SEP 21 1988

ESF COVER LETTER

Mr. Ralph Stein, Acting Associate Director
Office of Systems Integration and Regulations
Office of Civilian Radioactive Waste
Management
U. S. Department of Energy, RW-24
Washington, D. C. 20545

Dear Mr. Stein:

The purpose of this letter is to transmit the meeting summary for the July 18-19, 1988 NRC-DOE meeting on the Exploratory Shaft Facility. Representatives from the State of Nevada, Utility Nuclear Waste Management Group, and General Accounting Office also attended and participated.

Should you have any questions on the enclosure, please contact King Stablein (492-0446) of my staff.

Sincerely,

/S/

John Linehan, Acting Chief
Project Management and Quality Assurance Branch
Division of High-Level Waste Management
Office of Nuclear Material Safety
and Safeguards

Enclosure: As stated

cc: R. Loux, State of Nevada
C. Gertz, State of Nevada
K. Turner, GAO
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SUMMARY OF DOE/NRC MEETING
ON EXPLORATORY SHAFT FACILITY
July 18-19, 1988
Rockville, Maryland

Agenda: See Attachment 1

List of Attendees: See Attachment 2

Summary:

The objectives of the meeting were: 1) for DOE to explain how their Exploratory Shaft Facility (ESF) design process considers and implements the requirements of 10 CFR Part 60, and 2) for DOE to respond, to the extent practicable at this time, to NRC objections 2, 3, and 4 to the Consultation Draft Site Characterization Plan (CDSCP). Also, as a result of the July 7, 1988 NRC/DOE meeting on Quality Assurance (QA) open items, where it was agreed that QA level assignments for ESF design and construction would be discussed at this meeting, the DOE made a presentation concerning the assignment of QA levels for ESF design. All NRC and DOE presentation materials are included as part of this meeting summary as Attachments 3-13. The ultimate purpose of these presentations was to provide a basis for NRC and DOE to discuss and reach agreement on approaches to and schedules for resolution of the NRC concerns with respect to the ESF.

In opening the NRC presentations, the NRC provided a list of ESF open items (Attachment 3) which have resulted from meetings with the DOE since 1983, and suggested that a meeting be held to discuss closure of these items. The DOE agreed to meet on the topic and suggested that discussion of these open items be held in conjunction with the meeting on DOE's plans to revise the Site Characterization Plan (SCP) in response to NRC's objections, comments, and questions made on the CDSCP.

NRC presented their major concerns regarding consideration of 10 CFR Part 60 requirements in design, that is, that it did not appear that the DOE had systematically reviewed, considered, and incorporated 10 CFR Part 60 in the design process for the ESF. See Attachment 4. The DOE presented the organization and structure of its design efforts, including use of the Interface Control Work Group (ICWG) to control design interfaces, and use of the ICWG and engineering change requests to control design changes. The NRC indicated that the DOE presentation did not alleviate the NRC concerns about the DOE ESF design process. In particular, NRC noted that there is not one specific and identifiable entity responsible for ensuring and verifying that 10 CFR Part 60 requirements are considered and incorporated into the ESF design. The DOE also presented a matrix from the Generic Requirements Document, Appendix E, which related design requirements to 10 CFR Part 60 (Attachments 5 and 6). The NRC noted that the matrix should be more accurate and complete in spelling out the 10 CFR Part 60 requirements that apply to various portions of the ESF and expressed interest in further review and discussion of such an expanded matrix.

In a separate matter related to the design process, DOE presented a schedule showing final ESF design due to be completed in March 1989. NRC pointed out that if DOE hopes to obtain NRC comments on the ESF in March 1989 and begin

construction in June 1989, NRC must have design information relevant to safety or waste isolation for review two to three months prior to release of the SCP (currently scheduled for December 1988).

Regarding Objections 2, 3, and 4, the NRC summarized their concerns, as indicated in the NRC point papers. See Attachment 4. Concerning Objection 2, the DOE stated their position is to construct both shafts to a depth of approximately 1100 feet. The ES-1 will not penetrate the Calico Hills unit; however, the design of the facility will remain flexible enough to support drilling and testing in the Calico Hills, if necessary. Alternate methods of characterizing the Calico Hills were discussed. A decision about penetration by ES-1 into the Calico Hills has been deferred until evaluation of benefits vs. potential risks has been completed and consultation with the NRC has occurred.

DOE's presentation concerning potential interferences of testing in the ESF with each other or of ESF construction operations with testing in the shafts (NRC Objection 3) indicated that work to resolve this objection is in process and will be provided in Section 8.4 of the SCP. The process to respond to the objection, including formation of a working group to revise Section 8.4 of the SCP, was discussed. Both the NRC and the DOE agreed that the process for selecting the separation distance between the shafts was important. DOE will provide justification that the configuration presented in Section 8.4 will not result in significant interference effects. The NRC continued to be concerned about the adequacy of the proposed approach for evaluating test interferences from construction operations. The NRC expressed the need to review the ESF portions of the SCP prior to reviewing the final SCP if ESF-related comments are to be provided to DOE three months after release of the SCP. The DOE indicated that a mechanism for informal review prior to releasing the SCP will be examined.

The DOE's presentation on Objection 4, the shaft location and the potential for flooding and erosion at that location (see Attachment 11), included a status report of analyses underway to respond to this objection. The analyses underway include an evaluation of infiltration around the shaft, sealing concepts, and performance considerations. The methodology employed to select the shaft locations, the calculation of the probable maximum flood, and the bounding cases for surface and subsurface inflow to the ESF were discussed at length. The NRC expressed concern that these analyses currently underway are too limited in that they do not take into account the complete range of scenarios that can affect the site over the 10,000 year life of the repository. Conclusions from these analyses will be documented in the SCP (Section 8.4), SCP supporting documents, and in the Exploratory Shaft Performance Analysis Report (SAND85-0598). The NRC requested an updated copy of this report in draft.

The NRC expressed its concern that there is not an adequate design process in place to assure that appropriate quality levels are being assigned to ESF design and construction activities and stressed that such a design process needs to be in place now. See Attachment 12. The DOE gave a presentation on the QA level assignments for the design and construction of the ESF (Attachment 13). This included background on how QA levels are assigned, current status of QA level assignments, justification for QA level assignments with examples, and plans for incorporating Q-List requirements. NRC and the state raised several questions regarding the process used to assign quality levels to particular

items, activities, and documents. Specifically, based on the information provided by DOE, NRC indicated it has determined that there is not in place a design process that assures items or activities related to safety or waste isolation are quality level I.

NRC Closing Statements/Observations:

ESF Design Process

The ESF design process as presented by DOE does not ensure that 10 CFR Part 60 requirements are considered and incorporated into the ESF design. In particular, the lack of a specific and identifiable entity responsible for assuring that 10 CFR Part 60 requirements are considered in the development of the design and then for verifying that those requirements have in fact been incorporated into the design is a significant weakness in the overall ESF design process.

The guidance with respect to 10 CFR Part 60 requirements in Appendix E of DOE's Generic Requirements document is inadequate. The guidance needs to spell out more accurately and completely what parts of 10 CFR Part 60 apply to the various aspects of the ESF.

The current DOE schedule for the ESF calls for completion of the final ESF design in March 1989. The SCP is scheduled to be released in late December 1988. NRC will need to review the design information and specifications relevant to radiological health and safety and to waste isolation prior to issuing its comments on the ESF. NRC will need such information, as well as other key materials supporting the ESF design, at least two months prior to release of the SCP if NRC is to be able to provide comments on the ESF to DOE three months after release of the SCP. It has been the NRC's position, as indicated in the August 13, 1987 NRC-DOE management meeting on ESF review, that this expedited review of the ESF is clearly predicated on early receipt by NRC of such information.

The NRC needs to receive a copy of the Subsystem Design Requirements Document (SDRD) and the Engineering Change Requests (ECRs) modifying that document. DOE has committed to supplying those materials to NRC.

Quality Level Assignments for the ESF

The concern was expressed by NRC at the beginning of the meeting that there is not an adequate design process in place to assure that appropriate quality levels are being assigned to ESF design and construction activities. Such a design process needs to be in place now. The DOE presentation on the process currently in place to assign quality levels to those activities did not alleviate the NRC concern. Specifically, the staff has determined that there is not in place a design process that assures items or activities related to safety or waste isolation are quality level I. Further meetings or discussions will be needed to reach agreement on an approach and schedule for resolution of this concern.

CDSCP Point Paper Objection 2--Penetration of the Calico Hills Unit

DOE's approach to the NRC objection relating to penetration of the Calico Hills unit appears satisfactory. It is NRC's understanding that DOE does not

currently plan to penetrate the Calico Hills unit with the exploratory shaft, and that if DOE does later decide it does wish to penetrate the Calico Hills unit, it will do an impact analysis of that activity upon the waste isolation capability of the site. NRC would expect to review that analysis prior to DOE's going ahead with the penetration of the Calico Hills unit. NRC wishes to emphasize that data on the Calico Hills unit are needed, and that its concerns regarding penetration of the Calico Hills unit should not be construed to mean that DOE does not need to gather information on that unit. When DOE formally transmits their position on penetration of the Calico Hills unit to NRC, closure may be reached on this objection.

CDSCP Point Paper Objection 3--Potential Test Interferences

The approach and analyses proposed to treat the NRC concern regarding potential interference of one test with another appear satisfactory. On the other hand, an adequate approach to the concern about potential interference of construction operations with testing seems lacking. In developing such an approach, NRC recommends that the input of construction operations personnel and test principal investigators be specifically solicited.

Performance confirmation testing to be started during site characterization needs to be described in the SCP in sufficient detail that potential interferences involving that testing can be evaluated. Part 60 also requires seal testing to begin during site characterization. That testing must also be described in the SCP so that potential interferences can be evaluated. DOE mentioned that it will address both of these topics during the CDSCP point paper response meeting tentatively scheduled for August/September 1988.

CDSCP Point Paper Objection 4--Shaft Location

The NRC did not have the draft performance analysis that formed the basis for the DOE presentation on analysis of shaft locations. The most current draft available of that analysis should be provided to NRC.

Based on DOE's presentation, NRC is concerned that DOE is taking too limited an approach to the analysis of the impact of the ESF on repository performance. In doing the bounding analyses for the impact on waste isolation of locating the exploratory shafts at their proposed sites, DOE needs to consider the complete range of scenarios that may affect the repository site over the next 10,000 years, evaluate how those scenarios may affect the ESF, and analyze, in turn, whether the site would be significantly affected by the ESF. DOE should consider the list of scenarios presented in Section 8.3.5.13 of the CDSCP as a starting point for the analysis, and further develop that list keeping in mind the NRC comments on that section of the CDSCP.

As presented, the DOE treatment of preliminary performance assessments during the ESF design stage recognized the need to provide assurance either that the analyses are really bounding analyses or that for particular parameters where that is not the case the analyses are not sufficiently sensitive to those parameters for that to be a problem. However, NRC is concerned about DOE's implementation of this approach. For example, DOE has used 0.5 mm/year as an upper bound estimate of average flux for the performance assessments even though this value has been questioned by both the NRC staff and the State of Nevada for some time.

ESF Open Items

The NRC has proposed that a meeting be scheduled in the near future to discuss an approach to closure of each ESF open item and a schedule for closure. DOE proposed to have such a meeting in conjunction with the CDSCP point paper response meeting tentatively scheduled for August/September 1988. The NRC agrees that August is acceptable for scheduling the meeting. However, if the CDSCP point paper meeting is delayed, the NRC considers that the meeting on ESF open items still needs to be held in August.

List of DOE Documents Requested

A list of DOE documents containing information that NRC needs to receive from DOE is attached to this meeting summary. See Attachment 14.

DOE Closing Statements/Observations:

The DOE indicated that the material presented at this meeting was of a preliminary nature and has not been reviewed or completed. The DOE believes it has an adequate design process in place through the Engineering Change Request (ECR) process and the ICWG. The DOE recognizes that changes to Appendix E of the Generic Requirements Document may be needed with respect to 10 CFR Part 60 and will check to ensure proper implementation of such requirements.

With respect to NRC Objection 2, the current DOE approach is not to penetrate the Calico Hills unit with the exploratory shaft and therefore this objection is ready to be brought to closure. However, DOE recognizes the need to get information on the Calico Hills unit, and will assess the risks and benefits associated with penetrating the unit with the exploratory shaft and will consult with the NRC on this topic.

Regarding NRC Objection 3, potential test interferences, and NRC Objection 4, shaft location, the DOE believes it is on the right track, but will go back and look at other scenarios. DOE will address these objections as the design progresses.

On QA level assignments, NRC comments have been noted and concerns are being seriously considered. DOE will come forward with a QA program to give both NRC and DOE confidence in the program.

With respect to the list of ESF open items provided by the NRC during the meeting (Attachment 3), DOE indicated that discussion of these items could be held in conjunction with the meeting on DOE's plans to address the NRC point papers.

State of Nevada Closing Statements/Observations:

The State of Nevada participated in the discussions throughout the meeting. No closing statements were received from the State, or other interested parties.

Acknowledgements:

The undersigned agree that this summary is a fair representation of the meeting. The signatures below do not necessarily indicate agreement with the comments or views expressed by other participants.

King Stablein 9/21/88

King Stablein, Project Manager
Operations Branch
Division of High-Level Waste Management
Office of Nuclear Material Safety and Safeguards
U. S. Nuclear Regulatory Commission

Edward Regnier 9/21/88

Edward Regnier, Acting Chief
Licensing Branch
Office of Civilian Radioactive Waste Management
U. S. Department of Energy

for Naomi Comar 9/22/88.

Ram B. Lahoti, Chief
Underground Facilities Branch
Office of Civilian Radioactive Waste Management
U. S. Department of Energy

DOE / NRC MEETING ON ESF ISSUES

JULY 18-19, 1988

WHITE FLINT, MARYLAND

Attachment 1

DOE / NRC MEETING ON ESF ISSUES

MEETING OBJECTIVES

- EXPLAIN THE ESF DESIGN PROCESS: ITS RESPONSIVENESS, CONSIDERATION AND IMPLEMENTATION OF THE REQUIREMENTS OF 10 CFR 60
- RESPOND TO SPECIFIC NRC CONCERNS RELATED TO THE ESF

OVERVIEW OF MAJOR NRC CONCERNS

- ESF DESIGN PROCESS AND ITS RESPONSIVENESS TO 10 CFR 60 REQUIREMENTS
- POTENTIAL IMPACTS OF PENETRATING CALICO HILLS UNIT WITH ES-1 (NRC OBJECTION #2)
- ESF DESIGN INTERFERENCE CONCERNS (NRC OBJECTION #3)
- POTENTIAL ADVERSE IMPACTS OF EXPLORATORY SHAFT LOCATIONS (NRC OBJECTION #4)
- QA LEVEL ASSIGNMENTS

AGENDA

NRC/DOE MEETING ON EXPLORATORY SHAFT FACILITY JULY 18-19, 1988 ROCKVILLE, MARYLAND

OPENING STATEMENTS (8:30 a.m.)	NRC DOE STATE OF NEVADA
SCOPE OF MEETING	
• MAJOR NRC CONCERNS RELATED TO THE ESF	NRC
• DOE APPROACH TO ADDRESS NRC CONCERNS	DOE (R. LAHOTI)
OVERVIEW OF ESF DESIGN PROCESS	
• ESF DESIGN PROCESS AND ORGANIZATION INTERFACES	DOE (L. SKOUSEN)

AGENDA

NRC/DOE MEETING ON EXPLORATORY SHAFT FACILITY (CONT'D)

ESF DESIGN RESPONSIVENESS TO 10 CFR 60	
• ESF DESIGN APPROACH	DOE (L. SKOUSEN)
• VERIFICATION PROCESS FOR IMPLEMENTATION OF 10 CFR 60 REQUIREMENTS IN ESF DESIGN	DOE (L. SKOUSEN)
MAJOR ESF DESIGN CHANGES UNDER CONSIDERATION	DOE (L. SKOUSEN)
CONSIDERATION OF PRELIMINARY PERFORMANCE ASSESSMENT DURING THE ESF DESIGN STAGE	DOE (T. HUNTER)
RESPONSE TO NRC CDSCP-POINT-PAPERS OBJECTION #2 (PENETRATION INTO CALICO HILLS)	DOE (M. BLANCHARD)

AGENDA

NRC/DOE MEETING ON EXPLORATORY SHAFT FACILITY (CONT'D)

.RESPONSE TO NRC CDSCP-POINT-PAPERS OBJECTION #3 (ESF DESIGN/ INTERFERENCE CONCERNS)

- ESF CONSIDERATIONS FOR PREPARATION OF SCP SECTION 8.4 — DOE (M. VOEGELE)
- SHAFT SPACING — DOE (J. TILLERSON)
- INTERFERENCE — DOE (J. TILLERSON)

RESPONSE TO NRC CDSCP-POINT-PAPERS OBJECTION #4 (SHAFT LOCATION)

- INFILTRATION AROUND SHAFTS — DOE (J. TILLERSON)
- SEALING AND FREE DRAINAGE CONCEPT — DOE (J. TILLERSON)
- LONG TERM DRAINAGE PERFORMANCE (CLOGGING POTENTIAL) — DOE (J. TILLERSON)

AGENDA

NRC/DOE MEETING ON EXPLORATORY SHAFT FACILITY (CONT'D)

QA LEVEL ASSIGNMENTS FOR ESF	DOE (P. KARNOSKI)
CLOSING COMMENTS	NRC DOE STATE OF NEVADA
MEETING SUMMARY	NRC DOE STATE OF NEVADA

NRC CONCERN
(DESIGN PROCESS)

- DESIGN RESPONSIVENESS TO FLOW DOWN OF 10 CFR 60 REQUIREMENTS WILL BE PROVIDED IN DETAIL IN THE SUBSEQUENT PRESENTATION

- LARRY SKOUSEN OF DOE/NV WILL PRESENT:

  - ORGANIZATIONAL INTERFACES AND,

  - FLOW DOWN HIERARCHY OF 10 CFR 60 REQUIREMENTS

NRC OBJECTION #3
(SHAFT SPACING AND INTERFERENCE)

- ANALYSES ARE COMPLETE AND BEING DOCUMENTED
- JOE TILLERSON OF SANDIA WILL SUMMARIZE THE ANALYSES AND RESULTS

NRC OBJECTION #4
(SHAFT LOCATIONS)

- JOE TILLERSON OF SANDIA WILL PRESENT THE RATIONALE FOR EXPLORATORY SHAFT LOCATIONS, THE STATUS OF ONGOING ANALYSES, AND THE SCHEDULE FOR COMPLETION

NRC CONCERN
(QA LEVEL ASSIGNMENTS)

- PETER KARNOSKI OF SAIC WILL PRESENT THE RATIONALE FOR THE ASSIGNMENT OF QA LEVELS TO ESF ITEMS AND ACTIVITIES

Attachment 2

(1)

ESF MEETING
JULY 18-19, 1988

ATTENDANCE LIST

Name	Organization	Phone #
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(2)

ESF MEETING
JULY 18-19, 1988

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ESF MEETING
July 18-19, 1988
ATTENDANCE LIST

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ESF MEETING
JULY 18-19, 1988
ATTENDANCE LIST

(4)

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James E. Kennedy	USNRC	301 492-3402
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ESF

OPEN ITEMS

NRC/DOE MEETING
JULY 18 - 19, 1988

Attachment 3

Open Items from 1983 Information Request

INFORMATION CONSIDERED NECESSARY REGARDING EXPLORATORY SHAFT CONSTRUCTION AND SEALING

I. Shaft and Seal Design Considerations

a. Provide an analysis of the potential effects of construction of the exploratory shaft on long-term sealing capabilities of the rock mass and identify factors that determine the nature and extent of such effects

b. Describe how the selected excavation technique and shaft design accounts for limitations and uncertainties in long term sealing considerations

c. Provide design specifications for the shaft construction and show how they deal with the factors affecting sealing

d. Describe the seal design and materials

e. Discuss the selected locations of any planned explorations or testing to be performed along the length of the shaft. Include discussion of data on sealing characteristics to be gathered and the limitations and uncertainties associated with the data

f. Provide drilling history and results of geotechnical testing from the principal borehole, G-4

II. Construction Plans and Procedures

a. Identify the acceptance criteria for construction of the exploratory shaft

b. Identify procedures used to minimize damage to the rock mass penetrated

c. Identify liner construction and placement technique. Include such information as: liner type, liner material testing and placement of liner. This information needs to be fully considered in application of any permanent sealing program

III. Sealing or Grouting Plans and Procedures

a. Describe how the seals are expected to perform in sealing the exploratory shaft. Describe tests done, both laboratory and field, to determine their long-term durability and their compat, both chemical and physical, to the host rock environment.

b. Describe the placement methods

c. Describe remedial methods to be used if sealing methods are not adequate

IV. Construction Testing and Inspection Plans and Procedures

a. Describe test and inspection procedures to be used during excavation (e.g., plumbness of hole, rock mass disturbance etc.) to determine acceptability of the shaft as constructed.

b. Describe test and inspection procedures to be used during shaft liner construction. Include information such as grout injection rates, grout bond logs, thermal measurements of grout during curing, and liner instrumentation to be used

c. Describe test and inspection procedures to be used after sealing of the shaft to assess the results of the sealing effort in controlling adverse effects. Include information such as grout strength test, visual identification of seal conditions, records of water inflow, assessment of seal bond to hot rock, and logging of drill holes

d. Describe plans to document the above construction activities

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

a. Describe test plans and procedures used to obtain adequate data on site characteristics that can be measured either directly or indirectly <u>during construction of the exploratory shaft</u>. For example:

- Geologic mapping and rock mass characterization of the shaft walls
- Measurements of rates and quantities of groundwater inflow and collection of groundwater samples for testing
- Measurements of overbreakage during blasting
- Rock mechanics testing of samples obtained during drill and blast operations

VI. Quality Assurance (QA)

Administrative Procedures

a. Identify the line of responsibility for implementing QA procedures down to and including the Construction Contractor (10 CFR 50 Appendix B. Criteria I requires that "organizations performing quality assurance functions shall report to a management level such that this required authority and organizational freedom including sufficient independence from cost and schedule when opposed to safety consideration, are provided")

b. Identify the procedures to be used by the Quality Assurance organization for implementing and monitoring the QA program for exploratory shaft design, construction and testing.

   1. Provide a schedule for completion of ES Construction and testing QA procedures
   2. Provide basis for assignment of quality level to the ES construction
   3. Provide basis for assignment of quality level to date collection during construction
   4. Provide basis for assignment of quality level to the dewatering system

Open Items from August 1985 Meeting

1. DOE would like copies of Ted Johnson's analysis that indicated the 1/2" run-off from the E. S. Drainage Area could result in a 4 order of magnitude increase of water into the ES over the SNL 500 year floor scenario.

2. DOE would like a copy of the report on in situ stress measurement at NTC referenced by David Canover.

3. DOE would like specific details on the areas of landslides at Yucca Mountain referenced by John Trapp.

4. NRC position on the 1 part per 100,000 release limit as an instantaneous differential or an integral over a year.

5. Need to establish an authoritative set of references on the subject of rock damage around openings in the earth.

6. Need to establish a common approach to evaluating the magnitude of the damage around openings.

7. Need to establish the properties of characteristics that can be use in the evaluation of "representativeness." A method for analyzing the data also needs to be established.

8. Need to structure the open items in a manner that will allow the April 1983 NRC Letter (Coplan to Vieth) to be closed out.

9. NRC final comments on the Draft Performance Assessment on the Exploratory Shaft.

10. Need to review section 60.21(c) to determine NRC's expectations regarding the information of fracture characteristics to be obtained from the exploratory shaft.

11. NRC staff concerned about the fact that the second exploratory shaft was located outside of the preferred area, needs to more thoroughly explain his logic as to why this is a significant point. Is it an issue related to validity of testing data or radiological health and safety?

12. During the DOE presentation on the rationale for selection of the site for the exploratory shaft, the DOE stated that the site chosen is representative of the repository block but indicated that discussion of the question of representativeness would be deferred. The NRC staff agrees that this should be an agenda item for a future meeting.

13. The DOE will provide to the NRC the Keystone Document 6310/85/1, Recommended Matrix and Rock Mass Bulk, Mechanical, and Thermal Properties for Thermomechanical Stratigraphy of Yucca Mountain, Version 1, October, 1984, related to selection of the repository horizon.

14. The DOE delineated the underground layout of the exploratory shaft and drifts and stated that underground testing considerations heavily influenced the layout. The NRC cannot assess the adequacy of the planned tests and hence the testing layout until the test plans are provided prior to the NNWSI/NRC ESTP meeting.

15. The NRC is to furnish the DOE with the information as to whether NRC's 10^{-5}/yr release rate applies on a discrete year by year basis or a continuous rate basis.

16. The DOE will furnish the NRC with the document which contains recent information on thickness of the Calico Hills.

17. The DOE will send the NRC copies of the viewgraphs used in the DOE's presentation of the damaged zone model for tuff.

18. The DOE will provide the NRC with the data (e.g., RQD's, stresses, hydraulic conductivities) used to get the results presented during the DOE presentation on damaged zone model for tuff.

19. The NRC will provide the DOE with the U.S. Bureau of Mines reference related to horizontal stress of southern Nevada rocks.

20. DOE will provide NRC with information relating to testing performed in/or on samples obtained from USW G-4 in addition to that presented in USGS-OFR-84-789.

21. NRC requests that DOE identify the schedule for providing the items identified in DOE's response of June 7, 1985 as being under development.

22. A decision (and the implications of such a decision) on whether the DOE will remove the liner at permanent closure or use it as part of the long term sealing system has not been determined.

23. A discussion of sealing materials and placement method and timing for exploratory boreholes from the ES will be provided in a future meeting on repository design.

24. The testing program to characterize perched water zones will be discussed at the ESTP meeting.

25. The design specifications and acceptance criteria for the shaft construction including construction controls, test blasting and overbreak control will be provided to the NRC when available.

26. The NRC will provide guidance on the key parameters that should be considered in determining the representativeness of the ESF.

27. DOE's plans on the characterization of lithophysal zones and on plans for demonstrating horizontal emplacement and exploration holes will be discussed in a future meeting on repository design.

28. Has DOE/OGR made a decision that the use of radioactive materials in the site characterization program will not be considered in the future?

INFORMATION REQUESTS FROM THE APRIL 14-15, 1987, MEETING BETWEEN THE U.S. DEPARTMENT OF ENERGY (DOE) AND THE U.S. NUCLEAR REGULATORY COMMISSION (NRC)

Nine information requests (IRs) have been developed by the NNWSI Project from the paragraphs of the meeting summary identifying the NRC concerns. These IRs are as follows:

Proposed Change 1:

I.a. Demonstrate that flooding and erosion do not adversely affect long term repository performance (incorporate shaft location changes into performance analysis).

b. Provide reasonable assurance that shafts are adequately separated so that testing in one does not adversely affect ability to obtain required data in the other shaft and adjacent test areas.

Proposed Change 2:

II. No information on Change 2 was requested.

Proposed Change 3:

III.a. Adopt adequate drift construction controls to meet 10 CFR 60 pre/post closure performance requirements.

b. Discuss recognition of possible need for remedial measures to maintain postclosure isolation capabilities due to penetration of targeted geological/hydrological structures.

c. Provide assurance that planned drift length and directions are adequate for characterizing each of the targeted fault zones.

Proposed Change 4:

IV. Describe the measures to be taken to avoid interference with testing by drifting operations.

Proposed Change 5:

V.a. Modify performance analysis to reflect increase in size of ES-2 to 12 feet.

b. Describe how construction methods minimize shaft wall damage.

c. Demonstrate that there will be minimal interference with testing from underground construction activities. In particular, address the potential for:

- movement for construction fluids through fractures from ES-2 to ES-1 test areas.

- damage to test instruments from blasting vibrations.

ACTION/OPEN ITEMS

1. The DOE will assemble the draft ESF-Repository Interface Control Drawings in a manner that they can be released to NRC and the State by June 1, 1987.

2. The DOE will provide the technical analysis supporting the proposed size of the exploratory drifts by June 1, 1987.

3. The DOE committed to constructing exploratory drifts using controlled blasting techniques, but emphasized that this did not mean that DOE had agreed that Level I QA requirements will apply to controlled blasting in the drifts. The Department will evaluate the relevance of drift stability and damage control to retrievability and waste isolation considerations.

4. The DOE committed to using the same construction control requirements in the second 12 ft. diameter shaft as in the first 12 ft. diameter shaft.

5. The DOE committed to provide from files, if available, historic drawings depicting the initial repository elevation at the 1,200 ft. horizon, by June 1, 1987.

6. The NRC will review attachment 7 and will notify the DOE by June 1, 1987, if the proposed response plan to close out open items is satisfactory.

7. The DOE provided the information requested in Attachment 6 to NRC and the State of Nevada on April 15, 1986. Copies are included with distribution of this summary.

OBJECTION 2

The NRC staff considers that the need for extending the Exploratory shaft 1 (ES-1) approximately 400 ft below the proposed repository horizon into the zeolitic zone of the Calico Hills unit has not been established in the CDSCP, nor has the need been established for tests requiring drifting (horizontal excavation) through the Calico Hills unit. It has not been demonstrated that the proposed shaft (ES-1) penetration into the Calico Hills unit (an important barrier between the repository horizon and the underlying groundwater table) or the proposed drifting through it will not have potential adverse impacts on the waste isolation capability of the site.

OBJECTION 3

The CDSCP does not include sufficient and consistent conceptual design information on the proposed ESF. This does not allow the evaluation of the potential interference of proposed investigations with each other and the interference of construction operations in the two shafts and long drifts with these investigations.

OBJECTION 4

The CDSCP does not sufficiently consider the potentially adverse impacts resulting from the proposed locations of ES-1, ES-2, other shafts and ramp portals in areas which may be susceptible to surface water infiltration, sheet flow, and lateral and vertical erosion (Refs. 1 and 2). For the proposed locations, there is a possibility of (a) potentially significant and unmitigable long-term adverse impacts on the waste isolation capability of the site and/or (b) affecting the ability to adequately characterize the site.

COMMENT 1

The rationale for the specification of information needs does not appear to ensure completeness of those information needs. Furthermore, the integration of testing with design and performance assessment appears to be lacking.

COMMENT 27

The CDSCP (Section 8.4.1.1) states that current plans call for drilling approximately 300 to 350 shallow holes (50 ft to 150 ft deep), and 45 to 80 exploratory holes (presumably deep). Several trenches are also planned to be excavated for site characterization. In addition, Section 8.4.2.5.1 includes a summary of proposed numerous activities that would involve drilling from or very close to ES-1. The individual, the cumulative, and the synergistic effects of these holes have not been considered in the evaluation of the potential impacts of exploratory shaft construction and testing on the waste isolation integrity of the site (Section 8.4.2.6, and supporting references, in particular Fernandez et al., 1987; Case.and Kelsall, 1987).

COMMENT 29

CDSCP's approach to characterizing the complex three-dimensional nature of fracture systems in the repository block appears to rely on fractal analysis of outcrop exposures and geologic mapping of ES-1, drifts and boreholes (excluding floors and working faces). Also, the CDSCP limits the objectives of fracture network studies to providing fracture parameters and analyses to supporting hydrologic modeling. The approach and objective to characterization described in the CDSCP may not lead to sufficient descriptions of the fracture networks.

COMMENT 30

The required integration of site-specific subsurface information with repository design is not considered in this section (e.g., not even among the qualifying factors listed in the next to last paragraph on pg. 8.3.1.4-90).

COMMENT 42

This table, which summarizes the requests for thermal and mechanical rock properties, appears to be far from complete.

COMMENT 43

Section 8.3.1.15 does not present a clear testing rationale. Thermal and mechanical properties to be determined are not related to specific individual tests.

COMMENT 44

The testing program laid out in Section 8.3.1.15 is deficient in several respects. In some cases, important information that could be gained in testing is not identified. Also, some proposed tests are ill-defined, and others may not be able to provide required information.

COMMENT 45

The discussion and use of statistics in this chapter is not clear. A statistical approach has been suggested to determine numbers of tests required to determine various rock properties, but the approach suggested is confusing and apparently overlooks several considerations that should be factored into such an approach. Also, needed confidences of "low," "medium," or "high" have been assigned without explaining the basis for such assignments. Bases for assigning the needed confidence of low, medium or high are not discussed.

