the NRC has identified the following concerns which are addressed in Enclosure 1.

WM Record File
102.2

WM Project 11
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(Return to WM, 623-SS)

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1. At this time the NRC cannot accept the conclusion, as stated in the DOE response, that the construction of the Exploratory Shaft Facility will not affect the ability of the site to meet the performance objectives of 10 CFR Part 60. This conclusion cannot be accepted at this time based on the following concerns with DOE's supporting Performance Analysis document: (a) there are large uncertainties associated with the parameters used in the analyses; and (b) the scenarios utilized in the analyses may not represent an adequate bounding of the possible performance of the exploratory shaft, due to the limitations of the scenarios chosen.

2. The DOE's proposed construction controls for the excavation of the Exploratory Shaft (contained in Enclosure B of the response) are stated to be based upon the conclusions of the DOE's Performance Analysis. As stated in item 1 above, the NRC cannot accept the conclusions of the Performance Analysis report at this time. Therefore, the NRC considers that the DOE's proposed construction controls have not been adequately justified.

3. The testing and exploration that will be performed in the exploratory shaft are stated to be contained in the reference document entitled the "Exploratory Shaft Test Plan." This document is not available for NRC review at this time. DOE should submit this document for NRC review as soon as it is completed.

4. In response to many of NRC's concerns raised in our April 14, 1983 letter, the DOE has stated that the effort needed to resolve these concerns has yet to be completed. These unresolved concerns are considered to be open items and are identified in Enclosure 1 as such. The DOE should provide schedules for completion of each of these open items. As the items are completed, the DOE should submit the information to NRC for review.

5. Since a decision has been made to construct a second shaft, the DOE should provide the same information for the second shaft as was asked for in our 1983 letter.

6. The NRC does not agree with the quality assurance classifications that the DOE has given to (a) the construction of the exploratory shaft; (b) the liner; and (c) the rock support and structure system because those classifications are based upon the conclusion stated in item 1 above, which cannot be accepted by the NRC at this time.

The NRC concerns as stated in this letter and enclosures were discussed with you at the NRC/NNWSI Technical Meeting that was held on August 27-28, 1985.

OFC	:WMRP:mkb	:WMRP	:WMGT	:WMEG	:	:	:
NAME	:KStablein	:JJLinehan	:MRKnapp	:JTGreeves	:	:	:
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The NRC expects that after our comments have been considered by the DOE, an updated performance analysis and response would be submitted for NRC review.

This response should be submitted sufficiently far in advance of the planned start of shaft construction so that the NRC and DOE can thoroughly explore any remaining NRC concerns without delaying shaft construction.

If you have any questions about the attached material, please contact King Stablein of my staff at (FTS) 427-4611.

Sincerely,

Original Signed By:

John J. Linehan, Section Leader
Repository Projects Branch
Division of Waste Management
Office of Nuclear Material Safety
and Safeguards

Enclosures:
1. NRC comments on DOE letter of 6/7/85 and supporting reference on exploratory shaft construction and sealing.
2. NRC contractor comments.

Record Note: The technical review of the DOE June 7, 1985 letter and the supporting documents has been coordinated with the following staff members: Dinesh Gupta, David Tiktinsky, Tom Jungling, Jeff Pohle, Ted Johnson, John Trapp, Linda Kovach, Atef Elzeftawy, and Jim Kennedy. NKS

OFC	:WMRP:mkb	:WMRP	:WMGT	:WMEG	:	:	:
NAME	:KStablein	:JJLinehan	:MRKnapp	:JTGreeves	:	:	:
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encl. to 11/25/85 ltr. to Veith from Linehan

102.2

ENCLOSURE 1

NRC COMMENTS ON DOE'S LETTER OF JUNE 7, 1985 AND SUPPORTING REFERENCES ON EXPLORATORY SHAFT (ES) CONSTRUCTION AND SEALING

I. Shaft and Seal Design Considerations

A. In response to the NRC comment requesting an analysis of the effects of construction of the ES on long-term sealing, the DOE has provided an analysis to determine the impact of the Exploratory Shaft on the long-term performance of the repository (DOE's Ref. 1, entitled "Performance Analysis Studies to be Used in Determining Quality Assurance Levels for the Exploratory Shaft Design and Construction Activities" dated July 2, 1985).

