NOTE FOR: Joseph O. Bunting, Chief
Engineering Branch
Division of High-Level Waste Management

FROM: John J. Linehan, Director
Repository Licensing and Quality Assurance
Project Directorate
Division of High-Level Waste Management

SUBJECT: COMMENTS ON PROPOSED GUIDANCE FOR COORDINATING THE ESF DESIGN WITH THE DESIGN OF THE GEOLOGIC REPOSITORY OPERATIONS AREA

The staff of the Repository Licensing and Quality Assurance Project Directorate (HLPD) has reviewed the internal draft of the proposed subject guidance transmitted by your memorandum of April 30, 1990. Overall, the HLPD staff continues to support the development of guidance around this topic. However, HLPD does not believe that the information currently presented warrants development as a technical position (TP) for the reasons stated below. Rather, HLPD believes that the information to be presented to the U.S. Department of Energy (DOE) would be better provided in the form of a guidance letter. However, as stated in our earlier comments, the ultimate decision on the final form of guidance to be issued is the responsibility of the Engineering Branch (HLEN).

Regardless of the type guidance HLEN selects, the HLPD staff has the following general comments and recommendations that should receive serious consideration in future development of this guidance. Additional but lesser comments are also provided for your consideration and these are included in Attachment 1; Attachment 2 is a mark-up of the internal draft itself which suggests some editorial changes intended to clarify the content of the existing document.

General Comment No.1

The principal thrust of this TP appears to be an attempt by the staff to define what constitutes an acceptable design process regarding the coordination of the design of the exploratory shaft facility (ESF) with the design of the geologic repository operations area (GROA). In this regard, the TP focuses mainly on §§60.15(c)(3-4) which identifies the need for DOE to demonstrate that it has "planned" and "coordinated" its designs.

However, in the development of the guidance, HLEN does not describe what these terms and the term "integration," which is repeatedly referenced throughout 10 CFR Part 60, mean or what would be sufficient to demonstrate compliance with them. Moreover, the text also uses terms with ambiguous meanings such as "proper" or "suitable" without clarifying what they mean to the staff. Thus, in using undefined and ambiguous terms, the guidance has not been able to describe the concepts they embody nor has it been able to identify acceptance criteria that are technically defensible or could be used by DOE to demonstrate that its designs have been adequately planned, coordinated, and integrated.

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Because the document does not describe a position regarding what these terms mean or require, and because no criteria have been identified for use in judging DOE's degree of engineering design coordination, it appears that the draft TP falls short of its intended goal of describing an acceptable design process necessary to ensure that the ESF design is coordinated with the GROA design. Therefore, in order to make the guidance more effective, every attempt should be made to either avoid the use of ambiguous terms or to define those terms with ambiguous meanings. After defining the necessary terms, the guidance then needs to enumerate those criteria that could be used to judge if DOE's designs have been adequately planned, coordinated, and integrated.

General Comment No.2

As stated, the scope of the TP addresses no fewer than seven technical subjects (see page 2 of Section 1.0, "Introduction") for which there is not always a well-defined association. For example, the TP is intended to cover the ESF design process, the consideration of alternatives, excavation methods, test interference, test representativeness, and performance assessment. Although the topics identified for the subject of the TP relate to some aspect of the ESF, the TP itself has not had adequately defined a coherent theme around which all of these subjects can be associated. Therefore, it is not clear whether the TP is intended to address an acceptable approach for integrating the ESF design with the GROA design, an acceptable design process for the ESF itself, or an acceptable approach for designing and constructing the ESF.

If either of the first two approaches are intended, then the TP goes beyond the issue of the basic design process and establishes other acceptance criteria such as excavation methods, test interference, test representativeness, and performance assessment. On the other hand, if the TP is intended to address any or all of the design issues associated with the ESF including specific design considerations, then the TP is not complete. For example, in the matter of additional design criteria for the underground facility cited in §60.133, the TP only addresses the subject of "excavation methods," as referenced in §60.133(f). However, in identifying those 10 CFR Part 60 requirements applicable to the design of the ESF, Appendix B of the draft identified all of §60.133 as applicable (e.g., §§60.133(a-i)). Therefore, it is not clear why the TP focuses just on this particular aspect of §60.133.

In summary, it is not clear what the scope of the TP is intended to address. If its intent is to address only those issues associated with the design process, then the TP goes beyond that and also covers acceptance criteria for construction and performance. If the TP is intended to address all aspects of ESF design, construction, and performance, then it is incomplete. Therefore, HLEN should clarify what it intends the scope of the guidance to be, clearly state that scope and provide a sound basis for it, and then develop clear and complete guidance that is within the stated scope. In its present form, it is not possible to fully understand what the TP is trying to accomplish.

General Comment No.3

In a related matter, several of the staff positions sound like recitals or paraphrases of the regulations themselves which is of limited assistance to a user of this guidance, thus offering little new information to DOE beyond that which is presently given in the regulations. As a consequence, the usefulness of the TP to DOE in providing criteria that the staff would find acceptable in meeting the regulations is questionable.

Also, simpler and clearer statements are needed of what the staff positions are. As previously noted, in their current form, several of the staff positions discuss multiple topics and address multiple concepts that do not appear to be clearly associated.

General Comment No.4

HLPD is concerned about the information contained in Appendix B of the draft which identifies 10 CFR Part 60 requirements HLEN believes apply to the ESF design. It is generally understood that the information contained in this appendix represents what DOE is expected to generate as part of its design process. Although we support the development of this information, the guidance needs to describe what type of criteria were used in compiling this list so that DOE can gain an understanding of the staff's bases and reasoning for selecting those regulations considered to be pertinent. Moreover, HLPD believes that this list should be designated as "potential" inasmuch as DOE will be expected to ultimately conduct this analysis independently as part of its design control process.

