EDISON ELECTRIC INSTITUTE
and
UTILITY NUCLEAR WASTE MANAGEMENT GROUP

COMMENTS ON

THE DEPARTMENT OF ENERGY'S

CONSULTATION DRAFT SITE CHARACTERIZATION PLAN

FOR THE YUCCA MOUNTAIN SITE

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Table of Contents

List of Tables

1.0 INTRODUCTION

The following comments on the Department of Energy's Consultation Draft Site Characterization Plan for the Yucca Mountain Site are offered by the Edison Electric Institute (EEI) and Utility Nuclear Waste Management Group (UNWMG). EEI is the association of the nation's investor-owned electric utilities. UNWMG is a group of 45 electric utilities providing active oversight of the implementation of federal statutes and regulations related to radioactive waste management.

The Yucca Mountain area in southern Nevada is the proposed site of the nation's first geologic repository for high-level radioactive waste. The Department of Energy (DOE) has provided a Consultation Draft Site Characterization Plan (CDSCP) preparatory to issuance of the statutory Site Characterization Plan (SCP) required by Section 113(b) of the Nuclear Waste Policy Act, as amended (NWPA). The Nuclear Regulatory Commission (NRC) has also prepared Final Point Papers, dated May 11, 1988, presenting the results of its own Staff review of the CDSCP.

EEI/UNWMG have reviewed the CDSCP. We attended numerous associated workshop sessions, including:

- the DOE general session on the CDSCP, held January 28-29, 1988 in Reno, Nevada;
- the DOE quality assurance (QA) program meeting, held March 18, 1988 in Rockville, Maryland;

- the CDSCP workshop on the NRC's draft point papers, held March 21-24, 1988 in Rockville, Maryland;
- the alternative conceptual models workshop, held April 11-14, 1988 in Las Vegas, Nevada;
- the DOE/NRC meeting on QA open items and the Nevada Nuclear Waste Storage Investigations (NNWSI) QA plan, held July 7-8, 1988 in Rockville, Maryland; and
- the DOE/NRC meeting on Exploratory Shaft Facility issues, held July 18-19, 1988 in Rockville, Maryland.

The following comments are based upon the results of this work.

In preparing these comments, EEI/UNWMG have not conducted a page-by-page review of the entire CDSCP. Rather, we have concentrated on the overall logic and structure of the CDSCP, as well as the propriety of the characterization and licensing strategies embodied therein.

As a result, these comments are not a line-by-line critique. They are, however, aimed at being constructive. Each comment addresses an individual point. The point is then developed in an accompanying discussion. Further, we have attempted to develop specific recommendations whenever possible; rather than simply present a general criticism. Overall, our aim has been not to identify areas where the CDSCP might be improved; but to offer specific suggestions as to how improvements might be achieved.

2.0 COMMENTS

2.1 Overview

Overall, the CDSCP is thorough and sound. In particular, it is far more extensive and detailed than the general plan, descriptions and repository conceptual design information called for in Section 113(b) of the NWPA. As a result, the CDSCP forms a firm foundation upon which to proceed with the preparation of the statutory SCP and, ultimately, the actual work of site characterization, itself.

The NRC's Final Point Papers, however, contain five "Objections." Within the context of the Final Point Papers the term "Objection" is used to identify "matters of such immediate seriousness to the site characterization program that NRC would recommend DOE not start work until they are satisfactorily resolved." EEI/UNWMG agree with the Objections noted in the NRC's Final Point Papers, and urge that DOE continue its efforts to resolve these matters on a priority basis.

In this connection, EEI/UNWMG have been concerned for some time over the lack of progress in developing Quality Assurance plans and procedures for the DOE repository program. This same concern is the subject of Objection 5 in the Final Point Papers.

We are encouraged, however, by recent DOE initiatives in this area. The appointment of a permanent Director to head

the Office of Quality Assurance is an important step in establishing direction and long-term accountability in the QA program. Further, aggressive pursuit of the plan and schedule for obtaining NRC acceptance of the DOE QA program, as presented at the July 7, 1988 DOE/NRC meeting on open QA items, should assure the establishment of a QA program sufficient to support new site characterization work on a timely basis. DOE's approach to addressing the NRC's concerns with respect to QA, as expressed in Objection 5, should serve as a model for resolving the issues raised in other Objections.

Notwithstanding the Objections contained in the NRC's Final Point Papers, however, the CDSCP reflects the results of a dedicated and comprehensive effort by DOE. The discussions of each technical area -- such as geology, hydrology, and climatology -- demonstrate an in-depth understanding of the various disciplines and related issues. DOE is to be commended for assembling a technical team capable of addressing the broad scope of issues associated with investigating the Yucca Mountain site. DOE is also to be commended for its management of these resources; e.g., for the use of management and review procedures leading to thorough, yet focused, discussions of technical issues, plans, and methodologies in the CDSCP. The technical competence reflected in the CDSCP provides confidence that DOE's resources can meet all technical requirements for the Yucca Mountain project.