Based on a review of the DOE's performance analysis study, the NRC staff concludes that large uncertainties seem to be associated with the parameters used in the performance analysis. In addition, the scenarios utilized in the analysis may not represent an adequate bounding of the possible performance of the exploratory shaft, due to the limitations of the scenarios chosen. Therefore, at this time the NRC staff cannot accept the conclusion made in the reference document that construction of the Exploratory Shaft facility will not affect the ability of the site to meet the performance requirements of 10 CFR Part 60. The NRC staff's specific concerns with that conclusion and the underlying uncertainties include the following:

1. A total systems analysis should be performed, including, but not limited to, the effects of all ramps, shafts, and water producing fault zones on the volume of water coming in contact with the waste packages. In general, anticipated processes and events that must be considered in an evaluation of compliance with 10 CFR 60 performance objectives need to be considered.

2. A range of scenarios that might increase flood volumes due to lesser storm events (e.g., 20-year floods, annual floods) should be considered. It may be possible for the volume of water to be several orders of magnitude greater than that estimated in the performance analysis due to total runoff over a 10,000-year period (i.e., if runoff from surface rainfall was able to enter an unbackfilled shaft).

3. Scenarios that consider water escaping up the shaft(s) and ramps should be considered to determine whether they are credible events.

4. The DOE states that it considers the impoundment of water near the exploratory shaft to be a highly conservative condition and an unanticipated process (App.A, p.7). The NRC staff disagrees with this position and considers that an equivalent to this

impoundment could be achieved by an anticipated process, namely erosion, subsidence, and channelization at the surface, causing runoff to move along a preferred path directly toward the ES area. Since erosion, slumping, landsliding, and debris movement have been seen in many places on and about Yucca Mountain, the DOE should provide its rationale for considering such events to be unanticipated especially as they affect other shafts, ramps etc. as listed in Item 1 above.

5. Given the uncertainties about parameters included in the performance analysis report, the performance analysis should incorporate a sensitivity study which recognizes these uncertainties. For example:

   (i) Sensitivity of various flood parameters with respect to the total flood volume should be analyzed; and

   (ii) Sensitivity of the results of the analysis with respect to potential variability of significant parameters such as damaged rock thickness should be investigated to determine whether the numerical ranges should be expanded to more realistic (conservative) bounds.

6. The discussion contained in the Performance Analysis gives the perception that the problem of modeling waste package radionuclide releases is better understood than it actually is. The NRC staff considers that many of the assumptions do not appear to be substantiated; for example, it is assumed that the radionuclides are atomically dispersed within the matrix. Also, the analysis neglects the possibility of increased segregation as the linear power rating is increased in future commercial operations. As another example it is not clear whether the assumption of cracked fuel cladding means that all the cladding is assumed breached before the first event occurs or rather that the cladding is assumed to fail linearly with time from year 300 to year 10,000. Based on a failure mechanism such as stress corrosion cracking, such a slow failure rate is questionable. It is noteworthy that this failure rate is approximately 10 times slower than the rate assumed by Oversby (NNWSI-NRC waste package meeting 7/23-24/1985 - Also see Oversby and McCright, "Laboratory Experiments Designed to Provide Limits on the Radionuclide Source Term for the NNWSI Project," UCRL-91257, 1984) of 0.1% per year (1000 year total failure period).

7. The process in the performance analysis document by which the assumptions are made and the final conclusions are arrived at is not presented in sufficient detail that one could satisfactorily duplicate the analysis. For example, the report is ambiguous in terms of the volume of water which was used to calculate the radionuclide release. It appears that the volume of water directly above a waste container was assumed to contact the mass of waste within that particular container. However, it is not

obvious whether the radionuclide release was limited by the saturation of that volume of water or rather that the water was assumed to circulate (from thermal effects), thereby permitting fresh water to contact the waste and increase the dissolution and release of radionuclides. Also, it is not apparent whether the total surface area of each spent fuel rod was assumed to contact the water or if the total mass of the waste was taken as a single cylinder. This consideration may reduce the calculated quantity of radionuclides released.