Finally, HLPD wishes to note that this guidance, or any staff guidance, should be directed towards describing acceptance criteria that would be used to judge DOE's process for identifying applicable 10 CFR Part 60 requirements. The staff would then review the DOE design process to see if it would meet the acceptance criteria, and could verify proper implementation of the process by reviewing DOE's results, thereby confirming that the pertinent 10 CFR Part 60 requirements had been selected.

General Comment No.5

There is only one explicit reference to Figure 1 (caption: "Steps for compliance determination") throughout the entire text. If the intent of this illustration is to describe the staffs' concept of an acceptable design process leading to a demonstration of compliance with 10 CFR Part 60 requirements, then it would be desirable to structure the discussion of the TP around this logic and state why this particular logic is one that the staff considers acceptable and one that DOE should consider. Although, as indicated by the figure, the requirements in 10 CFR Part 60 may represent the desired design specifications, the guidance has failed to describe what generic steps are necessary to ensure that these requirements would be satisfied using any design that DOE should happen to propose. (As noted in General Comment No. 1, the guidance has yet to sufficiently describe what constitutes an acceptable design process.)

If you have any questions or desire additional information concerning these comments, please contact the Project Manager for this TP, Michael P. Lee.

John J. Linehan, Director
Repository Licensing and Quality Assurance
Project Directorate
Division of High-Level Waste Management

cc: R.E. Browning
B.J. Youngblood
R. Ballard
M. Nataraja
D. Gupta
J. Wolf

Enclosures (2): As stated

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SUBJECT: COMMENTS ON PROPOSED GUIDANCE FOR COORDINATING THE ESF DESIGN WITH THE DESIGN OF THE GEOLOGIC REPOSITORY OPERATIONS AREA

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ENCLOSURE 1

DETAILED COMMENTS

1.0 Introduction

(1) Page 1, Paragraph 2: Suggest incorporating this paragraph with the first paragraph. It is out-of-context in its current location.

(2) Page 2, Paragraph 1: In reference to Figure 1, it would be desireable to note that there is no guarantee that if DOE were to follow the steps identified in this illustration that the exploratory shaft facility (ESF) design would be acceptable. Conceivably, DOE could follow all of the steps described in the illustration and still generate poor design specifications that do not demonstrate compliance with 10 CFR Part 60. Therefore, the guidance should be careful to not imply that following any particular design process would ultimately lead to an acceptable design.

(3) Page 2, Paragraph 2: Suggest moving this paragraph to the first page and making it the second paragraph in this section. also, the logic underlying the relationships and concepts described in this paragraph need to be reexamined because they are not clear.

(4) Page 3, Paragraph 7: It is not clear what the significance of this paragraph is or what value it adds to the discussion in Section 1.0.

2.0 Regulatory Framework

(1) It isn't clear from this discussion which regulations provide the regulatory basis for the staffs' positions. At present, the regulations cited refer to a variety of concepts and requirements. The discussion in this section needs to be modified in order to clearly illustrate which regulations are driving this technical position (TP). A cursory examination of the regulations suggest that §§60.15(c)(1-4) is the principal driver for this TP as well as the quality assurance requirements in Subpart G of 10 CFR Part 60.

3.0 Technical Positions

(1) There are seven staff positions stated in this section representing what appears to be four topical areas. It might be beneficial to arrange these positions in some logic that is easy to track (e.g., design, construction, performance assessment, and quality assurance).

(2) It might be advisable to delete or modify the information contained in the brackets (e.g., pertinent 10 CFR Part 60 citations) as is in not clear how this information contributes to the discussion in this portion of the text.

4.0 Discussion

(1) It would be desirable for the discussion in this section to parallel the discussion of the technical positions stated in Section 3.0. Therefore, for each technical position stated in Section 3.0, Section 4.0 should have a corresponding subsection giving the rationale to support that position.

(2) The discussions for many of the sections in this chapter lack real substance. Although the issues underlying these topics may be well understood by the authors, the discussions are written in a style that is too subtle for the common reader to follow. Specific comments follow below.

Section 1 -- Quality Assurance:
No specific comment.

Section 2 -- Selection of Access Openings: Suggest re-ordering the paragraphs in this section to improve the logic and the flow of the discussion. Furthermore, it might be more appropriate to use a different title, such as "Design Considerations."

Section 3 -- Consideration of Alternative ESF Features:
No specific comment.

Section 4 -- Excavation Methods:
It is not clear what point is being made in this section of the text. Because of this, it appears that this topic may not be pertinent in the overall context of the guidance.

Section 5 -- Test Interference:
No specific comment.

Section 6 -- Representativeness:
After reading this subsection, it is not clear what the staff's technical position is. HLPD interprets the staff's technical position on this issue to be that the ESF needs to be sited in a location where it would provide the most representative sample of likely repository conditions, and that it is important to include in the ESF design sufficient flexibility to expand its use during characterization or later, during construction or operation.

Section 7 -- Performance Requirements:
a) The TP proposes that a preliminary performance analysis (PPA) be performed as part of the design process. However, the TP fails to discuss what attributes or characteristics the PPA should have.

b) It is not clear what the PPA should cover. Without giving some specific guidance, DOE will not know whether the PPA will have to be performed for every aspect of the geologic repository operations area design or just for the ESF's design.

