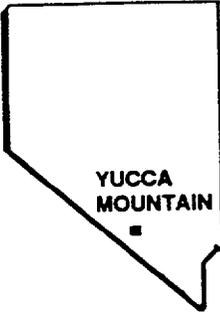


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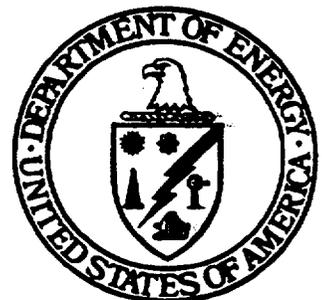


YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT

RESPONSES TO EDISON ELECTRIC INSTITUTE COMMENTS ON THE SITE CHARACTERIZATION PLAN

DECEMBER 1990

UNITED STATES DEPARTMENT OF ENERGY



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U.S DEPARTMENT OF ENERGY'S COMMENT RESPONSES FOR THE COMMENTS RECEIVED FROM
THE EDISON ELECTRIC INSTITUTE AND THE UTILITY NUCLEAR WASTE MANAGEMENT GROUP

The Edison Electric Institute (EEI) submitted comments on the SCP in a letter dated June 1, 1989. The U.S Department of Energy renumbered the pages contained in the letter received from the EEI and identified individual comments within the letter. The comments were then enumerated from the aggregate package that was submitted; twenty-eight comments were submitted. A copy of the enumerated comment package is provided under separate enclosure for cross reference. Each comment number is marked in the margin of the page and the page number is marked in the upper right hand corner of the page. Where multiple comments occur on one page, each is bracketed by horizontal lines.

For each comment, the DOE response package provides a description of the comment, followed by the response to the comment. Each comment was either furnished an individual response, or cross-referenced to a response addressing comments pertaining to the same overall theme.

ENCLOSURE (

U.S. DEPARTMENT OF ENERGY RESPONSES TO COMMENTS
FROM EDISON ELECTRIC INSTITUTE AND THE UTILITY NUCLEAR WASTE AND
TRANSPORTATION PROGRAM ON THE SITE CHARACTERIZATION PLAN

COMMENT 1:

Overall, we have found the SCP to be a thorough, fundamentally sound document. It is considerably more extensive and detailed than the plans, descriptions and information specified in the Nuclear Waste Policy Act and applicable Nuclear Regulatory Commission (NRC) regulations required. The SCP provides a comprehensive basis for proceeding with site characterization work. However, modification of certain areas would greatly enhance the site characterization effort.

As emphasized in the the enclosed comments, EEI/UWASTE urges that DOE begin developing an approach for evaluating site suitability as characterization proceeds. While there is no basis for concluding, at this time, that the Yucca Mountain site is unsuitable, the site is geologically complex. Any possibility -- however remote -- that the site could be found unsuitable or unlicensable should be addressed as early as possible, and not after years of characterization work and the expenditure of billions of dollars. DOE should conduct its site characterization program in a manner that will provide an early warning of any factor or set of factors indicative of fundamental site unsuitability, and factors favorable to site suitability.

Response:

As described in the U.S. Department of Energy's (DOE) "Report to Congress on Reassessment of the Civilian Radioactive Waste Management Program" (DOE, 1989), a cornerstone of the revised repository schedule is a new focus on the early evaluation of the suitability of the Yucca Mountain site as suggested by the Edison Electric Institute and the State of Nevada. Instead of beginning site characterization with a total-system approach directed at evaluating the performance of engineered barriers as well as the site and based to a large extent on underground testing, this evaluation would focus first on certain particular features of the site that can be investigated through surface-based testing. As described in the Site Characterization Plan (SCP) for the Yucca Mountain site, DOE is planning to collect information on zones of recent faulting, using trenching to better understand the potential for surface offsets in the vicinity of the waste-handling building and the potential for major earthquakes. Also planned are continued studies aimed at better understanding the origin of the calcite-silica deposits that have been identified by some program critics as indicators of saturated conditions in the proposed repository horizon. These scientific investigations would provide early information about the suitability of the site. DOE initiated an evaluation of prioritizing surface-based testing in February 1990. Recently, the scope of that effort, the Testing Prioritization Task (TPT) (formerly Surface-Based Testing Prioritization), has been revised to consider all tests enumerated in the SCP. Unsuitability conditions based on DOE's Siting Guidelines (10 CFR 960) and NRC's Siting Criteria (10 CFR 60.122) are the basis for determining which site conditions should be investigated early and, in addition, which testing activities are

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most likely to detect and/or characterize these conditions. The development of a site suitability methodology is now part of a separate but parallel and consistent effort.

REFERENCES

DOE (U.S. Department of Energy), 1989. Report to Congress on Reassessment of the Civilian Radioactive Waste Management Program, DOE/RW-0247, Office of Civilian Radioactive Waste Management, Washington, D.C., 22 p.

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COMMENT 2:

New site characterization work should be resumed as soon as the NRC's Objection concerning DOE's Quality Assurance program is resolved, and the Department has considered the NRC's comments on the SCP as presented in the Site Characterization Analysis. The repository program is now at the point where further refinement of the Site Characterization Plan can benefit significantly from information and data gathered through surface and subsurface exploration at the actual repository horizon. Timely, competent site characterization is in the interest, not only of electric utilities, but the State of Nevada and the public as a whole.

Response:

As described in the U.S. Department of Energy's (DOE) "Report to Congress on Reassessment of the Civilian Radioactive Waste Management Program" (DOE, 1989), a quality-assurance program that meets the requirements of the U.S. Nuclear Regulatory Commission (NRC) has been established. Much effort during calendar year 1989 was devoted to the preparation and issuance of quality-assurance (QA) procedures, the training of DOE and contractor staff, and qualification audits performed to determine ability to implement the required procedures. As a result, more than 1,000 persons working for eight major program participants have received the required training and are now working under an NRC-accepted program. When the remaining qualification audits of DOE/Headquarters and the Yucca Mountain Site Characterization Project Office are completed, a quality-assurance program that has been fully qualified and approved by the NRC would be in place. At this point, as agreed with the NRC, new site characterization activities can occur.

At the Program level, the Office of Civilian Radioactive Waste Management (OCRWM) developed and issued the Quality Assurance Requirements (QAR) document on November 3, 1988, and the Quality Assurance Program Description (QAPD) document on December 20, 1988. The QAR defines the QA requirements governing activities affecting quality, and the QAPD describes the OCRWM responsibilities, interfaces, and provisions necessary to implement the requirements of the QAR. In May 1989, the NRC issued Safety Evaluation Reports that accepted the QAR and QAPD documents. To implement the requirements of the QAPD, the OCRWM continued the preparation of subordinate QA procedures. As of September 30, 1989, 21 QA administrative procedures and one implementing line procedure had been issued for use.

DOE has recently revised the QAR and QAPD to incorporate aspects of both the OCRWM and Yucca Mountain Project Office QA requirements into a unified program. This program is currently being revised to reflect recent organizational changes and other program changes necessary to initiate new site characterization activities. It is anticipated that the revised QA Program would be ready for qualification by the Gold Star Audit scheduled for October 1990. DOE would request NRC acceptance of the OCRWM QA Program based on the results of this audit.

On October 24, 1990, the DOE received formal notification from the NRC that the following participant QA programs were accepted; Fenix & Scisson, Holmes & Narver, Lawrence Livermore National Laboratory, Reynolds Electrical

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Engineering Company, Sandia National Laboratories and the U.S. Geological Survey.

REFERENCES

DOE (U.S. Department of Energy), 1989. Report to Congress on Reassessment of the Civilian Radioactive Waste Management Program, DOE/RW-0247, Office of Civilian Radioactive Waste Management, Washington, D.C., 22 p.

DOE (U.S. Department of Energy), 1988. Quality Assurance Requirements Document, U.S. Department of Energy, Washington, D.C.

DOE (U.S. Department of Energy), 1990, Quality Assurance Program Description Document, U.S. Department of Energy, Washington, D.C.

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COMMENT 3:

The SCP is a thorough, fundamentally sound document that is considerably more extensive and detailed than required by the relevant statutes and regulations.