COMMENT 46

In order to examine the margin of safety engineered into the stability of emplacement holes from the standpoint of retrievability, the canister-scale heater experiment needs to be run beyond the average design heat load. The CDSCP does not include provisions for such testing. Also, no mention is made of testing of lined versus unlined holes, backfilled holes, etc.

COMMENT 47

This experiment is one of the more important rock mechanics experiments proposed; yet, virtually no detail is given regarding it. There seems to be a lack of integration between this experiment and the modeling activities and design.

COMMENT 48

Plate-load tests do not necessarily provide a means of determining in-situ (i.e., undisturbed) rock mass deformational properties. Data obtained from such tests may be useful in assessing spatial variability, effects of different excavation procedures, etc. as part of the overall program to characterize deformational relations of the rock mass adjacent to underground openings but may not be useful in thermomechanical calculations.

COMMENT 54

CDSCP has limited its consideration of how jointed tuff can be treated to equivalent continuum models. Although several possible models are described in Chapter 2 (pp. 2-19 and -20), representation of jointed tuff by equivalent

continuum models only and disregarding of other models such as quasi-discrete or distinct element models has not been justified.

COMMENT 55

Geomechanical analyses do not consider the effects of emplaced support components or the effect of elevated temperature on the support system components.

COMMENT 56

The first section of the next to last paragraph on pg. 8.3.2.2-55 expresses the anticipation that contingency measures might strongly emphasize constructibility based on semi-empirical rock mass classifications. These classifications bear no direct relation to the primary long-term repository performance requirements of containment and isolation. It is not clear, therefore, whether the selected criteria are appropriate for guiding emplacement decisions, and, specifically to perform system performance studies for off-normal conditions, as proposed in the first sentence of the last paragraph on pg. 8.3.2.2-55..

COMMENT 57

The CDSCP states that the potential for the development of new paths to the accessible environment or for an extension of the disturbed zone will be mitigated by backfilling the emplacement drifts.

Given the proposed loose backfill and only partial filling of the drifts, this effect may be quite limited.

COMMENT 58

The proposed wedge analysis and key block analysis are not capable of including the effects of thermal loading or stress gradients on the host rock.

COMMENT 59

The description of far field analysis in the CDSCP does not address potential for thermally induced movement along faults or fractures.

COMMENT 60

The comment that "...drifts will not be relied on to be open. They may have caved in or settled on the backfill" raises concerns because it is formulated as a very broad option.

COMMENT 61

Systematic studies or calculations may be needed to determine the heat and moisture transfer from the rock to the ventilation air.

COMMENT 63

The last tentative goal on pg. 8.3.2.5-21 indicates that high confidence is needed that ES-1 shaft will terminate no less than 150 m above ground-water table.

It does not appear that this goal is reached under the present ES-1 design.

COMMENT 64

The CDSCP does not include details of the in situ testing of the proposed seal design concepts. This information is necessary to evaluate the effects of seal testing activities on the ability of the site to meet the performance objectives (10 CFR 60.112 and 10 CFR 60.113).

In addition, the CDSCP states that in situ testing to evaluate seal components and placement methods would not start until after the submission of License Application. In view of the uniqueness of the proposed seal design concepts and the associated uncertainties with the long-term performance of the seals, the NRC staff considers that the proposed start date of in situ testing for evaluation of seal components and placement methods will result in a lack of sufficient data for evaluating the license application.

COMMENT 65

The CDSCP states that "The lack of aquifer above the waste emplacement horizon at the Yucca Mountain site, makes it unnecessary to install either permanent or temporary shaft or ramp seal components at the time of access construction."

No evidence or substantiation is presented for the statement that neither operational nor permanent seals will be required.

COMMENT 66

The CDSCP states that "The shaft liner can be removed to emplace seal components later."

This statement, without reference to an evaluation, analysis or justification, appears to imply that it is a straightforward matter to remove a shaft liner, and that such a procedure has no implications for the isolation capability of the site.

COMMENT 67

The statement near the end of the next to the last paragraph on pg. 8.3.3.1-4 that "boreholes that are upgradient or long distances from the repository may not require sealing" appears to be driven largely by considerations of the vertical downward flow in the pre-repository rock environment, and does not represent a conservative sealing approach.

COMMENT 68

It is stated in the second paragraph on pg. 8.3.3.2-24 that "more conservatism has been added by the selection of the design - basis performance goals to be substantially less than the maximum allowable values." Although this is true immediately after closure, the two curves (Fig. 8.3.3.2-3) do converge relatively rapidly. Although no time scale is included, it can be inferred from Fernandez et al, 1987, Fig 3-2, that the breakpoint in the Design Basis Performance Goals is at about 1,000 years. Beyond that point the two curves are so close together as to leave very little safety margin.

COMMENT 70

It is unclear whether a reasonably conservative design approach has been used to determine required backfill hydraulic conductivity.

COMMENT 72

In evaluating potential effects of credible accidents on projected radiological exposures, the CDSCP has not sufficiently considered retrieval operations.

COMMENT 97

Plans should be made to correlate persistence of geologic features from ES-1 to ES-2 which might provide preferential pathways and to develop a photographic record of ES-2 for possible future use.

COMMENT 98

A reasonable assurance that the shafts are far enough apart so that construction in ES-2 does not adversely affect the ability to obtain required data in ES-1 and adjacent test areas has not been provided.

COMMENT 99

The CDSCP does not present appropriate information on blasting to reflect the most recent strategy for minimizing shaft wall damage as outlined in DOE's

"Response to NRC Information Requests from the April 14-15 1987 Meeting Between DOE and NRC" (Ref. 1).

COMMENT 100

The extent of site exploration described in the CDSCP indicates that the DOE plans to explore only a small portion of the underground repository block through underground testing and drifting. Substantially more drifting may be necessary to reduce uncertainties about the presence of faults and other geologic and hydrologic conditions. In the CDSCP no exploratory drift is planned to cross the main waste storage area to the southern portions of the the block, which based upon existing information appears to contain more faults and fractures than other parts of the block. Borehole penetrations into the main waste storage area (boreholes from the surface, horizontal core drilling or other means) may not provide the representative information needed to construct a reliable three-dimensional geologic model of the repository block and to evaluate ranges of parameters that could affect repository performance.

COMMENT 101

Plans for remedial measures that may be required to minimize potentially adverse impacts of penetrating the target features are not given.

COMMENT 102

In several activity descriptions, it is proposed that air coring will be used to drill holes to be used for permeability testing (e.g., Infiltration test, pg. 8.4-52; bulk-permeability test, pg. 8.4-53; radial borehole tests, pg. 8.4.-53; Calico Hills tests, pg. 8.4-54; diffusion tests, pg. 8.4-54).

Aside from the potential technical difficulties associated with the feasibility of drilling such holes, this raises questions about the reliability of the permeability values thus obtained.

COMMENT 103

The performance confirmation program has not been sufficiently well defined, and appropriate details are not included in the CDSCP. The discussion concerning confirmation, Issue 1.7, has not presented the strategy or a plan to meet the requirements set forth in Subpart F of 10 CFR Part 60.

QUESTION 12

What are the definitions of the terms fracture "aperture" and "length"?

QUESTION 14

Does this program include all drilling or only surface based drilling?

QUESTION 16

How is the roughness coefficient parameter measured in a borehole? What is the difference between roughness coefficient listed here and "roughness" discussed elsewhere in Section 8.3.1.4.2.2.3?

QUESTION 17

What role, if any, will the data presented in Chapter 2 play in the proposed model development and in scoping the amount of planned site specific in situ testing?

QUESTION 25

What methods will be used to determine whether there is any impact of ground motion from underground nuclear explosions on repository design?

QUESTION 26

How will the heated block experiment be used for model validation if there are no imposed stress gradients or temperature gradients inside the block?

QUESTION 27

What are the parameters and the strength model for which the strength experiment(s) are designed, and how will a substantial volume of rock be driven to failure?

QUESTION 34

Why is there no link (other than that indicated in Figure 8.3.2.1-1) established between this plan and Issue 1.12 - Repository Sealing?

QUESTION 35

According to the last sentence of this section, the approach to develop this plan is given in Section 8.3.2.3, and the data requirements for this plan are given in Section 8.3.2.2.1. Both of these referenced sections cover extremely broad topics. What are the relevant items for this section?

QUESTION 36

Where in Section 8.3.2.2.1 are the data requirements for this activity discussed?

QUESTION 37

Some concerns exist as to whether the list of parameters for performance goal C2 (rock radiation shielding) given on pg. 8:3.2.3-30 is comprehensive. For example, does the expected pre-emplacement saturation value of 65% represent the expected post-emplacement saturation value?

QUESTION 38

Use of mechanical excavation is considered not feasible in some parts of the document and plausible in other parts. The next to last paragraph on pg. 8.3.2.4-28 mentions the possibility that mechanical excavation may be used. Does this contradict other implications in the CDSCP (e.g., pg. 8.3.2.2-70) that mechanical excavation is not feasible?

QUESTION 39

Why are the requirements for some items on pg. 8.3.2.5-23 different from the requirements for System Element 1.2.1.2 identified in Table 8.3.2.4-2, nonradiological health and safety?

QUESTION 40

What is the justification for the statement on pg. 8.3.2.5-24 that "no site characterization data is required to develop the high level of confidence needed for installation of borehole liners."

QUESTION 41

There are many inconsistencies in this section when compared with the details given in other sections of the CDSCP and reference documents. What are the potential impacts of such inconsistencies?

QUESTION 42

Description of items included in Table 8.3.3.2-1 need further clarification in several areas. Why have not all the seal components been included in the list?

QUESTION 48

There are many apparent inconsistencies in the write-up of the proposed activities presented in this section when compared with the details given in other sections of the CDSCP and reference documents. What are the impacts of such inconsistencies?

QUESTION 49

Site characterization investigations should be planned based on the total area that may be needed for repository development. Is this the case for the drilling program laid out in the CDSCP?

QUESTION 50

It is difficult to tell from various depictions in the CDSCP what are the actual boundaries of the area that may be involved in repository development and that therefore may need to be characterized intensively. What are these actual boundaries?

QUESTION 51

Which activity in Table 8.3.1.15-1 is planned to investigate the effects of radiation on thermal and mechanical rock properties?

OPEN ITEMS FROM 50% TITLE I ESF DESIGN REVIEW MEETING, MAY 9-10, 1988

1. DOE should demonstrate that it has in place and is implementing an overall systematic design and approval process for the ESF that (i) considers 10 CFR 60 requirements including those for QA, (ii) recognizes uncertainties associated with site characterization activities, (iii) recognizes the need for feedback and interaction among participants responsible for design, scientific tests, performance assessment, construction and operation, and (iv) considers operational impacts on tests and space requirements to avoid test interferences.

2. DOE should provide justification for assigning quality levels II and III to practically all activities for which specifications were handed out by F&S during the 50% Title I design review of the ESF.

MAJOR NRC CONCERNS REGARDING EXPLORATORY SHAFT FACILITY DESIGN

NRC/DOE MEETING
JULY 18 - 19, 1988

Attachment 4

EXPLORATORY SHAFT FACILITY (ESF) DESIGN OPEN ITEMS BACKGROUND

- APRIL 14, 1983 LETTER FROM NRC TO DOE
- AUGUST 27-28, 1985 NRC/DOE MEETING
- APRIL 14-15, 1987 DOE/NRC MEETING
- MAY 11, 1988 CDSCP REVIEW POINT PAPERS
- MAY 9 - JUNE 9, 1988 50 % TITLE I DESIGN REVIEW MEETING (NRC STAFF ATTENDED AS OBSERVERS)

SCOPE OF
JULY 18-19, 1988 MEETING

- NRC CONCERNS RELATED TO CONSIDERATIONS OF 10 CFR 60 REQUIREMENTS IN ESF DESIGN PROCESS

- THREE ESF DESIGN RELATED OBJECTIONS STATED IN CDSCP POINT PAPERS
  - CALICO HILLS PENETRATION
  - ESF DESIGN (INTERFERENCE CONCERNS)
  - SHAFT LOCATIONS

CONSIDERATIONS OF 10 CFR 60 REQUIREMENTS IN ESF DESIGN PROCESS

* QA REQUIREMENTS (SUBPART G)

* DESIGN BASES REQUIREMENTS

QUALITY ASSURANCE FOR ESF DESIGN

* ITEMS AND ACTIVITIES POTENTIALLY IMPORTANT TO SAFETY OR WASTE ISOLATION TO BE CONTROLLED UNDER APPENDIX B, 10 CFR PART 50 QA PROGRAM (DOE'S QA LEVEL I)

* STAFF'S Q-LIST TECHNICAL POSITION GIVES ADDITIONAL DETAILS ON ABOVE (NUREG - 1318)

* DOE NEEDS TO PROVIDE A CONSERVATIVE DETERMINATION OF Q-LIST ITEMS AND QUALITY ACTIVITIES

QA FOR ESF DESIGN (CONTD)

* EXAMPLES OF POSSIBLE Q-LIST ITEMS AND ACTIVITIES ARE

  - DRILLING AND BLASTING
  - SHAFT SEALS
  - ANALYSIS OF IMPACT OF SHAFT LOCATION

QA FOR ESF DESIGN (CONTD)

CRITERION III OF APPENDIX B CONTAINS PRINCIPAL QA MEASURES FOR DESIGN, SUCH AS :

- CONTROL OF DESIGN INTERFACES
- DESIGN VERIFICATION
- CONTROL OF DESIGN CHANGES
- USE OF APPROPRIATE STANDARDS

Nuclear Regulatory Commission

Part 50, App. B

III. Design Control

Measures shall be established to assure that applicable regulatory requirements and the design basis, as defined in § 50.2 and as specified in the license application, for those structures, systems, and components to which this appendix applies are correctly translated into specifications, drawings, procedures, and instructions. These measures shall include provisions to assure that appropriate quality standards are specified and included in design documents and that deviations from such standards are controlled. Measures shall also be established for the selection and review for suitability of application of materials, parts, equipment, and processes that are essential to the safety-related functions of the structures, systems and components.

Measures shall be established for the identification and control of design interfaces and for coordination among participating design organizations. These measures shall include the establishment of procedures among participating design organizations for the review, approval, release, distribution, and revision of documents involving design interfaces.

The design control measures shall provide for verifying or checking the adequacy of design, such as by the performance of design reviews, by the use of alternate or simplified calculational methods, or by the performance of a suitable testing program. The verifying or checking process shall be performed by individuals or groups other than those who performed the original design, but who may be from the same organization. Where a test program is used to verify the adequacy of a specific design feature in lieu of other verifying or checking processes, it shall include suitable qualifications testing of a prototype unit under the most adverse design conditions. Design control measures shall be applied to items such as the following: reactor physics, stress, thermal, hydraulic, and accident analyses; compatibility of materials; accessibility for inservice inspection, maintenance, and repair; and delineation of acceptance criteria for inspections and tests.

Design changes, including field changes, shall be subject to design control measures commensurate with those applied to the original design and be approved by the organization that performed the original design unless the applicant designates another responsible organization.

QA FOR ESF DESIGN (CONTD)

DOE NEEDS TO DEMONSTRATE HOW DESIGN PROCESS CONSIDERS 10 CFR PART 60 REQUIREMENTS

* DESIGN CRITERIA
* ITEMS & ACTIVITIES ON WHICH A DETERMINATION IS NEEDED PRIOR TO ESF CONSTRUCTION

ESF DESIGN BASES SHOULD ADDRESS 10 CFR 60.15 SITE CHARACTERIZATION REQUIREMENTS. FOR EXAMPLE,

(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) 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.

ESF SITING SHOULD CONSIDER 10 CFR 60.122(c) - POTENTIALLY ADVERSE CONDITIONS. FOR EXAMPLE,

(1) POTENTIAL FOR FLOODING OF THE UNDERGROUND FACILITY, WHETHER RESULTING FROM THE OCCUPANCY AND MODIFICATION OF FLOODPLAINS OR FROM THE FAILURE OF EXISTING OR PLANNED MAN-MADE SURFACE WATER IMPOUNDMENTS.

CALICO HILLS PENETRATION

* CALICO HILLS PRINCIPAL BARRIER

* ADVERSE IMPACTS ANALYSIS REQUIRED (10 CFR 60.17 (a)(2)(iv))

* POTENTIAL CONNECTION OF FLOW-PATHS FROM WASTE AREA TO ES-1 LOWER PORTION

* DOE's DESIGN GOAL - TERMINATE ES-1 150 m ABOVE WATER TABLE

CALICO HILLS PENETRATION (Contd.)

* DOE's DRAFT 1988 MISSION PLAN AMENDMENT SECTION 3.2.1.1 (EXPLORATORY-SHAFT FACILITY) STATES THAT BOTH EXPLORATORY SHAFTS WILL BE APPROXIMATELY 1100 FEET DEEP.

* ESF 50 % TITLE I DESIGN REVIEW (MAY-JUNE 1988) BASED ON TENTATIVE REQUIREMENT OF NO PENETRATION INTO CALICO HILLS.

ESF DESIGN

THE CDSCP DOES NOT INCLUDE SUFFICIENT AND CONSISTENT CONCEPTUAL DESIGN INFORMATION ON THE PROPOSED ESF. THIS DOES NOT ALLOW THE EVALUATION OF THE POTENTIAL INTERFERENCE OF PROPOSED INVESTIGATIONS WITH EACH OTHER AND THE INTERFERENCE OF CONSTRUCTION OPERATIONS IN THE TWO SHAFTS AND LONG DRIFTS WITH THESE INVESTIGATIONS.

RELATIVE TEST LOCATIONS

* CDSCP DOES NOT INCLUDE DETAILS OF TEST LOCATIONS

* CDSCP DOES NOT PROPOSE ANY IN-SITU SEAL AND DRAINAGE TESTS DURING SITE CHARACTERIZATION

* CDSCP DOES NOT INCLUDE DETAILS OF PERFORMANCE CONFIRMATION TESTING PROGRAM

CONCERNS ON LOCATIONS OF ES-1 & ES-2

SHAFT LOCATIONS (Contd.)

ES-1 AND ES-2 WILL EVENTUALLY BECOME PART OF REPOSITORY.

THEREFORE, SAME DESIGN CRITERIA MUST APPLY TO ESF AND THE REPOSITORY.

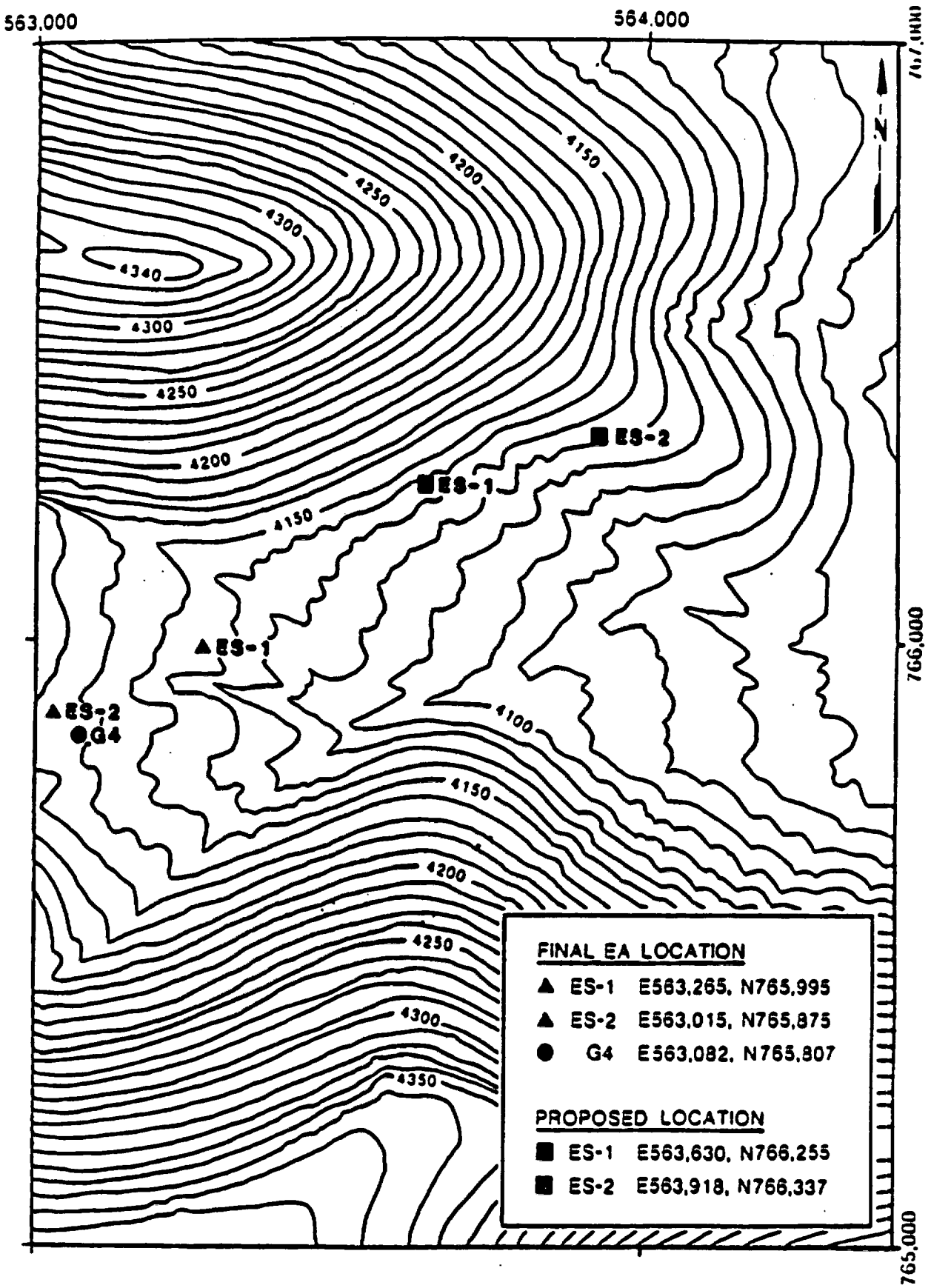
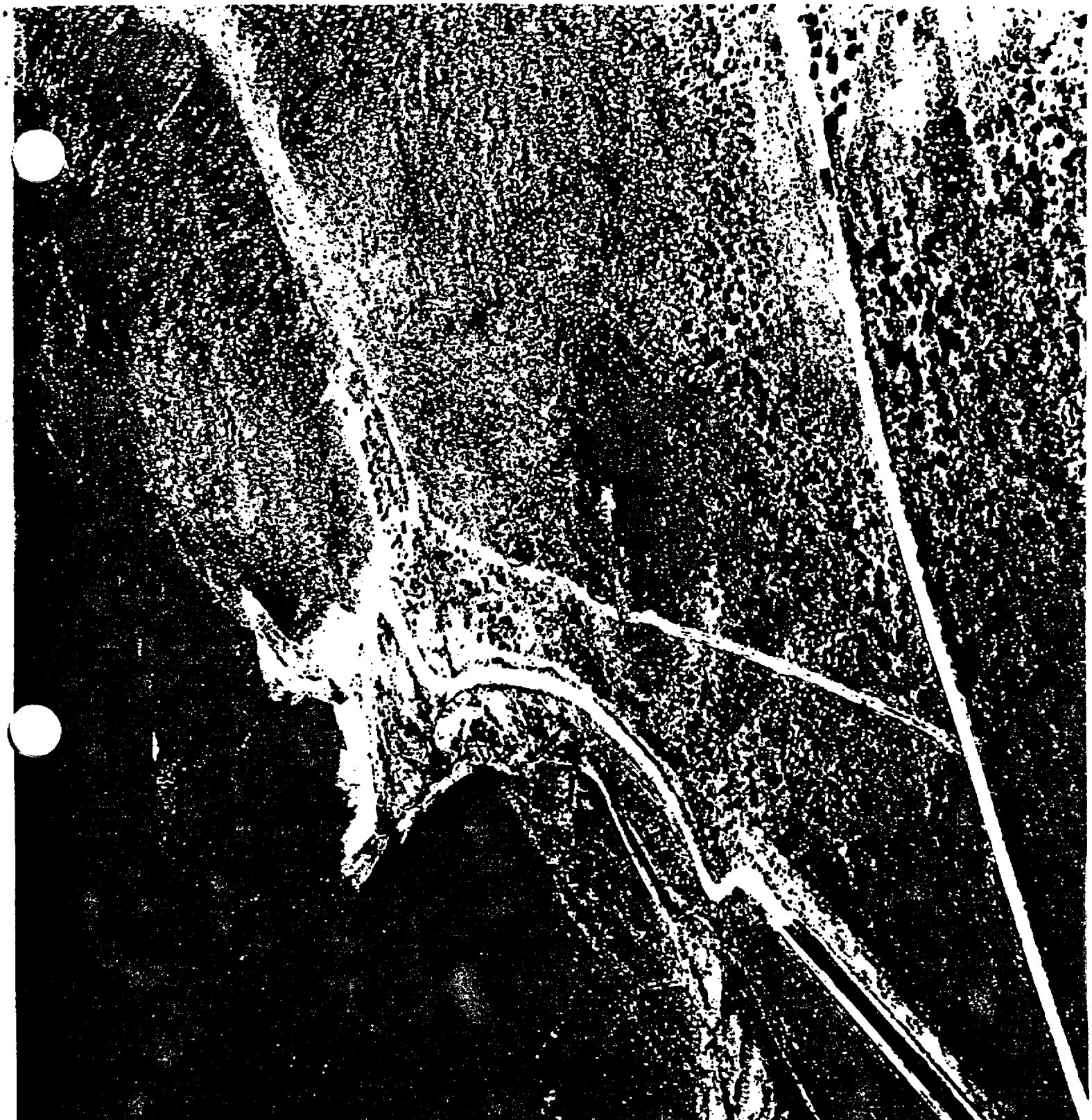
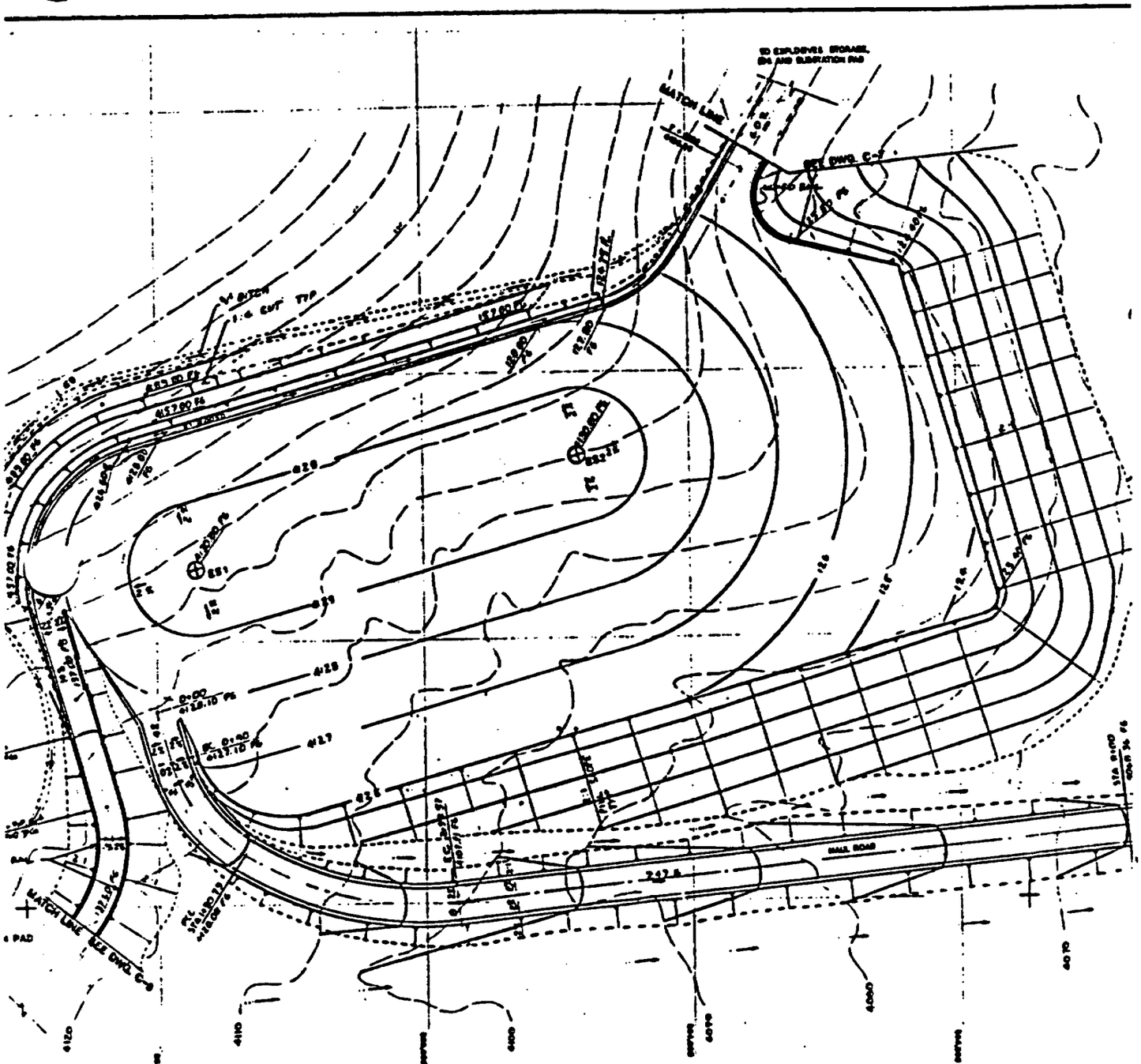


Figure 3. Comparative Illustration of the Final EA Versus the Proposed Exploratory Shaft Locations





GRADING PLAN

SCALE 1" = 40'

TITLE I
50% SUBMITTAL

SHAFT LOCATIONS (CHARACTERIZATION CONCERN)

EFFECT OF POTENTIAL INFILTRATION AROUND SHAFT OPENINGS ON ADEQUATE SITE CHARACTERIZATION.

EXAMPLES

- Radial Borehole
- Excavation Effects
- Testing at Calico Hills
- Chloride & Cl-36 Tests
- Diffusion Test

SHAFT LOCATIONS
(CHARACTERIZATION CONCERNS - CONTD.)

* INTERFERENCE WITH ES-1 TESTING BECAUSE OF PROXIMITY TO ES-2

* INTERFERENCE WITH UNDERGROUND TESTING BECAUSE OF PROXIMITY OF THE MAIN TEST AREA TO ES-1 AND ES-2

SHAFT LOCATIONS (Contd.)

DOE SHOULD DEMONSTRATE THAT ESF DESIGN LIMITS ADVERSE IMPACTS ON LONG-TERM REPOSITORY PERFORMANCE.