ENCLOSURE 2

Draft Technical Position on Coordinating the Design of the Exploratory Shaft Facility with the Design of the Geologic Repository Operations Area

Office of Nuclear Material Safety and Safeguards
U.S. Nuclear Regulatory Commission

Dinesh Gupta, John Peshel

ABSTRACT

The purpose of ~~staff of the U.S. Nuclear Regulatory Commission has prepared~~ this technical position is to provide ~~to serve as~~ guidance to the U.S. Department of Energy with ~~for~~ respect to ~~properly~~ coordinating the design of the exploratory shaft facility with the design of the geologic repository operations area. Section 2 of the technical position cite the key regulations in 10CFR Part 60 that apply to the design of the exploratory shaft facility. ~~are listed and~~ Staff position statements and corresponding discussions are presented in Sections 3.0 and 4.0 respectively.

Please note:
I don't think that there is a right way and a wrong way, as implied by the use of the word "properly". Unless it is in NRC's regulation, we usually don't have a proper way.

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DRAFT TECHNICAL POSITION ON
COORDINATING THE DESIGN OF THE EXPLORATORY SHAFT FACILITY
WITH THE DESIGN OF THE GEOLOGIC REPOSITORY OPERATIONS AREA

As part of the site characterization program, DOE will construct an Exploratory Shaft Facility (ESF).

1.0 INTRODUCTION

The U.S. Department of Energy (DOE) is required by the Nuclear Waste Policy Act of 1982 (NWPA) as amended, and by 10 CFR Part 60 to conduct a program of site characterization before submitting a license application. ~~The primary purpose of the Exploratory Shaft Facility (ESF) is to support site characterization activities.~~ However, since the ESF may become integrated as part of an eventual repository, the ESF design may be required to satisfy all repository design requirements. In reviewing DOE's ESF Title I design (ESF) and related documents (e.g., DOE's acceptability analysis of the ESF Title I design (ESF)), the U.S. Nuclear Regulatory Commission (NRC) staff noted that several 10 CFR Part 60 requirements applicable to repository design were not considered (Reference 1). The ~~U.S. Nuclear Regulatory Commission's~~ (NRC's) staff developed this technical position (TP) in order to provide guidance to ~~the U.S. Department of Energy~~ (DOE) on the coordination of the designs of the ~~exploratory shaft facility~~ (ESF) and the geologic repository operations area (GROA). Proper coordination between ESF design and GROA design by DOE is essential in order to ensure that the ESF, as constructed, will satisfy GROA design requirements, will not interfere with the waste isolation capability of the site, and will appropriately interface with site characterization activities.

reference?

what does this mean

In the ~~exploratory shaft facility~~ ESF and the GROA, the ground surface and the underground openings will be connected by shafts or ramps. (The term "shaft" as used in 10 CFR Part 60 is understood to include both vertical shafts and inclined ramps.)

This ¶ is out of context. Is there some point you wish to make? Think that this ¶ should be moved or deleted).

insert ¶ from page 2

The scope of the technical position ~~provides~~ is to describe an approach acceptable to the NRC staff for implementation of relevant 10 CFR Part 60 requirements related to the coordination and design of the ESF. The technical position covers topics that include certain technical aspects of the design control process and the GROA, integration of ESF design into GROA design,

consideration of alternatives, excavation methods, test interference, representativeness, and performance requirements.

why?

In reviewing DOE's work on the ESF design and related documents, including the ESF alternatives study, the NRC uses the following two general guidelines: (1) the ESF design and construction should limit adverse impacts on waste isolation capabilities of the site; and (2) the ESF design and construction should not preclude gathering adequate site data. Specific guidelines by which DOE's work on the ESF design and related documents are assessed are given by this technical position. The methodology given in Figure 1 can be used by DOE to demonstrate compliance with 10 CFR Part 60 requirements.

The primary purpose of the ESF is to collect site characterization data ~~to be~~ used for in designing the GROA. The design of the ~~ESF has to~~ GROA may be completed on the basis of only very limited subsurface in situ testing and exploration. Consequently, uncertainties associated with prediction of long-term performance of natural barriers, damage zone around shafts or ramps, drainage below the repository level, etc., should be allowed for in the design of the ESF and analysis of performance objectives.

The technical positions in Section 2 of this document focus on the key NRC regulations which relate to design of the ESF and/or coordination with the design of the GROA. The technical positions statements are listed in Section 3. ~~The discussion of technical positions in Section 4 of this paper amplifies the stated positions.~~ Appendix A to this draft version of the document is reserved for staff response to public comments on this TP. It will be prepared for inclusion in the final report after comments on this document have been satisfactorily resolved.

Technical positions are issued to describe and make available to the public criteria for methods acceptable to the NRC staff for implementing specific parts of the Commission's regulations, or to provide guidance to the Department of Energy. Technical positions are not substitutes for regulations, and

The supporting rationale behind the staff technical positions are given in section 4.

* This illustration is significant in the context of your guidance and, consequently, deserves more than one sentence in the text. Does this illustration represent design control? Recommend elaborating on this illustration in the "Discussion" section

compliance with them is not required. Methods and solutions different from those given in the position will be acceptable if they provide a basis for the findings requisite to the issuance or continuance of a permit or license by the Commission.

The existing NRC staff technical positions on Design Information Needs in the SCP (Reference 2), on In-Situ Testing (Reference 3), and on Borehole and Shaft Sealing (Reference 4) provide additional guidance in those specific areas.

FRAMEWORK

2.0 REGULATORY (BACKGROUND)

Q: Which specific 10CFR60 regulations provide the regulatory framework for this TPS? The purpose of this section is to state what these are. See [illegible] for an example

The 10 CFR Part 60 requirements applicable to the ~~exploratory shaft facility~~ (ESF) design are ~~listed in Appendix B to this document. Some of the key regulations in 10 CFR Part 60 applicable to that design are listed~~ are stated below, and the text of ~~some of~~ these regulations is given in Appendix C. ~~For the text of remaining applicable 10 CFR Part 60 requirements, refer to 10 CFR Part 60~~ (Reference 5).