Response:

The U.S. Nuclear Regulatory Commission's (NRC) regulations in 10 CFR 60.17 state the need for a "general plan" for site characterization and enumerates specific information that NRC anticipates to be part of such a plan. The U.S. Department of Energy (DOE) believes that the Site Characterization Plan (SCP) is comprehensive, in light of the requirements, and is pleased that the Edison Electric Institute believes the SCP to be a fundamentally sound document. The NRC has stated that DOE's SCP is a fundamentally sound plan with which to begin characterization, and the Nuclear Waste Technical Review Board has stated that the SCP has no significant omissions in the host of studies planned for characterization that would bear upon the suitability of the site.

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COMMENT 4:

DOE should conduct its site characterization program to provide an early warning of any factor or set of factors indicative of fundamental site suitability and unsuitability.

Response:

The U.S. Department of Energy's response to EEI/UWASTE Comment 1 discusses a new focus of the revised repository schedule, i.e., to focus on the early evaluation of the suitability of the site.

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COMMENT 5:

DOE must get its QA program in place and approved by the NRC.

Response:

As discussed in more detail in the U.S. Department of Energy's (DOE) response to EEI/UWASTE Comment 2, a quality assurance program that meets the requirements of the U.S. Nuclear Regulatory Commission (NRC) is now being established. The means to resolve Objection 2 in the NRC's Site Characterization Analysis (QA Program) has been agreed upon between DOE and NRC. It consists of a series of steps for QA program implementation leading to fulfillment of DOE's commitment not to begin new site characterization activities until an NRC-accepted QA program is in place.

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COMMENT 6:

It is imperative that DOE identify and retain a highly qualified, experienced individual to fill the position of OCRWM QA Director.

Response:

The U.S. Department of Energy's (DOE) response to EEI/UWASTE Comments 2 and 13 discusses the current status of the quality assurance program at both the program and project levels. As of October 16, 1989, both DOE/Headquarters and Yucca Mountain Site Characterization Project Office Quality Assurance (QA) management positions were filled. Dwight E. Shelor was Acting Director, Quality Assurance, and Donald G. Horton was Project Office, Director, Quality Assurance. On July 16, 1990, a new proposed organization was announced by John W. Bartlett, the newly appointed Director, Office of Civilian Radioactive Waste Management. Based on this proposed organization, Donald G. Horton was named Director, Office of Quality Assurance. In addition, Donald G. Horton is also acting as the Director, Project Office Quality Assurance Division. When the reorganization is formally implemented, the position of Director, Project Office Quality Assurance Division, is planned to be filled with a permanent replacement possessing appropriate experience and a solid QA background.

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COMMENT 7:

DOE should develop and present in the SCP specific strategic plans for dealing with potential uncertainties as they pertain to issue closure.

Response:

Resolution of uncertainties would be one of the most important issues the U.S. Department of Energy (DOE) would need to address in the license application. The EEI/UWASTE correctly points out that the Site Characterization Plan (SCP) does not deal in depth with this issue. Extensive as it is, the SCP is still a high-level document dealing with high-level issues and issues integration. More technical details are discussed in the lower tier documents such as study plans, scientific investigation plans, and activity plans.

There would always be some uncertainties regardless of how much site characterization (data collection) and testing are conducted, especially when projecting the anticipated performance of the repository up to 100,000 years. For this reason, neither 10 CFR 60 or 40 CFR 191 require an absolute proof of future performance but only reasonable assurance that the outcome would conform to regulatory objectives and criteria. Resolution of uncertainties is a key factor in the interpretation of the term "reasonable assurance," and DOE has been and would continue to meet with the U.S. Nuclear Regulatory Commission (NRC) to establish a position on this matter.

To the extent practicable, DOE plans to reduce the technical uncertainties that would remain after the site characterization and engineering testing. Accordingly, a management mechanism is being developed as part of the Testing Prioritization Task to apply total system and subsystem performance assessment to guide the site characterization and the design and testing of the engineered barriers. DOE's approaches in the uncertainties and sensitivity analyses are discussed in the document entitled Performance Assessment Strategy Plan (DOE, 1990). Briefly, this document discusses the types of uncertainties expected, i.e., uncertainties in parameters, conceptual models of the site and of the processes and events anticipated to occur, and uncertainties associated with potential evolution of the system due to unanticipated processes and events. These uncertainties are dealt with via a multiprong approach using sensitivity analyses, uncertainty analyses, model validation, and performance confirmation. The methodology for uncertainty and sensitivity analysis is still under development. A proposed model validation methodology, which includes peer review and use of expert judgment, has been developed and has gone through several internal and external reviews.

On a strategic level and, more to the substance of the comments, DOE recognizes that considerable uncertainty about the actual performance of the site and its engineered features would remain at the time of license application. This would be true whether the application date is now, after the characterization efforts planned in the SCP, or even after a much longer and extensive program of testing and model development. A strategy must be developed that acknowledges the inevitability of such "residual" uncertainty, and that provides a basis for reasonable assurance in the face of this acknowledgment. In EEI/UWASTE Comment 26, the EEI has provided some useful

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suggestions for building such a strategy. DOE would consider these suggestions. Other potential foundations of an "uncertainty" strategy include several concepts under consideration as part of ongoing activities to reconsider licensing strategies, surface-based testing priorities, and Calico Hills penetration options. Several examples include the following strategies:

1. Emphasis on the probability of failure of the total system given the probability of failure of the total system equal to the product of the probabilities of failure of the individual serial barriers. Given a conceptually rigorous definition of the sequencing of the multiple barriers to minimize the chance of common failure modes, this approach allows, in a rational decision arena, acceptance of greater uncertainty in the performance of individual subsystems.
2. Emphasis on the retrieval option in conjunction with a concept of "increasing reasonable assurance" during the currently defined licensing stages: construction authorization, license to receive waste, license amendment to close, and license amendment to decommission. More data, modeling technology, and, most importantly, time for observation of the behavior of waste in the ground would become available during construction, operation, and closure of the facility. Together, these expanding sources of information would lead to a more confident basis for concluding that uncertainties have been adequately treated by the facility design. DOE believes this approach is consistent with the spirit of 10 CFR 60 and could permit initial licensing decisions to be made while some "unreviewed safety issues" pertaining to the ultimate level of reasonable assurance required for closure remain before the licensing board.

These and other strategic options are being considered in recognition of the concern raised by EEI. DOE believes that the goal of uncertainty treatment is not, and should not be, the reduction of uncertainty from a scientific perspective, but rather the goal is to characterize uncertainty and its influence on the decisions about whether the repository can provide adequate protection of human health far into the future. In pursuing these decisions, DOE holds that protection of health and safety, encoded in 40 CFR 191, is the paramount measure of repository (site) suitability.

REFERENCES

DOE (U.S. Department of Energy), 1990. Performance Assessment Strategy Plan for the Geological Repository Program, DOE/RW-0266P, U.S. Department of Energy, Washington, D.C.

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COMMENT 8:

SCP updates should present plans for addressing and resolving scenario selection and assessment issues.

Response:

As noted in EEI/UWASTE Comment 21, the Site Characterization Plan (SCP) presents a thorough and rigorous approach to the selection and screening of scenarios. The SCP is, however, primarily a plan for obtaining site characterization data. Site characterization, scenario development, and performance assessment are all interrelated and would go through many iterations even after the license application. The response to EEI/UWASTE Comment 21 addresses this issue of scenario development.

The Nuclear Waste Policy Act requires U.S. Department of Energy (DOE) to issue Site Characterization Progress Reports to keep the public, the U.S. Nuclear Regulatory Commission and the State of Nevada informed about major accomplishments in the Office of Civilian Radioactive Waste Management repository program. DOE also intends to report significant changes to baselined items in the site characterization program, as described in the Project Office's Test and Evaluation Planning Basis (Rev. 0), in these progress reports.

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COMMENT 9:

Refinements should be made in the organization of the SCP.

Response:

The Site Characterization Plan (SCP) for the Yucca Mountain site was issued by the U.S. Department of Energy (DOE) in December, 1988. It provides the general description of the program as required by Section 113(b) of the Nuclear Waste Policy Act, as amended. As such, DOE does not intend to revise the SCP through "updates." Approved changes to the plan would be covered in progress reports. See the response to Comment 10.

A significant action taken since release of the SCP in December, 1988, has been preparation of the Test and Evaluation Plan (T&EP) (Rev. 0) and implementing procedures to govern the site study/testing program in the SCP, how recommended changes are evaluated, and how and when DOE knows when enough data has been gathered to fulfill the needs of the characterization program.