8. The NRC staff does not find sufficient basis to accept at this time the conclusion in the Performance Analysis Report that the penetration of the Calico Hills formation by the Exploratory Shaft and the creation of a sump will not affect the integrity or ability of the site to meet the performance objectives of 10 CFR Part 60 (App.A, p.27). Specific staff concerns include the following:

   a) After contacting the waste, water may enter the Calico Hills formation via the exploratory shaft sump and chemically react with the zeolite mineralization in that horizon. This may compromise the sorptive capacity of that unit.

   b) There appears to be a discrepancy between the thickness of the Calico Hills presented in the performance analysis document and that determined by the NRC from the DOE literature (see Attachment 2, EI document review, August 15, 1985, Table 1). The NRC review of the data indicates that the Calico Hills may be substantially thinner at the exploratory shaft location than stated in the performance analysis document. This is important to the performance analysis in that the DOE assumes a thickness of 150 m (Hunter to Oakley letter, p.2) for the Calico Hills unit as a bounding value. In addition, it appears that the term Calico Hills is used to designate at least three different entities in the performance analyses: a geological unit; a geohydrological unit; and a thermomechanical unit. The DOE should establish consistency in the use of the term Calico Hills.

   c) The effect of the damaged zone on performance for the portion of the ES that penetrates into the Calico Hills formation has not been adequately discussed.

9. A single hydraulic conductivity value, 10-5 cm/sec., was used in the performance analysis document (Hunter to Oakley letter, p.3). The DOE has not demonstrated that this is a conservative value which would lead to conservative results. As was pointed out in NRC comments on the DOE draft Environmental Assessment for the Yucca Mountain Site (Comment 3, pages 3-4), the limited available data indicate that many of the key hydrogeologic

parameters for the Yucca Mountain site are highly variable. Therefore, the NRC recommends that a realistic range of hydraulic conductivity values based on currently available data be used in the performance analysis unless a single value (such as 10-5) can be demonstrated to be conservative.

10. The DOE's Performance Analysis Report considers that water flowing down the fault zones surrounding the ES would not flow to the ES because of the emplaced dams and/or drains. However, this scenario assumes adequate long-term performance of the emplaced barriers, and does not consider the implications of failure of those features. If these barriers are to be considered in future evaluations, their long term performance should be analyzed.

The NRC staff considers that these concerns about the potential effects of construction of the exploratory shaft on long-term sealing capability can best be analyzed by considering the entire pre-closure repository system and by using realistic assumptions for the range of significant parameters.

B. In response to the NRC comment on how the excavation technique and shaft design account for limitations and uncertainties in long-term sealing, the DOE states that it appears that long-term sealing is relatively independent of the shaft design and construction techniques (based on the performance analysis report). Nevertheless, the DOE states that they will keep construction overbreak to a reasonable minimum and document any overbreak that does occur. The NRC staff considers that it has not been demonstrated that the assumed rock damage due to excavation addressed in the report is conservative. Specifically, the rock damage calculations presented in the document are based on a finished diameter, not on the excavated diameters; they do not appear to consider any site specific stress or strength values; no consideration is presented for rock jointing; and the calculations do not consider the damaged zone in the portion of the Exploratory Shaft that penetrates the Calico Hills. While there is a stated commitment to document overbreak, the construction controls called for in Enclosure B of the response appear to be weak and not sufficient to ensure that construction overbreak can be kept to a reasonable minimum using the described controls. The NRC staff suggests that DOE should revise its construction control specifications for the selected excavation technique and shaft design to provide assurance that limitations and uncertainties in long-term sealing requirements have been accounted for.

C. In response to the NRC comment requesting design specifications for shaft construction and their effect on sealing, the DOE states that the design specifications for the shaft are not yet complete. In addition, the DOE states that based on their performance analysis report, the ability to meet the performance objectives is not affected by the degree of damage from construction and it is not

necessary to show how the design specifications deal with factors affecting sealing.

The DOE should provide the NRC with a schedule for completion of the design specifications for the construction of the ES. After completion of the specifications, the DOE should submit them to the NRC for review and comment.

In view of comment I(A), the NRC staff considers that the question of how the design specifications deal with factors affecting sealing remains an open item and the DOE needs to further investigate this question before a firm conclusion can be drawn.

D. In response to the NRC request for the seal design and materials, the DOE states that the seal designs and materials being considered for the Yucca Mountain site are described in the reference document "Repository Sealing Concepts." However, the DOE states that at the present time, it is not clear which, if any, of the seals described in the report will be needed in the repository. Because of the uncertainties in the Performance Analysis Report concerning the need for sealing (see NRC comments on I(A)), the NRC staff recommends that the DOE continue to pursue a program of developing long-term sealing capability (including degradation mechanisms of seals). In addition, the NRC considers that it is prudent for the DOE to carefully control rock damage due to construction of the shaft, in the event that future performance analysis indicates the need to seal such zones.