OVERVIEW OF THE ESF DESIGN PROCESS

- ESF DESIGN PROCESS
- ORGANIZATIONAL INTERFACES

PRESENTED BY

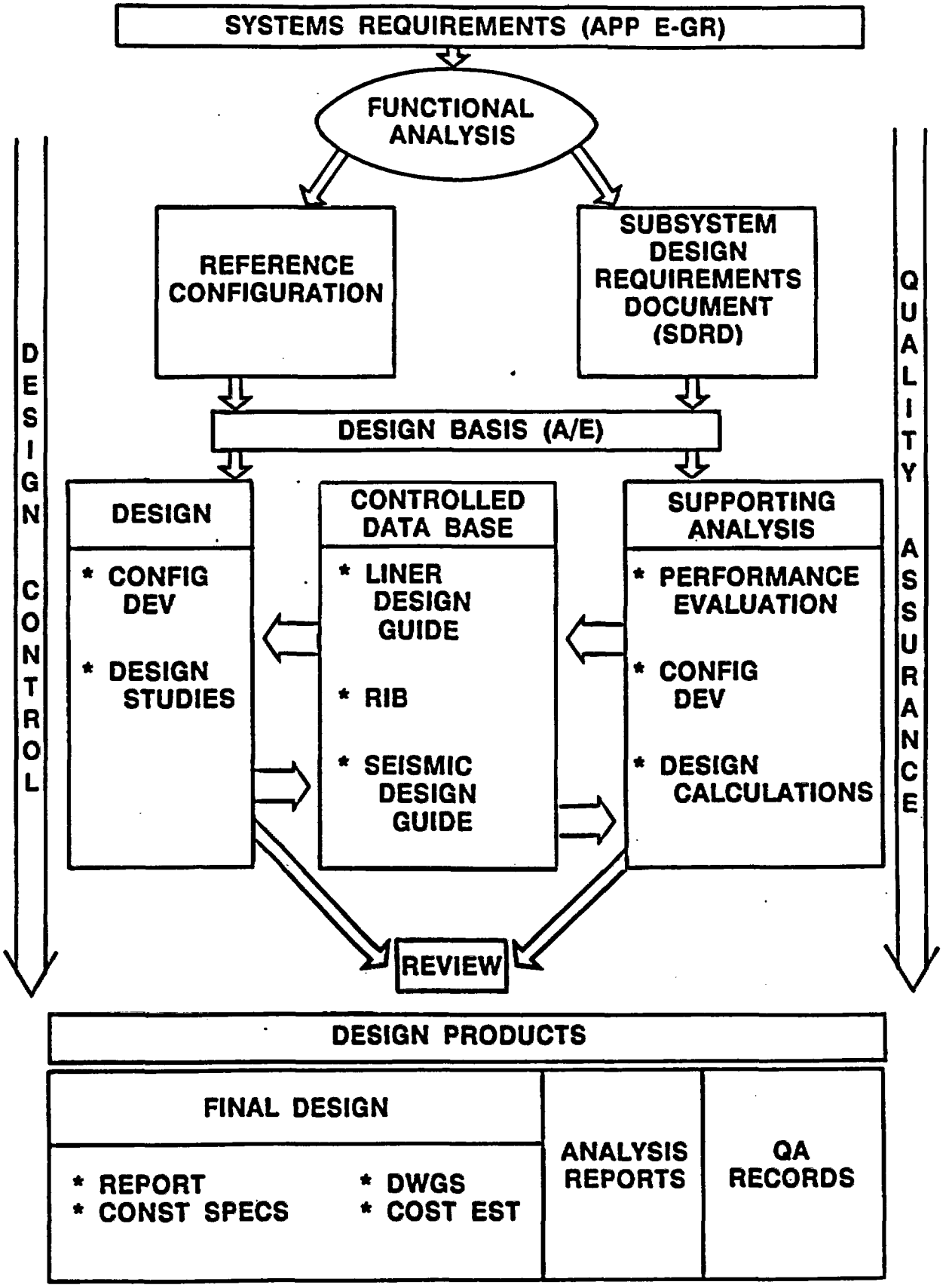
LARRY SKOUSEN

Attachment 5

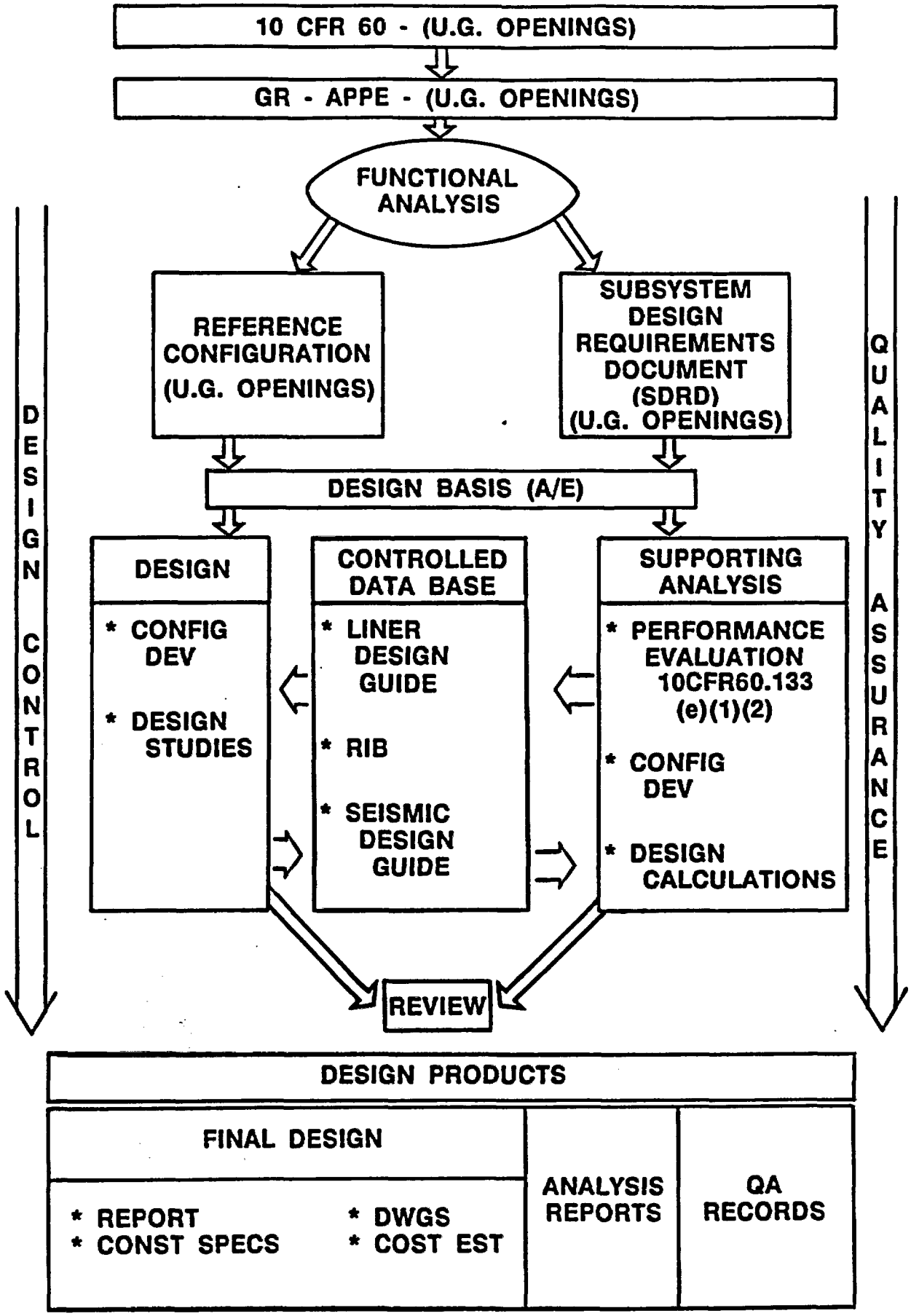
CONTENTS OF PRESENTATION

- GENERAL DESIGN PROCESS
- INCORPORATION OF REGULATIONS INTO PROCESS
- ESF DESIGN PROCESS
- ICWG ORGANIZATIONAL ROLES
- INTERFACE CONTROL PROCESS
- EXAMPLE OF INTEGRATION THROUGH ICWG
- VERIFICATION OF REQUIREMENTS
- QUALITY ASSURANCE
- DESIGN CONTROL AND REVIEW
- DESIGN PHASES
- SCHEDULE

GENERAL DESIGN PROCESS



INCORPORATION OF REGULATIONS INTO PROCESS



ESFLS.BRF-7/18,18/88 A-4

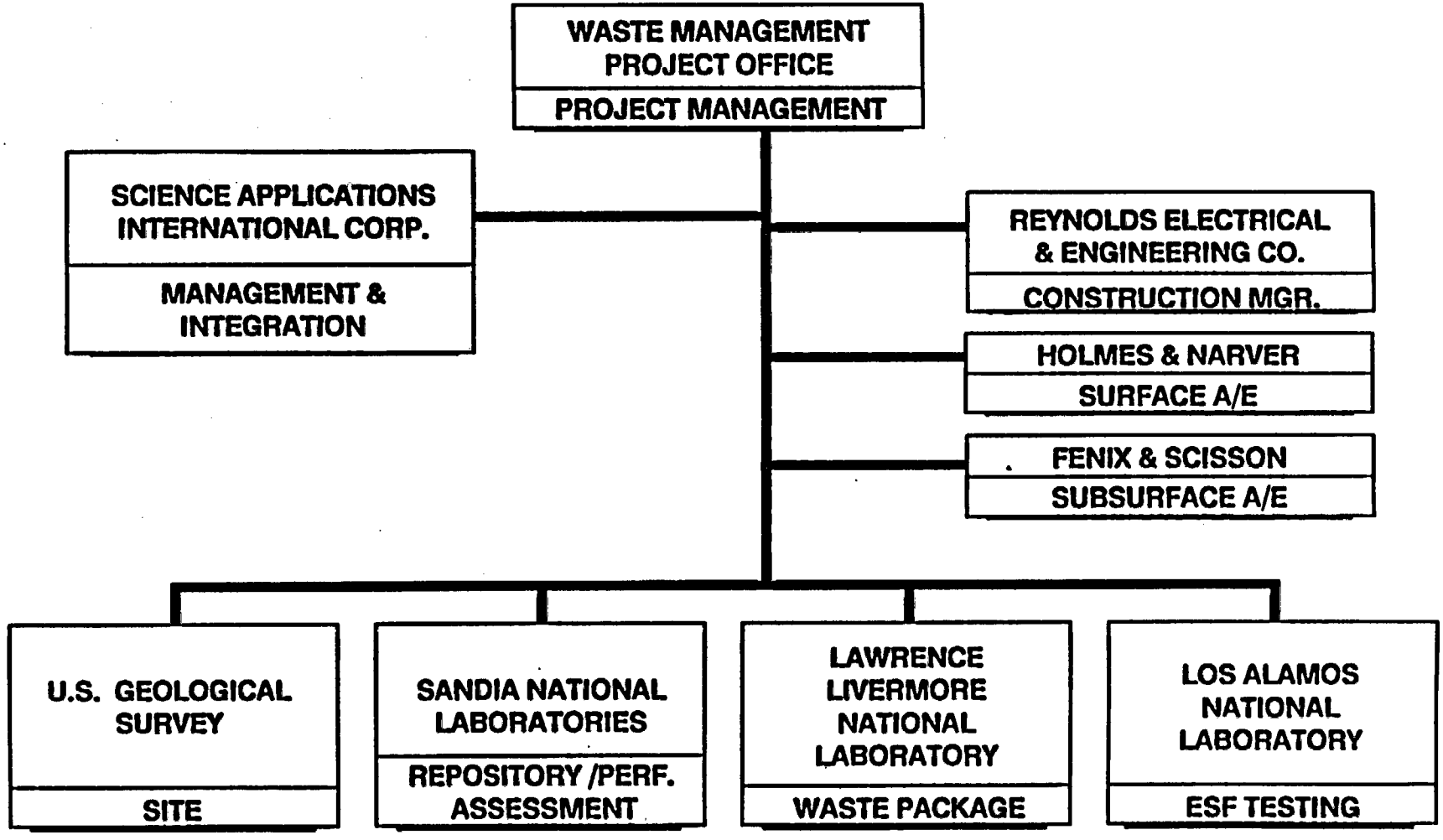
ESF DESIGN PROCESS

- DEVELOP PROJECT LEVEL REQUIREMENTS (SDRD)
- HQ APPROVAL OF SDRD
- DEVELOP APPENDICES TO SDRD
  - REFERENCE CONFIGURATION
  - TEST FACILITY REQUIREMENTS
  - TEST BOREHOLE REQUIREMENTS
- READINESS REVIEW TO START DESIGN
  - BASELINED DOCUMENTS IN PLACE
  - PREREQUISITES SATISIFIED

ESF DESIGN PROCESS
(CONTINUED)

- DEVELOP DESIGNS IN CONFORMANCE WITH SDRD
- PERFORMANCE EVALUATIONS BASED ON REFERENCE CONFIGURATIONS
- REVIEW AND AUDIT DESIGN
  - USE APPROVED PROCEDURES
  - VERIFY INCORPORATION OF ALL REQUIREMENTS
  - UPDATE THROUGH CONTROLLED CHANGE PROCESS
- FINAL APPROVAL
- ISSUE DESIGN

NNWSI ORGANIZATION



ESFLS.PM3 7/18-19/-88

ICWG ORGANIZATIONAL ROLES

WMPO

- MANAGES THE PROJECT
- PROVIDES THE SUBSYSTEM DESIGN REQUIREMENTS DOCUMENT AND GENERAL GUIDANCE AS REQUIRED
- CHAIRS INTERFACE CONTROL WORKING GROUP (ICWG)

SCIENCE APPLICATIONS INTERNATIONAL CORP.

- SUPPORTS THE WMPO IN THE INTEGRATION OF THE ESF

LOS ALAMOS

- SUPPORTS THE WMPO IN THE INTEGRATION OF ESF TESTING
- COORDINATES THE EFFORTS OF THE PRINCIPAL INVESTIGATORS
- DIRECTS THE DEVELOPMENT OF THE INTEGRATED DATA SYSTEM

ICWG ORGANIZATIONAL ROLES
(CONTINUED)

SANDIA
- REPOSITORY/PERFORMANCE ASSESSMENT INTERFACE
- PROVIDE PERFORMANCE ASSESSMENT CALCULATIONS TO SUPPORT ESF DESIGN

FENIX AND SCISSON
- DEVELOPS THE SUBSURFACE DESIGN

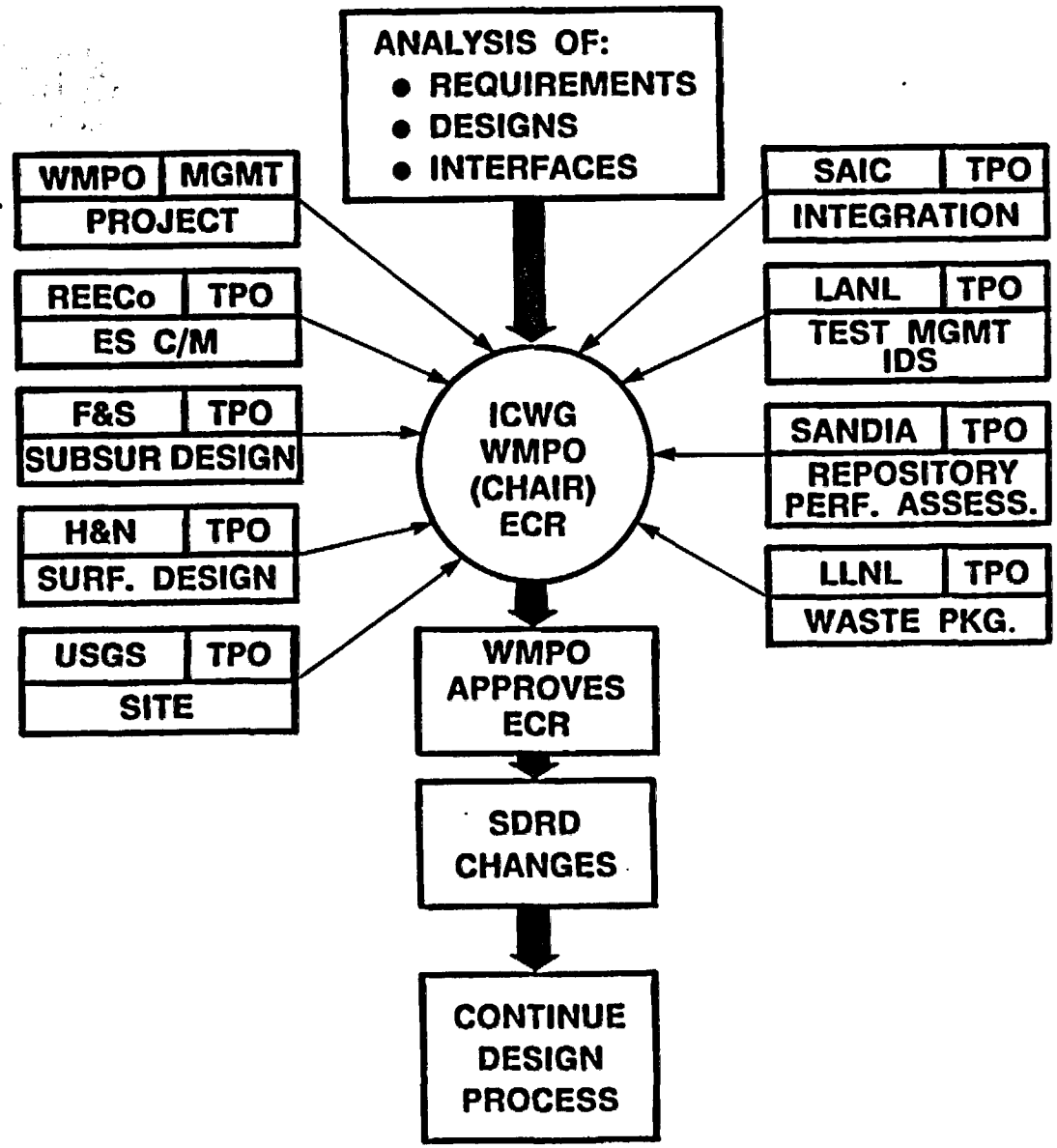
HOLMES & NARVER
- DEVELOPS THE SURFACE DESIGN

REECo
- ESF CONSTRUCTION MANAGER
- PROVIDE INPUT FOR M&O DESIGN REQUIREMENTS

LIVERMORE
- WASTE PACKAGE INTERFACE

U.S.G.S.
- SITE INTERFACE

INTERFACE CONTROL PROCESS



EXAMPLE OF INTEGRATION THRU ICWG

ESTABLISH REQUIREMENTS FOR TEST TO TEST INTERFERENCE

• PROVIDE INPUT ON TEST REQUIREMENTS	ALL PARTICIPANTS PI's
• ANALYZE INTERFERENCE OF TEST	SNL - P.A.
• ESTABLISH INTERFERENCE CONSTRAINTS	SNL - P.A./SAIC INTEGRATION
• DEVELOP ENGINEERING CHANGE REQUEST (ECR) TO ESTABLISH CONSTRAINTS	LANL
• REVIEW ECR IN EACH TECHNICAL AREA FOR IMPACT AND VALIDITY	ALL PARTICIPANTS

EXAMPLE OF INTEGRATION THRU ICWG
(CONTINUED)

• MANAGEMENT CONCURRENCES OF ECR	TPO FOR EACH PARTICIPANT
• DOE APPROVAL OF ECR	WMPO
• INSTRUCTION TO CHANGE SDRD	WMPO
• CHANGE SDRD - ISSUES CHANGES	SAIC
• UPDATE DESIGN BASIS	H&N / F&S

VERIFICATION OF REQUIREMENTS

CONTINUOUS REVIEW OF REQUIREMENTS DOCUMENTS

- PROJECT DOCUMENT REVIEW
- DOE/HQ REVIEW
- ICWG
- READINESS REVIEW TO BEGIN DESIGN PHASES

QUALITY ASSURANCE DURING DESIGN

- 10 CFR 60 (SUBPART G)
- 10 CFR 50 (APPENDIX B)
- NRC REVIEW PLAN
- OCRWM QAP (DOE/RW-0032)
- OGR QAP (OGR/B-3)
- NNWSI QAP (NNWSI/88-9)

ESTABLISHES 18 CRITERIA

- REQUIRES ASSIGNMENT OF QUALITY LEVELS
- REQUIRES DESIGN CONTROL PROCEDURES
- REQUIRES SURVEILLANCES AND AUDITS
- REQUIRES CERTIFICATION OF PERSONNEL
- REQUIRES QUALITY ASSURANCE RECORDS
- ETC.

QUALITY ASSURANCE DURING DESIGN
(CONTINUED)

- HOLMES & NARVER, INC., QAPP (H.N.-10471-1131)
  - NNWSI-ESF PROJECT PROCEDURES MANUAL
    - * NNWSI-001, GENERATION AND CONTROL PROCEDURES
    - * ⋮ ⋮
    - * NNWSI-038, QA DRAWING AND SPECIFICATION REVIEW
- FENIX & SCISSON, INC., QUALITY ASSURANCE MANUAL
  - QAPP-002
  - QUALITY ASSURANCE PROCEDURES
  - NNWSI PROJECT PROCEDURES MANUAL
  - PROJECT PROCEDURES PP-10 ..... PP-60
    - * ESF PROJECT CONTROL MANUAL
      - -- DESIGN CONTROL PROCEDURES (DCs)
        - ** DC-01 .... DC-23

DESIGN CONTROL AND REVIEWS

PROJECT OFFICE

- CONTROLS
  - APPROVAL OF DB AND SCOPE AND PLANNING DOC.
  - APPROVAL OF DESIGN PROCEDURES
  - QA SURVEILLANCE AND AUDITS
  - ON-SITE REPRESENTATIVE
  - ENFORCEMENT OF MSA REQUIREMENTS
  - APPROVAL OF CHANGE REQUESTS
  - APPROVAL OF DESIGN
- REVIEWS
  - READINESS
  - TECHNICAL
  - PEER
  - DOCUMENT

DESIGN CONTROL AND REVIEWS
(CONTINUED)

ARCHITECT/ENGINEER

- CONTROLS DESIGN
  - INPUT
  - ANALYSES
  - VERIFICATION
  - CHANGE CONTROL
  - INTERFACE CONTROL
  - OUTPUT REQUIREMENTS
  - DOCUMENTS AS QA RECORDS

TITLE I DESIGN
PRELIMINARY DESIGN

BASIS: CONCEPTUAL DESIGN AND DESIGN CRITERIA

DEVELOPS:

- THE DESIGN THAT FIRMLY FIXES THE PROJECT SCOPE
- TITLE I DESIGN REPORT WHICH INCLUDES
  - OUTLINE SPECIFICATION
  - PRELIMINARY DRAWINGS
  - TRADE OFF STUDIES
  - QUALITY LEVELS FOR SYSTEMS AND COMPONENTS
  - PRELIMINARY SAFETY ASSESSMENT
  - PROJECT SCHEDULE AND COSTS ESTIMATE

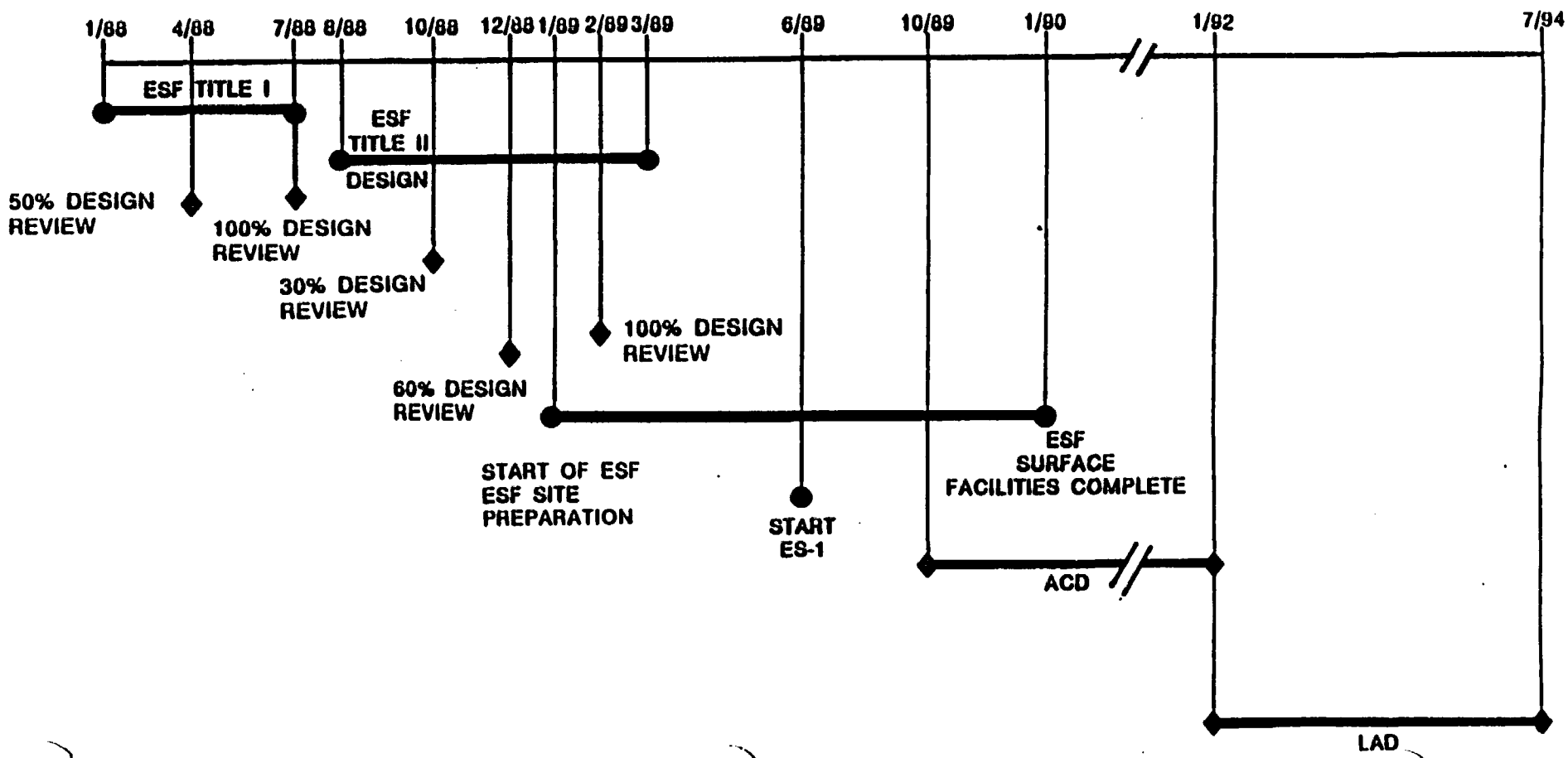
TITLE II DESIGN
DEFINITIVE DESIGN

BASIS: APPROVED TITLE I DESIGN AND THE REVISED DESIGN CRITERIA

DEVELOPMENT OF A DETAILED DESIGN THAT FULLY SUPPORTS SITE CHARACTERIZATION INCLUDING:

- CONSTRUCTION AND PROCUREMENT
  - DRAWING
  - SPECIFICATIONS
- ESTIMATE OF LABOR AND MATERIAL QUANTITIES
- DETAILED COSTS AND SCHEDULE

SCHEDULE


1/88
4/88
7/88
8/88
10/88
12/88
1/89
2/89
3/89
6/89
10/89
1/90
1/92
7/94
ESF TITLE I
ESF TITLE II DESIGN
50% DESIGN REVIEW
100% DESIGN REVIEW
30% DESIGN REVIEW
60% DESIGN REVIEW
100% DESIGN REVIEW
START OF ESF ESF SITE PREPARATION
START ES-1
ESF SURFACE FACILITIES COMPLETE
ACD
LAD

ESF DESIGN RESPONSIVENESS TO 10 CFR 60

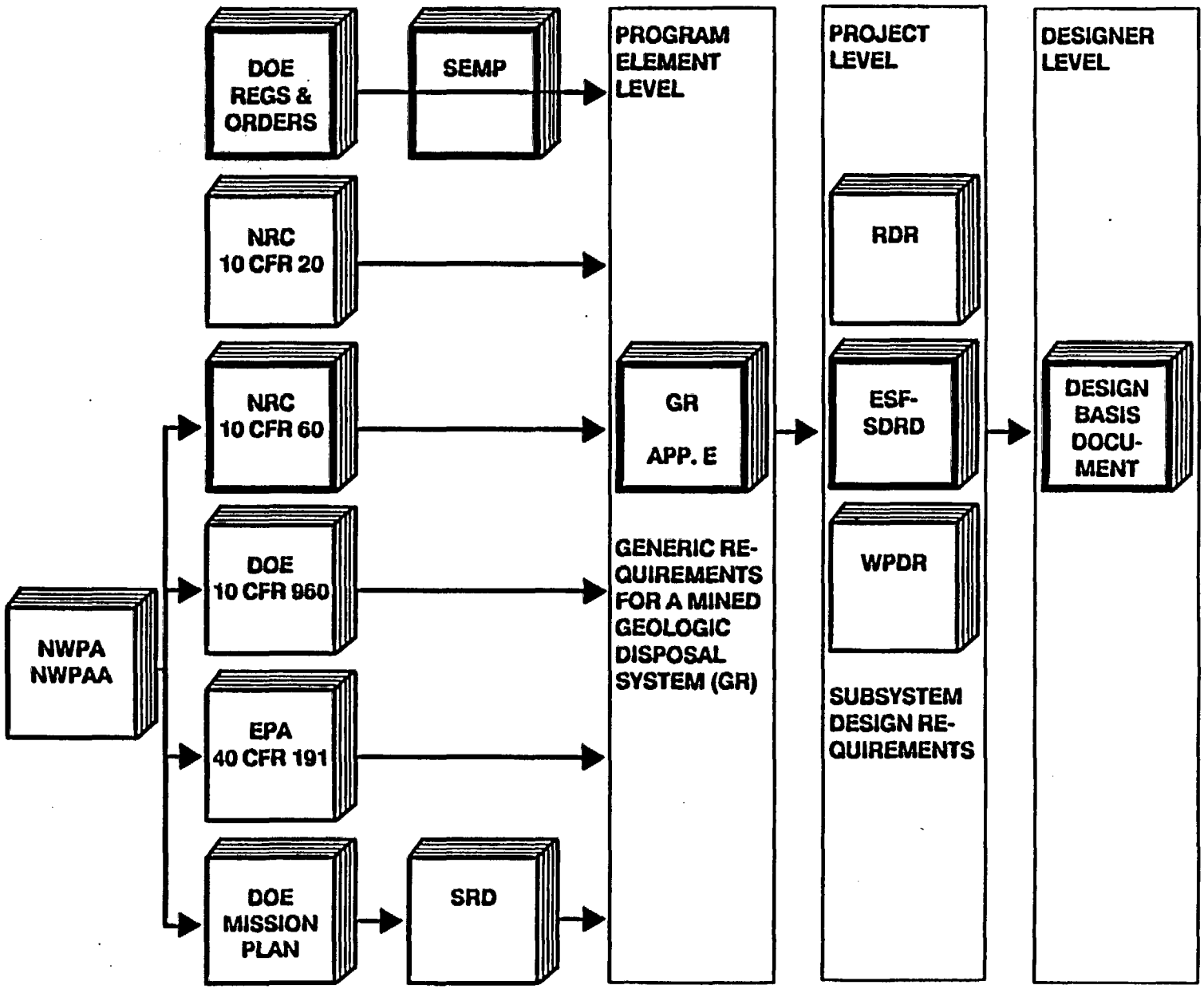
CONTENTS OF PRESENTATION

- HIERARCHY OF DOCUMENTS IMPLEMENTING THE REGULATIONS
- QUALITY ASSURANCE HIERARCHY
- 10 CFR 60 AND APPENDIX E MATRIX
- ESF SUBSYSTEM DESIGN REQUIREMENTS DOCUMENT (SDRD)
- ARCHITECT - ENGINEER DESIGN BASIS DOCUMENT
- BASIS FOR SDRD
- EXAMPLES OF CONSIDERATION OF 10 CFR 60 REQUIREMENTS IN THE ESF DESIGN
- VERIFICATION PROCESS FOR IMPLEMENTATION OF 10 CFR 60 REQUIREMENTS IN ESF DESIGN