Appropriate aspects of the SCP are baselined, encompassing its fundamental aspects (how and for what purpose data are to be gathered and analyzed). . Site geotechnical investigation and repository design/testing activities in the SCP are designed to provide information and data needed for the issue resolution and for the SAR. They have been developed using preliminary performance allocation based on preliminary performance assessment of the total system and major subsystems. Continuing assessments would contribute to iterations of performance allocation as test data are acquired. Although any ambiguities that might be present in the SCP would not be purged by a revision, technical reports that evolve from the SCP's study program would have to explain variances in how the plan for data acquisition and analysis, and performance modeling has evolved from those discussions that were considered adequate for the SCP.

The document that directs all the site geotechnical investigation and repository design/testing activities and their evaluations is the Test and Evaluation Plan (T&EP) issued by the Yucca Mountain Site Characterization Project Office of the DOE. The T&EP contains separate sections describing the three phases of the testing process: planning, implementation, and the evaluation of data. Some of the steps in the planning and evaluation phases require input from performance assessment. As the data from site investigation and testing become available they are evaluated through performance assessment for their contribution to site suitability, design issue resolution, and performance issue resolution. The first and the last may require total system performance assessment while the second may only need subsystem performance assessment. This interaction between site investigation and testing activities and performance assessment provides a formal mechanism that forces both of them to be iterative in practice.

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COMMENT 10:

The SCP is considerably more extensive and detailed than required for the plans, descriptions and information specified in Section 113(b) of the NWPA and 10 CFR 60.17. We do not take issue, however, with the scope of the document as it has been prepared. Rather, the comments that follow accept the SCP, including its breadth and depth, as a given. As a result, some of the points raised herein address matters that, in terms of the NWPA and NRC regulations, need not have been considered in the SCP at all. In any event, the document provides a comprehensive basis for proceeding with site characterization.

During site characterization, DOE is required by the NWPA, as amended, and by Nuclear Regulatory Commission (NRC) regulations to report not less than once every 6 months to the NRC and to the Governor and Legislature of Nevada on the nature and extent of site characterization activities and the information collected. EEI/UWASTE understands that, to comply with this requirement, DOE will issue semiannual progress reports during characterization at Yucca Mountain. These reports are intended to summarize the results of site characterization activities as information is collected and evaluated. This will help assure that the characterization process is adjusted and refined to develop appropriate information as work proceeds.

Response:

As required by Section 113(b) (3) of the Nuclear Waste Policy Act of 1982, as amended, the U.S. Department of Energy (DOE) has issued (February, 1990), and would continue to issue, a Site Characterization Progress Report. The progress report presents short summaries of the status of site characterization activities and cites the technical reports and research products that provide more detailed information on the activities. The report provides highlights of work started during the reporting period, work in progress, and work completed and documented during the reporting period. In addition, the report is the vehicle for the discussion of major changes, if any, to DOE's site characterization program resulting from ongoing collection and evaluation of site information; the development of repository and waste-package designs; the receipt of performance-assessment results; and any changes that occur in response to external comments.

The progress report only summarizes information and is intended to be used for information purposes only. It is not the mechanism for controlling and documenting technical or policy positions regarding changes in schedules or the testing program. Such changes are controlled through DOE change-control procedures, and the progress report only describes such approved changes.

See also the response to Comment 9.

EDISON ELECTRIC INSTITUTE COMMENTS ON
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REFERENCES

DOE (U.S. Department of Energy), 1990b. Progress Report on the Scientific Investigation Program for the Yucca Mountain Site, DOE/RW-0217P, Office of Civilian Radioactive Waste Management, Washington, D.C., No. 1, 9/15/88-9/30/89, 75 p.

EDISON ELECTRIC INSTITUTE COMMENTS ON
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COMMENT 11:

The program for site characterization presented in the SCP is extensive. The complexity of the Yucca Mountain site, itself, will require the expenditure of considerable resources, over an extended period of time, to complete characterization. This complexity will probably also result in substantial residual uncertainties despite massive data collection (potentially limited by the need to avoid compromising the site). Interpretations of the data -- in terms of scenarios, their probabilities and consequences -- will also be subject to uncertainty.

EELI/UWASTE agrees with DOE and the NRC that there is no basis for concluding, at this time, that the Yucca Mountain site is unsuitable. In view of the site's complexity and the fact that detailed characterization is now only beginning, the possibility that the Yucca Mountain site could be evaluated as unsuitable for a repository cannot be dismissed. Any possibility -- however remote -- that the site could be found unsuitable or unlicensable should be addressed as early as possible and not after years of characterization work and the expenditure of billions of dollars. To guard against such an outcome, DOE should conduct its site characterization program in a way so as to provide an early warning of any factor or set of factors indicative of fundamental site unsuitability and to identify factors indicative of site suitability.

The SCP does, in fact, acknowledge the potential for a fatal flaw at the site and site unsuitability. As stated on page 8 of the Overview document:

At any point in the site-characterization process, the DOE could uncover a major disqualifying flaw at the Yucca Mountain site. The discovery and confirmation of such a flaw would bring site-characterization activities to a halt; similarly, at the end of the site-characterization process, the DOE could reach the conclusion that the site is unsuitable.

Effective management of the repository program requires that characterization be conducted so that the chances of unsuitability not being identified until "the end of the site-characterization process" are minimized. Issues critical to site suitability and susceptible of early resolution should be identified and addressed on a priority basis. There is no indication in the SCP that this is being done.

There are a number of possible approaches to evaluating site suitability as characterization proceeds. For example, characterization activities could be specifically phased so as to identify -- at an early stage and with a substantial degree of certainty -- both the presence of all "favorable conditions," and the absence of "potentially adverse conditions," as those terms are defined in the NRC's high-level waste disposal regulations in 10 CFR Part 60.

Another approach would be to conduct an independent review of suitability, separate and apart from the basic program of site investigation presented in the SCP. Such a review might evaluate Yucca Mountain in terms of favorable

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and potentially adverse conditions, focusing on any perceived site vulnerabilities.

In this connection, we note that the SCP already addresses the NRC criteria in Section 8.3.5.17. The timing and completion of investigations necessary to support an early determination of site suitability, however, are not prescribed.

The discussion of Potentially Adverse Condition (PAC) 15 notes, for example, that the youngest volcanic rocks in the site area probably were formed as recently as 15,000 years ago. This places volcanic activity within the Quaternary Period (approximately the last two million years). The strategy proposed for this condition is to demonstrate that, although volcanism has occurred recently and may even be recurrent on a scale comparable to the repository's containment period, it will not significantly affect the ability of the geologic repository to meet the performance objectives. Such a demonstration involves the consideration of many scenarios and factors and might be relatively difficult to complete at an early stage of characterization.

On the other hand, PAC 7 concerns groundwater conditions at the site in terms of potential adverse effects on the engineered barrier system (i.e., the waste form, container, air gap separating the container from the borehole wall, and the underground facility). The investigation and analysis necessary to address this PAC may be relatively simple and straightforward, and involve little additional sampling and modeling. Accordingly, a plan for determining site suitability might involve the preparation of a schedule calling for an evaluation of PAC 7 and its completion, before PAC 15.

This is not to say that the commencement of characterization activities pertinent to considering volcanism and igneous activity should be delayed. It is beyond dispute that volcanic eruptions and igneous activity could adversely affect the performance of the repository system. Although not specifically designated as a disqualifying condition, volcanic eruption and igneous intrusion could result in so much uncertainty that demonstration of adequate repository performance would be impossible.

Site suitability issues should be identified and addressed early in the characterization program. The SCP, nevertheless, proposes a leisurely schedule for these studies in the area of postclosure tectonics, which includes the topics of volcanic eruption and igneous intrusion. For example, as presented in Table 8.3.1.8-9, proposed literature reviews on volcanic effects alone are scheduled to take one year (November 1990 and October 1991). This is an activity that could have completed even before the SCP was prepared, and certainly should not take an entire year to complete with the number of personnel available and in an era of computerized indices. In this connection, we note that the Journal of Geophysical Research, Volume 94, for May 10, 1989, included (beginning on page 5908) a comprehensive review of available information on volcanism in southwestern Nevada.

Further, as also presented in Table 8.3.1.8-9, the final report on the probability of future volcanic activity is planned for 1994 and, similarly, the draft report assessing waste package rupture due to faulting is planned

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for December 1993. There is no reason why realistic assessments of these issues cannot be available much earlier.