E. In response to the NRC request for information on testing to be performed in the shaft, the DOE states that the testing and exploration to be performed is described in the reference document entitled "Exploratory Shaft Test Plan." Since this document is not available to the NRC staff for review at his time, we consider this to be an open item.

The NRC staff recommends that the DOE provide early insight to the staff into proposed testing during exploratory shaft construction so that potential concerns can be identified in time for the DOE to factor them into their site characterization plans.

F. In response to the NRC request for the drilling history and geotechnical testing from the principal borehole, the DOE has provided the drilling history from the borehole, USW-G4, in a reference document entitled "Stratigraphic and Structural Characteristics of Volcanic Rocks in Borehole USW-G4," USGS-OFR-84-789. To complete the response to this comment, the DOE should provide additional available information that relates to geotechnical testing performed on samples obtained from this borehole for NRC review.

II. Construction Plans and Procedures

A. In response to the NRC request for the acceptance criteria for construction of the ES, the DOE states that specific acceptance criteria for the shaft are still being developed. In addition, it is stated that these criteria and their implementing construction controls need be no stricter from a sealing perspective than those required for short term stability (based on the performance analyses report) and will be representative of good quality, state-of-the-art conventional shaft construction practices.

The NRC staff recommends that the DOE provide a schedule for completion of the acceptance criteria for the construction of the ES. After the acceptance criteria are completed, they should be submitted to the NRC for review and comment. In view of the Comment I(A), the NRC considers that the DOE has not provided an adequate basis for its position that the acceptance criteria need be no stricter than needed for short term stability.

B. In response to NRC's request to identify procedures used to minimize damage to the rock mass, the DOE states that the excavation procedures described in Enclosure A of the response (good commercial practices) will be adequate based on the insignificant impact of rock damage on long term performance.

The NRC staff considers that the DOE has not adequately justified the conclusion that the potential damage due to excavation would have no significant impact on the long term repository performance [see NRC comments on I(A)].

It appears to the NRC that it is unlikely that the excavation procedures as specified in Enclosure A will limit rock damage to reasonable levels, because no construction controls have been specified for a good portion of the exploratory shaft [see NRC comments on I(B)].

C. In response to NRC's request to identify the liner and construction and placement technique, the DOE presents a summary of the shaft and liner construction in Enclosure B of the response and states that the liner materials being considered have not been selected from a sealing point of view based on the Performance Analysis Report. Based on all the preceding comments, the DOE selection of liner materials without regard for sealing capabilities cannot be supported by the NRC staff.

In addition, the DOE states that the liner could be removed in the future if necessary to emplace suitable sealing components. The DOE did not discuss the potential problems of removing the liner and the effect such removal will have on the rock surrounding the ES considering the length of time that the shaft will be in operation. In addition, unless a commitment is made by DOE that the shaft liner

will be removed, an analysis should be performed on what effect leaving the liner in place will have on the integrity of the site (i.e., liner degradation and chemical effects from liner degradation.)

III. Sealing or Grouting Plans and Procedures

A. In response to NRC's request to describe the expected performance of seals in the ES, the DOE stated that the performance requirements for long term repository sealing at Yucca Mountain are expected to be minimal based on the Performance Analysis Report. In addition, they also state that in view of the nature of sealing at Yucca Mountain and the time available prior to decommissioning in which to develop seals, the DOE is confident that the sealing requirement can be met.

Based on NRC comments on I(A) about the conclusions of the Performance Analysis Report concerning the need for sealing, we can not accept the DOE response to this question at this time. The level of performance that is necessary for the seals must be determined before it is possible to determine whether the sealing requirements can be met.

B. In response to the NRC request to describe the seal placement methods, the DOE states that the methods have not yet been developed pending establishment of the design requirements for sealing component.

The DOE should provide a schedule for development of seal placement method with respect to the need to establish design requirements for seals [see comment on III(A)].

C. In response to the NRC request to describe remedial methods to be used if sealing materials are not adequate, the DOE states that remedial methods for failure of long term seals placed during decommissioning have not yet been developed and need for remedial measures are believed to be minimal (based on performance analysis).

The NRC staff considers that the DOE's conclusions regarding the need for seals based on the performance analysis have not been adequately supported [see NRC comments on I(A)].

