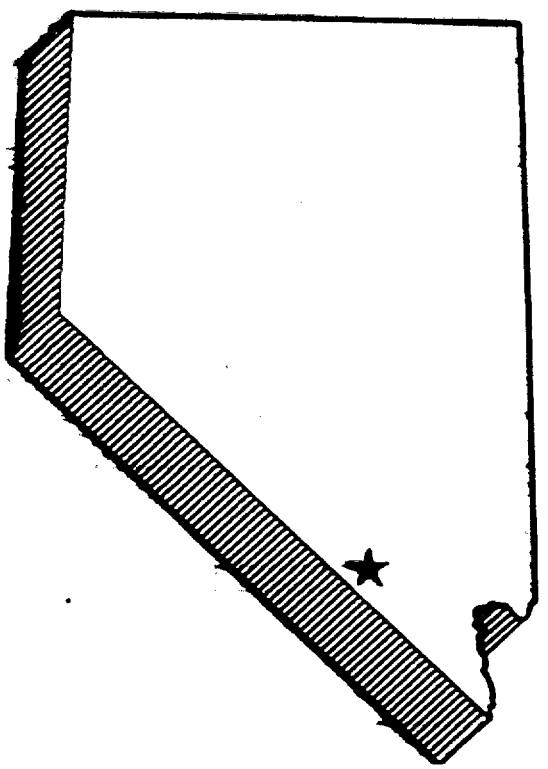
UWASTE

Utility Nuclear Waste and Transportation Program
A Program Administered by the Edison Electric Institute

REPORT ON DOE's SITE CHARACTERIZATION PLAN FOR THE YUCCA MOUNTAIN SITE



June 1, 1989

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UWASTE

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SITE CHARACTERIZATION PLAN

FOR THE YUCCA MOUNTAIN SITE

June 1, 1989

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Summary of Conclusion

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

- 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.

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

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

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

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

- Refinements should be made in the organization of the SCP.

1.0 INTRODUCTION

The following comments on the Department of Energy's Site Characterization Plan for the Yucca Mountain Site are offered by the Edison Electric Institute (EEI) and the Utility Nuclear Waste and Transportation Program (UWASTE). EEI is the association of the nation's investor-owned electric utilities. UWASTE is a group of electric utilities providing active oversight of the implementation of federal statutes and regulations related to radioactive waste management and nuclear transportation.

The Yucca Mountain area in southern Nevada is the site to be characterized for the nation's first geologic repository for high-level radioactive waste disposal. Last year the Department of Energy (DOE) issued a Consultation Draft Site Characterization Plan (CDSCP). One objective of the CDSCP was to provide an opportunity for input to DOE's plans for the development and issuance of the statutory Site Characterization Plan (SCP), required under the Nuclear Waste Policy Act of 1982, as amended (NWPA). A second objective was to facilitate formal review following issuance of the SCP by enabling parties to become familiar with the document in advance. EEI and the Utility Nuclear Waste Management Group (or UNWMG, a predecessor of UWASTE) reviewed the CDSCP and attended numerous workshops. In August 1988, EEI/UNWMG submitted comments on the CDSCP.

In December 1988, DOE issued the SCP. EEI/UWASTE has reviewed this document and, in addition, have attended the March 21, 1989 hearings in Las Vegas,

Nevada, which were conducted by DOE to obtain public input. The following comments are based on that work.

In preparing these comments, EEI/UWASTE has not conducted a line-by-line review of the entire SCP. We have concentrated on the overall logic, structure and content of the document to gauge it in terms of both completeness and the propriety of the licensing approach embodied therein. Portions of the SCP have also been spot-checked for consistency and accuracy.

A number of comments in this report are similar to those we offered last year in connection with the CDSCP. They have been included here -- when and where appropriate -- in order to combine all comments pertinent to the SCP in one place.

2.0 COMMENTS

2.1 Overview

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 C.F.R. § 60.17. We do not take issue here, 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 semi-annual 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.

2.2. Site Suitability

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.

EEI/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 C.F.R. 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 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 vulcanism 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 been 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 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.

2.3 Quality Assurance

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. [1]

DOE has committed to having a QA program -- consistent with 10 C.F.R. 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

[1] Under section 5.3.2 of the "Review Plan for NRC Staff Review of DOE's Site Characterization Plan" (December 12, 1988), Objections are reserved primarily for concerns with activities that "could cause significant and irreparable adverse effects on . . . eventual usability of the data for licensing." Because of their nature, NRC recommends that DOE not start work until objections are satisfactorily resolved.

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.

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 that DOE take action to identify and acquire a highly qualified, experienced individual to fill this position on an expedited basis.

2.4 Presumptions Underlying Planned Site Investigation

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.

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 suggests high rates of absorption by the rock matrix and fractures, and rapid vertical and horizontal transmission.

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.

In addition, DOE plans to determine hydrogeologic units from test results on the basis of geostatistical/probabalistic 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.

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.

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.

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.

2.5 Adequacy of Scenario Selection and Assessment

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.

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.

2.6 Supplemental Issue Documents and the Relationship among Regulatory Requirements and Technical Parameters

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.

2.6.1 Supplemental Issue Documents

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 C.F.R. Part

60 requirement 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/UWASTE believes that such guides would be helpful companion documents to the SCP.

2.6.2 Relationship among Regulatory Requirements and Technical Parameters

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-emplacement 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 flow 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 across the individual technical disciplines discussed in the SCP. Following the plan would help assure that progress within each discipline proceeds in an efficient manner, directed at issue resolution.

3.0 CONCLUSION

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 C.F.R. 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.