Up until now it may have been too early to decide on a specific approach to evaluating site suitability. Nevertheless, at this point DOE should begin developing a process for evaluation of site suitability, on a real time basis as site investigation proceeds. The process should then become a part of the Yucca Mountain characterization program. EEI/UWASTE urges that DOE begin now to evaluate various approaches to determining site suitability, and to integrate such a process into the site characterization program. This is an extremely important aspect of site characterization and one that we will continue to emphasize.

Response:

The U.S. Department of Energy (DOE) response to Comment 1 discusses a new focus of the revised repository schedule, i.e., to focus on the early evaluation of the suitability of the Yucca Mountain site.

The Testing Prioritization Task (TPT) is a DOE initiative identified in the Secretary of Energy's "Report to Congress on Reassessment of the Civilian Radioactive Waste Management Program" (DOE, 1989). The objective of the TPT is to review the current plans for conducting the testing program to ensure that activities are prioritized to study unsuitability conditions based upon DOE's Siting Guidelines (10 CFR 960) and U.S. Nuclear Regulatory Commission's (NRC) Siting Criteria (10 CFR 60), as well as other conditions early during site characterization. In addition, methodologies are being developed to support early determinations of site suitability during site characterization, and after site characterization has been completed. Comments and issues raised by the NRC, Nuclear Waste Technical Review Board, Edison Electric Institute, Advisory Committee on Nuclear Waste, State of Nevada, etc., are being considered. This activity would be coordinated with ongoing activities, such as (1) an evaluation of alternative license application strategies, (2) an assessment of data needs from the Calico Hills unit, and (3) an evaluation of alternative strategies for the ESF. Also, please see the response to Comment #23.

REFERENCES

DOE (U.S. Department of Energy), 1989. Report to Congress on Reassessment of the Civilian Radioactive Waste Management Program, DOE/RW-0247, Office of Civilian Radioactive Waste Management, Washington, D.C. 22 p.

EDISON ELECTRIC INSTITUTE COMMENTS ON
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COMMENT 12:

DOE's Quality Assurance (QA) Program for high-level waste disposal has presented problems for some time. In reviewing the CDSCP, the NRC expressed considerable concern over the QA program, which was detailed in Objection 5.

DOE has committed to having a QA program -- consistent with 10 CFR Part 60, Subpart G, and approved by the NRC -- in place before initiating any new site characterization activities or Exploratory Shaft Facility (ESF) construction, but has not yet completed the necessary work. As first explained by DOE during the October 19-21, 1988 meetings with the NRC on ESF open items, the Department will not be able to implement an adequate QA program in time to support the start of ESF construction any earlier than November of this year. Furthermore, based on EEI/UWASTE reviews of progress against schedule, DOE will not meet the November 1989 date, either. Thus, the entire repository program now faces delay because of QA deficiencies.

EEI/UWASTE concurs in Objection 5 and the NRC's criticism of the DOE QA program. We support the development of a sound, rigorous QA program. Although the need for such a program has been known to DOE for many years, progress has been slow and unsteady.

Response:

As discussed in more detail in the U.S. Department of Energy response to Comment 2, a quality assurance that meets the requirements of the U.S. Nuclear Regulatory Commission is now being established.

EDISON ELECTRIC INSTITUTE COMMENTS ON
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COMMENT 13:

Of particular concern to EEI/UWASTE is DOE's failure to maintain qualified, experienced management leadership in the area of QA. For example, as explained in Section 8.6.3 of the SCP, the Office of Quality Assurance within the Office of Civilian Radioactive Waste Management (OCRWM) provides vital guidance in the development of the Yucca Mountain Project QA program by: (1) reviewing and approving the Project QA plan; (2) specifying applicable requirements; (3) performing QA audits and surveillances of the Project; and (4) participating as observers of selected audits of Project contractors. In spite of its importance, the position of Director of the OCRWM Office of Quality Assurance has often been vacant. A permanent Director was only selected last year. We applauded his appointment, noting that it constituted an important step in establishing direction and long-term accountability. The "permanent" appointment, nonetheless, was short-lived, and the Director's position is now, again, vacant.

The Office of Quality Assurance was established as a separate entity, reporting directly to the Director of OCRWM, to assure the development and implementation of an effective QA program. The position of QA Director is of vital importance to the overall high-level waste program. It is imperative to DOE take action to identify and acquire a highly qualified, experienced individual to fill this position on an expedited basis.

Response:

Dr. John Bartlett, U.S. Department of Energy (DOE) Director of the Civilian Radioactive Waste Management (OCRWM) Program, announced a proposed reorganization of the program on July 9, 1990. The reorganization resulted from an independent management review and is designed to provide clear lines of responsibility, authority and accountability of the program and its contractors. As part of this reorganization, Donald Horton was named Director of the Office of Quality Assurance. He reports directly to the Director and is responsible for developing program quality assurance requirements and overseeing compliances and for interacting with the U.S. Nuclear Regulatory Commission on quality assurance requirements. In addition, Donald G. Horton is also acting as the Director, Yucca Mountain Quality Assurance Division (YMQAD). When the reorganization is formally implemented, it is planned to fill the position of Director, YMQAD, with a permanent replacement. Donald G. Horton has over 20 years of QA program and related experience in the private and commercial nuclear power industry. He has held QA positions with increasing responsibilities and has been the QA Manager for Arkansas Nuclear One, an operating commercial nuclear power station.

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COMMENT 14:

An aggressive approach to site characterization is appropriate. Uncertainties in current data and in the results of future site investigations should, nevertheless, be more clearly recognized in the SCP.

Similarly, it would be appropriate for the SCP to reflect the possibility that certain parameters may not be quantified with a high degree of precision, even after site characterization is complete. The SCP should clearly indicate how uncertainties are to be accommodated, and why they will not preclude -- in and of themselves -- a demonstration of suitability. In this same context, the SCP should acknowledge that DOE's expert judgment is likely to be challenged. The SCP should describe how DOE expert judgments will be developed and defended, and how differences in expert judgment will be resolved. Activities associated with developing positions based on expert judgment and resolving differences in expert judgment will be important, and they should be an integral part of site characterization plans.

Certain realities exist with respect to the site characterization process that should be recognized. Extensive as it is, the planned site characterization program (ESF, boreholes, trenches, etc.) will -- quite appropriately -- sample only a small fraction (on the order of one one-millionth) of the site volume. The database will be used primarily as input for interpretative expert judgments leading to the valuation of parameters such as the probability of future volcanic activity. Furthermore, because of site complexity, predicted parameters will have wide ranges. When these uncertainties are combined in performance assessment models, the assessments will, themselves, be uncertain.

EEI/UWASTE believes that these realities -- stemming from the basic nature of the site and its geologic history -- could make issue closure, in terms of site suitability and site performance, more difficult than the SCP implies. Simply put, necessary interpretive expert judgments will likely be subject to challenge. Further, it may not be possible to resolve issues by merely expanding data gathering, because intensive testing could compromise the future performance of the site.

EEI/UWASTE recommends that DOE develop and describe in the SCP specific, strategic plans for dealing with these potential difficulties in issue closure. Candidate strategies include reliance on wide margins between required and predicted performance; use of multiple, independent expert judgment groups performing peer review functions and operating under prescribed procedures; and early rulemakings to guide resolution of important issues, such as establishing a methodology for determining groundwater travel time. The development of plans and specific strategies will aid DOE in refining the site characterization program both by providing a clearer reflection of the level of residual uncertainty likely to be associated with site performance parameters after characterization is complete; and by helping to identify the aspects of characterization important to accommodating that uncertainty.

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Response:

The U.S. Department of Energy (DOE) response to Comment 7 discusses plans and strategies for dealing with potential uncertainties in characterizing the future performance of the site. DOE wishes to point out that there are several concurrent efforts now underway to carry out the types of initiatives identified. 1) the Testing Prioritization Task and its expansion to include in situ, or underground, testing, 2) development of a site suitability methodology, 3) the consideration of alternative license application strategies (ATLAS), 4) the development of strategic principles for the high-level waste program at DOE/Headquarters, and 5) the scoping and development of a new mission plan for the Office of Civilian Radioactive Waste Management.