The DOE should provide a schedule for completion of the determination of remedial/contingency plans that will be implemented if sealing methods prove to be inadequate during performance confirmation testing [see comment on III(A)].

IV Construction Testing and Inspection Plans and Procedures

A. In response to the NRC request to describe test and inspection procedures, the DOE states that test and inspection activities during ES construction other than for site characterization are being developed and will be specified in the ESF Title II Design.

When completed, the DOE should submit to the NRC for review and comment the test and inspection procedures that will be used in the shaft.

B. In response to the NRC request for test and inspection procedures for the liner, the DOE states that test and inspection procedures for the shaft liner are being developed as part of the Title II Design for the ESF.

When completed, the DOE should submit to the NRC for review and comment the test and inspection procedures for the liner.

C. In response to the NRC request for test and inspection procedures to determine seal adequacy, the DOE states that test and inspection procedures for seal adequacy after decommissioning have not yet been developed.

When completed, the DOE should submit to the NRC for review and comment, the test and inspection that will be used to determine seal adequacy after decommissioning.

D. In response to the NRC request for detailed plans to document construction activities, the DOE states that detailed documentation plans have not yet been finalized for shaft construction activities and will be found in the Title III summary reports on construction.

When completed, the DOE should submit to the NRC for review and comment, the documentation plans for shaft construction activities.

V. Plans and Procedures for Gathering Specific Information Related to Site Characterization

A. In response to the NRC request for a description of test plans used to obtain data during exploratory shaft construction, the DOE states that plans for gathering data during ES construction are discussed in the reference document entitled "Exploratory Shaft Test Plan" (ESTP). In addition, they state that detailed procedures for data gathering have not yet been completed.

The reference document, ESTP, is not available for review by the NRC at this time [see NRC comment on I(E)]. The DOE should submit to the NRC for review and comment when they are completed, the detailed procedures for data gathering.

VI. Quality Assurance

A. The NRC requested the DOE to identify the line of responsibility for implementing Quality Assurance. The line of responsibility was satisfactory.

B. The DOE states that QA procedures for ES construction and testing have not been completed at his time. The DOE also presented a list

of NNWSI systems for the Exploratory Shaft and has provided the quality levels that will be associated with those systems. The NRC has the following comments on this response.

1. The DOE should provide a schedule for completion of ES construction and testing QA procedures.

2. Regarding construction of the ES, the DOE has conducted a performance analysis of the ES demonstrating that rock damage associated with construction of the shaft will not compromise the ability of the site to meet the NRC (10 CFR Part 60) and EPA criteria (40 CFR Part 191). In addition, on page 1 of the cover letter of the response (Vieth to Linehan, June 7, 1985), the DOE has concluded that the construction of the exploratory shaft is not an activity that impacts radiological health and safety of the public. As a result, the DOE has taken the position that construction activities of the ES do not need to be classified as Level I QA. Level I is defined in the NNWSI QA Plan (NVO-196-17) and prescribes that the NRC QA requirements in Subpart G of Part 60 be utilized. Level I also involves NRC review to assure that the requirements of Part 60 are being met.

   The DOE indicated in their June 7, 1985 letter (page 2) that the conclusions presented (including those related to quality levels), were based on preliminary data and unverified assumptions. Further, the NRC staff has identified a number of concerns with the analyses presented [see comments on I(A)]. The staff therefore cannot agree at this time that Level II is an appropriate classification for ES construction activities. Either DOE should resolve the concerns and reduce uncertainties in the analyses (see NRC comments in I(A)) so that there is adequate confidence that the classification is correct, or should assume that exploratory shaft construction activities are Level I.

   The staff believes the actual QA measures applied to specific construction activities could be identical whether they were classified Level I or Level II and need not necessarily be "elaborate" as DOE has indicated on Page 4 of their letter response. The principal difference would be the NRC review of Level I activities. The staff is ready to review the specific approaches DOE selects for assuring quality if Level I is required. This should be a topic for a future NRC/DOE technical meeting.

3. The DOE should indicate in the response what quality assurance level will apply to data collection during construction. The staff considers that data collected during construction will be part of site characterization and therefore must be subject to level I QA.

4. Based on the review of the given quality assurance designations the NRC does not agree with the classification of the liner and rock structure and support as Level II. These levels are based on the conclusions made in the Performance Analysis Report which the NRC cannot accept at this time (see comments on I(A)).