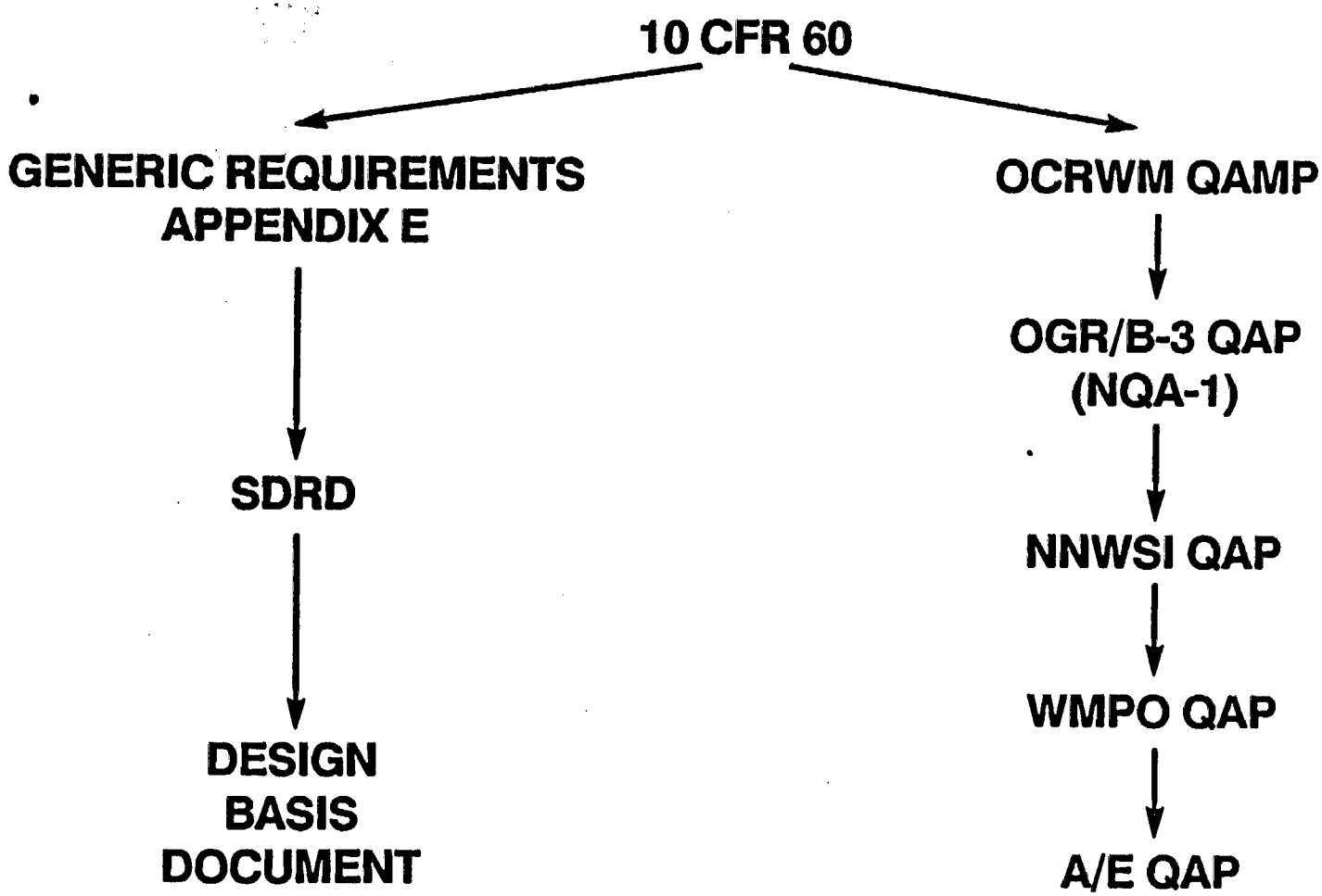
PRESENTED BY
LARRY SKOUSEN

Attachment 6

HIERARCHY OF DOCUMENTS IMPLEMENTING THE REGULATIONS



QUALITY ASSURANCE HIERARCHY



10 CFR 60 AND APPENDIX E MATRIX

		GR. APPENDIX E										
		GENERAL REQUIREMENTS	MANAGEMENT AND INTEGRATION	SITE PREPARATION	SURFACE FACILITIES	FIRST SHAFT	SECOND SHAFT	SUBSURFACE EXCAVATIONS	UNDERGROUND SERVICES	OPERATIONS	TESTING	DECOMMISSIONING AND CLOSURE
		6.0	6.1	6.2	6.3	6.4	6.5	6.6	6.7	6.8	6.9	6.10
	10CFR60.15(b)(1)-(3)	X	X							X	X	X
	10CFR60 SUBPART D										X	
	10CFR60	X	X								X	
	10CFR60 SUBPART F	X	X								X	
	10CFR60.112	X									X	
	10CFR60.113(a)	X										
	10CFR60.131(b)(1)	X										
	10CFR60.131(b)(2)	X										
	10CFR60.131(b)(3)(II)	X										
	10CFR60.131(b)(3)	X										
	10CFR60.131(b)(8)	X									X	
	10CFR60.131(b)(9)	X										
(3)	10CFR60.133(b)							X				
	10CFR60.133(d)	X										
(1)	10CFR60.133(e)(2)					X	X	X				
(2)	10CFR60.133(f)	X										
	10CFR60.133(l)	X										
	10CFR60.134(a)	X										
	10CFR60.134(b)	X										
	10CFR60.72(b)		X		X						X	
	10CFR60 SUBPART G		X									

EXPLORATORY SHAFT FACILITY SUBSYSTEM DESIGN REQUIREMENTS DOCUMENT* (SDRD)

- GENERAL
- SITE
- UTILITIES
- SURFACE FACILITIES
- FIRST SHAFT
- SECOND SHAFT
- UNDERGROUND EXCAVATIONS
- UNDERGROUND UTILITY SYSTEMS
- UNDERGROUND TESTS
- ESF DECOMMISSIONING STRATEGY

* BASELINED AND UNDER CHANGE CONTROL

EXPLORATORY SHAFT FACILITY SUBSYSTEM DESIGN REQUIREMENTS DOCUMENT* (SDRD)

(CONTINUED)

APPENDICES

A - REFERENCE CONFIGURATION

B - TEST AND IDS REQUIREMENTS & TEST DATA SHEETS

C - TEST HOLE REQUIREMENTS

D - REFERENCE PROJECT DOCUMENTATION

E - APPLICABLE REGULATIONS, CODES, AND SPECIFICATIONS

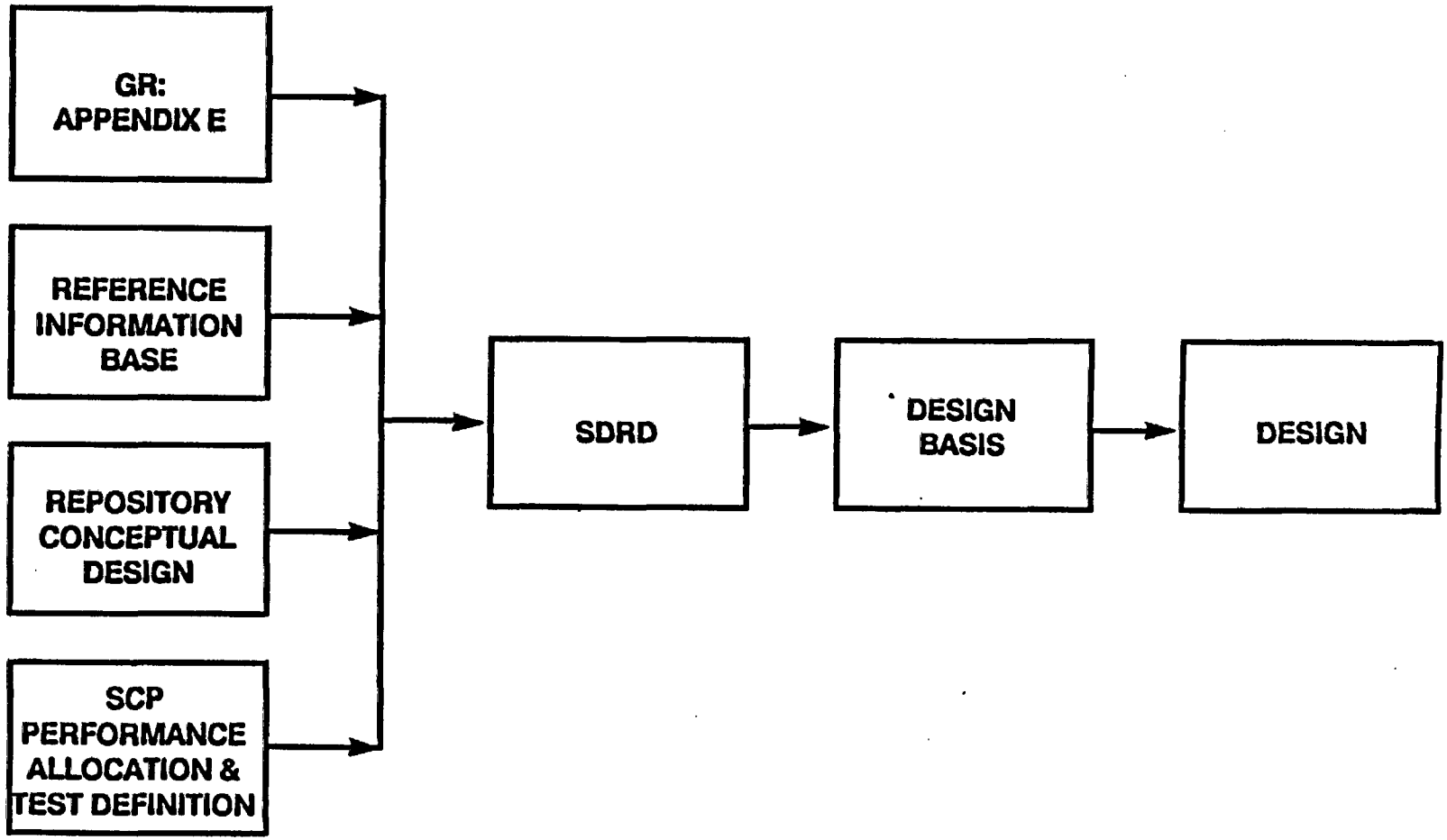
F - WORK ORDER SYSTEM/WORK BREAKDOWN STRUCTURE

* BASELINED AND UNDER CHANGE CONTROL

ARCHITECT-ENGINEER DESIGN BASIS DOCUMENT

- GENERAL
- SITE
- UTILITIES
- SURFACE FACILITIES
- FIRST SHAFT
- SECOND SHAFT
- UNDERGROUND EXCAVATIONS
- UNDERGROUND UTILITY SYSTEMS
- UNDERGROUND TESTS
- APPENDICES

BASIS FOR SDRD



EXAMPLES OF CONSIDERATION OF 10 CFR 60 REQUIREMENTS IN THE ESF DESIGNS

EXAMPLE NO. 1

10 CFR 60.133(e)(2)	OPENINGS IN THE UNDERGROUND FACILITY SHALL BE DESIGNED TO REDUCE THE POTENTIAL FOR DELETERIOUS ROCK MOVEMENT OR FRACTURING OF OVERLYING OR SURROUNDING ROCK
GR APPENDIX E	
6.6 PC 1d	UNDERGROUND OPENINGS SHALL BE DESIGNED TO PROVIDE STABILITY AND TO MINIMIZE THE POTENTIAL FOR DELETERIOUS ROCK MOVEMENT OR FRACTURING THAT MAY CREATE A PATHWAY FOR RADIONUCLIDE MIGRATION
6.6 PC 1e	ROCK SUPPORT AND OTHER STRUCTURAL ANCHORING MATERIALS SHALL BE COMPATIBLE WITH WASTE ISOLATION AND SHALL NEITHER INTERFERE WITH RADIONUCLIDE CONTAINMENT NOR ENHANCE RADIONUCLIDE MIGRATION
SDRD	
1.2.6.6 FR 2	PROVIDE COMPATIBILITY WITH THE REPOSITORY CONCEPTUAL DESIGN SO THAT THE TEST LEVEL DEVELOPMENT DOES NOT ADVERSELY IMPACT FUTURE REPOSITORY DEVELOPMENT
1.2.6.6 PC 4	ROCK SUPPORT AND OTHER STRUCTURAL ANCHORING MATERIALS USED IN ROCK SUPPORT SYSTEMS SHALL BE COMPATIBLE WITH WASTE ISOLATION OPERATIONS AND SHALL NEITHER INTERFERE WITH RADIONUCLIDE CONTAINMENT NOR ENHANCE RADIONUCLIDE MIGRATION
1.2.6.6 PC 5	THE DESIGN OF UNDERGROUND OPENINGS AND THEIR SUPPORTS SHALL UTILIZE PILLAR AND OPENING GEOMETRIES THAT LIMIT STRESS CONCENTRATION TO ACCEPTABLE LEVELS

EXAMPLES OF CONSIDERATION OF 10 CFR 60 REQUIREMENTS IN THE ESF DESIGNS

EXAMPLE NO. 1
(CONTINUED)

DESIGN BASIS

1.2.6.6.0 C 15	THE DESIGN OF UNDERGROUND OPENINGS AND THEIR SUPPORTS SHALL CONSIDER PILLAR AND OPENING GEOMETRIES THAT LIMIT EXCESSIVE STRESS CONCENTRATION
1.2.6.6.0 C 19	ROCK SUPPORT AND OTHER STRUCTURAL ANCHORING MATERIALS USED IN ROCK SUPPORT SYSTEMS SHALL BE COMPATIBLE WITH WASTE ISOLATION OPERATIONS AND SHALL NEITHER INTERFERE WITH RADIONUCLIDE CONTAINMENT NOR ENHANCE RADIONUCLIDE MIGRATION
1.2.6.6.0 C 5	ROCK SUPPORT AND OTHER STRUCTURAL ANCHORING MATERIALS USED IN ROCK SUPPORT SYSTEMS SHALL BE COMPATIBLE WITH WASTE ISOLATION OPERATIONS AND SHALL NEITHER INTERFERE WITH RADIONUCLIDE CONTAINMENT NOR ENHANCE RADIONUCLIDE MIGRATION

EXAMPLES OF CONSIDERATION OF 10 CFR 60 REQUIREMENTS IN THE ESF DESIGNS

EXAMPLE NO. 2

10 CFR 60.133f	ROCK EXCAVATION. THE DESIGN OF THE UNDERGROUND FACILITY SHALL INCORPORATE EXCAVATION METHODS THAT WILL LIMIT THE POTENTIAL FOR CREATING A PREFERENTIAL PATHWAY FOR GROUND WATER TO CONTACT THE WASTE PACKAGES OR RADIONUCLIDE MIGRATION TO THE ACCESSIBLE ENVIRONMENT
GR APPENDIX E	
6.0 FR 6	PROVIDE DESIGN AND CONSTRUCTION METHODS THAT WILL DEMONSTRATE LICENSABILITY AND CONSTRUCTIBILITY FOR THE CANDIDATE REPOSITORY
6.0 CE	THE DESIGN AND CONSTRUCTION OF THE PERMANENT ESF STRUCTURES, SYSTEMS, AND COMPONENTS SHALL NOT SIGNIFICANTLY INCREASE THE PREFERENTIAL PATHWAYS FOR GROUND-WATER OR RADIOACTIVE-WASTE MIGRATION TO THE ACCESSIBLE ENVIRONMENT
SDRD	
1.2.6.6 PC 23	EXCAVATION TECHNIQUES SHALL CONTROL OVERBREAK OF ROCK AND MINIMIZE DISTURBANCE TO THE INTEGRITY OF THE ADJOINING ROCK MASS
1.2.6.0 C 3	THE ENGINEERED BARRIER SYSTEM MUST BE DESIGNED SUCH THAT OTHER SYSTEMS, STRUCTURES, AND COMPONENTS OF THE ESF AND THE CANDIDATE REPOSITORY DO NOT EVENTUALLY BECOME GROUND-WATER FLOW PATHS AND DO NOT PROMOTE THE RELEASE OF RADIONUCLIDES TO THE ACCESSIBLE ENVIRONMENT

EXAMPLES OF CONSIDERATION OF 10 CFR 60 REQUIREMENTS IN THE ESF DESIGNS

EXAMPLE NO. 2
(CONTINUED)

DESIGN BASIS
1.2.6.0.0
GENERAL D 3

DEFINITION OF REQUIREMENTS FOR DEMONSTRATING COMPLIANCE WITH 10 CFR 60 IN REGARD TO UNDERGROUND OPENINGS ACTING AS PATHWAYS FOR RADIONUCLIDE MIGRATION

ANALYSES USED TO DESIGN RQ ITEMS SHALL INDICATE THE METHODS EMPLOYED TO DEMONSTRATE COMPLIANCE WITH THE INTENT OF 10 CFR 60. EXAMPLES ARE AS FOLLOWS:

- METHODS OF FLUID CONTROL
  AN ESF PROJECT SUBSURFACE WATER CONTROL PLAN WILL BE PREPARED

- CONTROLLED BLASTING
  QUALITY CONTROL PLAN FOR CONTROLLED BLASTING WILL BE PREPARED

- DESIGNED GROUND CONTROL/SUPPORT SYSTEMS
  GROUND CONTROL/SUPPORT SYSTEMS DESIGNED IN ACCORDANCE WITH NNWSI DESIGN GUIDES

- DRAINAGE DESIGNED TO ISOLATE ESF DRAINAGE FROM THE FUTURE REPOSITORY
  MTL WILL BE GRADED TO ISOLATE ESF SUBSURFACE DRAINAGE AS SHOWN ON BASELINE INTERFACE DRAWING R07048/5

- DESIGNS INTERFACE WITH REPOSITORY INTERFACE CONTROL DRAWINGS
  MTL WILL BE DESIGNED TO MATCH DRIFT INTERFACES SHOWN ON BASELINE INTERFACE DRAWINGS R07048/1 TO 15

EXAMPLES OF CONSIDERATION OF 10 CFR 60 REQUIREMENTS IN THE ESF DESIGNS

EXAMPLE NO. 2
(CONTINUED)

DESIGN BASIS
(CONTINUED)
1.2.6.0.0
GENERAL F 6

CONTROLLED BLASTING REQUIREMENTS

A) METHODS AND LOCATIONS

CONTROLLED BLASTING USING SMOOTHWALL TECHNIQUES WILL BE THE GENERAL BLASTING METHOD FOR ALL OF THE ESF

B) BLAST EFFECTS MEASUREMENT AND CONTROL WILL CONSIST OF A COMBINATION OF THE FOLLOWING TO BE DEFINED IN THE ESF BLASTING QUALITY CONTROL PLANS

EXAMPLES OF CONSIDERATION OF 10 CFR 60 REQUIREMENTS IN THE ESF DESIGNS

EXAMPLE NO. 3

10 CFR 60.133(b)	FLEXIBILITY OF DESIGN. THE UNDERGROUND FACILITY SHALL BE DESIGNED WITH SUFFICIENT FLEXIBILITY TO ALLOW ADJUSTMENTS WHERE NECESSARY TO ACCOMMODATE SPECIFIC SITE CONDITIONS IDENTIFIED THROUGH IN SITU MONITORING, TESTING, OR EXCAVATION
GR APPENDIX E PC 1b	ALL MAJOR SYSTEMS FOR VENTILATION, UTILITIES, EMERGENCY EGRESS, ROCK HANDLING, PERSONNEL SUPPORT AND OTHERS SHALL BE ANALYZED TO DETERMINE THE NEED FOR THE UNCERTAINTY ALLOWANCE. IF IT CAN BE DEMONSTRATED THAT CRITICAL PARTS OF THE ALLOWANCE WOULD REQUIRE EXCESSIVE COST, SCHEDULE, TEST DISRUPTION OR OTHER PROGRAM IMPACTS TO DESIGN, PROCURE AND/OR CONSTRUCT LATER (AFTER THE BASIC TEST PLAN NEEDS ARE COMPLETED), CONSIDERATION SHALL BE GIVEN TO DESIGNING, PROCURING AND/OR CONSTRUCTING THESE CRITICAL ITEMS AS PART OF THE INITIAL FACILITY
PC 1c	THIS UNCERTAINTY ALLOWANCE SHALL BE INCORPORATED IN THE SITE-SPECIFIC DESIGN REQUIREMENTS DOCUMENTS AS A PERCENTAGE OVER AND ABOVE THE REQUIREMENTS FOR THE BASIC TEST AREA NEEDS

EXAMPLES OF CONSIDERATION OF 10 CFR 60 REQUIREMENTS IN THE ESF DESIGNS

EXAMPLE NO. 3
(CONTINUED)

SDRD

1.2.6.0 PC-2

UNDERGROUND OPENINGS SHALL BE DEVELOPED TO MEET THE NEEDS OF IN SITU SITE CHARACTERIZATION, INCLUDING BASIC NEEDS FOR THE INITIALLY PLANNED TESTS. ADDITIONALLY AN ALLOWANCE FOR UNCERTAINTIES FOR THE TEST AREA NEEDS AT THE MAIN TEST LEVEL HAS BEEN SET AT 100 PERCENT; I.e., ALL MAJOR SYSTEMS FOR VENTILATION, UTILITIES, EMERGENCY EGRESS, ROCK HANDLING, PERSONNEL SUPPORT, AND OTHERS SHALL BE ANALYZED TO DETERMINE THE NEED FOR AND THE IMPACT ASSOCIATED WITH THIS UNCERTAINTY ALLOWANCE. IF IT CAN BE DEMONSTRATED THAT CRITICAL PARTS OF THE ALLOWANCE WOULD REQUIRE EXCESSIVE COSTS, SCHEDULE, TEST DISRUPTION, OR OTHER PROGRAM IMPACTS TO DESIGN, PROCUREMENT, AND/OR CONSTRUCTION LATER (AFTER THE BASIC TEST PLAN NEEDS ARE COMPLETED), CONSIDERATION SHALL BE GIVEN TO DESIGNING, PROCURING, AND/OR CONSTRUCTING THESE CRITICAL ITEMS AS PART OF THE INITIAL FACILITY. THE UNCERTAINTY ALLOWANCE FOR EACH OF THE MAJOR ESF SYSTEMS SHALL BE DETERMINED BY AN ANALYSIS OF THE FOLLOWING SYSTEMS:

DESCRIPTION	UNCERTAINTY ALLOWANCE
UNDERGROUND TEST AREA AT THE MAIN TEST LEVEL	100 PERCENT
• SYSTEMS - SITE, UTILITIES, SURFACE FACILITIES, FIRST SHAFT, SECOND SHAFT, UNDERGROUND EXCAVATIONS, UNDERGROUND UTILITY SYSTEMS, UNDERGROUND TESTS	DETERMINED BY ANALYSES IN THE TITLE I DESIGN PHASE

SPECIFIC ALLOWANCES FOR EACH MAJOR SYSTEM SHALL BE IDENTIFIED AND INCORPORATED PRIOR TO THE START OF TITLE II DESIGN (DETAILED DESIGN)

EXAMPLES OF CONSIDERATION OF 10 CFR 60 REQUIREMENTS IN THE ESF DESIGNS

EXAMPLE NO. 3
(CONTINUED)

DESIGN BASIS
F&S
1.2.6.0.F.2(a)

UNCERTAINTY ALLOWANCES ANALYSES

BASIS FOR UNCERTAINTY ALLOWANCE ANALYSIS. ESF UNCERTAINTY ALLOWANCE ANALYSES ARE REQUIRED IN THE SDRD. THE FOLLOWING ITEMS INDICATE SPECIFIC AREAS WHERE UNCERTAINTY ANALYSES MAY BE REQUIRED. BASIC UNCERTAINTY ALLOWANCE ANALYSIS CRITERIA FOR THESE AREAS MUST BE DEVELOPED BEFORE DESIGN ANALYSES ARE INITIATED

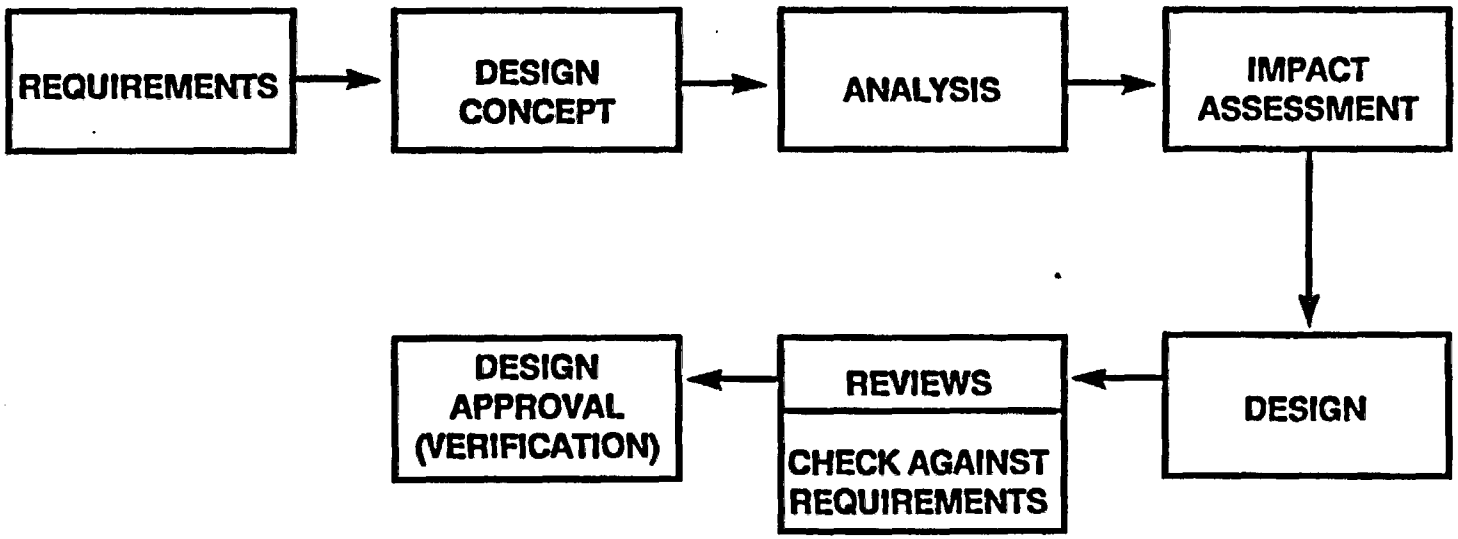
(1) ESF TEST EXPANSION PLANS

UNCERTAINTY ALLOWANCE MUST PROVIDE FOR 100% EXPANSION OF THE UNDERGROUND TEST AREA AT THE MTL

(2) COMPONENTS AND SYSTEMS

- VENTILATION
- WATER SUPPLY
- WASTE WATER REMOVAL
- COMPRESSED AIR
- ELECTRIC POWER
- EMERGENCY EGRESS
- MUCK HANDLING
- DESIGN OCCUPANCY

VERIFICATION PROCESS FOR IMPLEMENTATION OF 10 CFR 60 REQUIREMENTS IN THE ESF DESIGN



MAJOR ESF DESIGN CHANGES UNDER CONSIDERATION AS A RESULT OF 50% DESIGN REVIEW MEETING COMMENTS

- COMPLETED 50% ESF TITLE I DESIGN REVIEW
- RESOLVED ALL COMMENTS
- 50% REVIEW REPORT COMPLETE AND BEING DISTRIBUTED
- ALTHOUGH CHANGES HAVE BEEN MADE IN THE PAST, THE DESIGN REVIEW RESOLUTIONS HAVE NOT RESULTED IN CHANGES IN THE SHAFT DIAMETER, SHAFT LOCATION, OR FACILITY CONFIGURATION

CONSIDERATION OF PRELIMINARY PERFORMANCE ASSESSMENT DURING THE ESF DESIGN STAGE

PRESENTED BY

TOM HUNTER

Attachment 7

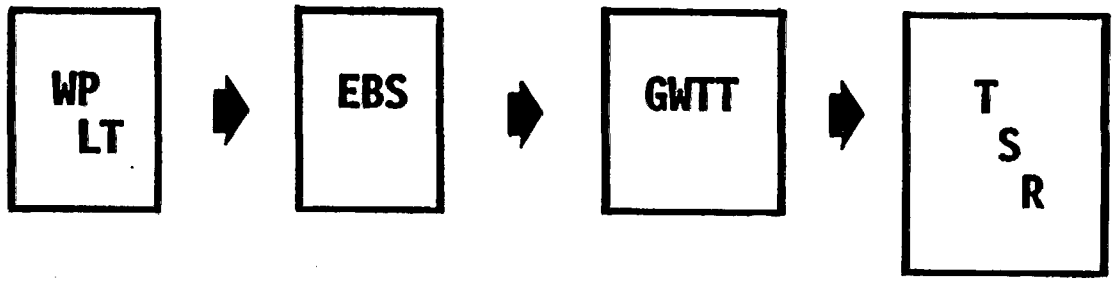
BACKGROUND ON YUCCA MOUNTAIN PERFORMANCE ASSESSMENT

GROUNDWATER FLOW AND TRANSPORT SYSTEM AT YUCCA MOUNTAIN

- MUST BE CHARACTERIZED TO DESIGN AND ANALYZE THE REPOSITORY
- PROVIDES THE BASIS FOR UNDERSTANDING:
  - THE NEED AND CONCERN FOR PENETRATION INTO UNITS BELOW THE REPOSITORY HORIZON
  - THE INTERACTION OF TEST AND CONSTRUCTION ACTIVITIES
  - THE LOCATION OF THE SHAFTS WITH RESPECT TO REPOSITORY PERFORMANCE

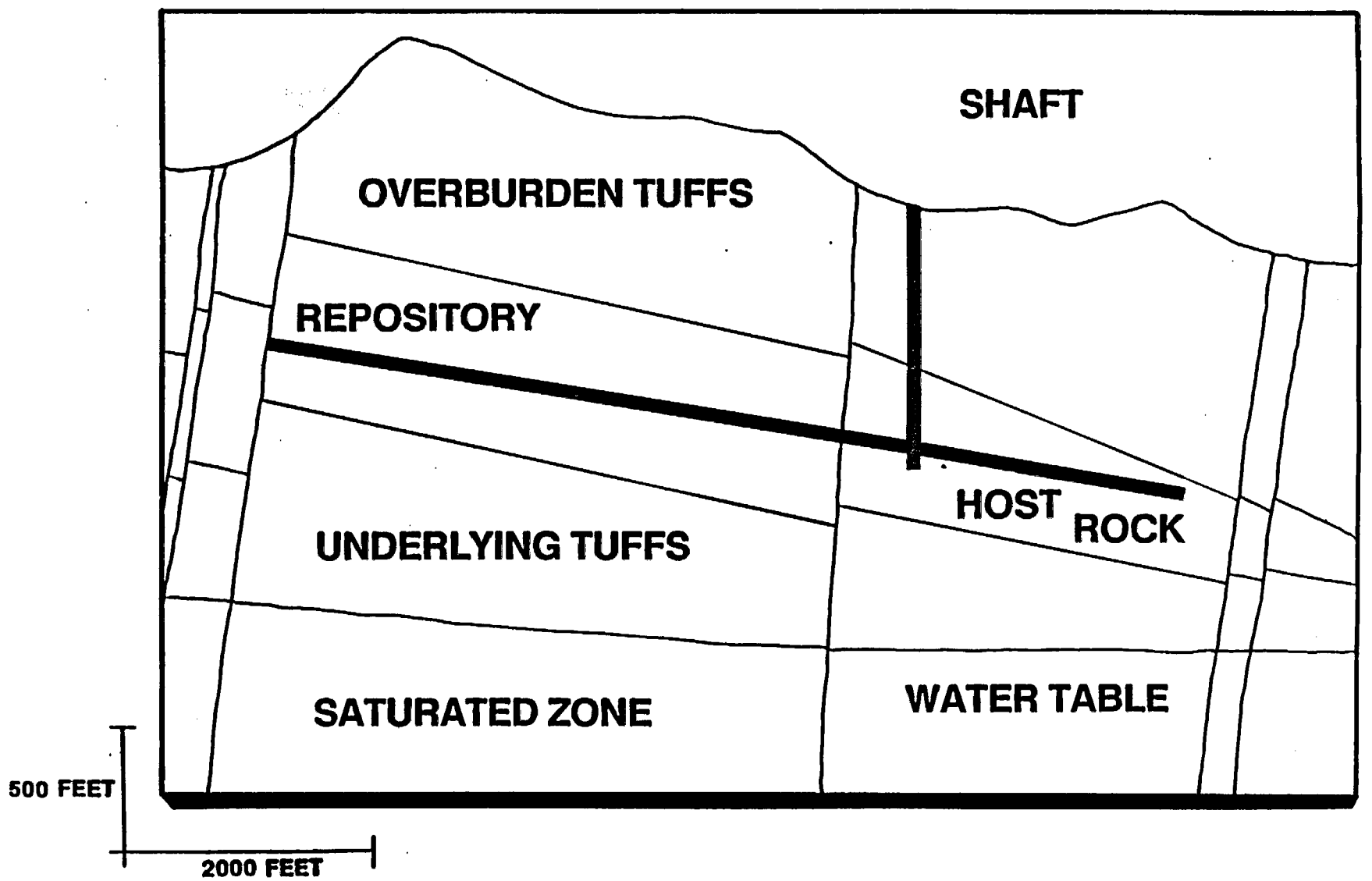
HOW WILL THE IMPACT OF THE EXPLORATORY SHAFT AND ES FACILITY ON THE PERFORMANCE OF THE YUCCA MOUNTAIN REPOSITORY SYSTEM BE EVALUATED?