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COMMENT 15:

In connection with uncertainty and groundwater, some additional points bear mention. First, the SCP indicates that significant volumes of drilling fluid from borehole USW G-1 were encountered in borehole USW UZ-1, about 300 meters away (see, for example, p. 3-150). The NRC review comments on the CDSCP also mention large fluid losses from USW G-4. However, we could find no discussion of how these losses and fluid migration correlate with the proposed model of groundwater movement in the unsaturated zone, or with a plan to evaluate the model based on present distribution of drilling fluids. This could be a problem in that the fluid loss suggest high rates of absorption by the rock matrix and fractures, and rapid vertical and horizontal transmission.

Response:

The U.S. Department of Energy (DOE) does not find the USW G-1 fluid losses, nor their occurrence in USW UZ-1, to be surprising. USW G-1 was drilled with a polymer-based mud at a time when the target repository zone was beneath the water table. Migration for 300 m along strike of the probable fracture zone represented by Drill Hole Wash is consistent with expected fracture characteristics in the Topopah Spring welded tuff. Large fracture permeability to liquids under conditions of concentrated flux is accepted as the probable condition but is not an adverse one. Rather, it is considered in 10 CFR 60.122 as the favorable condition of free drainage. If drilling fluids are encountered in fractures during mining of the exploratory shaft facility (ESF), their significance would be re-evaluated.

DOE has proposed a new activity in the Site Characterization Plan involving construction and testing of multipurpose boreholes (MPBHs) near the exploratory shafts, as part of the site geohydrology program (Activity 8.3.1.2.2.4.9). The primary objectives of this planned activity are to monitor and evaluate potential hydrologic and engineering interference effects due to shaft construction, to identify the possible occurrence of perched water, and to sample and test perched water if present. If perched water is detected in either of the two MPBHs, it may be the result of drilling fluids lost during the drilling of USW G-4. Drilling fluids used in USW G-4 contained 20 ppm LiBr tracer, and analyses for this tracer would establish whether any of the water samples obtained from the MPBHs contain drilling fluid that has migrated laterally from USW G-4 to the ESF excavation area. If water containing tracers is encountered, it may be useful in understanding fluid movement in the unsaturated zone. How the MPBHs are utilized depends in large part on the results of the ESF Alternatives Study.

DOE does not, however, expect to encounter drilling fluids from USW G-4 because the borehole was drilled under relatively low fluid pressures using an air-foam mixture with high surface-tension. DOE expects drilling fluids to drain back into the borehole rather than move through the surrounding rock mass. Several studies would be directed at understanding the nature of fracture and matrix interactions, with the goal of being able to predict how water moves in fractures. A few are identified in the following list:

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SCP Study 8.3.1.2.2.2: Water movement tracer tests using chloride and chlorine-36 measurements of percolation at Yucca Mountain

SCP Activity 8.3.1.2.2.3.1: Matrix hydrologic properties testing

SCP Activity 8.3.1.2.2.4.1: Intact-Fracture test in the exploratory shaft facility

SCP Activity 8.3.1.2.2.4.10: Hydrologic properties of major faults encountered in main test level of the exploratory shaft facility

Geologic and fracture mapping would provide information on the extent and interconnectedness of fractures and fracture systems.

Some performance assessment modeling activities would also provide understanding of how fractures and the matrix interact. These activities are expected to provide input on how tests should be conducted, similarly, the tests are expected to provide some insight on how unsaturated flow is to be modeled.

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COMMENT 16:

Second, an extensive program for testing hydrologic properties of the rocks in the unsaturated zone is presented in Section 8.3.1.2.2.3.1. This program would include a great number of tests on large pieces of rock from excavation of the exploratory shaft, plus tests on core samples obtained from drilling. We are concerned that this important program may not be well founded.

One potential difficulty stems from the fact that the large blocks recovered after each round of blasting might be the most indurated and coherent rocks in each interval (i.e., those that best survived the blast) and might not have representative properties. A second concern is that properties of the rock samples could be affected by the blasting.

Response:

The current appraisal by scientists responsible for the matrix-properties testing is that the introduction of water during shot-hole drilling is likely to be more deleterious to large-block representativeness than the blasting itself. In general, they prefer dry-drilled core sampling as the best method to minimize the disturbance that is inherent in any sampling method. This comment is noted, however, for consideration under the broader question of whether drill-and-blast or mechanical shaft-sinking and mining techniques should be employed. If the drill-and-blast method is selected, the results of testing on block samples would be compared with those for core samples (and, in the target-zone rocks, with in situ Exploratory Shaft Facility tests) to determine if there is a persistent blast-induced bias.

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COMMENT 17:

In addition, DOE plans to determine hydrogeologic units from test results on the basis on geostatistical/probabilistic methods (p. 8.3.1.2-189). While such methods can be useful, units should initially be defined deterministically on the basis of geologic/stratigraphic characteristics in order to aid understanding of the system and reduce the amount of testing needed.

Response:

The current conceptual model is, in fact, based on lithostratigraphic units, and further exploration would likely lead to refinement rather than replacement of this model. Therefore, the test results would incorporate deterministic analysis as well as statistical analysis. Also, the purpose of the sampling and testing is to "characterize" the matrix hydrologic properties of Yucca Mountain. The ability to better define the hydrogeologic units would help to group rocks with common characteristics for modeling (similitude). The number of samples tested would be determined by statistical and geostatistical analysis to define, with known certainty, the hydrologic properties of large blocks of rock. The definition of hydrogeologic units would be used to incorporate these blocks together into more easily modeled units. Study Plan 8.3.1.2.2.3 (Characterization of Percolation in the Unsaturated Zone--Surface-Based Study) includes more details.

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COMMENT 18:

Third, the SCP notes (p. 3-201) that the available water-level measurements are mostly composites of heads in various units. This results in some uncertainty regarding understanding of groundwater movement in the unsaturated zone. The investigations proposed in the SCP (in Sections 8.3.1.2.1.3.2 and 8.3.1.2.3.1.2) do not appear to resolve this uncertainty.

Response:

On the basis of the nature of the comment and the Site Characterization Plan (SCP) reference, the second sentence of the comment is assumed to refer to the saturated zone rather than the unsaturated zone.

The referenced statement on page 3-201 of the SCP does not accurately reflect the nature of the data on Figure 3-28. Although it is true that water levels in USW G-1, USW G-2, and USW G-3 are composites, data for the other holes are based on only slight penetration of the saturated zone (generally 50 to 100 m in the WT-series of holes) or on head measurements in shallow intervals isolated with packers (USW H-series, USW G-4, UE-25b#1, UE-25C#1, and UE-25p#1). The level in production well J-13 is dominated by the productive zone in the Topopah Spring welded tuff, which occurs at and slightly below the static water level. For USW G-1, a lack of vertical variability of head is indicated by the uniform temperature profile in the hole. The temperature profile in USW G-2 indicates that the principal permeability occurs from the "water table" downward for about 250 m, and the level is compatible with that in nearby UE-25 WT#6. USW G-3 also has a uniform temperature profile, and the water level is similar to the levels in holes to the north, south, and east. Consequently, the "composite potentiometric-surface map" is based on data that closely reflect water-table altitudes at the points of measurement.

The U.S. Department of Energy agrees, however, that there is uncertainty in inferring ground-water flow because of very small gradients, probable anisotropic conditions due to fracturing and principal stress orientations, and vertical changes of principal flow paths and head distribution. SCP Study 8.3.1.2.3.3, "Saturated Zone Hydrologic System Synthesis and Modeling," would integrate the results of multidisciplinary investigations in saturated-zone characterization (Study 8.3.1.2.3.1, "Characterization of the Site Saturated-Zone Ground-Water Flow System"), saturated-zone hydrochemistry (Study 8.3.1.2.3.2, "Characterization of the Saturated Zone Hydrochemistry") including natural isotopes, and ambient thermal conditions at the site (Study 8.3.1.15.2.2, "Characterization of the Site Ambient Thermal Conditions") to provide a more complete understanding of saturated-zone flow than is currently available.

For the future, the possibility of constructing piezometer nests to monitor vertical differences of head is discussed briefly in SCP Section 8.3.1.2.1.3.1 in a regional context and is expanded upon in the corresponding study plan. At the site scale, a piezometer nest already exists in USW H-1, and various depth intervals are isolated by packers in other holes. In addition, the hydraulic-testing methods have and would continue to include provisions for determining heads in multiple zones isolated by packers.