   In addition, the DOE should show additional justification for the QA classification of the dewatering system. If this system fails, then there is a possibility that the water that could not be removed may preclude the ability of the DOE to obtain some site characterization data about the unsaturated zone.

GENERAL COMMENTS

The DOE should in their response, discuss for each of the applicable information requests, as stated in the NRC to DOE letter (Coplan to Vieth, April 13, 1983), the second exploratory shaft that will be constructed.

ENCLOSURE II

NRC CONTRACTOR COMMENTS

To: D. Gupta, NRC, WMEG

From: J. Daemen

Re: Comments on the Nevada Nuclear Waste Storage Investigations (NNWSI) Exploratory Shaft Conceptual Design Report (LA-9179 -MS). Letter from D.L. Vieth to J.J. Linehan, dated June 07 -85, with enclosures.

Date: 8-29-85

The fundamental claim made in the cover letter is that the construction of the Exploratory Shafts is not an activity that impacts radiological health and safety of the public. This claim is based largely on the performance analysis study, the conslusions of which have not been supported adequately by back-up analysis and data. Therefore the fundamental claim made in the cover letter can not be accepted.

Basic aspects of the Yucca Mountain site invoked in favor of the fundamental claim are:

- -semiarid environment, hence limited surface water supply
- -repository in unsaturated zone, hence limited groundwater entry into the repository, and easy drainage through the floor and away from the repository

Both arguments are valid technical arguments, and fundamentally alter probable sealing requirements when compared to other candidate repository sites, even though the numerical data and aspects of these arguments need to be firmed up considerably. Actual site-specific sealing requirements can be determined only on the basis of a site-specific performance analysis. This approach has been taken by NNWSI, based on its draft ES performance analysis study. The present draft, however, can not fully support the claim that the ESF will not perturb transport mechanisms to such an extent that the isolation potential of the site will not be compromised, mainly because this draft:

- -considers only a very small number of release scenarios, and for example does not consider the presence of two exploratory shafts, nor of the simultaneous presence of multiple shafts and ramps, nor of thermal effects on water flow patterns. (This could be a significant impact, given the proximity of waste to ES-1 and ES-2; as a minimum an uncoupled analysis of temperature distributions and possible influence on water/steam/saturated air circulation would seem highly desirable).
- -considers only a narrow range of numerical values (frequently only a single number) for parameters that could influence the results significantly (examples: fault zone or damaged zone thickness and hydraulic conductivity)
- -does not consistently use conservative analyses

For these reasons, the main conslusion, that the construction of ES is not an activity that impacts radiological health and safety of the public is not adequately supported by the evidence presented.

(The converse conclusion, that ES construction does impact radiological health and safety, can not be supported either by the analysis, because the analysis does include several possibly very conservative assumptions.)

The main conclusion of the cover letter pervades the entire DOE response: the detailed responses in Enclosure 1 repeatedly disclaim a need to respond, based on the conclusion. Before this DOE response can be accepted, it is essential that the main conclusion be established beyond any reasonable doubt. Even then, many of the detailed responses will not be acceptable, because the exploratory shafts will be part of the post-closure isolation system.

Detailed Comments

Note: the document reviewed here relies heavily on the ES performance analysis study. Redundancy in the review has been minimized by not repeating detailed comments already made in the review of that document. It is assumed that the reader is familiar with criticisms of the performance analysis study.

Enclosure 1

Page 1, I., Conclusions

For reasons discussed in the review of the performance analysis study the conclusion in the first bullet, that (radiological) public health and safety are not compromised during the post-closure period by the presence of a damaged zone near the ES is not acceptable because it is not supported adequately by analysis and data presented. (It is of some interest to note the qualifier "during the post-closure period", not used in the cover letter nor in the performance analysis study--pre-closure isolation or containment impact has never been addressed).

The testing commitment in the third bullet is excellent, and the results will provide data necessary for a much more reliable and realistic performance analysis.

page 1, last paragraph

Contrary to the statement in the first sentence of this paragraph, it is not obvious that the assumed rock damage because of excavation as addressed in the referenced performance analysis study is conservative. Specifically, the rock damage calculations as presented in the document are based on a finished internal diameter, not on the excavated diameter, do not consider any site-specific stress or strength values, do not consider the intense rock jointing, and do not take into account overbreak. The updated analysis presented by Kelsall during the 8-28 meeting is site-specific, and might well be conservative, although this needs to be checked.