IMPACT IS EVALUATED WITH RESPECT TO POSTCLOSURE PERFORMANCE OBJECTIVES



- WASTE PACKAGE LIFE TIME
- ENGINEERED BARRIER SYSTEM PERFORMANCE
- GROUND-WATER TRAVEL TIME
- TOTAL SYSTEM RELEASE

POSTCLOSURE PERFORMANCE OF SYSTEM



PERFORMANCE ASSESSMENT APPROACH

- UNSATURATED ZONE FROM REPOSITORY DOWNWARD IS THE MOST IMPORTANT COMPONENT TO WASTE ISOLATION
- UNSATURATED HYDROLOGIC ENVIRONMENT IS RELIED ON BY ALL FOUR POSTCLOSURE PERFORMANCE OBJECTIVES
- SIMPLIFIED PERFORMANCE-ASSESSMENT MODELS INCORPORATE RELEVANT PHYSICS FROM ALTERNATIVE CONCEPTUAL MODELS
- PRELIMINARY PERFORMANCE ASSESSMENTS GENERALLY RELY ON SENSITIVITY AND BOUNDING ANALYSES

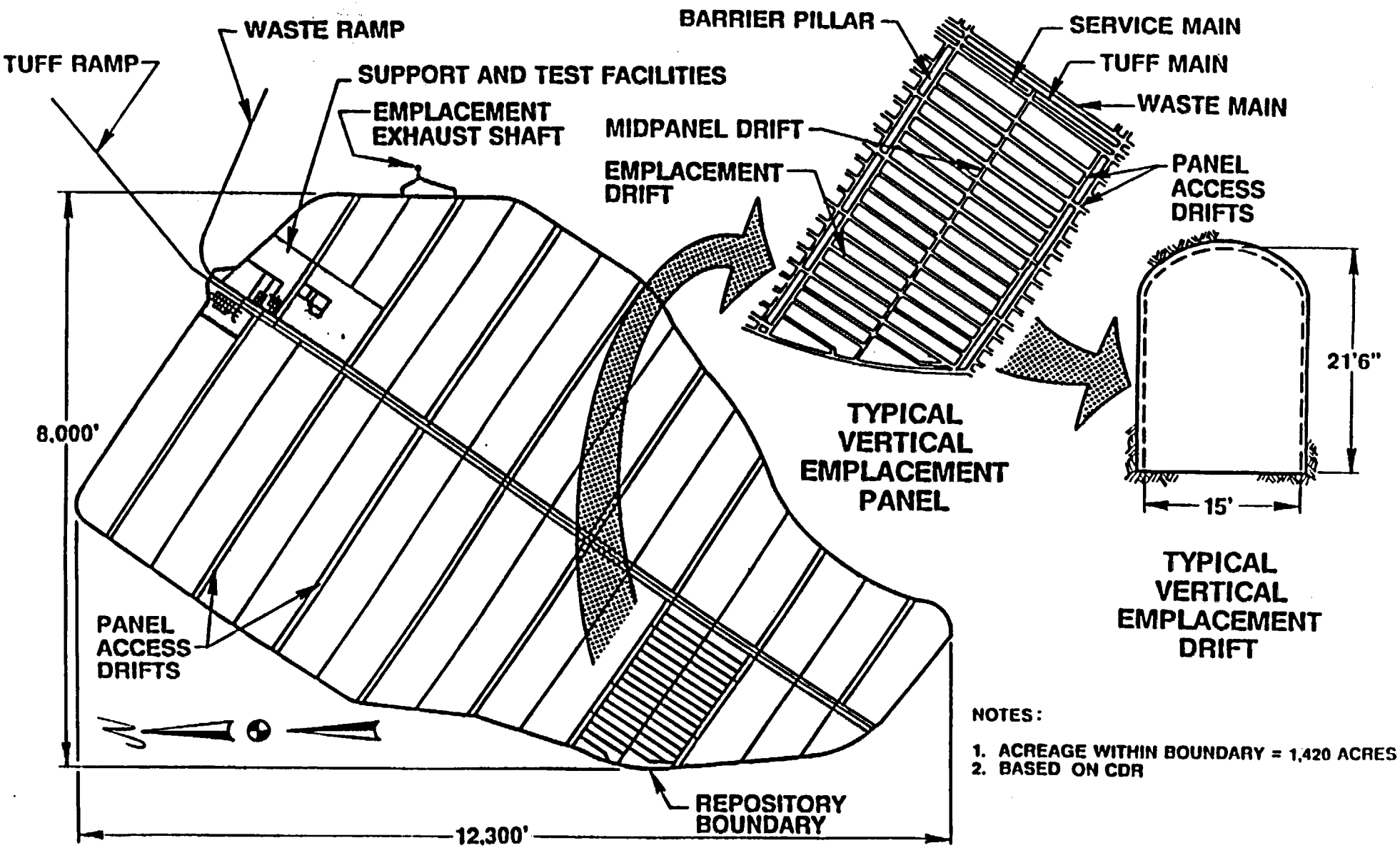
HYDROLOGIC MODELS FOR THE UZ

- DATA ARE CONSISTENT WITH THE HYDROGEOLOGIC UNITS FROM THE REPOSITORY TO THE WATER TABLE BEING PARTIALLY SATURATED AND NEAR STEADY-STATE

- DATA ARE NOT CONSISTENT WITH THOSE UNITS BEING SATURATED OR WITH HIGHLY TRANSIENT CONDITIONS

- WITH THESE CONSTRAINTS, MODELS DESCRIBING FLOW IN UNSATURATED FRACTURED, POROUS ROCK PREDICT MATRIX-DOMINATED FLOW UNDER A WIDE RANGE OF PROPERTY VALUES, BOUNDARY AND INITIAL CONDITIONS, AND SYSTEM GEOMETRIES

UNDERGROUND DESIGN FOR VERTICAL EMPLACEMENT



NOTES:

1. ACREAGE WITHIN BOUNDARY = 1,420 ACRES
2. BASED ON CDR

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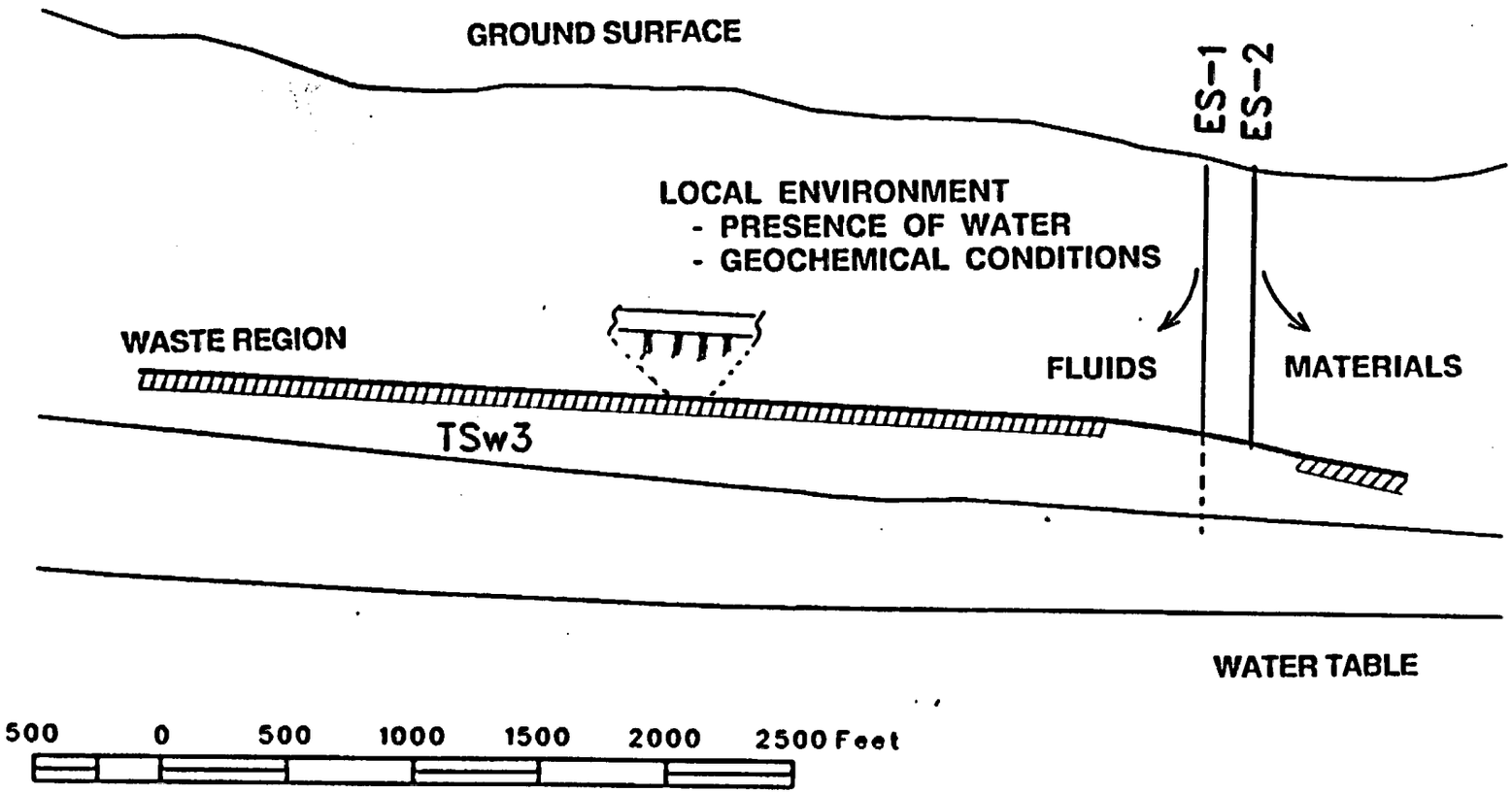
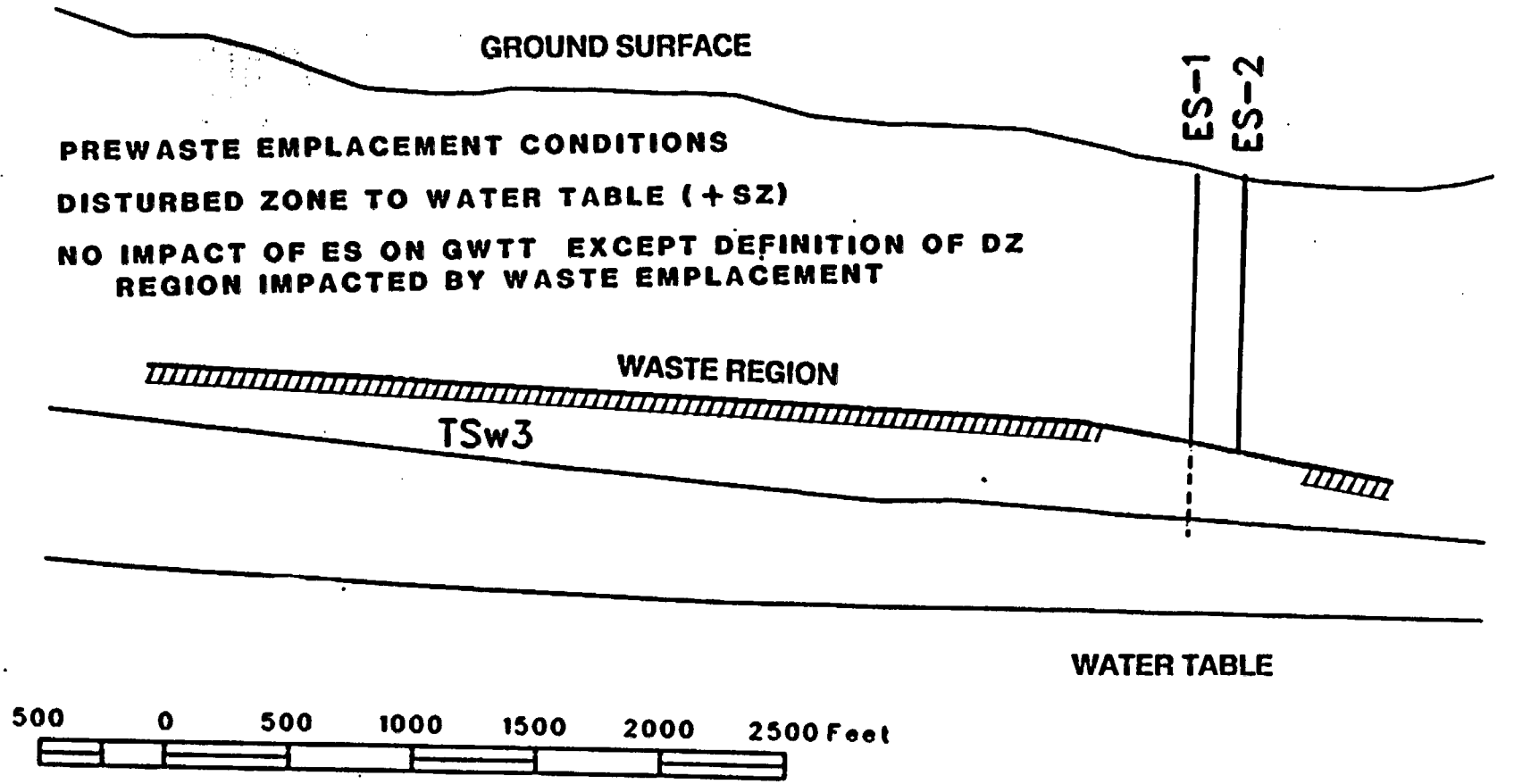
WASTE PACKAGE LIFETIME AND EBS PERFORMANCE



GROUNDWATER TRAVEL TIME



PERFORMANCE ASSESSMENTS OF TRAVEL TIMES

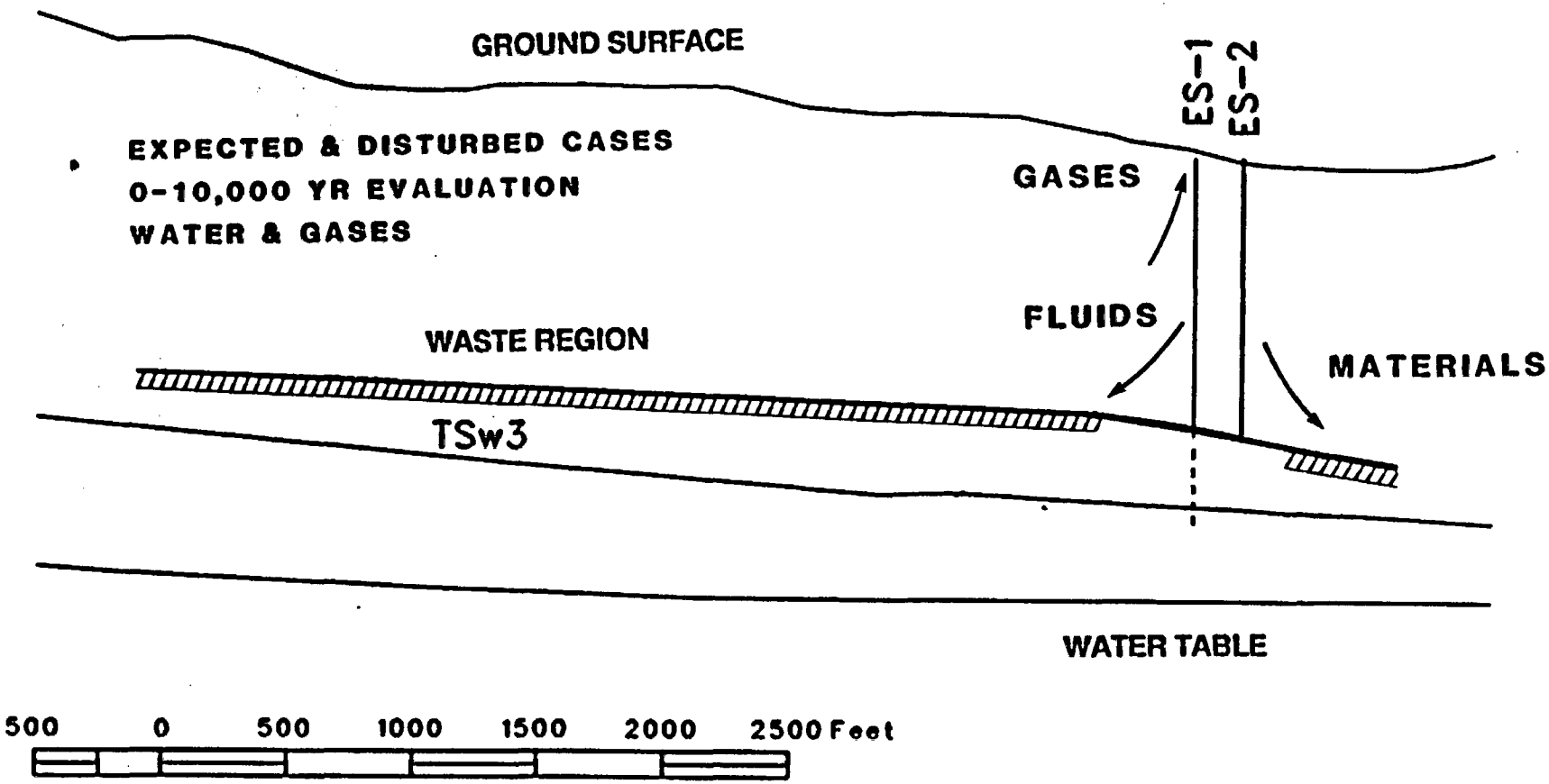
- AVERAGE TRAVEL-TIME ESTIMATES DEPEND PRIMARILY ON WATER FLUX (AND ITS RELATIONSHIP TO MATRIX AND FRACTURE HYDROLOGIC PROPERTIES)

- CURRENT UPPER ESTIMATE OF AVERAGE FLUX IS 0.5mm/YEAR (NNWSI FINAL EA)

- UNCERTAINTY EXISTS IN THIS VALUE, BUT THE ACTUAL VALUE IS LESS THAN THE AVERAGE MATRIX HYDRAULIC CONDUCTIVITY AND IS LIKELY TO BE MUCH LESS THAN 0.5mm/YEAR

- MORE THAN 150m OF UNSATURATED ZONE, INCLUDING 127m OF CALICO HILLS, LIES BETWEEN THE WATER TABLE AND REPOSITORY HORIZON AT ES LOCATION; PROVIDES GWTT > 40,000 YRS.

TOTAL SYSTEM RELEASE



WHAT FACTORS MUST BE CONSIDERED IN EVALUATING ES IMPACTS?

WPLT

EBSP

GWTT

TSR

FLUIDS
- NATURAL
- SURFACE
- INTRODUCED

MATERIALS
- TESTING
- CONSTRUCTION

HOW WILL EVALUATION OF ES PERFORMANCE BE PRESENTED IN THE SCP?

DEFINITION OF SHAFT & DRILLING PROGRAM

PHYSICAL DESCRIPTION OF ACTIVITIES

BASIS FOR PERFORMANCE ASSESSMENT FOR YUCCA MOUNTAIN

ANALYSIS OF IMPACTS OF CHARACTERIZATION ACTIVITIES ON PERFORMANCE

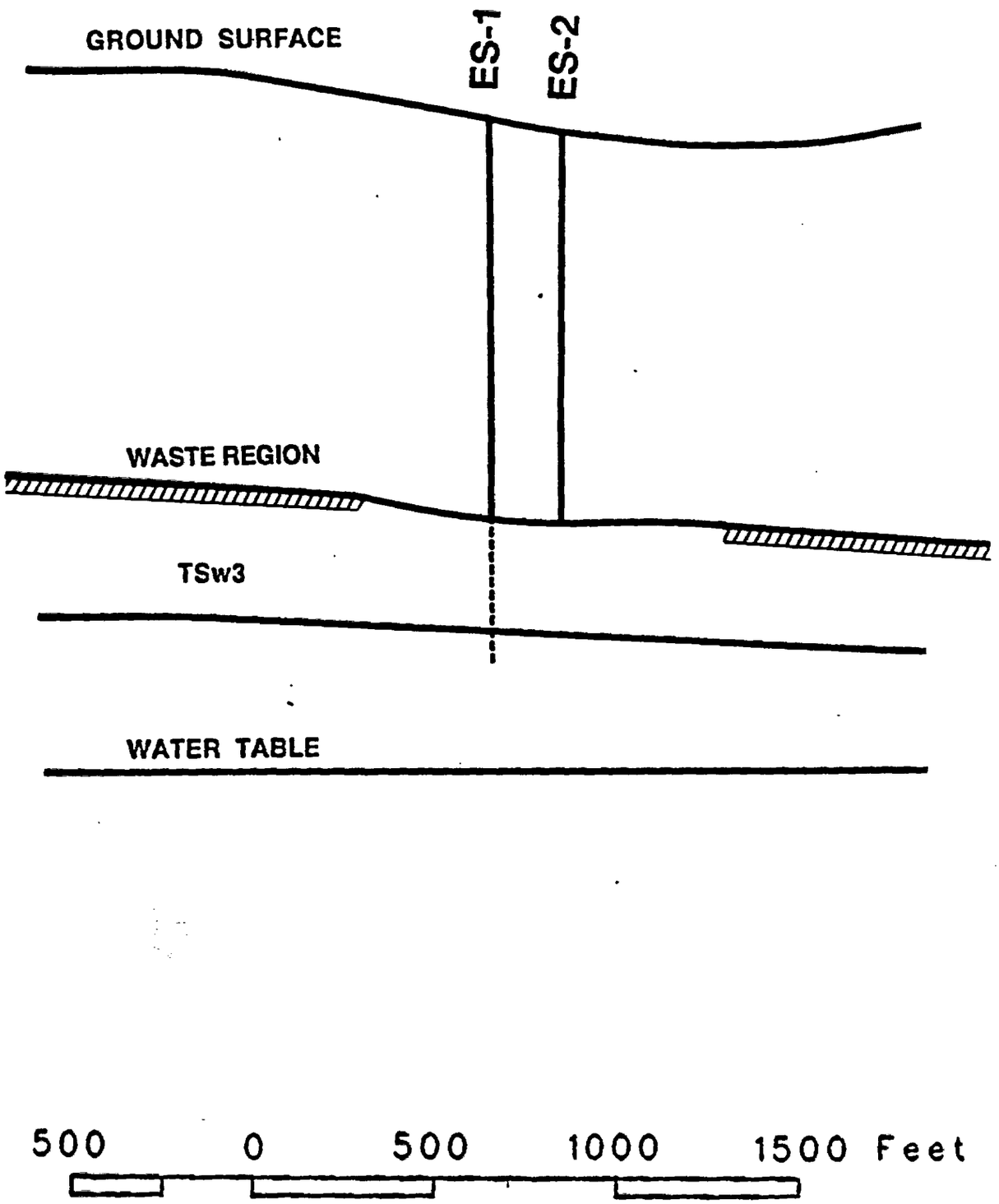
→ POSTCLOSURE PERFORMANCE OBJECTIVES → SCP SECTION 8.4

PERSPECTIVE ON IMPACTS FROM CONSTRUCTION WATER

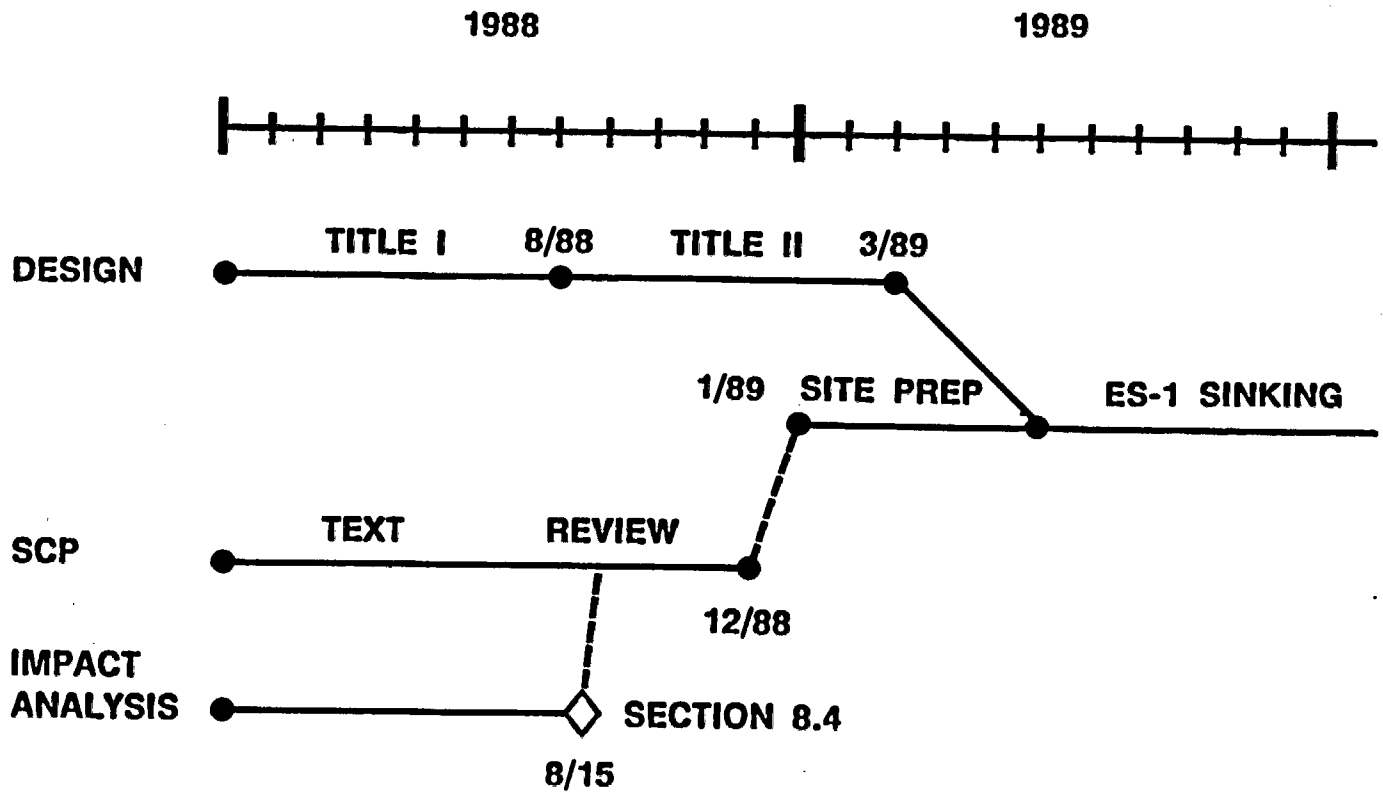
- TOTAL AMOUNT OF WATER ESTIMATED TO BE LOST IN ESF CONSTRUCTION AND TESTING: $<4 \times 10^6$ GALLONS (WEST, DRAFT)

- ESTIMATE OF PORE WATER WITHIN REPOSITORY PERIMETER AND ABOVE WATER TABLE: $\sim 10^{11}$ GALLONS

- ESTIMATED WATER LOSS BECAUSE OF ESF CONSTRUCTION, IF UNIFORMLY DISTRIBUTED TO A DISTANCE OF 3 METERS AROUND AN OPENING, WOULD RAISE SATURATION <0.08


GROUND SURFACE
ES-1
ES-2
WASTE REGION
TSw3
WATER TABLE
500
0
500
1000
1500 Feet

SCHEDULE


1988
1989
DESIGN
TITLE I
8/88
TITLE II
3/89
1/89
SITE PREP
ES-1 SINKING
SCP
TEXT
REVIEW
12/88
IMPACT
ANALYSIS
SECTION 8.4
8/15

FOLLOWING PRESENTATIONS WILL PROVIDE SPECIFIC INFORMATION ON:

- PENETRATION OF CALICO HILLS
- ESF DESIGN (SPACING OF SHAFTS) AND TEST INTERFERENCE (CHARACTERIZATION IMPACTS)
- ANALYSES SUPPORTING SHAFT LOCATIONS

RESPONSE TO NRC CDSCP POINT PAPERS
OBJECTION NO. 2
(PENETRATION OF CALICO HILLS UNIT)

- DOE ACKNOWLEDGEMENT OF NRC OBJECTION
- DOE APPROACH TO ADDRESS THE OBJECTION

PRESENTED BY

MAX BLANCHARD

Attachment 8

OUTLINE

- DOE ACKNOWLEDGEMENT OF NRC'S OBJECTION #2
  - NRC SUMMARY
  - NRC BASIS
  - NRC RECOMMENDATION

- DOE'S APPROACH TO ADDRESS OBJECTION #2
  - UNDERSTAND NRC'S OBJECTION
  - ES-1 REFERENCE DESIGN MODIFIED
  - ESTABLISH WORKING GROUP #7 TO REVISE SCP - FOLLOW A CONSERVATIVE STRATEGY FOCUSED UPON REDUCING UNCERTAINTY AND EVALUATING RISKS

DOE ACKNOWLEDGEMENT OF NRC'S OBJECTION #2

NRC'S SUMMARY

- THE NEED HAS NOT BEEN ESTABLISHED TO EXTEND, OR TO DRIFT HORIZONTALLY FROM ES-1, INTO THE CALICO HILLS

- POTENTIAL ADVERSE IMPACTS ON WASTE ISOLATION AS A RESULT PENETRATING THE CALICO HILLS HAVE NOT BEEN DEMONSTRATED

DOE ACKNOWLEDGEMENT OF NRC'S OBJECTION #2
(CONTINUED)

NRC'S BASIS

- 10 CFR 60.17(a)(2)(iv) REQUIRES DOE TO CONTROL ANY ADVERSE IMPACTS ON WASTE ISOLATION CAUSED BY SITE CHARACTERIZATION
- A DETAILED DISCUSSION IS NEEDED BY DOE TO SHOW WHY THE BENEFITS OUTWEIGH THE POTENTIAL ADVERSE IMPACTS OF PENETRATING THE CALICO HILLS, RATHER THAN OBTAINING THE NECESSARY INFORMATION BY <u>ALTERNATE MEANS</u>
- SECTIONS FOR TOTAL SYSTEM PERFORMANCE (8.3.5.13) & P.W.E.G.W.T.T (8.3.5.12) IDENTIFY THE CALICO HILLS AS A "<u>PRIMARY BARRIER</u>"

DOE ACKNOWLEDGEMENT OF NRC'S OBJECTION #2
(CONTINUED)

NRC'S BASIS (CONTINUED)

- SECTION ABOUT HYDROLOGIC TESTING (8.3.1.2) FROM ES-1 IN THE CALICO HILLS ACKNOWLEDGES THAT PENETRATING THIS ROCK UNIT MAY JEOPARDIZE THE INTEGRITY OF THE BARRIER
- SECTIONS DO NOT PRESENT ANALYSIS OF EFFECTS OF DRIFTING IN CALICO HILLS AND DO NOT CONSIDER <u>ALTERNATE</u> <u>MEANS</u> TO OBTAIN NEEDED INFORMATION

DOE ACKNOWLEDGEMENT OF NRC'S OBJECTION #2
(CONTINUED)

NRC RECOMMENDATION

- CONSIDER CHARACTERIZING THE CALICO HILLS WITHOUT PENETRATING THE BARRIER BETWEEN THE REPOSITORY HORIZON AND THE WATER TABLE

- IF <u>ALTERNATE MEANS</u> CANNOT BE DEVELOPED, THEN JUSTIFY DESTRUCTIVE TESTING OF CALICO HILLS; INCLUDE THE CONSEQUENCES OF CONNECTING PATHWAYS FOR RADIONUCLIDES FROM WASTE EMPLACEMENT AREAS TO THE WATER TABLE

DOE'S APPROACH TO ADDRESS NRC'S OBJECTION #2
(CONTINUED)