2.2 Supplemental Issue Documents

Because the CDSCP is organized in such a way as to separate the discussion of: (a) the technical base and fundamental design concepts (Chapters 1-7); from (b) the proposed program rationale (Section 8.1), issues strategy (Section 8.2), and the planned characterization activities (Section 8.3), it is difficult to identify DOE's integrated strategic and technical approach for demonstrating compliance with regulatory requirements. For example -- because of the need to review many different parts of the CDSCP 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 10 CFR 60 requirements for substantially complete containment within the waste package and engineered barrier system.

To assist the reader, it would be helpful for DOE to supplement the statutory SCP (which, presumably, will have the same basic structure as the CDSCP) with separate, "guide" documents, highlighting the integration and interaction of the diverse technical factors bearing on the major repository siting and safety performance issues. These "guides" would permit individuals to follow the development and planned implementation of DOE strategy for addressing such issues without first becoming familiar with the entire SCP.

To be more specific, attached to these comments as Appendix A is a "prototype" of a typical guide. It is intended to serve as a general, illustrative example of the type of document we would suggest.

The prototype is entitled: "Yucca Mountain Site Consultation Draft Site Characterization Plan, Guide for Engineered Barrier System Performance." The guide is -- in effect -- a roadmap to the CDSCP for understanding DOE's strategy for addressing the engineered barrier system (EBS) design requirements contained in NRC regulations. The prototype is not a final document, which has been developed to the point of being ready for publication as an actual guide concerning EBS design requirements. For example, Table 1 in the prototype, cross-referencing individual EBS strategy elements to particular CDSCP sections, is illustrative in nature. It does not present a rigorous, complete listing of all pertinent parts of the CDSCP. However, the prototype is sufficiently detailed to provide, by example, a clear description of the type of supplemental, guide documents we would recommend that DOE produce as companions to the SCP.

2.3 Presumptions Underlying Planned Site Investigations

For the most part, the CDSCP reflects thorough and competent consideration of the need for, and the uses of, data and expert judgment. It is also positive in its expectations that future data will resolve current uncertainties owing to sparse data concerning the site, as well as in its expectations that the data, analyses, and expert judgments will produce clear resolution of licensing issues.

While a positive approach is appropriate, uncertainties in existing data, as well as the results of future site investigations,

should be recognized and reflected in the SCP. The CDSCP should adopt a conservative treatment of uncertainties, and consider a full range of alternative interpretations of existing data.

Similarly, it would be appropriate for the SCP to indicate the possibility that certain parameters may not be quantified with a great deal of precision even after site characterization is complete. For example, the SCP might conclude that predictions of future tectonic activity will almost inevitably be quite uncertain.

At the same time, however, the SCP should clearly indicate how uncertainties are being accommodated, and why they are not barriers -- in and of themselves -- to demonstrating 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 expert judgment based differences, will be important; and they should be an integral part of site characterization plans.

More specifically, with respect to existing information, one of the Objections raised by the NRC Staff in its Final Point Papers is that the CDSCP does not provide for "a conservative treatment of uncertainties in the existing limited data by considering a full range of alternative interpretations

(alternative conceptual models) in the development of the site characterization program." The NRC Staff has specifically expressed the view that "It is important that DOE consider areas where introduction of a greater degree of conservatism is needed in site characterization activities." [Letter to Ralph Stein from Robert E. Browning, dated May 11, 1988.]

Beyond "existing limited data," the CDSCP does not reflect and accomodate the fact that substantial uncertainties may remain even after characterization is complete. In discussions of planned characterization activities, the CDSCP anticipates an unambiguous and definitive valuation of parameters important to repository performance. For example, the CDSCP states that the impacts of future climate conditions and the effects of future faulting on the hydrologic system at the site will be predicted. [See CDSCP §§ 8.3.1.5, 8.3.1.8.3.] It also states that groundwater and nuclide transport in the unsaturated zone will be characterized, and that probabilities of volcanic activity will be established. [See CDSCP §§ 8.3.1.2, 8.3.1.8.]

These matters must, of course, be evaluated sufficiently for issue closure, either before or during licensing reviews, and it is appropriate for DOE to indicate that it will perform the work necessary to do so. It is also appropriate, however, for the SCP to acknowledge that precise, unambiguous, and definitive valuations of all site performance parameters may be difficult, because of the basic nature and complexity

of the Yucca Mountain site.

There are certain realities that apply to the site characterization process. Extensive as it is, the planned site characterization program (exploratory shaft, boreholes, trenches, etc.) will -- quite appropriately -- sample only a very small fraction (on the order of one one-millionth) of the site volume. The data base will be used primarily as the basis 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/UNWMG believe that these realities -- stemming from the basic nature of the site, and its geologic history -- could make closure of issues concerning site suitability and site performance more difficult than the CDSCP implies. Simply put, necessary interpretive expert judgments will likely be subject to challenge. Further, it may not be possible to resolve issues by simply expanding data gathering, because site complexity limits the worth of data extension, and too much intrusion could compromise the future performance of the site.