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 OCRWM 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.

EEI/UWASTE 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.

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.

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.

Appendix A

P R O T O T Y P E

Yucca Mountain Site

Consultation Draft

Site Characterization Plan

Guide

for

Engineered Barrier System Performance

Nuclear Regulatory Commission (NRC) regulations contain requirements for the performance of certain barriers within a high-level waste (HLW) repository after permanent closure. In particular, under the regulations, the engineered barrier system 1/ must be designed so that, assuming anticipated processes and events: (1) the containment of HLW will be substantially complete during the period when radiation and thermal conditions in the engineered barrier system are dominated by fission product decay; and (2) any release of radionuclides from the engineered barrier system will be a gradual process resulting in small fractional releases to the geologic setting over long periods of time. Section 60.113(a)(1)(ii) specifically provides that, in satisfying these requirements, the engineered barrier system be designed so that, assuming anticipated processes and events,

> (A) Containment of HLW within the waste packages will be substantially complete for a period to be determined by the Commission taking into account the factors specified in Section 60.113(b) provided, that such period shall be not less than 300 years nor more than 1,000 years after permanent closure of the geologic repository; and

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1/ The "engineered barrier system" is made up of the waste packages and the underground facility. A "waste package," in turn, is the waste form and any containers, shielding, packing and the absorbent materials immediately surrounding an individual waste container; while the "underground facility" is the underground structure, including openings and backfill materials, but excluding shafts, boreholes, and their seals. 10 C.F.R. Section 60.2.

> (B) The release rate of any radionuclide from the engineered barrier system (EBS) following the containment period shall not exceed one part in 100,000 per year of the inventory of that radionuclide calculated to be present at 1,000 years following permanent closure, or such other fraction of the inventory as may be approved or specified by the Commission; provided, that this requirement does not apply to any radionuclide which is released at a rate less than 0.1% of the calculated total release rate limit. The calculated total release rate limit shall be taken to be one part in 100,000 per year of the inventory of radioactive waste, originally emplaced in the underground facility, that remains after 1,000 years of radioactive decay.

The Department of Energy (DOE) has prepared a Consultation Draft Site Characterization Plan (CDSCP) for the Yucca Mountain site. The CDSCP presents available geotechnical information about the site; a description of the conceptual design of the repository; a description of the waste package; and a detailed discussion of the plans for characterizing the site.

More specifically, Part A of the CDSCP consists of an introduction and seven chapters. The introduction describes the geographic setting of the site and discusses sources of information and the history of site investigations. Chapters 1 through 5 discuss the available information about the site. The last two chapters in Part A are concerned with the conceptual design of the repository (Chapter 6) and the waste package (Chapter 7).

Part B of the CDSCP consists of only one chapter (Chapter 8). It describes, in detail, the site characterization program itself.

The DOE strategy for resolving major repository licensing issues is embodied within the CDSCP. In particular, with respect to meeting the design requirements for the EBS, discussed above, the DOE strategy is as follows:

1. As the primary means of achieving regulatory compliance, design the waste package container for a 10,000-year lifetime, and impose strict manufacturing QA requirements to help assure the design lifetime goal is achieved.

2. As concomitant and a secondary means for achieving compliance, demonstrate that for EBS design and expected site conditions, the potential for groundwater contact with the containers and corrosion resulting in container penetration and nuclide release, is extremely small.

3. Postulate that nuclide release does occur, despite design measures, and demonstrate that amounts released are extremely small. Perform detailed analyses for less than 100 years, 100-300 years, 300-1,000 years, and more than 1,000 years.

4. Show, on the basis of experimental data, that expected waste-form leach rates will help constrain nuclide releases, but do not rely upon leach resistance as basis for compliance. (Current data indicate that releases from spent fuel are several orders of magnitude below the one part in 100,000 per year limit, and that glass releases are about two orders of magnitude higher than spent fuel.)

5. As a backup, confirm in detail the potential nuclide releases from waste form and waste package throughout the range of potential service conditions.

The CDSCP is organized to provide for an orderly presentation of pertinent site information and description of characterization activities. However, because relevant material is distributed throughout the document, it is necessary to integrate a number of different sections within the CDSCP -- some of which are widely separated -- in order to obtain a comprehensive understanding of DOE's strategy for resolving major licensing issues.

As an aid to the CDSCP reader, Table 1, below identifies those portions of the CDSCP which provide information pertinent to DOE's strategy, outlined above, for meeting design requirements to for the EBS. 2/ Embodied within the cited portions of the CDSCP is the DOE strategy, itself, as well as the details of its implementation and background. A review of those portions of the CDSCP referred to in the Table will provide the reader with a comprehensive understanding of the EBS containment issue, DOE's approach in addressing it, and the interaction of the pertinent and diverse technical factors associated with it.

2/ The separate "Yucca Mountain Site Consultation Draft Site Characterization Plan Guide for the Waste Package" provides information analogous to that presented in this Guide, but pertinent to DOE's strategy for meeting the separate requirements for the waste package portion of the EBS.

EBS STRATEGY REFERENCED TO CDSCP SECTIONS

Strategy Element	CDSCP Section(s)
10,000-year lifetime design	8.3.4.2
Requirement for strict manufacture QA	8.3.5.9
Restrict groundwater contact	8.2.2.1
Postulated nuclide release	8.3.5.9
Time interval studies	8.3.5.10
Waste form leach resistance to limit release	7.4.3.4
Limitation on leach resistance as a principal barrier	8.3.5.9
Confirmation of strategy effectiveness with EBS system-level performance assessments	7.4.5 8.3.5.10

Table 1