IN MAY 1988, DOE ESTABLISHED WORKING GROUP #7 TO REVISE SECTION 8.4

- MAKE SECTIONS 8.3 AND 8.4 FULLY COMPATIBLE
- ITEMS UNDER PREPARATION THAT PROVIDE INFORMATION RELEVANT TO PENETRATING CALICO HILLS ROCK UNIT
  - SITE ATLAS
  - SURFACE BASED INVESTIGATION PLAN
  - SYSTEMATIC DRILLING PROGRAM
  - STUDY PLANS ADDRESSING ES & SURFACE BASED TESTING
  - ESF SUBSYSTEMS DESIGN REQUIREMENTS DOCUMENT

DOE'S APPROACH TO ADDRESS NRC'S OBJECTION #2
(CONTINUED)

- AN EVALUATION OF THE BENEFITS AND RISKS ASSOCIATED WITH PENETRATING THE ROCK BETWEEN THE REPOSITORY AND THE WATER TABLE IS UNDERWAY

  (A) BENEFITS WILL FOCUS ON THE NEED TO REDUCE UNCERTAINTY AND IMPROVE UNDERSTANDING OF HYDROLOGIC & GEOCHEMICAL PARAMETERS USED TO ASSESS BARRIER'S POTENTIAL TO ISOLATE WASTE

DOE'S APPROACH TO ADDRESS NRC'C OBJECTION #2
(CONTINUED)

- AN EVALUATION OF THE BENEFITS AND RISKS...(CONTINUED)

  (B) REPRESENTATIVENESS OF INFORMATION THAT COULD BE OBTAINED FROM BOREHOLES AND IN SITU TESTING AT DEPTH WILL BE EVALUATED

  EXAMPLES UNDER CONSIDERATION:

  BOREHOLES FROM SURFACE
  IN SITU FROM TOPOPAH SPRING
  BOREHOLES FROM ES-1
  IN SITU FROM BELOW TOPOPAH SPRING

  (C) RISKS WILL ADDRESS THE LACK OF SUFFICIENT DATA AND POTENTIAL IMPACT ON FLOW PATHS, TRAVEL TIME, AND RADIONUCLIDE RETARDATION

DOE'S APPROACH TO ADDRESS NRC'S OBJECTION #2
(CONTINUED)

QUANTIFICATION OF UNCERTAINTIES IS NEEDED ABOUT CHARACTERISTICS OF ROCK BENEATH REPOSITORY AND ABOVE WATER TABLE ASSOCIATED WITH THE FOLLOWING:

- HYDROLOGIC PARAMETERS & PROCESSES
  - MATRIX VS. FRACTURE FLOW
  - RANGE OF VALUES USED IN TRAVEL-TIME CALCULATIONS
  - IDENTIFICATION OF FLOW PATHS & TRAVEL TIMES
- RADIONUCLIDE RETARDATION PARAMETERS & PROCESSES
  - SORPTION, DIFFUSION, PRECIPITATION, ETC. ALONG FLOW PATHS

INFORMATION THAT CAN BE OBTAINED FROM AN ESF THAT DOES NOT PENETRATE ROCK BENEATH THE REPOSITORY

- CONSTRUCTABILITY & STABILITY
- EXTENT OF DISTURBED ZONE
- THERMAL-MECHANICAL RESPONSE
- WASTE PACKAGE ENVIRONMENT
- WATER FLUX REACHING REPOSITORY HORIZON FROM SURFACE
- UPWARD MIGRATION OF GAS IN UNSATURATED ZONE AT REPOSITORY HORIZON

DOE's APPROACH TO ADDRESS NRC's OBJECTION #2

SUMMARY OF STATUS

- WORKING GROUP #7 IS CURRENTLY DEVELOPING THE RATIONALE FOR EXPLORATION OF THE ROCK BENEATH THE REPOSITORY
- CURRENTLY, THE RATIONALE RELIES UPON INFORMATION OBTAINED PRIMARILY FROM SURFACE BASED EXPLORATION TO ACQUIRE SUFFICIENT GEOSTATISTICS ABOUT KEY PROPERTIES OF THE ROCK
- THE DECISION WHETHER OR NOT TO CONDUCT IN-SITU TESTING IN ROCKS BENEATH THE REPOSITORY DEPENDS UPON THE UNCERTAINTY IN THE INFORMATION GAINED FROM SURFACE BASED EXPLORATION AND AN ASSESSMENT OF POTENTIAL IMPACTS TO ISOLATION

EXPLORATORY SHAFT-RELATED CONSIDERATIONS FOR PREPARATION OF SCP SECTION 8.4

PRESENTED BY

M. D. VOEGELE

Attachment 9

INTERFERENCE AND IMPACT ASSESSMENTS	SCP
PRECONSTRUCTION ACTIVITIES	IN SITU TESTING AND SCP PROGRESS REPORTS
SHAFT PHASE	
MAIN TEST LEVEL PHASE	

- SCP PRESENTS RESULTS OF INTERFERENCE AND IMPACT ASSESSMENTS
- DATA COLLECTION PHASES PROVIDE OPPORTUNITIES TO ASSESS DATA AND EVALUATE ESF ASPECTS RELATIVE TO SCP SECTION 8.4 CONSIDERATIONS
- REVIEWS PRIOR TO MAJOR DECISION POINTS

INTERFERENCE AND IMPACT ASSESSMENTS

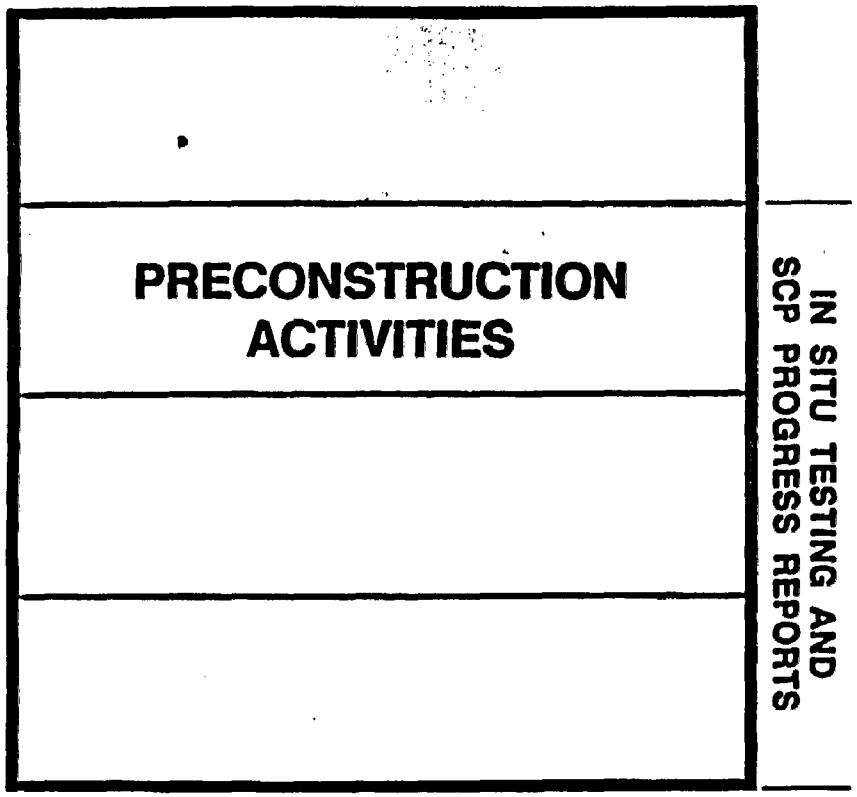
SCP

ASSESS

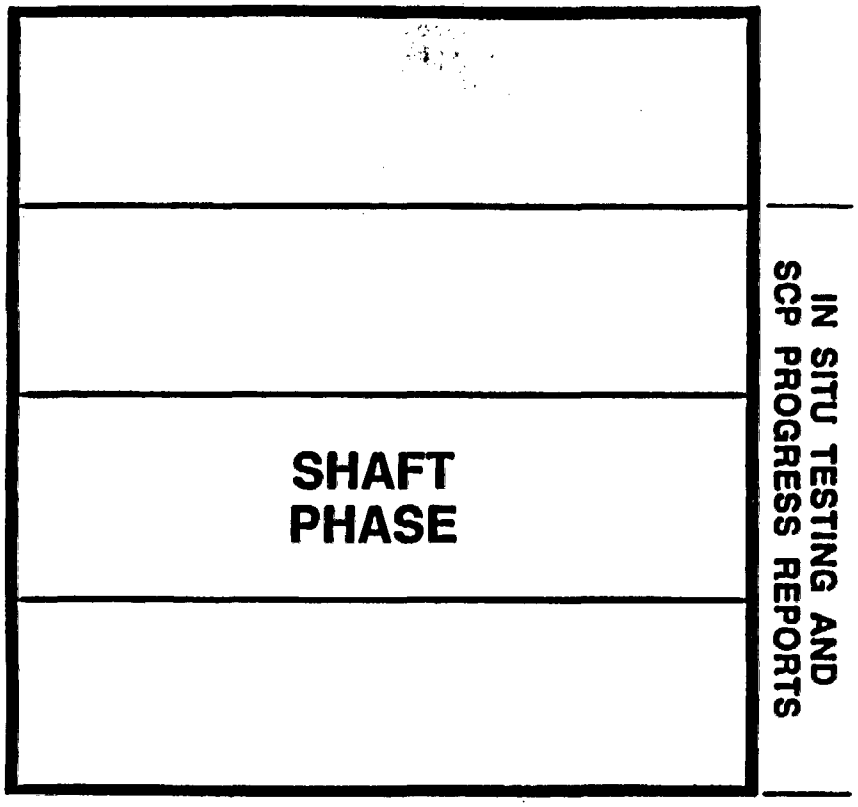
- IMPACTS OF PREVIOUS CHARACTERIZATION
- CONSTRUCTION FLUID MOVEMENTS; MATERIALS USED
  - SHAFT-TO-SHAFT
  - SHAFT-TO-TEST
  - TEST-TO-TEST
- OPERATIONAL IMPACTS
- POST CLOSURE IMPACTS

PRESENT RATIONALE

- ESF LAYOUT
- IDENTIFY DATA TO BE CONFIRMED
- IDENTIFY POTENTIAL IMPACTS



- PROTOTYPE TESTING
- ESTABLISH MONITORING PROGRAM
- POSSIBLY REENTER G-4
- PAD CONSTRUCTION
- COLLAR CONSTRUCTION



CONSTRUCTION

- MONITOR CONSTRUCTION FLUID MIGRATION (RECOVERY)
- POSSIBLE INSTRUMENTATION
- PROBE HOLE

TESTING

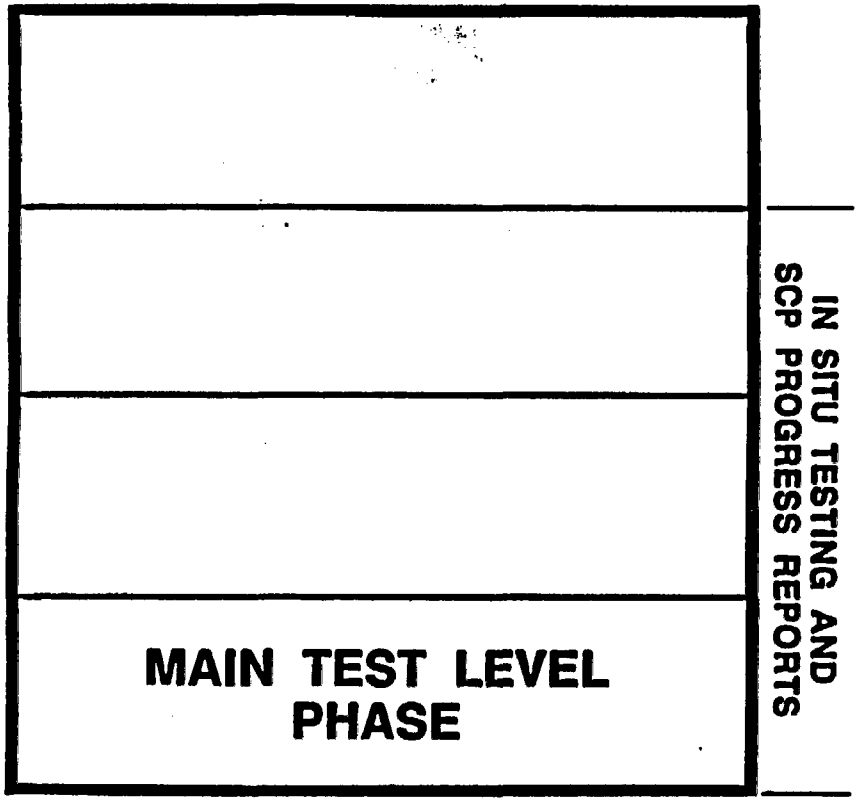
- MONITOR EXCAVATION EFFECTS (FLUID MIGRATION)
- DEMONSTRATION BREAKOUT ROOMS

CONFIRM

- SHAFT DESIGN (POSSIBLE)
- ACCEPTANCE CRITERIA FOR BLAST PROGRAM

EVALUATE

- IMPACT CALCULATIONS
- INTERFERENCE CALCULATIONS
- RATIONALE FOR LAYOUT



PHASED APPROACH TO DEVELOPMENT OF MTL

- MAINTAIN CORE AREA
- DEVELOPMENT BASED ON RESULTS OF LATE SHAFT PHASE (e.g., DEMONSTRATION BREAKOUT ROOM
- DEVELOPMENT BASED ON RESULTS FROM SHAFT CONSTRUCTION/MONITORING
- RE-ASSESS LAYOUT RATIONALE CONSIDERING:
  - FLUID EFFECTS
  - INTERFERENCE
  - FLEXIBILITY
  - APPROPRIATE ACCEPTANCE CRITERIA
  - INITIAL MTL RESULTS

RESPONSE TO NRC CDSCP POINT PAPERS
OBJECTION NO. 3
(ESF DESIGN INTERFERENCE CONCERNS)

PRESENTED BY
JOE TILLERSON

Attachment 10

OUTLINE

- DOE ACKNOWLEDGEMENT OF NRC'S OBJECTION #3
- DOE'S APPROACH TO ADDRESS OBJECTION #3
- SHAFT SPACING
- INTERFERENCE

DOE ACKNOLWEDGEMENT OF NRC'S OBJECTION #3

NRC'S SUMMARY -

- CDSCP DOES NOT INCLUDE ADEQUATE AND CONSISTENT CONCEPTUAL DESIGN INFORMATION ON PROPOSED ESF. THIS DOES NOT ALLOW EVALUATION OF POTENTIAL INTERFERENCE
  - BETWEEN INVESTIGATIONS, AND
  - BETWEEN CONSTRUCTION OPERATIONS AND INVESTIGATIONS

DOE ACKNOWLEDGEMENT OF NRC'S OBJECTION #3
(CONTINUED)

NRC RECOMMENDATION -

- INCLUDE CONCEPTUAL DESIGN INFORMATION IN SCP IN MORE DETAIL AND CONSISTENT FASHION

- DISCUSS STRATEGY TO MINIMIZE POTENTIAL INTERFERENCE BETWEEN INVESTIGATIONS

DOE'S APPROACH TO ADDRESS NRC'S OBJECTION #3

- IN MAY 1988, DOE ESTABLISHED WORKING GROUP #7 TO REVISE SCP SECTION 8.4
  - EXPAND DESIGN DESCRIPTION IN SECTION 8.4 BASED UPON ESF TITLE I DESIGN
  - EXPAND TEST DESCRIPTIONS IN SECTION 8.4 TO INCLUDE CONSTRAINTS ON ESF LAYOUT
  - EXPAND ESF OPERATIONS DESCRIPTIONS TO PROVIDE BASIS FOR INTERFERENCE EVALUATIONS
  - ADD DESCRIPTION OF ASSESSMENTS OF INTERFERENCE CONSIDERATIONS TO SECTION 8.4

DOE'S APPROACH TO ADDRESS NRC'S OBJECTION #3
(CONTINUED)

- REVIEW SCP CHAPTER 8 TO ASSURE CONSISTENCY IN PRESENTATION OF ESF DESIGN DESCRIPTION

- PROVIDE OPPORTUNITY FOR NRC OBSERVATION OF ESF DESIGN REVIEWS

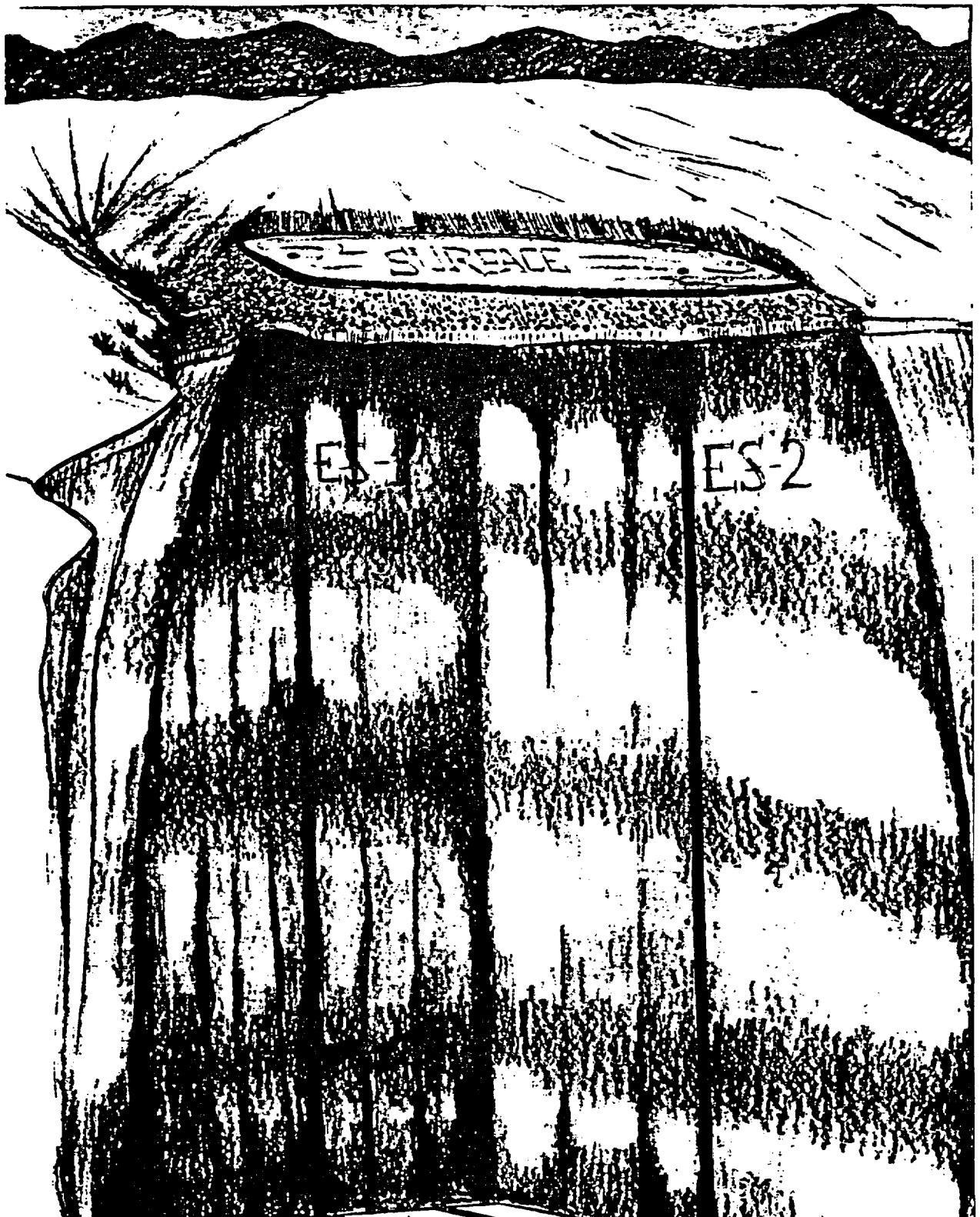
INTERFERENCE EVALUATION

ACTIVITY	RESPONSIBILITY
1. DOCUMENT ES TEST REQUIREMENTS IN ESF SUBSYSTEMS DESIGN REQUIREMENTS DOCUMENT (ESF-SDRD)	TEST PI, ICWG *
2. REVIEW, CHANGE, AND ACCEPT REFERENCE ESF INTERFACE CONTROL DRAWINGS	TEST PI, ICWG
3. PROVIDE INPUT TO WORKING GROUP #7 ON LAYOUT CONSTRAINTS AND POTENTIAL INTERFERENCE FOR EACH TEST	TEST PI
4. CONDUCT/EVALUATE SPECIFIC TECHNICAL ANALYSES FOR APPLICABILITY TO LAYOUT EVALUATION	WG #7, TEST PI
5. REVISE ESF-SDRD TO INCLUDE SPECIFIC TEST CONSTRAINTS RELATED TO INTERFERENCE	TEST PI, ICWG
6. EXPAND SCP SECTION 8.4 TO INCLUDE MORE DETAILED TEXT ON INTERFERENCE AND DESIGN	WG #7

* INTERFACE COORDINATION WORKING GROUP

STATUS OF INTERFERENCE EVALUATIONS

ACTIVITY	STATUS
1. DOCUMENT TEST REQUIREMENTS FOR ESF EXPERIMENTS	COMPLETE
2. ACCEPT ESF INTERFACE CONTROL DRAWINGS	COMPLETE
3. LAYOUT CONSTRAINTS TO WG #7	COMPLETE
4. ANALYSES OF EXPERIMENTS	ONGOING
5. DETAILED INTERFERENCE CONSTRAINTS IN SDRD	IN PREPARATION
6. SCP SECTION 8.4 MODIFICATION	IN PREPARATION



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CONCLUSIONS REGARDING ACCEPTABILITY OF SHAFT SEPARATION DISTANCE

- 300' SEPARATION DISTANCE IS ACCEPTABLE BECAUSE:
  - UNLIKELY THAT LARGE-SCALE HYDROLOGIC INTERFERENCE WILL BE OBSERVED
  - CANNOT PRECLUDE POSSIBILITY OF LOCALIZED FLOW IN LARGE APERTURE FRACTURES REACHING ADJACENT SHAFT. UNLIKELY TO SIGNIFICANTLY REDUCE THIS POSSIBILITY BY REASONABLE INCREASES IN SEPARATION
  - NO MECHANICAL INTERFERENCE OR UNACCEPTABLE VIBRATORY INTERFERENCE EXPECTED
  - SEPARATION DISTANCE CONSISTENT WITH OPERATIONAL AND INDUSTRIAL SAFETY CONSIDERATIONS

CONSIDERATIONS IN SHAFT SPACING

- POTENTIAL FOR HYDROLOGIC INTERFERENCE
- INDUSTRIAL SAFETY AND OPERATIONAL CONSIDERATIONS

POTENTIAL FOR HYDROLOGIC INTERFERENCE

APPROACH:

- IDENTIFY FLUID QUANTITIES LIKELY TO BE USED IN ESF CONSTRUCTION AND ASSESS IMPACTS

BASIS:

- ESF FLUIDS AND MATERIALS EVALUATION (LANL DRAFT REPORT) CONTAINS MULTI-PARTICIPANT INPUT ON:
  - FLUIDS AND MATERIALS USED IN ESF CONSTRUCTION, OPERATION, MAINTENANCE, AND TESTING
  - SCREENING ANALYSIS FOR POTENTIAL DELETERIOUS INTERACTIONS
  - EVALUATIONS OF GROUNDWATER MOVEMENT, MICROORGANISM EFFECTS, AND POTENTIAL TRANSPORT TO WASTE PACKAGES

POTENTIAL FOR HYDRAULIC INTERACTION BETWEEN SHAFTS-ANALYSIS RESULTS

- EFFECTS OF CONSTRUCTION WATER

- MATRIX FLOW CALCULATIONS

  - ASSUMPTIONS:

    10% OF CONSTRUCTION WATER GOES INTO FORMATION

    CONSTRUCTION WATER RETAINED IN MODIFIED PERMEABILITY ZONE (ESTIMATED = 1 SHAFT RADIUS)

  - RESULTS:

    CHANGES INITIAL SATURATION OF MPZ BY LESS THAN 0.08

    WATER MOVES LATERALLY BY MATRIX FLOW TO 11 m IN 10 YEARS

POTENTIAL FOR HYDRAULIC INTERACTION BETWEEN SHAFTS-ANALYSIS RESULTS
(CONTINUED)

- SMALL APERTURE (24 TO 100 MICRONS) FRACTURE FLOW CALCULATIONS
  - WATER MOVED 10 TO 15 m VERTICALLY WITH 20 m HEAD
  - EQUILIBRATION BETWEEN MATRIX AND FRACTURES OCCURS RAPIDLY (A FEW HOURS)
- LARGE APERTURE (250 MICRON) FRACTURE FLOW CALCULATIONS
  - WATER MOVED 55 m VERTICALLY WITH 0.2 m HEAD

1987 PHOTO

COMPARISON OF G-4 AND G-1

	G-4	G-1
DRILLING	• AIR FOAM • PRESURE 100 PSI	• WATER/MUD • DRILLING INDUCED .HYDRO FRACTURE
GEOLOGIC STRUCTURAL	LOCATED IN BLOCK	ALONG LINEATION
UZ CASING	CASING PROGRAM PROTECTED UZ	ALWAYS OPEN BELOW 1000'

POTENTIAL FOR HYDRAULIC INTERACTION BETWEEN SHAFTS-ANALYSIS RESULTS

- SUMMARY
  - DURING CONSTRUCTION, WATER WOULD MOVE SHORT DISTANCES IN THE MATRIX OR SMALLER APERTURE FRACTURES
  - CHANGES IN ROCK MASS SATURATION DUE TO CONSTRUCTION WATER WILL BE SMALL
  - RELATIVELY LARGE APERTURE FRACTURES REQUIRED FOR WATER TO MOVE LONG DISTANCES
  - MOST LIKELY SOURCE OF WATER THAT COULD INFLUENCE TESTING IN ES-1 IS CONSTRUCTION WATER USED IN ES-1

INDUSTRIAL SAFETY AND OPERATIONAL CONSIDERATIONS IN SHAFT SPACING

- SUFFICIENT SEPARATION TO PRECLUDE SIGNIFICANT MECHANICAL INTERFERENCE
- PROVIDE ADEQUATE PILLAR TO PRECLUDE GROUND CONTROL PROBLEMS BETWEEN SHAFTS
- PROVIDE FOR RAPID EMERGENCY EGRESS FROM BOTH/ EITHER SHAFTS-EMPHASIS ON RAPID ESCAPE FROM CORE AREA
- ASSURE EGRESS VIA TWO SEPARATE ROUTES SOON AFTER REACHING MAIN TEST LEVEL
- LOCATE AT SURFACE TO ASSURE TERRAIN DOES NOT POSE MAJOR ENGINEERING OR CONSTRUCTION PROBLEMS
- ALLOW REASONABLE DISTANCES FOR UTILITY (POWER, WATER, ETC.) SYSTEMS
- LIMITED POTENTIAL EXPOSURE OF PERSONNEL TO HIGH PRESSURE OR HIGH VOLTAGE SYSTEMS

POTENTIAL FOR MECHANICAL INTERFERENCE BETWEEN SHAFTS

- STRESS CHANGES OR DISPLACEMENTS DUE TO MINING ES-2 ARE NOT LIKELY TO BE DETECTABLE BY TEST INSTRUMENTATION IN ES-1 BECAUSE SHAFT SEPARATION IS GREATER THAN 20 SHAFT DIAMETERS

- UNLIKELY THAT CONTROLLED BLASTING IN ES-2 WILL AFFECT INSTRUMENTATION IN ES-1. G-TUNNEL TESTING DEMONSTRATES INSTRUMENTATION SURVIVAL WITHIN 1 m OF A FREE FACE BLAST

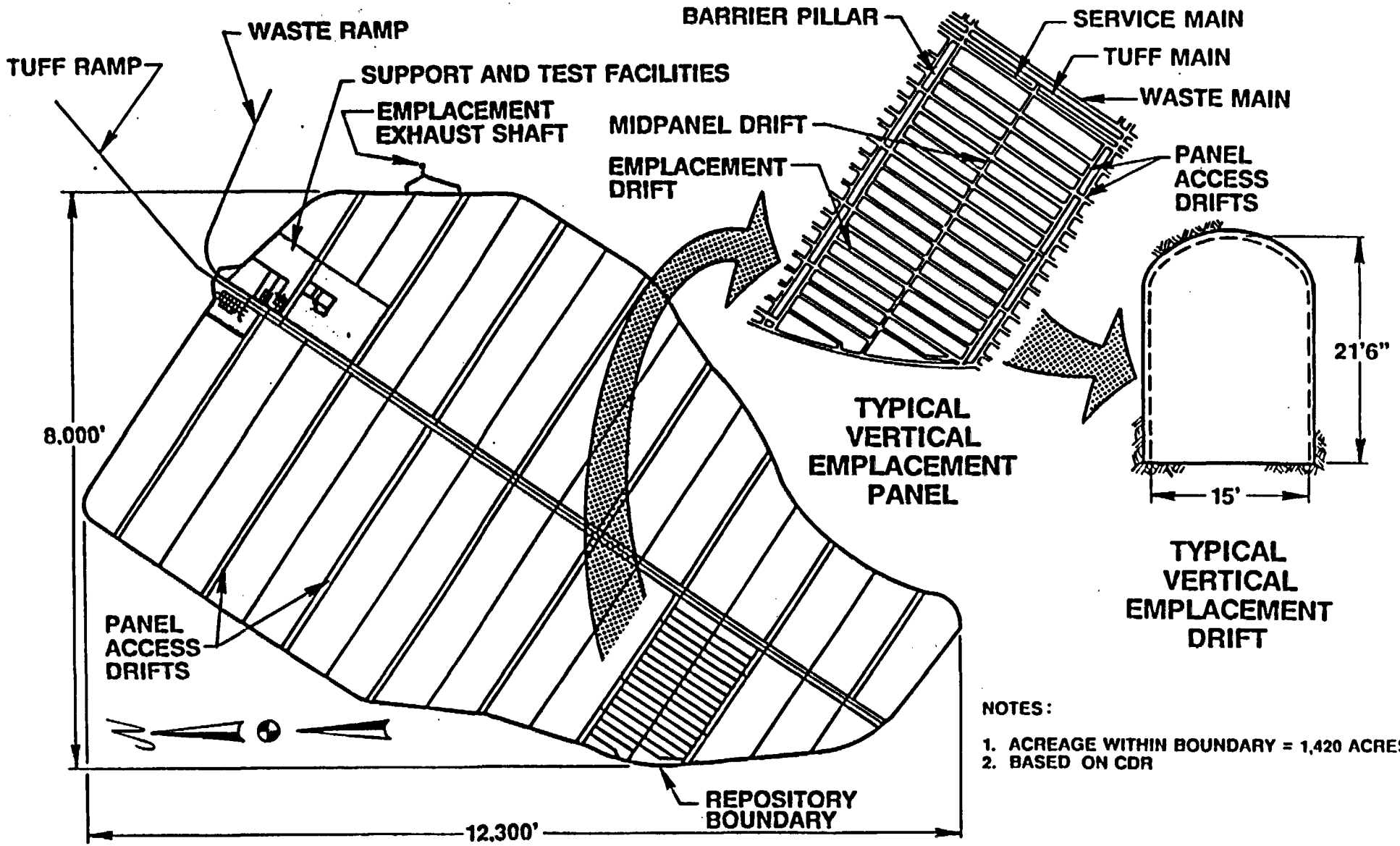
TYPES OF POTENTIAL INTERFERENCE CONCERNS AFFECTING ESF DESIGN AND TESTING

- ESF AND REPOSITORY INTERFERENCE
- TEST AND CONSTRUCTION/OPERATIONS INTERFERENCE
- TEST-TO-TEST INTERFERENCE

INTERFERENCE CONSIDERATIONS

- PHYSICAL SEPARATION (DISTANCE, INTERCONNECTION, ETC.)
- TIMING OF OPERATIONS/TESTING
- CONTROL OF OPERATIONS (BLAST CONTROL, FLUID USAGE CONTROL, ETC.)
- MONITORING/OBSERVATION PRIOR TO ACCEPTANCE OF TEST LOCATION

UNDERGROUND DESIGN FOR VERTICAL EMPLACEMENT



NOTES:

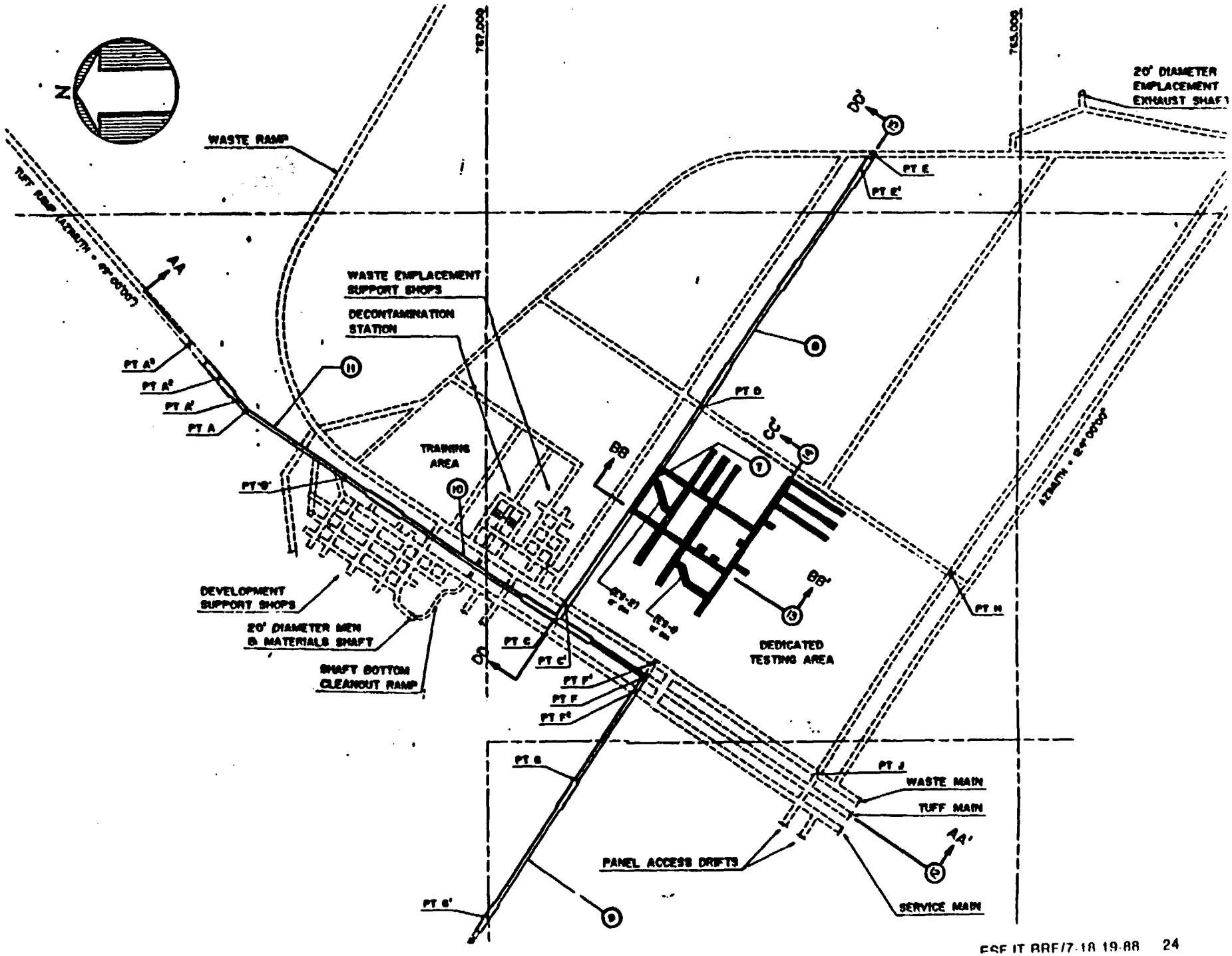
1. ACREAGE WITHIN BOUNDARY = 1,420 ACRES
2. BASED ON CDR

APPROACH TAKEN TO LIMIT ESF AND REPOSITORY INTERFERENCE CONCERNS

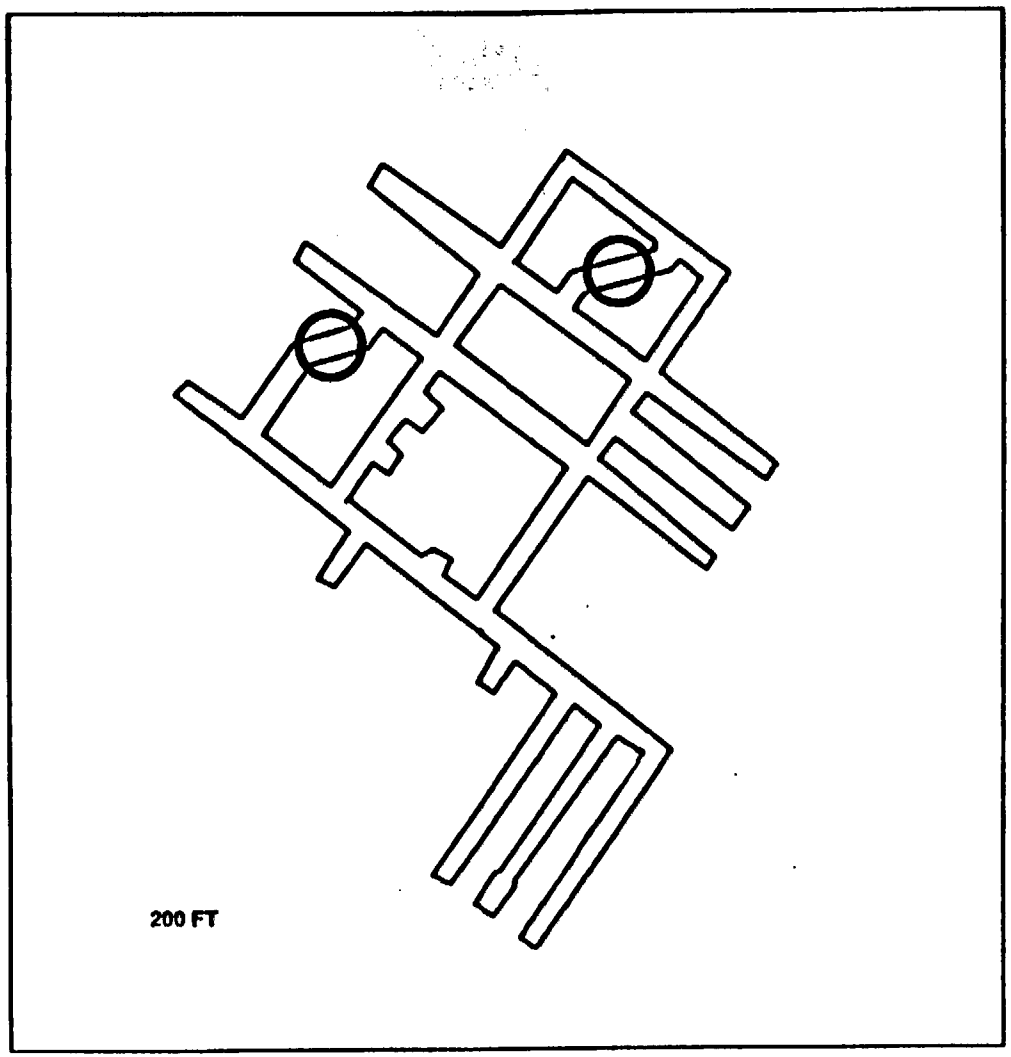
- ESTABLISH DEDICATED TESTING AREA AT REPOSITORY LEVEL
  - NO WASTE STORAGE IN TESTING AREA
  - LIMITED IMPACT ON USABLE AREA
  - FLEXIBILITY TO EXPAND WITHOUT IMPACTING MAINS AND PANEL ACCESS DRIFTS
  - ESF AND PERFORMANCE CONFIRMATION REGIONS CLOSE TO SUPPORT FACILITIES
  - STANDOFF FROM REPOSITORY DRIFTS AND WASTE EMPLACEMENT AREAS
  - LIMITED NUMBER OF INTERCONNECTIONS WITH REPOSITORY
- ESTABLISH LONG LATERAL DRIFTS COINCIDENT WITH PLANNED DRIFTS FROM REPOSITORY
- ESTABLISH DRAINAGE PLAN COMPATIBLE WITH REPOSITORY OPERATIONS AND POSTCLOSURE SEALING

MECHANISMS OF POTENTIAL INTERFERENCE

- HYDROLOGIC
- THERMAL
- MECHANICAL
- GEOCHEMICAL
- OTHER (VENTILATION, VIBRATION, INSTRUMENTATION, TRAFFIC, ETC.)

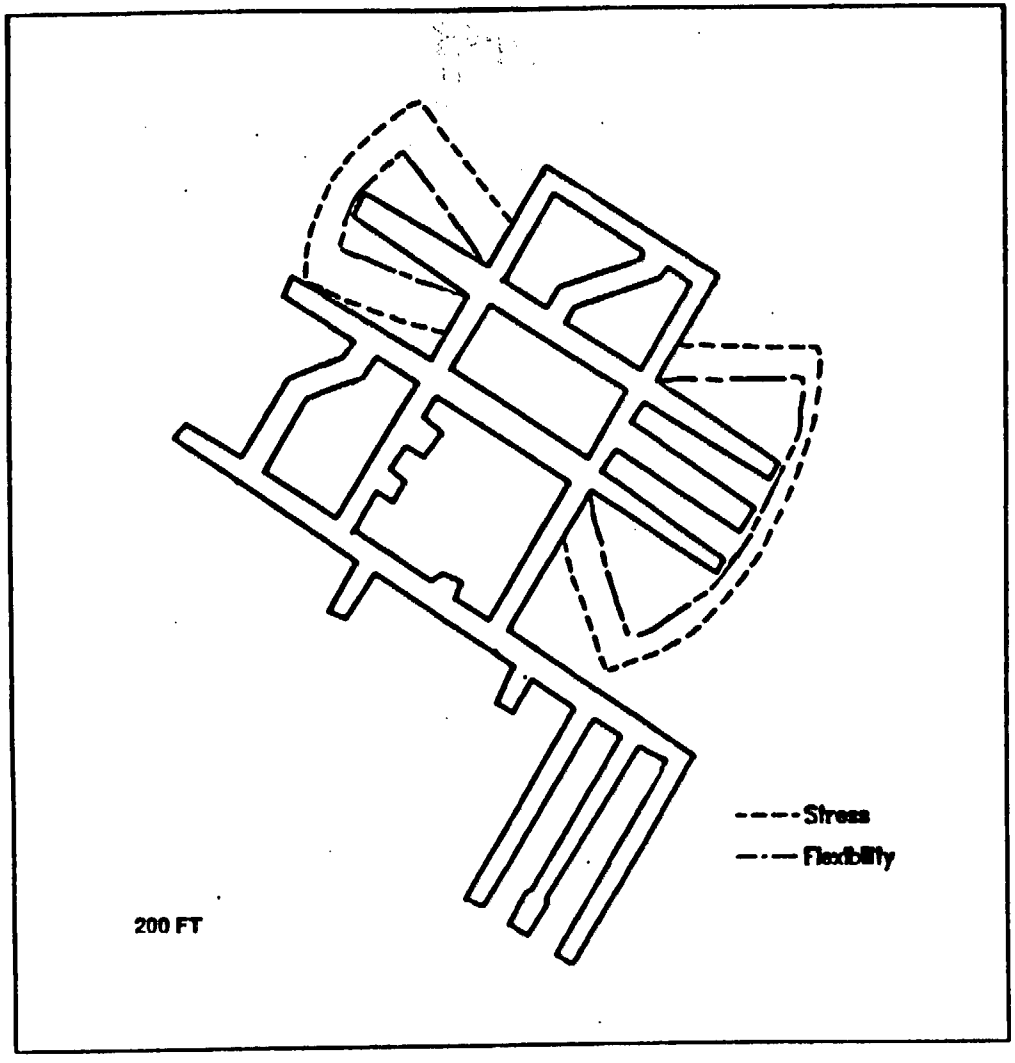

N
WASTE RAMP
TUFF RAMP (AZIMUTH = 6°00'00")
AA
PT A'
PT A''
PT A'
PT A
PT B'
WASTE EMPLACEMENT SUPPORT SHOPS
DECONTAMINATION STATION
TRAINING AREA
DEVELOPMENT SUPPORT SHOPS
20' DIAMETER MEN & MATERIALS SHAFT
SHAFT BOTTOM CLEANOUT RAMP
DD
PT C
PT C'
PT F'
PT F
PT F''
PT G
PT G'
BB
CC
PT D
PT E
PT E'
DD'
BB'
DEDICATED TESTING AREA
PT H
PT J
WASTE MAIN
TUFF MAIN
AA'
PANEL ACCESS DRIFTS
SERVICE MAIN
767,000
765,000
20' DIAMETER EMPLACEMENT EXHAUST SHAFT
AZIMUTH = 6°00'00"

EXAMPLE OF HYDROLOGIC INTERFERENCE CONSIDERATIONS



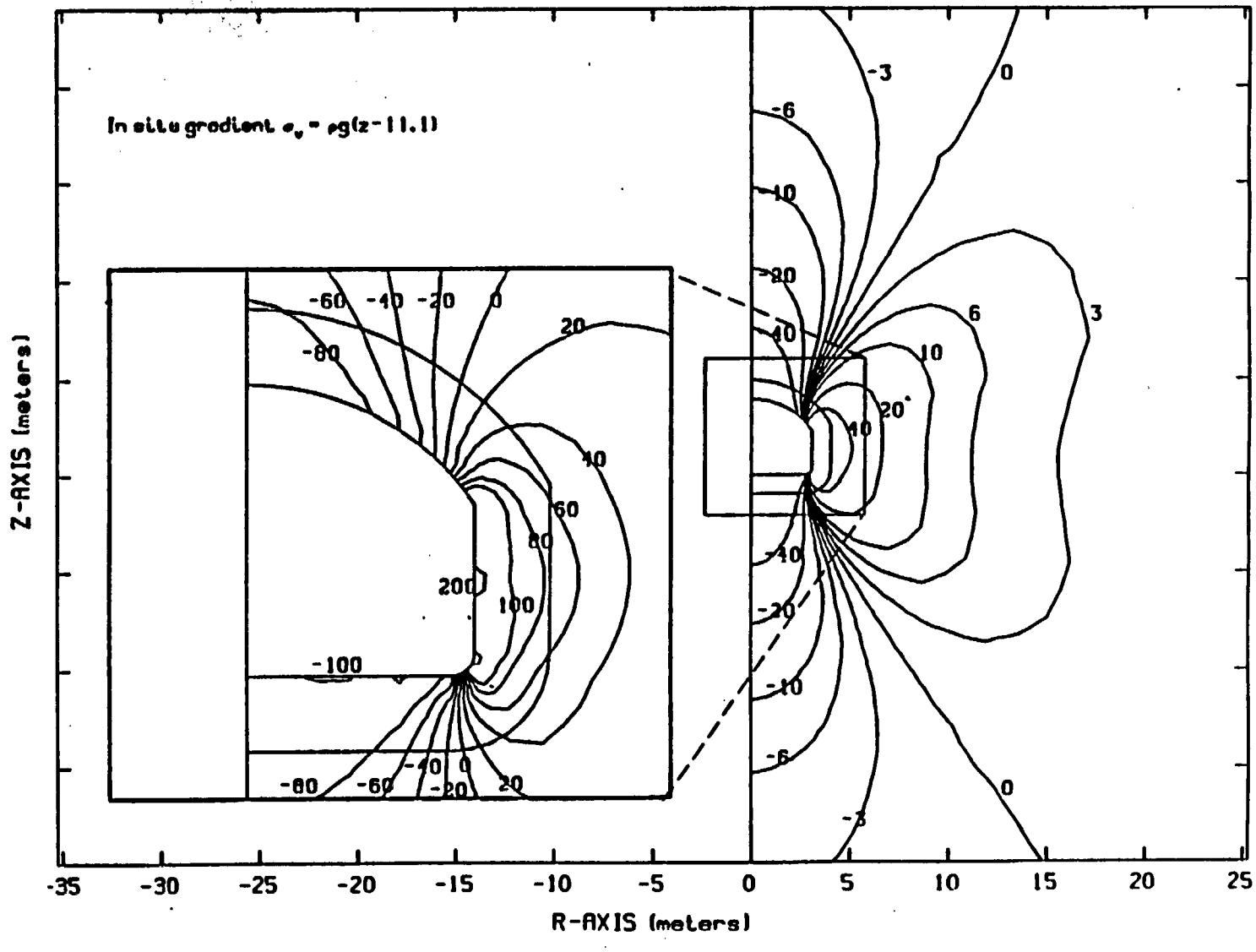
- HYDROLOGIC ZONE OF INFLUENCE AROUND SHAFTS
- IF 10% CONSTRUCTION WATER GOES INTO FORMATION
  - SATURATION CHANGE IN MP2 IS 0.08
  - AFTER 2 YEARS, ALTERED ZONE IS APPROX. 8 M FROM SHAFT CENTERLINE
  - VERY LOW CHANGES IN SATURATION IF WATER FLOWS LATERALLY IN FRACTURES
- EXPECTED ZONE OF GENERAL INFLUENCE IS LESS THAN 10 M

EXAMPLE OF MECHANICAL INTERFERENCE CONSIDERATIONS

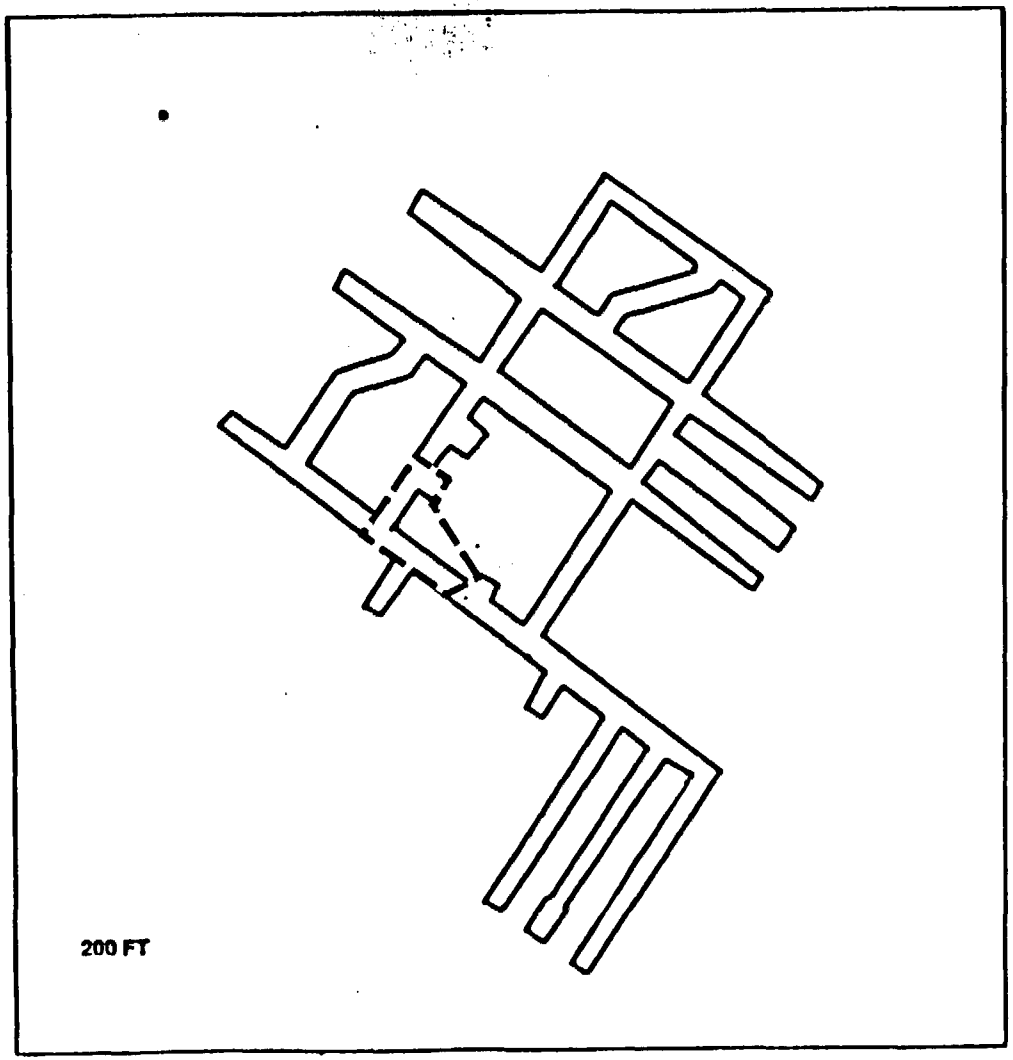


- DEMONSTRATION BREAKOUT ROOM
  - CONSTRAINTS - NEED 100 FT STANDOFF FROM OTHER MINING WHILE MEASUREMENTS IN PROGRESS (DOTTED LINE) BECAUSE OF DISPLACEMENT GAUGE ANCHORS. LARGE AREA REQUIRED BECAUSE OF NEED FOR FLEXIBILITY IN ORIENTATION
  - ZONE OF INFLUENCE - STRESS ALTERED REGION EXTENDS APPROX. 2 DRIFT DIA. (50 FT) (SOLID LINE)
- SEQUENTIAL DRIFT MINING
  - CONSTRAINT - NO OTHER MINING WITHIN 50 FT OF OUTER DRIFTS (INSTRUMENTS DO NOT EXTEND BEYOND OUTER DRIFT)
  - ZONE OF INFLUENCE - 2 DIA.

ANALYSIS OF DEMONSTRATION BREAKOUT ROOM PERCENT CHANGE FROM IN SITU VERTICAL STRESS

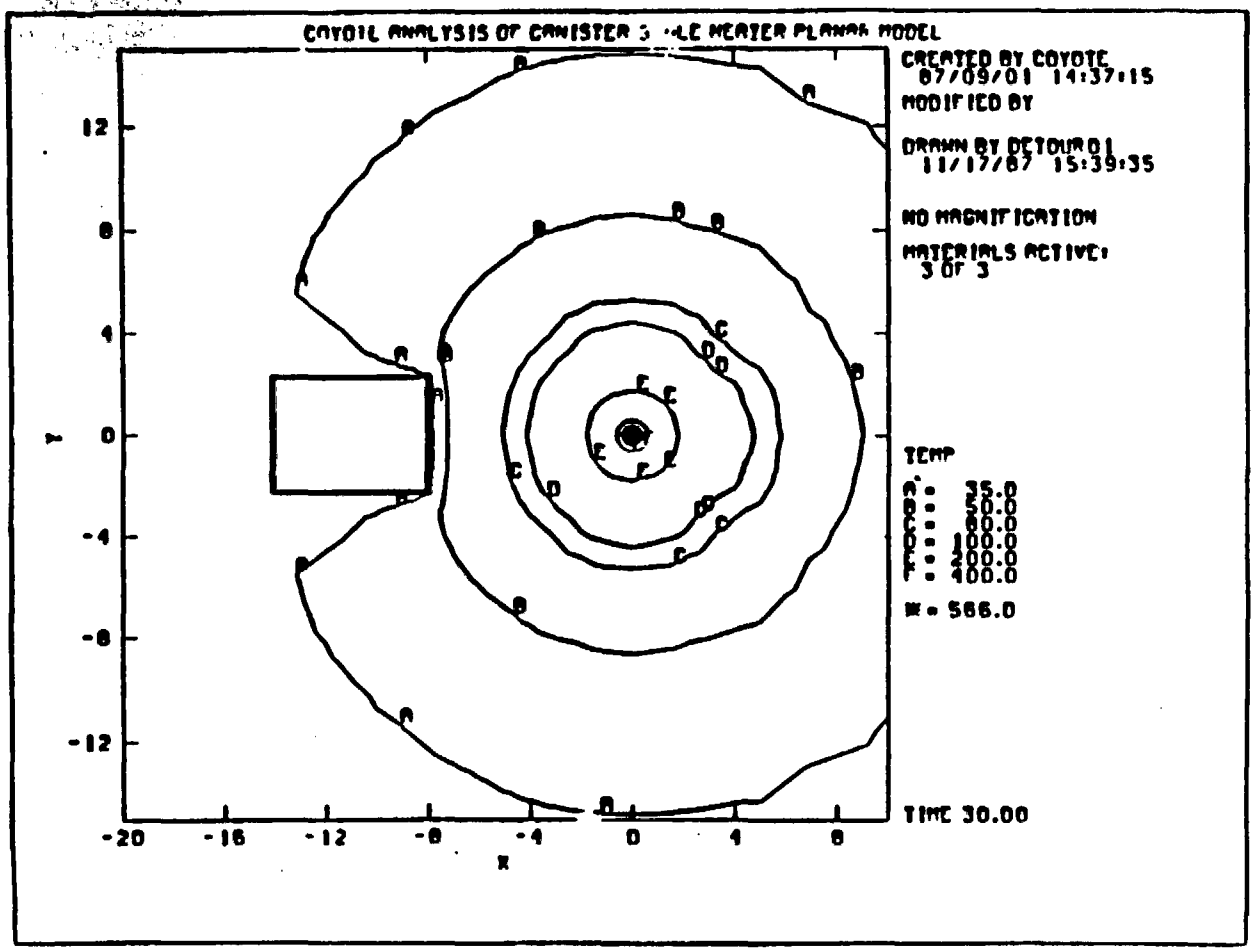


EXAMPLE OF THERMAL INTERFERENCE CONSIDERATIONS



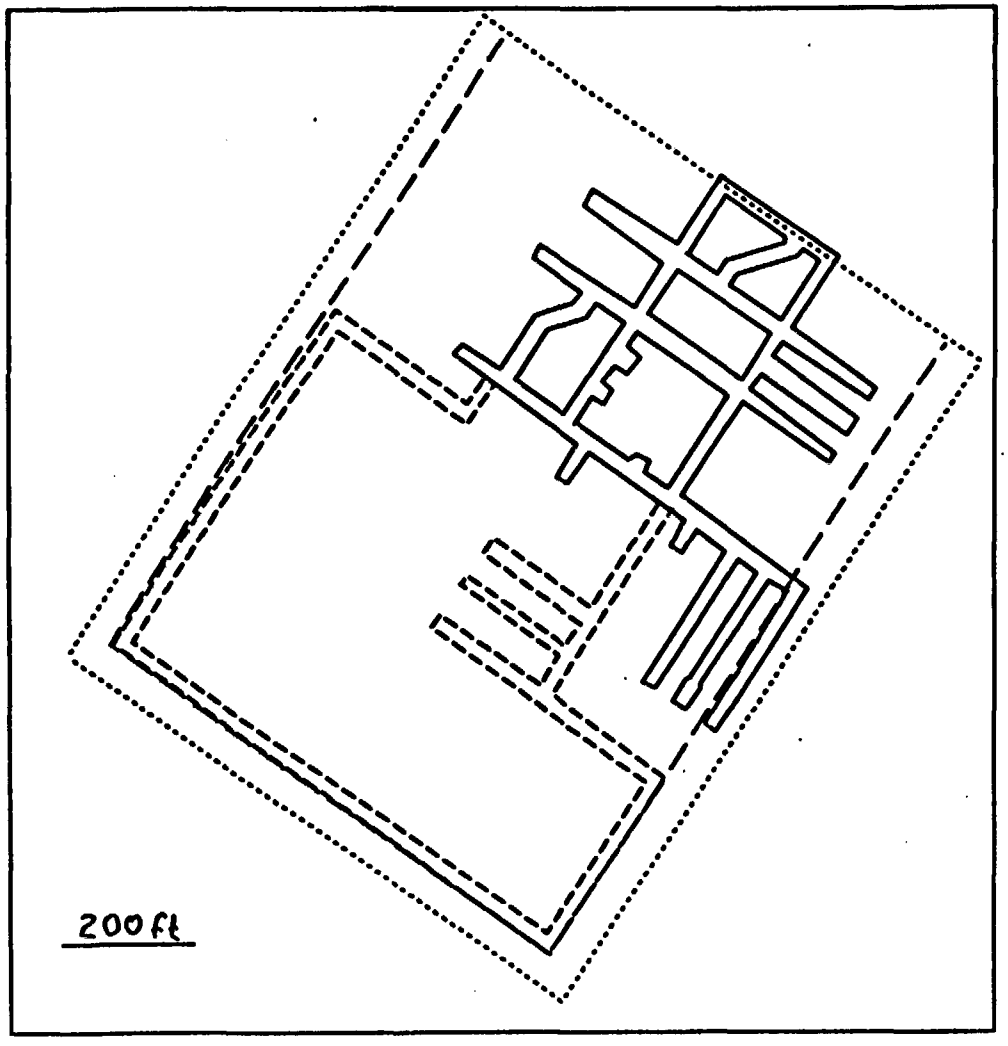
- CANISTER SCALE HEATER TEST
- CONSTRAINTS-CANISTER SHOULD BE LOCATED A MINIMUM OF 30 FT FROM LATERAL DRIFT TO LIMIT INFLUENCE OF DRIFTS ON NEAR FIELD
- ZONE OF INFLUENCE-THERMAL FIELD WILL EXTEND 45 FT RADIALLY AND 60 FT ALONG AXIS OF HEATER

THERMAL ANALYSIS OF CANISTER SCALE HEATER PLANAR MODEL



PLANAR MODEL TEMPERATURE CONTOURS AT 30 MONTHS

STATUS OF INTERFERENCE EVALUATIONS
SUMMARY



ES TEST LAYOUT

- EXPERIMENTER'S INPUT ON LAYOUT CONSTRAINTS OBTAINED
- TEST ANALYSES/EVALUATIONS IN PROCESS
- EVALUATION OF LAYOUT TO BE IN EXPANDED SECTION 8.4 OF SCP

RESPONSE TO NRC CDSCP POINT PAPERS
OBJECTION NO. 4
(SHAFT LOCATIONS)

PRESENTED BY
JOE TILLERSON

Attachment 11

OUTLINE

- DOE ACKNOWLEDGEMENT OF NRC'S OBJECTION #4
- DOE'S APPROACH TO ADDRESS OBJECTION #4
- SUMMARY/STATUS OF ASSESSMENTS OF SHAFT LOCATION
  - BACKGROUND
  - INFILTRATION AROUND SHAFTS
  - SEALING CONCEPTS AND PERFORMANCE CONSIDERATIONS

DOE ACKNOWLEDGEMENT OF NRC's OBJECTION #4

NRC'S SUMMARY -

- CDSCP DOES NOT ADEQUATELY CONSIDER THE POTENTIALLY ADVERSE IMPACTS RESULTING FROM LOCATING SHAFT AND RAMP PORTALS IN AREAS WHICH MAY BE SUSCEPTIBLE TO SURFACE WATER INFILTRATION, AND LATERAL AND VERTICAL EROSION

- ES-1 IS SUBJECT TO SHEET FLOW

- FOR THE PROPOSED LOCATIONS, THERE IS POSSIBILITY OF

  - POTENTIALLY SIGNIFICANT AND UNMITIGABLE LONG-TERM ADVERSE IMPACTS ON WASTE ISOLATION CAPABILITY OF SITE

  - AFFECTING ABILITY TO ADEQUATELY CHARACTERIZE THE SITE

DOE ACKNOWLEDGEMENT OF NRC's OBJECTION #4
(CONTINUED)

NRC RECOMMENDATION -

- PRIOR TO FINALIZING SHAFT AND RAMP LOCATIONS, CONSIDER:
  - SURFACE WATER INFILTRATION AND FLOODING
  - VERTICAL AND LATERAL EROSION
  - POTENTIAL FOR SEALS (DRAINAGE) TO BECOME INEFFECTIVE
  - FUTURE CHANGES IN GEOMORPHIC PROCESSES DUE TO TECTONIC EVENTS OR REPOSITORY-INDUCED UPLIFT/SUBSIDENCE
  - POTENTIAL ADVERSE IMPACTS ON ISOLATION CAPABILITY OF SITE
  - POTENTIAL IMPACT ON ABILITY TO CHARACTERIZE SITE