Rather than [illegible], think that these should be statements.

- ~~10 CFR 60.2: defines the term "site characterization."~~ doesn't add anything to discussion

- 10 CFR 60.15(c): addresses the site characterization requirements. These requirements state that (1) the manner of investigations should limit adverse impacts on long-term performance of repository; (2) the number of exploratory boreholes and shafts should be limited to the extent practical; (3) the exploratory boreholes and shafts should be located where large unexcavated pillars for repository are planned; and (4) the ESF design should be planned and coordinated with the geologic repository operations area design.

- 10 CFR 60.21(c)(1)(ii)(D): requires the DOE to assess the effectiveness of engineered and natural barriers, including barriers that may be themselves a part of the geologic repository operations area, against the release of radioactive material to the environment. The analysis shall also include a comparative evaluation of alternatives to the major design features that are important to waste isolation.

It appears that the reqs of 60.15(d)(1-4) are the big drivers for the req to plan and coordinate the design of the ESF w/ the GROA, as well as others (in the context of QA). ∴ the point should be made that there are a number of 'drivers' for this TP. Also, Julia C always reminds me not to paraphrase reqs, just repeat them

(# 3.0 would do better if it were organized under headings/subheadings, as indicated. This would help to focus the thinking here about what the technical positions are all about ... Design, Construction, PA (PC), and QA.

- o 10 CFR 60.112: addresses the requirements for selecting the geologic setting and design of the engineered barrier system and the shafts, boreholes, and their seals to meet the overall system performance objectives for the geologic repository after permanent closure with respect to both anticipated and unanticipated processes and events.

- o 10 CFR 60.131 and 10 CFR 60.133: design criteria for the underground facility in the geologic repository operations area are specified in these sections of the rule. For text of these regulatory requirements, please refer to 10 CFR Part 60 (Reference 5).

- o 10 CFR 60.134: specifies general criteria for design of seals and selection of materials and placement methods.

- o 10 CFR 60.151 and 10 CFR 60.152: require the DOE to implement a quality assurance program based on the criteria of Appendix B to 10 CFR Part 50, as applicable. If the components of the exploratory shaft facility are determined to be important to waste isolation, they and the activities that affect their performance should be covered by the applicable quality assurance program.

3.0 TECHNICAL POSITIONS

3.1 Design Considerations
3.1.1 (2)
3.1.2 (3)
3.1.3 (5)
3.1.4 (6)

3.2 Construction Considerations
3.2.1 (4)

Ob (1) Items and activities of the exploratory shaft facility which are potentially important to safety and waste isolation should be identified in accordance with the NRC guidance in NUREG-1318 (Reference 6). The identified structures, systems, and components should be designed, constructed, and operated under the appropriate parts of the quality assurance program. The quality assurance program, including the design control process, should be established and implemented in accordance with the NRC staff positions identified in "Review Plan for High-Level Waste Repository Quality Assurance Program Descriptions (Reference 7)." [10 CFR Part 60, Subpart G]

Draft (2) A conceptual design of the ~~repository~~ GROA should be developed before any work is performed on the design of the ~~exploratory shaft facility (~~ESF~~)~~. Furthermore GRO'A's The final conceptual design should be based on a comparative evaluation of several alternatives to major design ~~features~~. The ESF design should be planned

3.3 Performance Confirmation
3.3.1 (2)

3.4 Quality Assurance
3.4.1 (1)

Sounds like 3.4 positions here ... break out

and coordinated with the conceptual design of the GROA ~~a geologic repository operations area~~ which is based on the selected alternative. The shafts or ramps designed for the GROA ~~a geologic repository operations area~~ should be used for the ESF unless a need for different openings can be justified on the basis of an analysis of their impact on the waste isolation capability of the site. [10 CFR 60.15(c)(3) and (4)); (10 CFR 60.21(c)(1)(ii)(D)]

what are this mean?

(3) In analyzing the adequacy of the ESF design, alternatives to such major GROA design features as (a) location, number, and size of shafts or ramps, (b) excavation methods, (c) drainage, and (d) sealing should be considered with particular attention to the alternatives that would provide longer radionuclide containment and isolation.
[10 CFR 60.15(d)(2, 3, and 4); 10 CFR 60.21(c)(1)(ii)(D); 10 CFR 60.134]

(4) To the extent practical, the methods of constructing the ESF should be selected to avoid damaging rock and creating potential pathways around the shafts, ramps and the underground openings to provide confidence that the ESF will meet the objectives for repository performance and site characterization. [10 CFR 60.133(d, e and f)]

(5) The ESF design features, including test layout, test sequencing, and separation between test area and proposed future repository, should be selected to avoid potential for interference with site characterization and repository performance. [10 CFR 60.15(c)(1) and (4)]

what?

what does this mean?

(6) The physical extent of the ESF and the location of shafts or ramps, exploratory drifts, boreholes, and tests should be designed to establish the geologic conditions and ranges of parameters important to repository performance and to site characterization. [10 CFR 60.2] can't find.

(7) A preliminary performance analysis should be performed to demonstrate that the ESF as designed would limit adverse effects on the long-term waste isolation capability of the geologic repository.
[10 CFR 60.15(c)(1), 112, and 133]

can this really be achieved?

what is critical to GROA perf., ESF design or ESF location

4.0 DISCUSSION

The following discussion parallels the list of technical positions given in Section 3.0

(1) Quality Assurance

The ESF design process should be subjected to a quality assurance (QA) program in order to assure compliance with the QA requirements of 10 CFR 60.151 and 152. Because the ESF may become integrated as part of an eventual repository, its design may be required to satisfy all the pertinent repository design (and performance) requirements. Adequate implementation of the ~~quality assurance (~~QA~~)~~ program ~~should be~~ is considered vital to successful coordination of the ~~exploratory shaft facility (~~ESF~~)~~ design with the GROA design. Section 3 of the NRC "Review Plan for High-Level Waste Repository Quality Assurance Program Descriptions" (Revision 2)" provides acceptance criteria for the os activities related to design control. The ~~Department of Energy's (~~DOE's~~)~~ design control process would be considered acceptable if ~~DOE~~ it complies with the requirements given in Section 3 of the QA review plan.