While the commitment to document overbreak is laudable, the construction controls called for in Enclosure B appear to be extremely weak, and unlikely to ensure that construction overbreak will be kept to a reasonable minimum.

page 2, fifth paragraph, Response

The "Repository Sealing Concepts" report, Ref. 2, needs to be reviewed in detail, but a few general comments can be made:

- "sealing" relies heavily on long-term drainage through the floor
- "sealing" might rely heavily on dams and grout curtains in drift floors

page 2-3, Response

Shaft wall rock characterization appears to be very comprehensive. According to information provided at the 8-28 meeting, large blocks will be collected from the muckpile. This raises the "representativeness" issue, e.g. will the sample be biased because stronger than average rock survives blasting, rock is damaged by blasting , etc.

page 4, paragraph 6, Response

The blast criteria presented in Enclosure B (A?) are not good quality, state-of-the-art conventional shaft construction practice.

page 4, paragraph 8, Response

It is unlikely that the excavation procedures as specified in Enclosure A will limit rock damage to reasonable levels, because no controls are specified along most of the shaft.

page 4, paragraph 3, Response

The response reinforces the NRC request for a complete drilling history. Ref. 2, p. 69, does provide information on hole enlargement and poor conditions at several levels, and lost returns. Reference 4, page 56, last paragraph, specifically identifies drill hole enlargement and high fracture permeability in the Topopah Spring. A detailed analysis of G-4 information would provide a direct check on parameter values and analysis results used in the performance analysis study. Logs provided in Ref. 4 (last 2 pages) are difficult to read and to scale.

page 4, first and second Comment and Response in II

Controls in Enclosure A on blasting are minimal. A question that has not yet been addressed to any significant extent is whether or not blasting damage is likely to affect rock mass characterization, in particular shaft wall (fracture) mapping and testing.

page 5, top paragraph

Enclosure B gives no information on liner for second exploratory shaft.

page 5, section III

Sealing issues:

- addressed indirectly, through references, which need to be reviewed
- permanent sealing will be designed later, if required, and the information will be provided to NRC, if NRC needs it
- remedial action will be designed later, if needed

page 7, first response

In response to the last sentence, NRC needs to confirm that information is necessary and needs to be made available to NRC.

page 8, Discussion, point 1

This point contains several contradictions with the performance analysis study:

- it is claimed here that the shafts will be stripped of all internals, utilities, conveyances, and hoisting systems. According to the Shaft Performance Analysis (Hunter to Oakley letter, July 2, 1985, p.5., third paragraph), the internals of the six-foot diameter shaft can be left in place, and if so the shaft could continue its use as an emergency exit. This suggests that this shaft might become a significant aspect of the operational safety system. During the oral presentation on the ES Sealing (NRC-DOE Nevada, 8-28-85), a possible more intensive use of ES-1 during construction has been mentioned, i.e. utilizing the hoisting system during initial repository construction.

-Most of the Performance Analysis Study calculations are based on the use of one exploratory shaft. Adding the second shaft will add about twenty to thirty percent to the cross sectional flowpath area, and hence will increase water inflow into the repository (for the limiting steady state case) by about the same percentage. It is unclear by how much this would increase the flooded repository area, and hence exposure of waste to water.

-According to the Performance Analysis Study (Oakley letter, 7-2-85) the exploratory shaft will be used as the primary source of intake air for the waste emplacement operations. This in its own right clearly points out the extreme importance of the stability of this shaft. If, as claimed, all internals will be removed, regular inspection and routine maintenance of the liner, clearly necessary for a 50-70 year life, will be difficult and time-consuming (it will require moving some type of hoist above the shaft, and such mobile hoists always have very low hoisting speeds and capacities). A failure of the prime air intake (e.g. local shaft failure and air blockage) for the waste emplacement area operations could have major implications for air flow, airborne radionuclide removal, cooling, etc. No detailed assessment of the implications is possible, because several other air intakes (shafts, ramps) are available, and detailed implications would depend on how airflow is rerouted.

Additional comments raised by this point:

-When will ESF testing be completed? Specifically, will ESF testing continue as part of performance confirmation? When will internals from shafts be removed, and hence when will unobstructed air flow through shafts be possible, and when will routine inspection and maintenance of shaft liners become difficult?

page 8, liner

As discussed earlier, the liner might become an important operational safety item if the large exploratory shaft does indeed become the primary air intake shaft for waste emplacement operations. The importance of the liner would be enhanced if all internals were removed, as this would complicate shaft inspection, routine maintenance, and any remedial action that might be required over the life of the shaft (i.e. until permanent closure).