COMMENT 19:

Fourth, the importance of reducing uncertainties -- or learning early of major difficulties in doing so -- can be seen clearly in terms of the 1,000 year minimum for groundwater travel time (GWTT) from the disturbed zone to the accessible environment. The equations presented on pages 8.3.5.12-34 and -35 of the SCP can be combined to show that GWTT can be evaluated in terms of measurable site properties; i.e., in terms of porosity, permeability, hydraulic gradient, travel distance, and fluid viscosity and density. Section 8.3.5.12 discusses, competently and in depth, the issues involved in the evaluation, e.g., selection of GWTT models; permeability as a function of the degree of saturation; and distribution of flow between the matrix and fractures.

Our assessment of the SCP's treatment of GWTT is that the program can be expected to conduct the necessary evaluations -- in terms of principles and methods -- with competence. We do have a concern, however, with the uncertainty in, and the defensibility of, the results to be obtained.

Combining site parameters into relationships for evaluating GWTT results in combining the uncertainties in those parameters. EEI/UWASTE is concerned that, when the realities of the Yucca Mountain site, in terms of its complexity and diversity, are brought into play through data, the results of the GWTT evaluations will probably have very large uncertainties and be difficult to defend. Technically, the mean value of the GWTT is likely to be poorly defined; the probability distribution may be broad; and, as a result, the tail of the distribution may well fall below the 1000-year standard.

To take a simple example, information presented in the SCP (Section 3.9.4) indicates that compliance with the GWTT requirement will be based almost entirely on the estimated time for travel (vertical flux of 0.5 mm/yr) of vadose water through the unsaturated zone to the water table; a minimum of 9300 years. Minimum travel time through the saturated zone is estimated at 170 years (pp. 3-216 to 3-220).

DOE's estimates of travel times are based entirely on matrix flow, even though fracture flow could be important, as acknowledged in the SCP. However, the SCP notes that "hydrologic conditions within the fractured rocks of the unsaturated zone are not well known" (p. 3-7), and that "the conceptual model of groundwater flow through the unsaturated zone at the site has not been developed to a high confidence level" (p. 3-8). These statements reflect the need to reduce uncertainty. Estimates of groundwater travel time vary by orders of magnitude. If DOE's current minimum travel time of 9300 years were reduced by an order of magnitude, the resultant travel time would be less than 1000 years (about 930 years), and the site would not meet regulatory requirements.

EEI/UWASTE suggests that DOE address special attention to linking site geohydrologic data and GWTT evaluation as soon and in as much detail as possible. A principal purpose of such a near-term effort (i.e., before significant additions to the database are made) would be to identify key issues, and to devise more focused methods of addressing them.

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Response:

The U.S. Department of Energy (DOE) appreciates the Edison Electric Company's comments on the competent and in-depth discussion of the approach to addressing groundwater travel time. DOE also notes the concern that application of this approach may lead to estimates of the "true" travel time that include very large uncertainties even after site characterization is complete. The results are not in yet, but if this turns out to be the case, DOE would have to evaluate the consequences of such uncertainty in formulating its strategy for demonstrating site suitability or unsuitability as discussed in the DOE response to Comment 7.

One point of clarification needs to be made. The basis for estimating a minimum of 9,300 years of travel time on pages 3-216 through 3-220 of the Site Characterization Plan was not based on an assumption of matrix flow only. Indeed, the percentage of the distance along individual flowpaths characterized by flow through fractures ranged from more than 50 percent in the northeast part of the repository to less than 5 percent in the southwest. Therefore, the current estimates of the potential range of travel times incorporate, to a limited degree, the uncertainty associated with the potential for fracture flow. Accordingly, it is not apparent that the likelihood of travel times less than 1,000 years would be much higher than current estimates after all uncertainties remaining after with characterization are accounted for in the licensing analysis. Though the likelihood of short travel may change (either increase or decrease), the uncertainty should decrease about whether the modeling approach, in conjunction with the supporting site information, adequately captures the true likelihood.

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COMMENT 20:

In terms of uncertainty, EEI/UWASTE is also concerned that DOE might -- to some extent -- actually be complicating the problem unnecessarily. The rock characteristics program presented in section 8.3.1.4 provides an example.

Aside from recognizing the need to develop a three-dimensional model of rocks at the site, the logical basis of this program is not apparent. Because this site has been investigated extensively for many years, we would expect the general geologic model to have already been largely defined, and that proposed exploration would be focused on specific information needs. Instead, the plan seems to begin with a general, comprehensive program of site investigation. Many of the activities appear to have been incompletely planned. The plans for geophysical exploration seem particularly vague. Rather than being directed and focused on specific information needs, the plan summarized in Table 8.3.1.4-4 gives the impression that virtually all known geophysical techniques will be tried to determine if any of them will provide useful information about the site. This applies especially to the surface-based geophysical surveys (section 8.3.1.4.2.1.2), and -- to a lesser extent -- to the borehole geophysical surveys (section 8.3.1.4.2.1.3).

A particularly troublesome aspect of blanket geophysical exploration is that results are often uncertain and subject to considerable speculation. Indications may or may not correlate with geologic features which, themselves, may or may not be significant. These features become "uncertainties" and -- even though not important from a technical perspective -- may be difficult to dispose of in a licensing context.

Geophysical techniques should be employed only where appropriate, and in a deliberate fashion. Indiscriminate use of geophysical methods will not produce useful results and, in fact, may well add unnecessary confusion.

Response:

Although earlier investigations have defined the site geologic model in general terms, more detailed specific information is needed on the spatial lithofacies variability and continuity of individual stratigraphic units constituting the repository block. This includes a need for detailed information on the nature of subsurface faults and fracture networks, which are germane to developing models of the hydrologic flow system. Much of the required information would be provided by the analysis of core and borehole geophysical surveys conducted as part of the integrated drilling program. The surface-based geophysical surveys would provide the means of interpolating stratigraphic and structural characteristics of the repository area between borehole locations.

The geophysical surveys also provide support for satisfying information needs required by several other program elements, including unsaturated and saturated zone hydrology, mineral and energy resource assessment, and engineering studies of the surface-facilities site. Consequently, the geophysical program is widely dispersed throughout the Site Characterization Plan (SCP) and may give the impression of being vague and not optimally integrated. This concern has now been addressed by the issuance of a supplemental document to the SCP entitled "Status of Data, Major Results and

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Plans for Geophysical Activities, Yucca Mountain Project" (DOE, 1990). The purpose of this report is to review past geophysical activities and to present plans for conducting an integrated geophysical effort during site characterization that is sharply focused on the specific information needs required by all program elements. The report also presents the rationale for conducting feasibility tests to establish the effectiveness of various geophysical methods before they are used in the highly fractured volcanic terrain at the repository site. The report puts the entire geophysical program in a more sharply focused perspective than was possible within the organizational format of the SCP.

REFERENCES

Oliver, H.W., E.L. Hardin, and P.H. Nelson, 1990. Status of Data, Major Results and Plans for Geophysical Activities, Yucca Mountain Project, YMP/90-38.

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COMMENT 21:

DOE has expanded and improved the technical basis for scenario selection and assessment in the SCP. Section 8.3.5.13 presents a thorough and rigorous approach to the subject, and the Department is to be commended on the quality of its effort.

Nevertheless, DOE's plans and activities should reflect greater sensitivity to the potential difficulties to be encountered in resolving scenario-related issues in view of the significant role expert judgment will play, and the possibility for disagreement. The technical discussion in Section 8.3.5.13 demonstrates, implicitly, that a massive, far-reaching database will be needed to justify scenario selections. Moreover, every step beyond data acquisition (i.e., from data interpretation through defense of the final results) will rely principally on expert judgment.

Every exercise of expert judgment is, of course, subject to challenge. Experience with the licensing of nuclear power reactors indicates challenges can be formidable, and often difficult to resolve. EEI/UWASTE is particularly concerned over the fact that, for the high-level waste (HLW) repository, challenges will deal not only with interpretation of the geologic record, but, extend to projections of future conditions for 10,000 or more years. Difficulties will be compounded by the fact that the complexity and diversity of Yucca Mountain geologic and hydrologic conditions will cause uncertainty in the bases for data interpretations and judgments. In sum, DOE should anticipate and acknowledge the problems associated with making and defending scenario-related expert judgments that are critical to site evaluation and to repository licensing.

EEI/UWASTE believes that the Department's plans are not sufficiently sensitive to these difficulties. Our impression concerning the balance displayed in the SCP between data acquisition plans, and data utilization plans, is that the data utilization phase -- which will be the more difficult -- has not been given adequate attention.