NUREG-1318 provides guidance on how to identify those items and activities "important to safety" and "important to waste isolation" for both the preclosure and postclosure phases of the repository

DOE should review all of the structures, systems, and components associated with the ESF, ~~and~~ using the metholodogy in NUREG-1318, in order to identify those ~~that~~ which are important to safety or waste isolation. The identified structures, systems, and components should then be designed, constructed, and operated under the appropriate parts of the QA program. Those aspects of design that may affect waste isolation should be translated into requirements that consider the need to meet the performance objectives for the geologic repository for the next 10,000 years. A verification process should ensure that the 10 CFR Part 60 requirements are incorporated into the various stages of design.

The overall systematic design and approval process should take into account 10 CFR Part 60 requirements that deal with site characterization, retrieval, containment and long-term isolation. The process should establish a link between the NRC regulatory requirements and the design. The applicable 10 CFR Part 60 requirements dealing with the ESF design are listed in Appendix B to this document. There should be clear and systematic documentation of how each relevant 10 CFR Part 60 requirement is translated into design basis, specifi-

cations, drawings, and procedures as specified in Criterion III of Appendix B to 10 CFR Part 50. The principal QA measures should include: control of design interfaces, design verification, control of design changes, and use of appropriate standards.

(2) Design Considerations Selection of Access Openings (Is this the same as 'design'?)

ok 10 CFR 60.15(~~c~~d)(4) requires that the "subsurface exploratory drilling, excavation, and in situ testing before and during construction shall be planned and coordinated with geologic repository operations area design and construction." Also, 10 CFR 60.15(~~c~~d)(3) requires that "to the extent practical, exploratory boreholes and shafts in the geologic repository operations area shall be located where shafts are planned for underground facility construction and operation or where large unexcavated pillars are planned." To meet these requirements, it is necessary ~~essential~~ that a conceptual design of the GROA be developed first, so that the exploratory shaft(s) can be located where ventilation or access shafts or unexcavated pillars for the GROA are ~~already~~ planned. (The conceptual design of the GROA and the ESF should meet all applicable 10 CFR Part 60 requirements. which are defined in ____.)

already stated in 2.0

3

what are these? shall they be tabulated?

Several possible alternatives ~~to~~ for example, major design features should be evaluated at the initial stages of designing the GROA. ~~The~~ This evaluation should include a study of possible variations in the location and number of shaft or ramps, excavation methods, and other major design and construction features. Selecting an ~~alternative~~ design from those considered should be made with particular attention to the ~~alternatives~~ design that provide longer radionuclide containment and isolation.

what does this concept mean?

4

fuzzy concept

design or location?

On the basis of the ~~alternative~~ design selected, a conceptual design for the repository GROA? should be developed. The ESF design should be planned and coordinated with this repository design. For example, the shafts or ramps designed for the GROA should be used for the ESF, unless a need for different openings can be justified and an analysis of their impact on the capability of the site to isolate waste is completed.

Wait! what comes first ESF or GROA? sounds like ESF what does this mean?

5

1

ESF shafts or ramps will become the first major penetrations through the geological barrier. As such, they could become preferential ~~flowpaths,~~ pathways e.g.,

flowpaths flowpaths

for water ~~inflow~~ into the repository, or for gaseous radionuclide releases. Recognizing that at the time of ESF construction considerable uncertainty will remain about what ultimately the likely dominant flowpaths may be, a conservative approach to the selection, design and construction of these penetrations ~~must be deemed~~ is desirable.

(2) In order to minimize the total number of penetrations through the geological barrier, coordination of ESF design and GROA design should permit selection of ESF shafts or ramps that can be integrated as repository shafts or ramps in the GROA design. Such integration will allow compliance with the requirement in 60.15(a)(3) to minimize the number of penetrations, as well as the requirements in 60.15(a) and 60.15(d)(4).

(3) Consideration of Alternative for ESF Features

At the initial stage of the ESF design work, a comparative evaluation of the major ESF design features should be conducted. The evaluation should include a study of possible variations in the location, number, and size of shafts or ramps; underground excavation methods; drainage and sealing; etc. In the evaluation of major ~~design~~ features for the ESF design, it is important to pay particular attention to repository performance requirements as well as site characterization needs.

The location and size of ESF shafts or ramps should be closely coordinated with GROA design. In general, the requirements for the ESF should not define unnecessarily increase the number of the repository shafts or ramps. It may be desirable to select an option for the ESF design that meets all the regulatory requirements and yet permits several alternatives for GROA layouts. Suitable provisions should be made for proper drainage from the underground openings and the design should facilitate future sealing options.

The location of ESF shafts or ramps should take into account possible uplift or subsidence due to thermal effects of waste emplacement, fault movement and tectonics. Also, potential effects of fault movements due to thermal effects

should be considered when selecting the locations for the openings. The liner material and construction methods for the access openings should be selected to accommodate future needs for sealing and drainage.