All indications are that the shafts, and hence their liners, will be part of the repository.

page 8, Ventilation

The statement that "ESF ventilation components are not intended to be used in the repository" presumably refers to Fans, doors, surface conduits, etc... It has been stated repeatedly that the shafts themselves will be part of the repository ventilation circuit.

page 9, Hoist

According to the Performance Analysis Study, the hoist in the small exploratory shaft may be left in place and become an emergency escape hoist for repository operations. Another option that remains open is that the ES-1 hoist may be used during initial repository construction (D. Vieth, Oral presentation, 8-28-85). In either case

one of the hoists would become part of repository operations.

page 9, Rock Structure and Support

It is very unclear to me what this statement refers to, and clarification from DOE would seem desirable. If this refers to the shafts, it overlaps with the previous Liner section, and the comments made there apply. If this statement refers to the underground test facilities outside the shaft only, then the following comments apply:

- -520 ft level breakout: total collapse would locally create a high permeability zone, and probably would locally affect shaft stability. Presumably this will be prevented by appropriate measures (e.g. dense backfill) at the time of ESF test completion, although no indication of this is given anywhere.
- -1480 ft level breakout: complete collapse would create a localized high permeability zone, enhancing drainage but compromising somewhat the geochemical barrier
- -1200 ft level breakout: assuming that some of the drifts on this level will become part of the operations ventilation system suggests that these drifts will have a significant role in operational safety, e.g. on a similar level as the intake shafts. Because these drifts always will be readily accessible for inspection, maintenance, and repairs, it is less critical than for shaft liners that durability and stability of these structures and their support be assured from the very early stages until permanent closure.

Enclosure A: U.S. Department of Energy; NNWSI ESF Project; Technical Specification Division 2-Site Work. Specification 02310 Excavation.

The document is preliminary, and only parts of it have been provided, so that the following comments can be considered tentative only.

02310-3 of 7, 3.1 Excavation

Section 3.1.2 provides monitoring and control for surface structures, based on outdated, but still widely used USBM specifications. Section 3.1.3 provides the apparently only control on excavation procedure. No monitoring is required, and no detailed limits are specified. Smooth wall blasting procedures are left entirely to the contractor, and unacceptable conditions include neither overbreak, rock damage nor liner damage.

The specifications include a direct quote from the Du Pont Blaster's Manual (pages 02310-6 of 7 and 7 of 7). The last sentences on page 6 of 7 state particularly clearly why smooth wall blasting in shafts usually is difficult: confinement relief is difficult to obtain.

The section quoted from the Du Pont Manual deals with tunnel (or mine drift) headings. It would be highly desirable to also include the section on shaft rounds, as the Du Pont Manual

recommends significantly tighter patterns (closer spaced holes) for shafts, and specifically suggests reducing the burden to less than the spacing in order to improve shear. It is unclear where Table II-Smooth Blasting (page 02310-7 of 7) is taken from, as I can not find it in the Controlled Blasting, Tunneling, or Underground Mining Chapters of my edition of the Du Pont Handbook. The spacings and burdens given in this table are identical to those in the Langefors and Kihlstrom "Rock Blasting" reference, which does not explicitly discuss shaft sinking, and the charge densities listed here as averages considerably exceed the values recommended in Langefors and Kihlstrom (by up to a factor of 3 for the smaller holes).

In summary, it is to be recommended that the blasting control specifications be tightened up considerably.

Enclosure B, page 6-13, top paragraph

The explanation of controlling the blasts lists maximizing vertical advance, minimizing shaft wall rock damage, and optimizing rock fragment size. These three objectives are partially in conflict, and priorities will need to be set. The sinking deck and associated equipment will be raised during blasting in order to avoid damage, but no indication is given as to liner protection requirements.

Enclosure B, pages 6-18/20

It is to be noted that the ground support at all three landings (intersections of shaft with breakouts) includes many steel components, obviously with limited durability.

No explanation is given as to what is meant by optimizing blast results (middle of second paragraph on page 6-18).

Enclosure B, page 6-22, Table 6-2

Schedule does not include time for shaft logging prior to liner installation.

Enclosure B, pages 6-24/26, ESF drift mining

No indication given as to whether any controls will be applied to mining (e.g. blasting, reinforcement) beyond conventional practice.