EEI/UNWMG recommend that DOE develop, and describe in the statutory 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, and selecting and characterizing disruption scenarios). Developing plans and specific strategies will aid DOE in refining the site characterization program both by providing a more realistic indication 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.

2.4 Relationship among Regulatory Requirements and Technical Parameters

The CDSCP 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 charcterization activities, and to assist in eliminating unnecessary characterization work, it would be helpful if the SCP contained 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 indentify the couplings among key issues across the individual technical disciplines discussed in the CDSCP. Following the plan would help assure that progress within each discipline proceeds in an efficient manner, directed at issue resolution.

2.5 Adequacy of Scenario Selection and Assessment

Because of their significance, EEI/UNWMG reviewed those portions of the CDSCP dealing with scenario selection and assessment in detail. We found, in general, that the CDSCP displays considerable technical insight concerning scenario assessment issues. Basically, it presents a practical approach to resolution of scenario issues, and demonstrates an in-depth

command of assessment methods and requirements. In short, the DOE technical approach is sound and sensible.

Nevertheless, EEI/UNWMG are of the view that DOE plans and activities concerning scenario assessment should reflect greater sensitivity to the potential for disagreement than is displayed in the CDSCP. Given the uniqueness of scenario selection and evaluation for a geologic repository, the significance of this area of effort to the licensability of the Yucca Mountain site, and the nature and complexity of the site, the data base will undoubtably require a number of expert judgments pertaining scenarios. Further, these expert judgments are almost certain to undergo close scrutiny. These eventualities could be recognized more clearly in project plans.

As indicated above, the DOE scenario assessment process described in the CDSCP is fundamentally sound. In essence, it can be described as a process of winnowing away everything that's not important, coupled with exhaustive analysis of what is important. It must be recognized, however, that the selection of "what's important" is primarily a matter of expert judgment. In the opinion of others (than DOE), the scenario targets for exhaustive analyses might simply be the wrong targets.

Perhaps the most obvious approach to forestalling such disputes would be to provide overwhelming evidence that the proper targets have been selected. However, because of inherent uncertainties, "proving" that the proper targets have been

selected to the satisfaction of all parties may be difficult.

An alternative approach to dealing with disputes -- in addition to establishing a formal process for applying expert judgment in making decisions, as discussed in section 2.3, 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 CDSCP 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.

EEI/UNWMG recommend that DOE consider supplementing the scenario selection and assessment methods described in the CDSCP with plans for producing multiple, independent results using a method such as that outlined above. Such an approach will provide a broader and more meaningful indication of repository performance. This, in turn, will increase the resiliency of DOE determinations.

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*/ The universe of possible scenarios, of course, will encompass these "specific significant threat scenarios," but DOE's methods simply might not identify them. For example, discussion in the CDSCP suggests that, under present data, the water table could not rise enough to saturate the vadose zone. However, uncertainty analysis might produce results corresponding to saturation, or licensing reviews might require postulation and evaluation of vadose saturation on the grounds that the scenario which produces that effect really exists.

2.6 Site Suitability

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

EEI/UNWMG agree with DOE and the NRC that there is no basis for determining, at this time, that the Yucca Mountain site may be unsuitable. However, in view of the foregoing, 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 after years of characterization work and the expenditure of billions of dollars should be minimized. In particular, 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.

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, with a substantial degree of certainty -- both the presence of all "qualifying conditions," and the absence of any "disqualifying conditions," as those terms are defined in DOE's site selection guidelines, 10 CFR Part 960.

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 qualifying and disqualifying conditions, focusing on any perceived site vulnerabilities.

At this stage of characterization, prior to issuance of the statutory SCP, it is probably too early to select a specific approach to evaluating site suitability. However, at some point a process for such an evaluation, on a real time basis as site investigation proceeds, should become a part of the Yucca Mountain characterization process. EEI/UNWMG recommend that DOE begin to evaluate various approaches to determining site suitability, and integrate such a process into the site characterization program as appropriate.

3.0 CONCLUSION

The CDSCP is thorough and fundamentally sound. In particular, it is far more extensive than required under the NWPA and, accordingly, provides a firm base from which to proceed with the preparation of the statutory SCP, and for performing actual site characterization work itself.

The CDSCP can be improved, however, in certain respects. In particular, those areas considered in the NRC Final Point Paper Objections should be addressed. In addition, refinements can be made in the organization of the document, and in the techniques for identifying and accomodating uncertainties in data, and scenario selection and assessment. Finally, DOE should begin to consider establishing an approach for evaluating site suitability on a real time basis, as characterization proceeds.

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

Forward

The purpose of this document is to supplement the Department of Energy's Consultation Draft Site Characterization Plan for the Yucca Mountain site (CDSCP) by providing a guide to the integration and interaction of the diverse technical factors pertinent to repository engineered barrier system (EBS) requirements. It's purpose is to serve as a roadmap to the CDSCP for understanding the Department's strategy for addressing EBS design requirements as they are contained in Nuclear Regulatory Commission regulations.

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 § 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. § 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 Chaterization 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 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