(4) Excavation Methods (It's discussion of "construction") This section ramples needs to be tightened up

If the site is found suitable for develop~~ing~~ment as a repository, and if the ESF becomes ~~a~~ part of the GROA, the methods ~~of~~ for constructing the (underground ESF openings) should be compatible with the requirements for the repository to meet the performance objectives. Also, the degree of damage to the rock surrounding the openings and the extent of the damage disturbed zone should be limited so that the damage does not preclude adequate site characterization and performance. The construction and operation should be compatible with such data gathering activities at the site as geologic mapping, and geotechnical, thermomechanical, hydrological, and geochemical testing.

needs clarification

are the ESF and the underground openings the same

The excavation methods should be selected to limit the potential for creating a preferential pathway for groundwater to contact the waste packages or radionuclide migration to the accessible environment. The use of water or other foreign substances should be limited so that the site characterization of the surrounding rock mass and ability of the site to meet the performance objectives are not compromised.

(5) Test Interference (what technical position does this discussion refer to?)

The exploratory shaft facility should be designed and constructed to limit adverse impacts on site characterization. Sufficient separation distances should be provided between the locations of the ESF construction and operation activities and in situ tests to prevent interference with site characterization activities. Likewise, in situ tests should be so designed, located, and sequenced that interference between tests is avoided.

Performance confirmation tests need to be initiated during site characterization, and need to be continued until permanent closure. This makes the need

for coordination between ESF design and repository design particularly obvious, because it will be necessary to assure that repository construction and operations do not unduly interfere with ongoing performance confirmation testing. Because of the very long duration required for performance confirmation testing, a reasonably conservative approach for estimating interference effects would be prudent.

(6) Representativeness (Doesn't this section concern flexibility in ESF design?)

what does this section apply to? eg. →

site characterization involves more than an interest in problems

The extent of site characterization should be planned to provide sufficient range of data for an adequate assessment of conditions or features potential problems at the site. The data should also provide adequate information for designing the GROA and analyzing its performance. Therefore, the ESF design should ensure that the data collected will be representative of range of conditions and processes throughout the site.

or location

To some extent, site characterization has to be an iterative procedure. A better understanding of investigation needs will develop as characterization results are acquired. Sufficient flexibility should be built into the ESF design to allow modifications and expansion of the site characterization efforts if such changes are indicated on the basis of the initial results.

Extensive drifting is the most promising approach to resolve representativeness uncertainties. It also presents one of the more difficult challenges for coordination with repository design. Optimum drift orientation and length may not necessarily coincide with preferred repository layout. A careful balancing of the site characterization versus repository performance requirements will be essential.

(7) Performance Requirements

The performance requirements for access openings, boreholes and their seals and drainage are governed by the performance objectives of 10 CFR Part 60.

Accordingly, the ESF design of shafts or ramps, drifts, alcoves, drainage, seals, and their construction and operations in the ESF should meet the pre- and post-closure performance requirements.

Since only preliminary information is likely to be available at the time the ESF is being designed, a final performance analysis cannot be performed at this stage. However, a preliminary performance analysis should be performed to demonstrate that the ESF, when integrated into repository design, would not impair the repository performance. Performance analysis should confirm that the size and orientation of all underground excavations associated with the ESF will not compromise site integrity. Such analysis should include the effects of exploratory drifting and of any auxiliary excavations proposed for construction.

Inevitably, some uncertainties will be associated with several factors affecting long-term performance of the repository and preliminary performance analysis, e.g., damage zone around access openings and drainage performance below the repository level. Therefore, the ESF design and the repository preliminary performance analysis should account for these uncertainties.

Q:
What criteria or features should the PPA have?
Can a PPA be performed. Will a PPA be performed for every aspect of the GROA design? If not, why should one be performed for the ESF. Moreover, how meaningful can it be. Finally, would it be more meaningful to address the issue of ESF impact on GROA performance in the context of an exclusion zone?

5 REFERENCES

1. U.S. Nuclear Regulatory Commission, "NRC Staff Characterization Analysis of the Department of Energy's Site Characterization Plan, Yucca Mountain Site, Nevada," NUREG-1347, U.S. Nuclear Regulatory Commission, Washington, D.C., 1989.

2. U.S. Nuclear Regulatory Commission, "Generic Technical Position on Design Information Needs in the Site Characterization Plan," December 1985

3. U.S. Nuclear Regulatory Commission, "Generic Technical Position on In-Situ Testing during Site Characterization for High-Level Nuclear Waste Repositories," December 1985

4. U.S. Nuclear Regulatory Commission, "Generic Technical Position on Postclosure Seals, Barriers, and Drainage System in an Unsaturated Medium," August 1989

5. U.S. Nuclear Regulatory Commission, Code of Federal Regulations, "Disposal of High-Level Radioactive Wastes in Geologic Repository," Part 60, Chapter I, Title 10, "Energy."

6. U.S. Nuclear Regulatory Commission, "Technical Position on Items and Activities in the High-Level Waste Geologic Repository Program Subject to 10 CFR Part 60 Quality Assurance Requirements," NUREG-1318, 1988.

7. U.S. Nuclear Regulatory Commission, "Review Plan for High-Level Waste Repository Quality Assurance Program Descriptions," Revision 2, March 1989.