It is not possible to determine from the content of the SCP if this lack of attention is due to a planned deferral of a detailed discussion to future SCP updates, or to a lack of an appreciation of these issues and their importance. EEI/UWASTE believe it would be highly beneficial to the DOE program, and to perceptions of the program by interested parties, if SCP updates were to display, as soon as possible, a fuller appreciation of these scenario selection and related judgment issues and to present plans -- comparable in quality and depth to the Study Plans for acquisition of technical data -- for addressing and resolving them.

One approach to dealing with disputes -- in addition to establishing a formal process for applying expert judgment in making decisions, as discussed in section 2.4 above -- is to demonstrate that an adequately representative scope of scenarios has been selected. A means for implementing this strategy would be to use a set of multiple, independent methods for obtaining the required results. Within the context of this discussion, the "required results" are those necessary for a comprehensive evaluation of compliance with regulatory standards.

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A specific multiple-method approach would be to supplement the SCP approach with three parallel independent evaluations:

An evaluation of repository performance under the assumption that the vadose zone saturates without change in the geologic setting (e.g., a major-climate-change scenario);

An evaluation of repository performance assuming saturation of the vadose zone accompanied by "nominal" changes in the geologic setting; and

A "threshold" evaluation in which marginal violation of a performance standard (the engineered barrier system nuclide release standard is suggested) is assumed and the scenarios necessary to produce that result are determined.

Note that these are not "bounding" or "worst-case" evaluations (in fact, the array of possible scenarios has no bounds or worst cases). Rather, they could be termed "specific significant threat scenarios," which might or might not emerge from DOE's planned winnowing of the universe of possible scenarios. The first two evaluations will serve to establish repository performance under reasonable upset conditions. The third evaluation will establish the severity of upset conditions necessary to cause repository performance to fall below that which is allowable. Taken altogether, the three scenarios will serve to indicate the general sensitivity of the site to perturbations in technical parameters. This, in turn, will serve to help evaluate whether or not an adequate scope of scenarios has been selected.

Other approaches could, no doubt, be developed. Greater attention to data utilization plans, however, is appropriate and will be necessary at some point.

Response:

As noted in this comment, the Site Characterization Plan (SCP) presents a thorough and rigorous approach to the selection and screening of scenarios. Nonetheless, the commentator is also correct in noting the imbalance between the data acquisition plans and the data utilization plans for scenario development. However, as noted in the U.S. Department of Energy (DOE) response to Comment 8, the SCP is a plan for obtaining site characterization data. Site characterization, scenario development, and performance assessment are all interrelated and would go through many iterations even after the license application.

DOE is aware of the potential difficulties, the significant role expert judgment would play, and the possibility of disagreement. It is developing methodologies to systematically select and screen scenarios, which include use of expert judgment. It should be noted that the set of scenarios in the SCP Section 8.3.5.13 is only preliminary and is intended to guide the site characterization program. These scenarios would be systematically reviewed in the early stage of the program and then updated as new information becomes available.

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With regard to the suggested multiple method approach using three parallel independent evaluations, it is consistent with what DOE is planning. The scenarios do, however, have to be bounded, i.e., scenarios should be constructed within the bounds of reasonableness. If we apply Markov's inequality to the U.S. Environmental Protection Agency containment requirement criteria (also U.S. Nuclear Regulatory Commission's criteria in CFR 60.112), it can be easily shown that the system may violate the requirement with only a few unrealistic assumptions made in the scenarios even if the performance of the overall system is robust. The bounds of reasonableness can only be established with the help of performance assessment and actual site data, taking into account the uncertainty of concerns expressed in Comments 7, 14 and 26. DOE is in the process of developing the methodologies as part of its performance assessment activities.

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COMMENT 22:

The SCP is a massive document containing an enormous amount of information. Because of this, and the manner in which it is organized, the SCP is difficult for anyone not having a fairly detailed understanding of the high-level waste repository program to understand. In addition, the complexity of the document tends to obscure the interrelationship of technical factors and information needs. These problems and some suggestions are discussed in greater detail below.

Because the SCP is organized in such a way as to separate the discussion of: (a) the technical bases and fundamental design concepts (Chapters 1-7); from (b) the program rationale (Section 8.1), issues strategy (Section 8.2), and the planned tests, analyses and studies (Section 8.3), it is difficult to identify DOE's integrated strategic and technical approach to demonstrating compliance with regulatory requirements. For example -- because of the need to review many different parts of the SCP pertinent to the issue -- it is not easy to obtain a clear picture of an integrated approach to the various geologic, hydrologic, geochemical, and design factors involved in compliance with the 10 CFR Part 60 requirements for substantially complete containment within the waste package.

To assist the reader, and also to provide useful guidance to the NRC and future licensing boards, it would be helpful for DOE to supplement the statutory SCP with separate "guide" documents, highlighting the integration and interaction of the diverse technical factors bearing on the major repository siting and safety performance issues. By way of example, a prototype of a typical "guide" document, of the type we would suggest, was attached to our CDSCP comments as Appendix A, and is also included as the Attachment to these comments.

The prototype is entitled: "Yucca Mountain Site Consultation Draft Site Characterization Plan, Guide for Engineered Barrier System Performance." The guide represents, in effect, a roadmap to the CDSCP for understanding DOE's strategy for addressing the engineered barrier system design requirements contained in NRC regulations. EEI/WASTE believes that such guides would be helpful companion documents to the SCP.

Response:

The comment regarding the organization of the Site Characterization Plan (SCP) was also valid for the SCP/Consultation Draft (SCP/CD). The separation of the various types of information is based on the guidance provided by the U.S. Nuclear Regulatory Commission (NRC) in Regulatory Guide 4.17. An effort has been made to provide appropriate forward references to Chapter 8 in Chapters 1-7, and to refer to the existing information discussed in Chapters 1-7 through references provided in Chapter 8. In addition, the U.S. Department of Energy (DOE) issued a SCP Overview which serves as a general summary of the SCP and indicates where more detailed information can be found in the SCP. Section 5.1 of the Overview discusses some aspects of the type of information recommended as appropriate for a "guide" document envisioned in Appendix A of Edison Electric Institute comment package. However, the information contained in the example "guide" document is also in the SCP itself though perhaps not in the same format suggested by the "guide."

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Study Plans would provide a more detailed technical presentation and would relate the activities performed to other studies that would potentially utilize the information. The recommendation to develop supplemental guides for the major issues has merit, but DOE believes that a series of currently planned interactions with the NRC on the major issues needs to occur prior to committing to such guides. In any case, the strategy and activities necessary to resolve major issues would be defined early during site characterization in order to organize the issues for development of the license application.

DOE agrees that the SCP is a large and complex document that cannot be well understood with a partial or cursory review. As stated in DOE's response to EEI Comment 1 on the SCP/CD, which is essentially reiterated in this comment, the fundamental organization of the SCP was based on NRC Regulatory Guide 4.17 (NRC, 1987). SCP Chapters 1-7 (description of the site, waste form and package, and conceptual design of a repository) contains forward references to Chapter 8 (site characterization program) and existing information about the site discussed in Chapters 1-7 is referenced in Chapter 8. In addition, Chapter 8 was organized to address DOE's issues hierarchy and the investigations, data, and analyses needed to resolve those issues.

REFERENCES

NRC (U.S. Nuclear Regulatory Commission), 1987. Standard Format and Content of Site Characterization Plan for High-Level-Waste Geologic Repositories, Regulatory Guide 4.17, Washington, D.C.

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COMMENT 23:

The SCP treats postclosure regulatory requirements (e.g., those concerning containment, nuclide release from engineered barriers, and nuclide release to the accessible environment) and the pre-emplacment groundwater travel time criterion, as independent issues of equal rank. In terms of issue resolution for licensing, this approach is appropriate. Programmatically, however, there is a high degree of commonality in the technical factors and information needs bearing on compliance with these standards. Further, postclosure standards are technically interactive.

As an aid to conducting site characterization activities, and to assist in eliminating unnecessary characterization work, it would be helpful if the SCP were to contain an integrated plan for the conduct of tests, analyses and studies. Such a plan might be keyed to a diagram illustrating the interrelationships among technical factors together with regulatory requirements. The plan would make clear, for example, that the fastest likely path associated with groundwater travel time to the accessible environment can only be determined after the conceptual model for the hydrologic regime has been established.