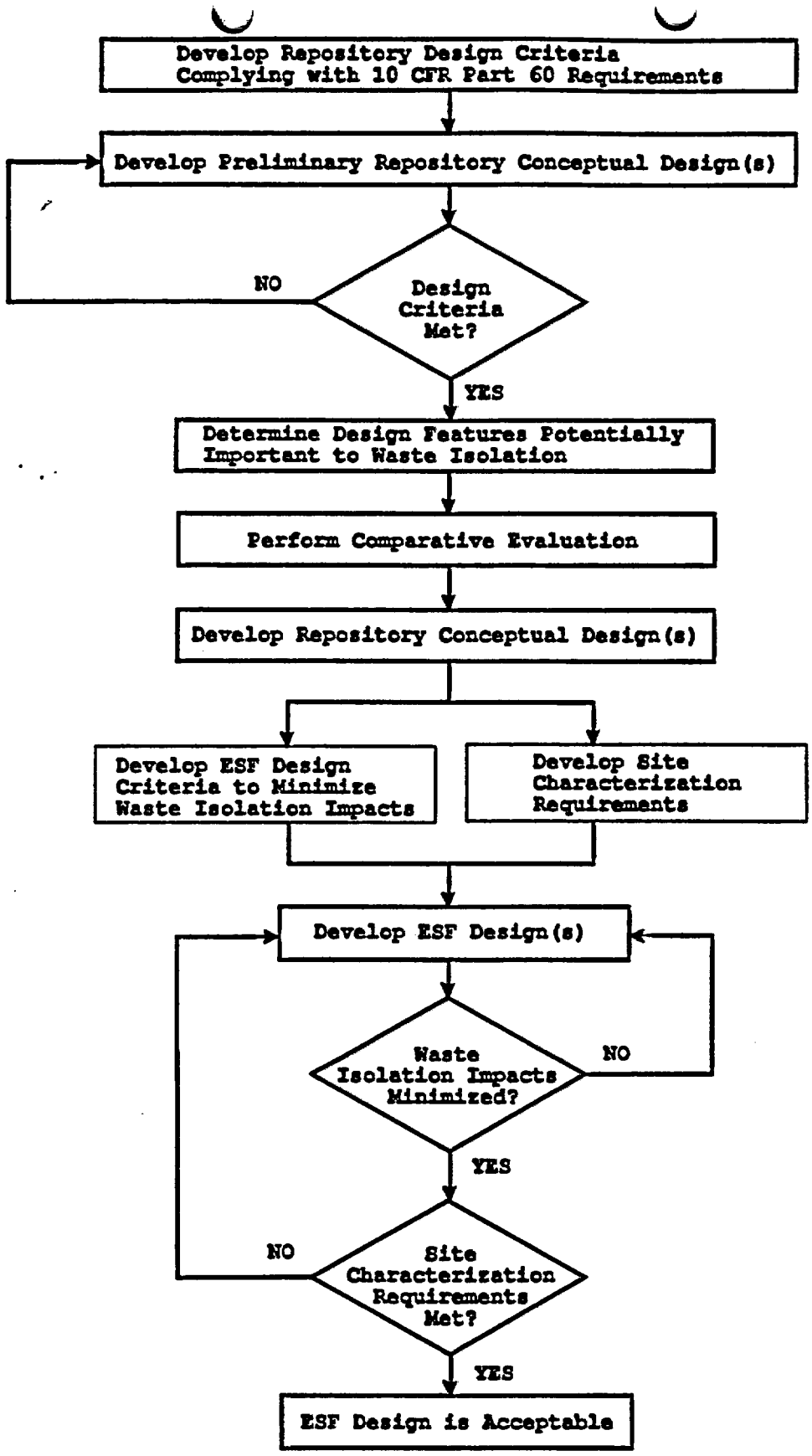

Figure 1. Steps for Compliance Determination

APPENDIX A

STAFF RESPONSE TO PUBLIC COMMENTS

This appendix will be added after receipt of public and Advisory Committee on Nuclear Waste (ACNW) comments and their resolution.

APPENDIX B

LIST OF 10 CFR Part 60 REQUIREMENTS APPLICABLE TO THE DESIGN OF THE EXPLORATORY SHAFT FACILITY

Table 1

SUBPART A - GENERAL PROVISIONS

Part 60 Requirement	Applicability to ESF Design
60.1	
60.2	A*
60.3	
60.4	
60.5	
60.6	
60.7	
60.8	
60.9	
60.10	

*The letter A appearing in column 2 indicates that the 10 CFR 60 requirement in column 1 is considered applicable to ESF design.

Table 1 (continued)

SUBPART B -LICENSES

Part 60 Requirement	Applicability to ESF Design
60.15(a)	
60.15(b)	A
60.15(c)	A
60.16	A
60.17(a)	A
60.17(b)	A
60.17(c)	A
60.18	
60.21(a)	
60.21(b)(1)	
60.21(b)(2)	
60.21(b)(3)	
60.21(b)(4)	
60.21(b)(5)	
60.21(c)(1)(i)	
60.21(c)(1)(ii)(A-C)(F)	
60.21(c)(1)(ii)(D)	A
60.21(c)(1)(ii)(E)	A
60.21(c)(2)	
60.21(c)(3)	
60.21(c)(4)	
60.21(c)(5)	
60.21(c)(6)	
60.21(c)(7)	
60.21(c)(8)	

Table 1 (continued)

SUBPART B LICENSES

Part 60 Requirement	Applicability to ESF Design
60.21(c)(9)	
60.21(c)(10)	
60.21(c)(11)	A
60.21(c)(12)	
60.21(c)(13)	
60.21(c)(14)	
60.21(c)(15)	
60.22	
60.23	
60.24(a)	A
60.31	
60.32	
60.33	
60.41	
60.42	
60.43	
60.44	
60.45	
60.46	
60.51	
60.52	

Table 1 (continued)

SUBPART C - PARTICIPATION BY STATE GOVERNMENTS AND AFFECTED INDIAN TRIBES

Part 60 Requirement	Applicability to ESF Design
60.62	
60.63	
60.64	
60.65	

Table 1

SUBPART D - RECORDS, REPORTS TESTS AND INSPECTIONS

Part 60 Requirement	Applicability to ESF Design
60.71	
60.72(a)	A
60.72(b)	A
60.73	
60.74	A
60.75	

Table 1 (continued)

SUBPART E -TECHNICAL CRITERIA

Part 60 Requirement	Applicability to ESF Design
60.101	
60.102	
60.111(a)	A
60.111(b)(1)	A
60.111(b)(2)	
60.111(b)(3)	A
60.112	A
60.113(a)(1)(i)	A
60.113(a)(1)(ii)	A
60.113(a)(2)	A
60.113(b)(1)	
60.113(b)(2)	A
60.113(b)(3)	A
60.113(b)(4)	A
60.113(c)	
60.121	
60.122(a)(1)	A

Table 1 (continued)

SUBPART E - TECHNICAL CRITERIA

Part 60 Requirement	Applicability to ESF Design
60.122(a)(2)	A
60.122(b)	A
60.122(c)	A
60.130	A
60.131(a)	A
60.131(a)(1)	
60.131(a)(2)	
60.131(a)(3)	
60.131(a)(4)	
60.131(a)(5)	
60.131(a)(6)	
60.131(b)(1)	A
60.131(b)(2)	A
60.131(b)(3)	A
60.131(b)(4)(i)	A
60.131(b)(4)(ii)	A
60.131(b)(5)	
60.131(b)(6)	A
60.131(b)(7)	
60.131(b)(8)	A
60.131(b)(9)	A
60.131(b)(10)	A
60.132(a)	
60.132(b)	
60.132(c)	
60.132(d)	
60.132(e)	

Table 1 (continued)

SUBPART E - TECHNICAL CRITERIA

Part 60 Requirement	Applicability to ESF Design
60.133(a)	A
60.133(b)	A
60.133(c)	A
60.133(d)	A
60.133(e)(1)	A
60.133(e)(2)	A
60.133(f)	A
60.133(g)	A
60.133(h)	A
60.133(i)	A
60.134(a)	A
60.134(b)	A
60.135(a)	
60.135(b)	
60.135(c)	
60.135(d)	
60.137	A

Table 1 (continued)

SUBPART F -PERFORMANCE CONFIRMATION PROGRAM

Part 60 Requirement	Applicability to ESF Design
60.140(a)	
60.140(b)	A
60.140(c)	A
60.140(d)(1)	A
60.140(d)(2)	
60.140(d)(3)	
60.140(d)(4)	
60.141(a)	A
60.141(b)	A
60.141(c)	A
60.141(d)	A
60.141(e)	A
60.142(a)	A
60.142(b)	A
60.142(c)	A
60.142(d)	A
60.143(a)	A
60.143(b)	A
60.143(c)	A
60.143(d)	A

Table 1 (continued)

SUBPART G - QUALITY ASSURANCE

Part 60 Requirement	Applicability to ESF Design
60.150	
60.151	A
60.152	A

Table 1 (continued)

SUBPART H - TRAINING AND CERTIFICATION OF PERSONNEL

Part 60 Requirement	Applicability to ESF Design
60.160	
60.161	
60.162	

APPENDIX C

TEXT OF 10 CFR 60 REQUIREMENTS CITED

10 CFR 60.2

"Site characterization" means the program of exploration and research, both in the laboratory and in the field, undertaken to establish the geologic conditions and the ranges of those parameters of a particular site relevant to the procedures under this part. Site characterization includes borings, surface excavations, excavation of exploratory shafts, limited subsurface lateral excavations and borings, and in situ testing at depth needed to determine the suitability of the site for a geologic repository, but does not include preliminary borings and geophysical testing needed to decide whether site characterization should be undertaken.

10 CFR 60.15(c)

The program of site characterization shall be conducted in accordance with the following:

(1) Investigations to obtain the required information shall be conducted in such a manner as to limit adverse effects on the long-term performance of the geologic repository to the extent practical.

(2) The number of exploratory boreholes and shafts shall be limited to the extent practical consistent with obtaining the information needed for site characterization.

(3) To the extent practical, exploratory boreholes and shafts in the geologic repository operations area shall be located where shafts are planned for underground facility construction and operation or where large unexcavated pillars are planned.

(4) Subsurface exploratory drilling, excavation, and in situ testing before and during construction shall be planned and coordinated with geologic repository operations area design and construction.

10 CFR 60.21(c)(1)(ii)(D)

The assessment (of the site at which the proposed geologic repository operations area is to be located) shall contain:

The effectiveness of engineered and natural barriers, including barriers that may not be themselves a part of the geologic repository operations area, against the release of radioactive material to the environment. The analysis shall also include a comparative evaluation of alternatives to the major design features that are important to waste isolation, with particular attention to the alternatives that would provide longer radionuclide containment and isolation.

10 CFR 60.112

The geologic setting shall be selected and the engineered barrier system and shafts, boreholes and their seals shall be designed to assure that releases of radioactive materials to the accessible environment following permanent closure conform to such generally applicable environmental standards for radioactivity as may have been established by the Environmental Protection Agency with respect to both anticipated processes and events and unanticipated processes and events.

10 CFR 60.134

(a) Seals for shafts and boreholes shall be designed so that following permanent closure they do not become pathways that compromise the geologic repository's ability to meet the performance objectives or the period following permanent closure.

(b) Materials and placement methods for seals shall be selected to reduce, to the extent practicable:

(1) the potential for creating a preferential pathway for groundwater to contact the waste packages or

(2) for radionuclide migration through existing pathways.

10 CFR 151

The quality assurance program applies to all systems, structures and components important to safety, to design and characterization of barriers important to waste isolation and to activities related thereto. These activities include: site characterization, facility and equipment construction, facility operation, performance confirmation, permanent closure and decontamination and dismantling of surface facilities.

10 CFR 60.152

DOE shall implement a quality assurance program based on the criteria of Appendix B of 10 CFR Part 50 as applicable, and appropriately supplemented by additional criteria as required by 10 CFR 60.151.