Development of such a plan would identify the couplings among key issues and the individual technical disciplines discussed in the SCP. Following the plan would assure that progress within each discipline proceeds in an efficient manner, directed to issue resolution.

Response:

The Site Characterization Plan (SCP) contains an issue resolution strategy based upon an exhaustive cross-referencing between the regulatory requirements and the technical data that needs to be gathered to satisfy these needs. The comment states that U.S. Department of Energy (DOE) should have a plan which identifies the couplings among key issues and the individual technical disciplines needed to carry out the SCP study program. The SCP is DOE's integrated plan to conduct these tests, analyses, and studies, which may not have been constructed according to the preferences of the commentor. Some of the studies described in the SCP were not "driven down" to the same low-level of detail in performance allocation, which may be a partial source of the commentor's concern.

The Secretary of Energy's "60-day" report to Congress (DOE, 1989) committed DOE to focus on early surface-based testing aimed specifically at evaluating whether the site has any features that would indicate that it is not suitable as a potential repository site, based on an application of the potentially adverse conditions (PACs) identified in 10 CFR Part 960. A major review of surface-based testing at Yucca Mountain was initiated in February 1990 at the Yucca Mountain Site Characterization Project Office in Las Vegas. The objective of this review is to determine the sequencing for SCP studies and activities, based on a review of the performance allocation tables in the SCP, and analysis of which SCP studies and activities are gathering the data that has the most bearing upon determining whether geotechnical conditions at the site may indicate it to be not suitable. Duplicative tests and analyses can be identified and removed from the planned technical program, and a formal decision-aiding methodology that is

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to evolve from this study can be used iteratively to determine whether proposed future changes to the test and analysis program are warranted, based on a consistently applied methodology. Recently, the scope of that effort, the Testing Prioritization Task (TPT), has been revised to consider all tests enumerated in the SCP. Unsuitability conditions based on DOE's Siting Guidelines (10 CFR 960) and U.S. Nuclear Regulatory Commission's Siting Criteria (10 CFR 60.122) are the basis for determining which site conditions should be investigated early and, in addition, which testing activities are most likely to detect and/or characterize these conditions. The development of a site suitability methodology is now part of a separate but parallel and consistent effort.

Appropriate aspects of the SCP are baselined, encompassing its fundamental aspects (how and for what purpose data are to be gathered and analyzed). Site geotechnical investigation and repository design/testing activities in the SCP are designed to provide information and data needed for the issue resolution and for the SAR. They have been developed using preliminary performance allocation based on preliminary performance assessment of the total system and major subsystems. Continuing assessments would contribute to iterations of performance allocation as test data are acquired. Although any ambiguities that might be present in the SCP would not be purged by a revision, technical reports that evolve from the SCP's study program would have to explain variances in how the plan for data acquisition and analysis, and performance modeling has evolved from those discussions that were considered adequate for the SCP.

The document that directs all the site geotechnical investigation and repository design/testing activities and their evaluations is the Test and Evaluation Plan (T&EP) issued by the Yucca Mountain Site Characterization Project Office of the DOE. The T&EP contains separate sections describing the three phases of the testing process: planning, implementation, and the evaluation of data. Some of the steps in the planning and evaluation phases require input from performance assessment. As the data from site investigation and testing become available they are evaluated through performance assessment for their contribution to site suitability, design issue resolution, and performance issue resolution. The first and the last may require total system performance assessment while the second may only need subsystem performance assessment. This interaction between site investigation and testing activities and performance assessment provides a formal mechanism that forces both of them to be iterative in practice.

REFERENCES

DOE (U.S. Department of Energy), 1989. Report to Congress on Reassessment of the Civilian Radioactive Waste Management Program, DOE/RW-0247, Office of Civilian Radioactive Waste Management, Washington, D.C., 22 p.

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COMMENT 24:

The SCP is a thorough, fundamentally sound document. In particular, it is considerably more extensive and detailed than required for the plans, descriptions and information specified in the Nuclear Waste Policy Act, as amended, and applicable Nuclear Regulatory Commission regulations in 10 CFR Part 60. The document provides a comprehensive basis for proceeding with site characterization work.

EEI/UWASTE urges, however, that DOE begin developing an approach for evaluating site suitability on a real time basis, as characterization proceeds. The Yucca Mountain site has had a dynamic geologic history and is structurally complex. While there is no basis for concluding, at this time, that the Yucca Mountain site is unsuitable, it is not inconceivable that disqualifying flaws could be identified in the future. Any possibility -- however remote -- that the site could be found unsuitable or unlicensable should be addressed as early as possible, and not after years of characterization work and the expenditure of billions of dollars. To guard against such an outcome, DOE should conduct its site characterization program in a way so as to provide an early warning of any factor or set of factors indicative of fundamental site unsuitability.

Response:

The U.S. Department of Energy response to Comments 1 and 23 discusses a new focus of the revised repository schedule that is to focus on the early evaluation of the suitability of the site.

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COMMENT 25:

In addition, DOE's QA program for high-level waste disposal has been a source of problems for some time. QA was the subject of an NRC Objection, raised during review of the CDSCP, which has yet to be resolved. Of special concern to EEI/UWASTE has been DOE's failure to maintain qualified management leadership in the area of QA. The position of QA Director in the OCRM Office of Quality Assurance is of vital importance to the overall high-level waste program. It is imperative that DOE identify and retain a highly qualified, experienced individual to fill this position on an expedited basis.

Response:

The U.S. Department of Energy response to Comments 2 and 13 discusses the current status of the quality assurance program at both the program and project levels.

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COMMENT 26:

EEI/OWASTE is also concerned that the characterization plans presented in the SCP do not reflect a full appreciation of, and concern for, difficulties that will be encountered in attempting to reduce uncertainties associated with site parameters to acceptable levels. DOE should develop and present in the SCP specific strategic plans for dealing with potential uncertainties as they pertain to issue closure. Candidate strategies include reliance on wide margins between required and predicted performance; use of multiple, independent expert judgment groups performing peer review functions and operating under prescribed procedures; and early rulemakings to guide the resolution of important issues.

Response:

The U.S. Department of Energy (DOE) response to Comment 7 recognized that the Site Characterization Plan does not address the resolution of uncertainties in depth. That response also discusses regulatory and technical aspects of the uncertainties in future performance. DOE notes the strategies for dealing with this problem contained in this comment and in Comment 14. The response to Comments 7 and 14 discusses several examples of avenues where new strategies are being considered.

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COMMENT 27:

The adequacy of scenario selection and assessment is also likely to present serious difficulties. SCP updates should present plans -- comparable in quality and depth to the Study Plans for the acquisition of technical data -- for addressing and resolving scenario selection and assessment issues.

Response:

The U.S. Department of Energy response to Comment 21 addresses the adequacy of scenario selection and assessment.

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COMMENT 28:

Finally, refinements should be made in the organization of the SCP. It would be helpful if DOE's integrated and strategic technical approach to demonstrating compliance with regulatory requirements was presented more succinctly. In addition, the relationship among regulatory requirements and technical parameters should be clarified.

Response:

The Site Characterization Plan (SCP) for the Yucca Mountain site was issued by the U.S. Department of Energy (DOE) in December, 1988. It provides the general description of the program as required by Section 113(b) of the Nuclear Waste Policy Act, as amended. As such, DOE does not intend to revise the SCP through "updates." As required by the Act, DOE has issued (DOE, 1990) and would continue to issue Site Characterization Progress Reports. The progress report presents short summaries of the status of site characterization activities and cites the technical reports and research products that provide more detailed information on the activities. The report provides highlights of work started during the reporting period, work in progress, and work completed and documented during the reporting period. In addition, the report is the vehicle for the discussion of major changes, if any, to DOE's site characterization program resulting from ongoing collection and evaluation of site information; the development of repository and waste-package designs; the receipt of performance-assessment results; and any changes that occur in response to external comments.

The progress report only summarizes information and is intended to be used for information purposes only. It is not the mechanism for controlling and documenting technical or policy positions regarding changes in schedules or the testing program. Such changes are controlled through DOE change-control procedures, and the progress report only describes such approved changes.

See also the response to Comment 9.

REFERENCES

DOE (U.S. Department of Energy), 1990b. Progress Report on the Scientific Investigation Program for the Yucca Mountain Site, DOE/RW-0217P, Office of Civilian Radioactive Waste Management, Washington, D.C., No. 1, 9/15/88-9/30/89, 75 p.