DOE's APPROACH TO ADDRESS OBJECTION #4

- IN MAY 1988, DOE ESTABLISHED WORKING GROUP TO REVISE SCP SECTION 8.4
  - EXPAND SCOPE OF SECTION 8.4 TO INCLUDE PERFORMANCE IMPACTS OF SITE CHARACTERIZATION ACTIVITIES FOR
    - SURFACE-BASED TESTING, AND
    - ESF
  - EXPAND OPERATIONS DESCRIPTIONS IN SECTION 8.4 TO PROVIDE BASIS FOR PERFORMANCE EVALUATIONS
  - PUBLISH SUPPORTING TECHNICAL STUDIES, INCLUDING
    - ESF FLUIDS/MATERIALS USAGE
    - ESF PERFORMANCE ANALYSES

STATUS OF PERFORMANCE IMPACT EVALUATIONS

ACTIVITY	STATUS
1. PUBLISH ES PERFORMANCE ANALYSES (SAND85-0898)	FINAL COMMENTS RECEIVED
2. PUBLISH ESF FLUIDS AND MATERIALS USAGE STUDY	IN PRESS
3. PREPARE TEXT ON PERFORMANCE IMPACTS FOR SCP SECTION 8.4	DRAFT TEXT
4. COMPLETE AND PUBLISH EVALUATION SUPPORTING SCP SECTION 8.4	IN PROGRESS

ASSESSMENTS OF SHAFT LOCATION

- BACKGROUND
- INFILTRATION AROUND SHAFT
- SEALING CONCEPTS AND PERFORMANCE CONSIDERATIONS

BACKGROUND-SELECTION OF COYOTE WASH

SELECTION PROCESS DOCUMENTED IN SAND84-1003

DETAILED DISCUSSION WITH NRC IN 8/85 MEETING

SELECTION PROCESS FOR GENERAL LOCATION OF EXPLORATORY SHAFTS

ESTABLISHED 5 ALTERNATIVE SITES

ESTABLISHED SELECTION CRITERIA AND WEIGHTING FACTORS FOR SITE SELECTION

SELECTED COYOTE WASH SITE BASED ON FIGURE OF MERIT APPROACH

BASIS FOR ESTABLISHING 5 ALTERNATIVE SITES

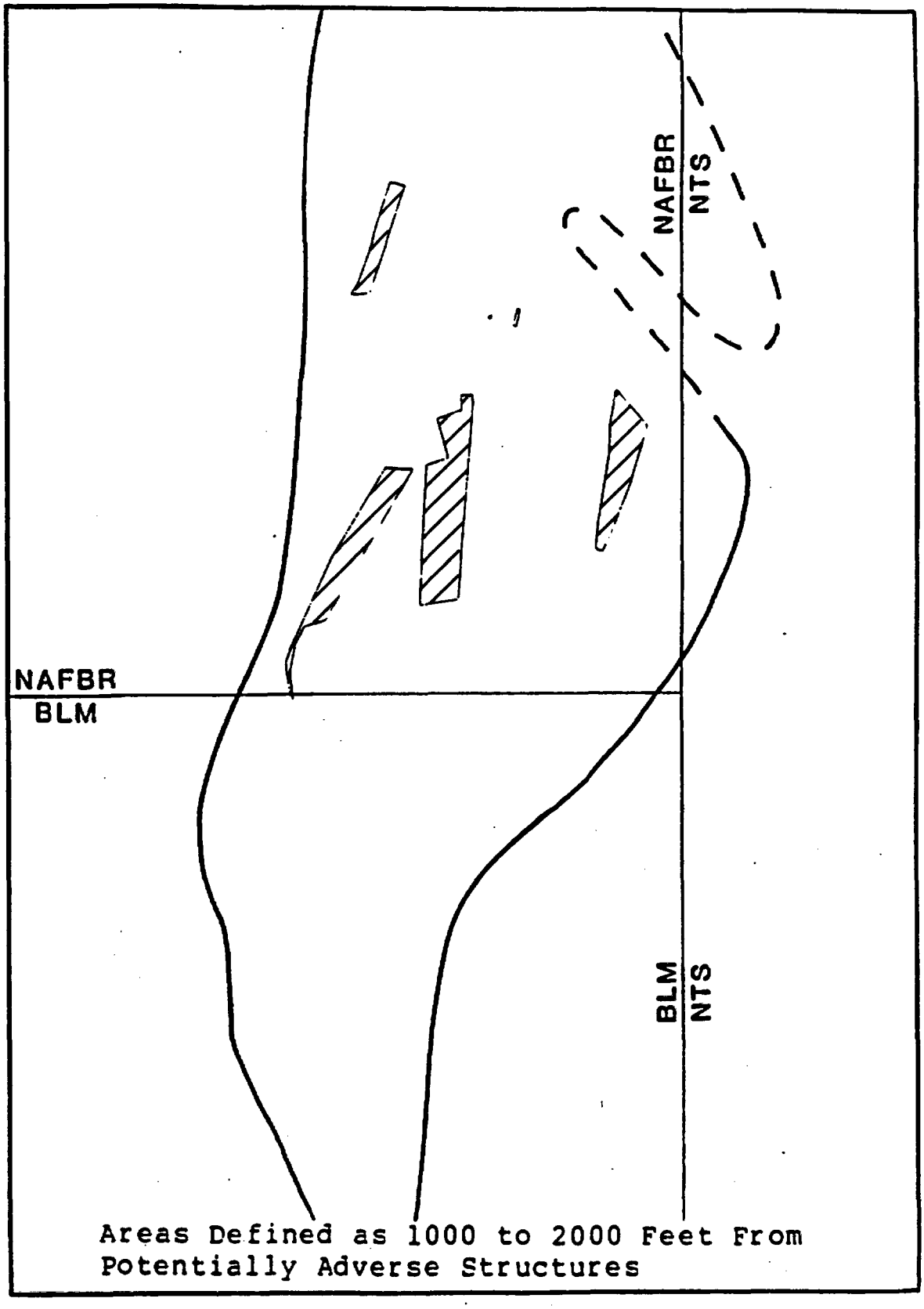
SITE INSIDE, BUT SET BACK FROM, BLOCK BOUNDARIES IN ROCK JUDGED TYPICAL OF EXPLORATION BLOCK

SITE 1000-2000 FEET FROM POTENTIALLY ADVERSE STRUCTURE

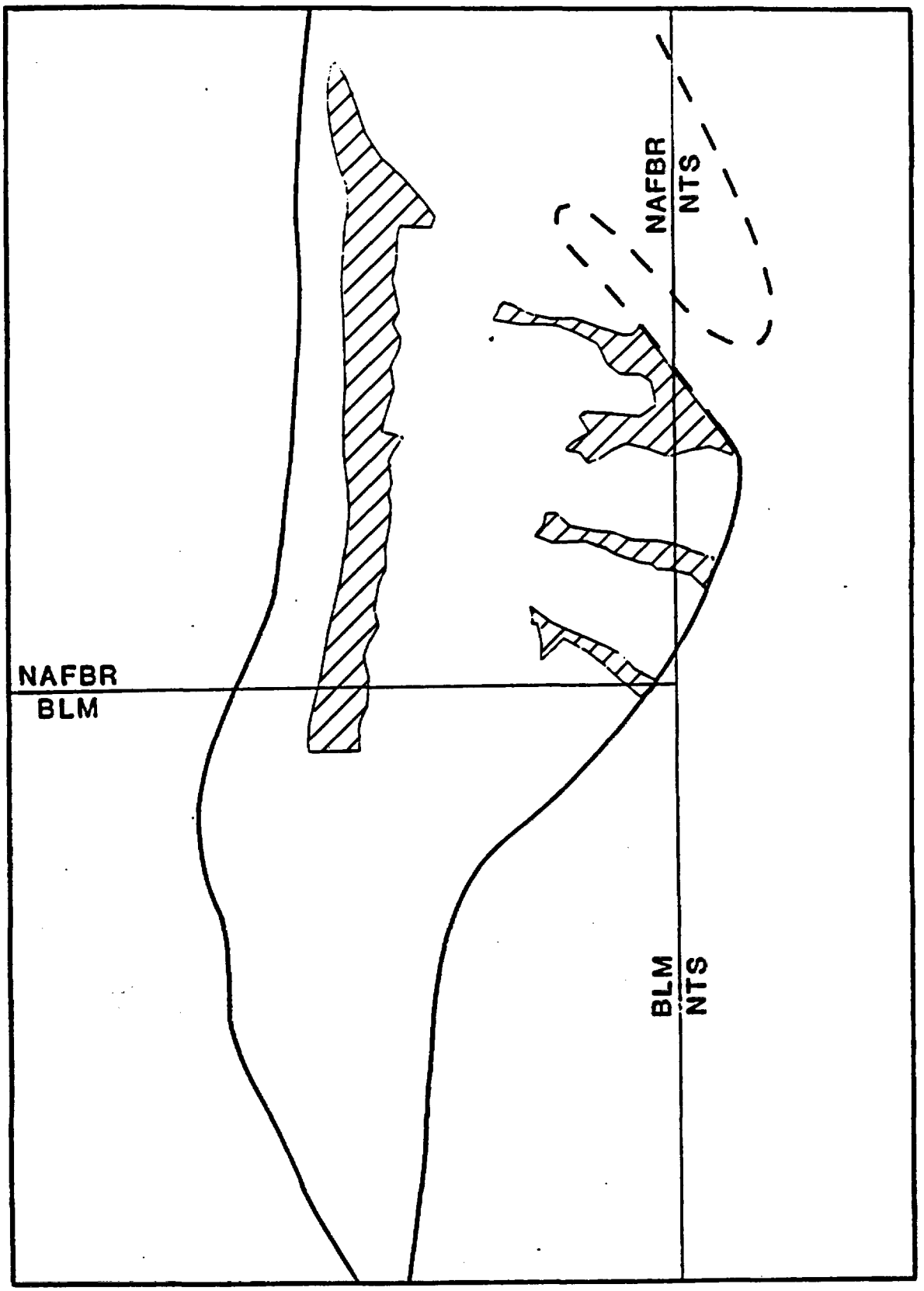
SITE LOCATED TO ENSURE CONSTRUCTIBILITY

SITE SHOULD AVOID ADVERSE TOPOGRAPHY AND SLOPES

STANDOFF FROM POTENTIALLY ADVERSE STRUCTURES



AVOIDING ADVERSE TOPOGRAPHY



Areas Defined by Avoiding Adverse Topography

COMBINED SCIENTIFIC AND ENGINEERING PREFERENCES

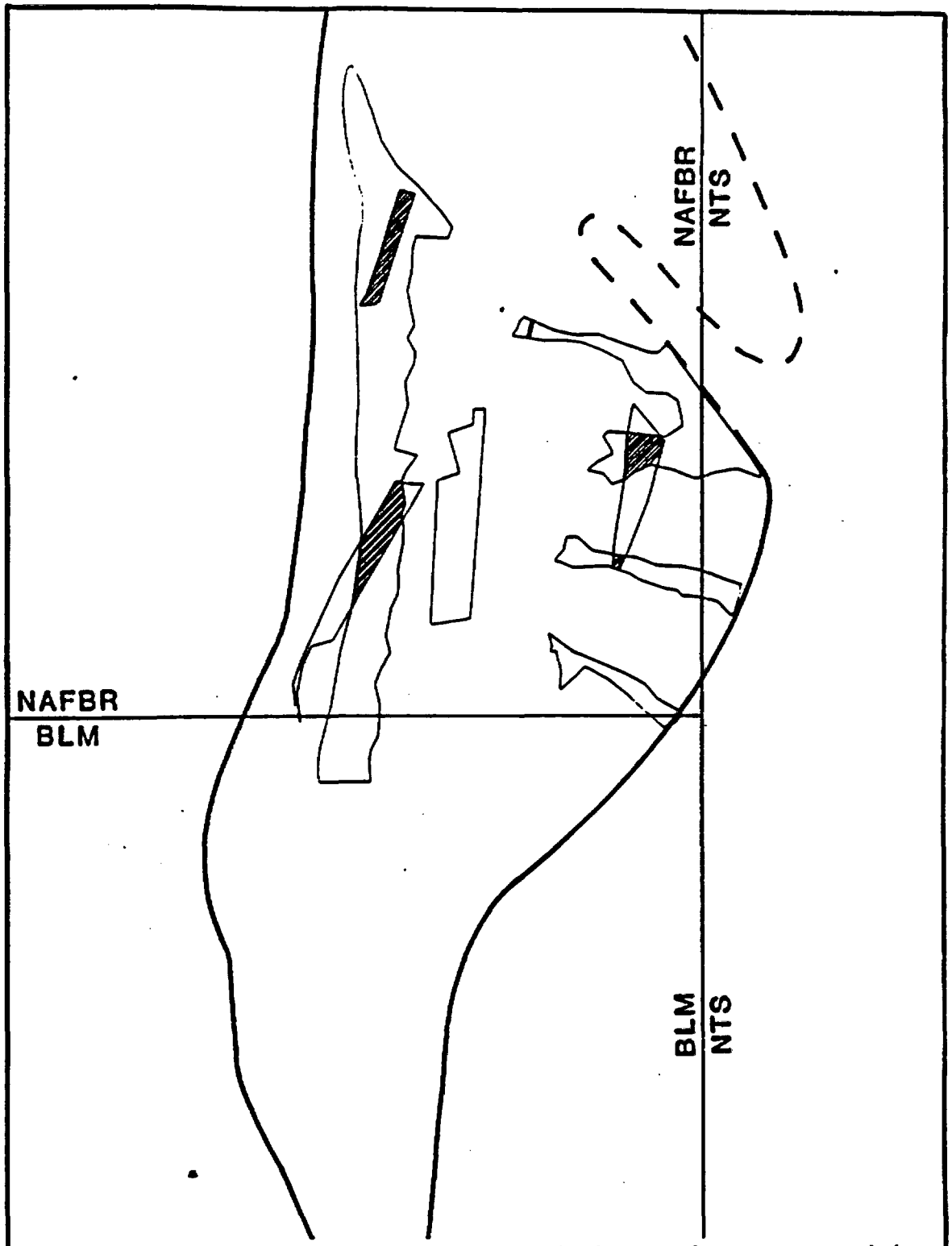


Figure 7. Overlay of Scientific and Topographic Preference Areas

CONSIDERATIONS THAT LED TO MOVING PROPOSED ES LOCATIONS WITHIN COYOTE WASH*

- CONCERNS ASSOCIATED WITH SHAFT LOCATION
  - NRC STAFF EXPRESSED CONCERN ABOUT LOCATION OF SHAFT IN ALLUVIAL FILL OF COYOTE WASH
  - NRC STAFF BELIEVE MORE PRUDENT APPROACH IS TO SET SHAFT COLLAR IN HARD ROCK OUTSIDE OF FLOW CHANNELS. ACTION WOULD MINIMIZE LIKELIHOOD OF CONCERN RELATIVE TO POTENTIAL FLOW OF WATER AROUND SHAFT DUE TO CHANNELING

* PROPOSED CHANGES TO THE NNWSI PROJECT EXPLORATORY SHAFT FACILITY: BACKGROUND PAPER FOR THE U.S. NUCLEAR REGULATORY COMMISSION (NRC) AND THE STATE OF NEVADA AGENCY FOR NUCLEAR PROJECTS, MARCH 1987

CONSIDERATIONS THAT LED TO MOVING PROPOSED ES LOCATIONS WITHIN COYOTE WASH
(CONTINUED)

- PROPOSED CHANGE (MARCH 1987)
  - MOVE LOCATION OF SHAFTS 440 FEET TO NORTHEAST OF LOCATION PROPOSED IN EA. THIS REMOVES SHAFTS (AND ASSOCIATED FACILITIES) FROM MIDDLE OF COYOTE WASH AND PLACES THEM ON A CUT-AND-FILL ROCK SHELF LOCATED ON THE SIDE OF THE HILL THAT BOUNDS THE WASH TO THE NORTHEAST

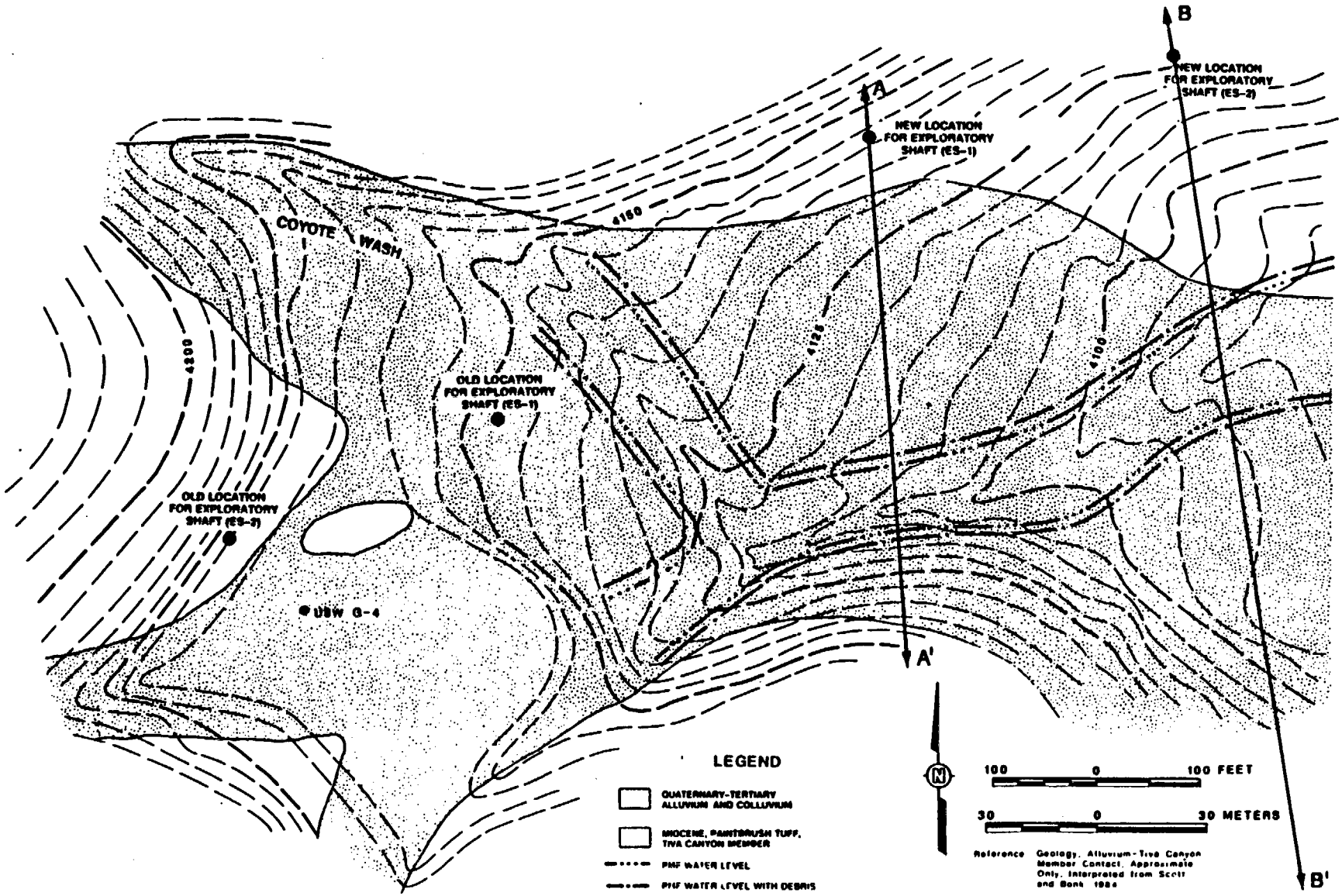
CURRENT EVALUATIONS FOCUSED PRIMARILY ON RESPONDING TO NRC CONCERNS IN APRIL 1987 MEETING SUMMARY AND IN POINT PAPER OBJECTION #4

INFILTRATION AROUND SHAFT

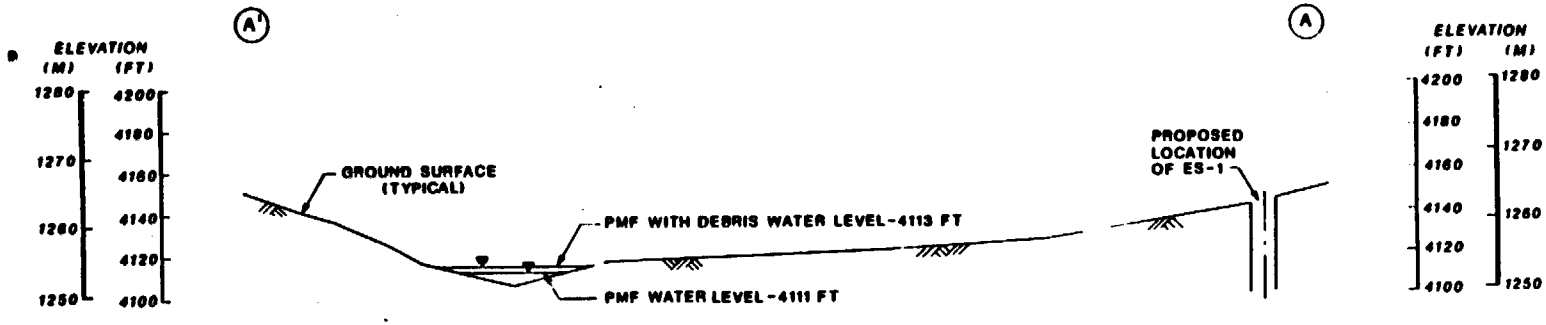
TOPICS:

- COYOTE WASH DRAINAGE AREA
- EXTENT OF ALLUVIUM BOUNDARY
- EFFECT OF CUT AND FILL, PADS AND ROAD CONSTRUCTION ON FLOODING POTENTIAL
- MARGIN OF SAFETY AGAINST FLOODING AND INFILTRATION AROUND SHAFTS
- POTENTIAL EFFECTS OF INFILTRATION ON EXPLORATORY TESTING AROUND ES-1

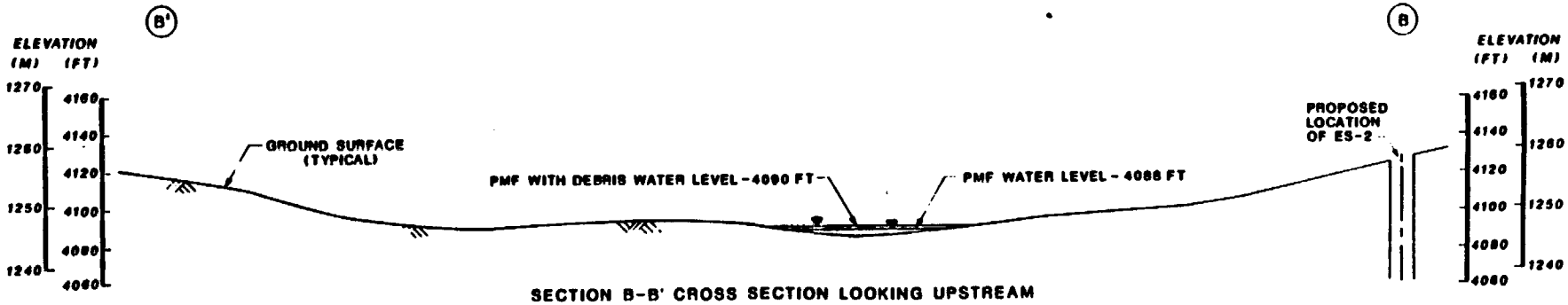
ESTIMATED HIGH-WATER LOCATIONS ASSOCIATED WITH A PMF IN THE EXPLORATORY SHAFT AREA



TOPOGRAPHIC CROSS SECTIONS IN VICINITY OF ES-1 AND ES-2 LOCATIONS

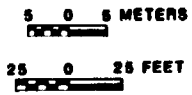


SECTION A-A' CHANNEL CROSS SECTION LOOKING UPSTREAM



SECTION B-B' CROSS SECTION LOOKING UPSTREAM

SCALES FOR CROSS SECTIONS A-A' AND B-B'



COMPARATIVE FLOOD PEAK DISCHARGES IN YUCCA MOUNTIAN AREA

WASH	DRAINAGE AREA (SQUARE MILES)	ESTIMATED PEAK FLOOD DISCHARGE (CUBIC FEET PER SECOND)
FORTYMILE	312	540,000(1)
BUSTED BUTTE	6.6	44,000(1)
DRILL HOLE	15.4	86,000(1)
YUCCA	16.6	92,000(1)
COYOTE	0.2	3,350(2)
COYOTE - DISCHARGE TO REACH ES-1 COLLAR	0.2	~156,000(3)
COYOTE - DISCHARGE TO REACH ES-2 COLLAR	0.2	~1,050,000(4)

(1)FROM SQUIRES AND YOUNG FOR THE REGIONAL MAXIMUM FLOOD.
(2)FROM BULLARD 1986 FOR THUNDERSTORM PMF.
(3)COMPUTED PEAK DISCHARGE TO REACH ES-1 COLLAR. (>45 TIMES PMF DISCHARGE)
(4)COMPUTED PEAK DISCHARGE TO REACH ES-2 COLLAR. (>300 TIMES PMF DISCHARGE)

ANALYSES OF POSTCLOSURE PERFORMANCE IMPACTS

- PRELIMINARY PERFORMANCE ANALYSES COMPLETED/IN PROCESS TO ESTABLISH PERSPECTIVE ON
  - FLOW MECHANISMS POTENTIALLY APPLICABLE AT YUCCA MOUNTAIN
  - IMPACT ON WASTE ISOLATION CAPABILITIES OF SITE
  - SENSITIVITY OF RESULTS TO VARIABILITY OF PROPERTIES CONTROLLING FLOW
  - PERFORMANCE ALLOCATION

SURFACE
ES-2

SURFACE WATER INFLOW ANALYSES

- ANALYSES INCLUDE
  - BOUNDING CASE - ASSUMING NO DIVERSION OF WATER BY SEALING COMPONENTS
  - CURRENT (3/87) SHAFT LOCATION - PROBABLE MAXIMUM FLOOD

SURFACE WATER INFLOW ANALYSES
BOUNDING CASE - PMF

- SCENARIO AND MODEL*
  - INTENSE RAINFALL IN COYOTE WASH - PROBABLE MAXIMUM FLOOD
  - ALL RAINFALL INFILTRATES GROUND SURFACE (2 CASES: UNIFORMLY AND IN DRAINAGE COURSES)
  - UNIFORM LATERAL DISPERSION OF FLOW UNDERGROUND
  - NO RETENTION OF FLOW IN FORMATION
  - FLOW INTO EXPLORATORY SHAFTS CALCULATED ON BASIS OF DISTANCE FROM SHAFTS AND CROSS SECTION OF SHAFTS AND MPZ POTENTIALLY INTERSECTED BY FLOW

*SAND85-0598, DRAFT

SURFACE WATER INFLOW ANALYSES
BOUNDING CASE - PMF
(CONTINUED)

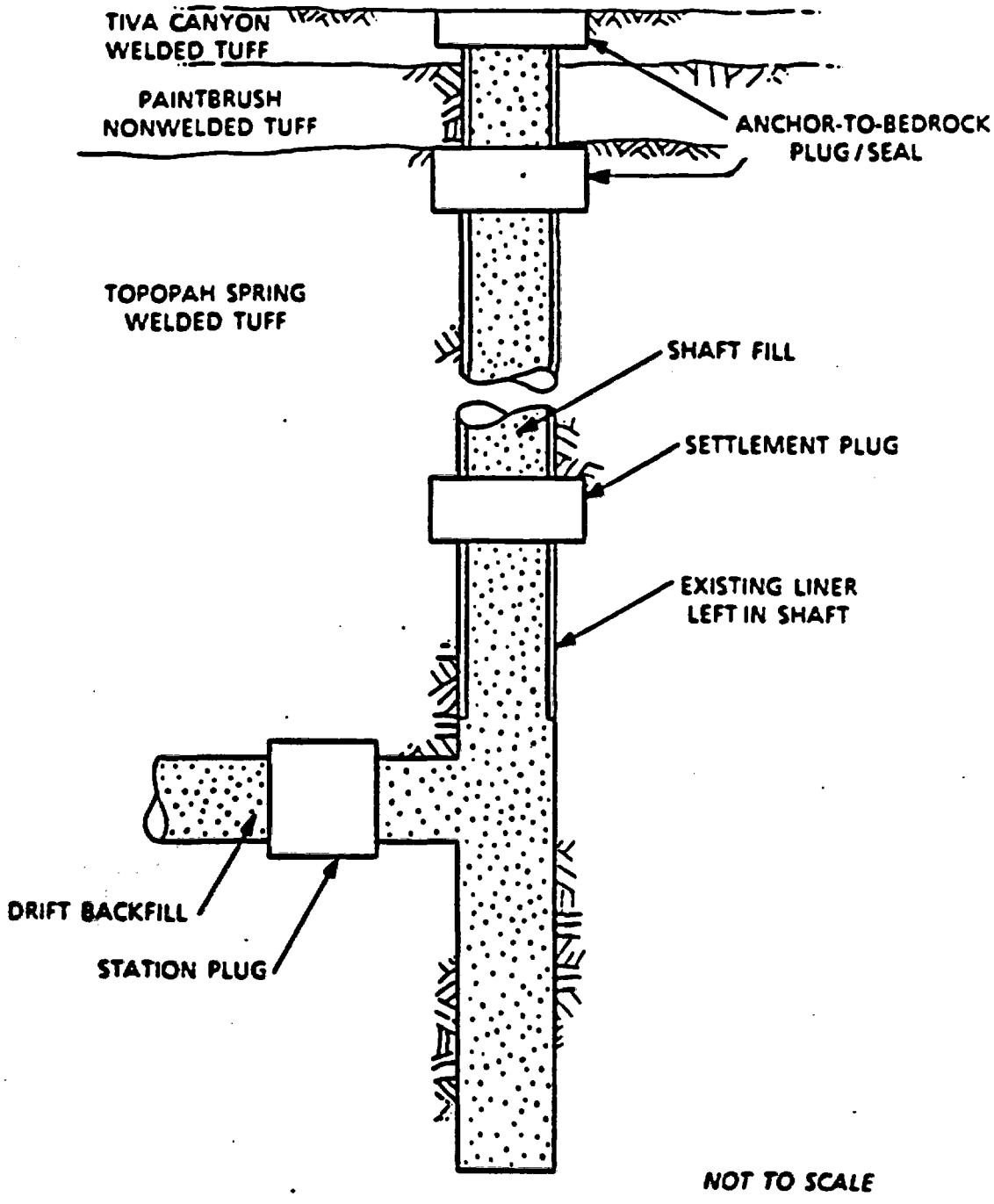
- RESULTS
  - TOTAL PREDICTED FLOW INTO EXPLORATORY SHAFTS
    - * UNIFORM FLOW THROUGHOUT DRAINAGE AREA - 1250 m^3
    - * FLOW FROM DRAINAGE COURSES - 1320 m^3
    - * WATER WOULD NOT REACH WASTE EMPLACEMENT AREA
  - ESTIMATE THAT MORE REALISTIC POTENTIAL INFLOW FOR PMF CONSIDERING RUNOFF AND RETENTION WITHIN FORMATION LIKELY TO BE 1-2 ORDERS OF MAGNITUDE LESS THAN FLOW PREDICTED ABOVE
    - * VOLUME COULD BE CONTAINED (EVEN WITHOUT DRAINAGE) WITHIN ESF

FUNCTIONAL REQUIREMENTS FOR SHAFT SEALS

- PRIMARY FUNCTIONS FOR SHAFT SEALS ARE
  - REDUCE THE POTENTIAL FOR SURFACE WATER OR GROUNDWATER TO ENTER THE WASTE EMPLACEMENT AREAS VIA THE SHAFTS, AND
  - DETER HUMAN ENTRY TO THE REPOSITORY VIA THE SHAFTS

REF: SAND84-1895 - TECHNICAL BASIS FOR PERFORMANCE GOALS, DESIGN REQUIREMENTS AND MATERIAL RECOMMENDATIONS FOR THE NNWSI SEALING PROGRAM.

SEALING CONCEPTS



SUMMARY OF SHAFT SEAL DESIGN REQUIREMENTS

DESIGN OPTION	DESIGN REQUIREMENTS
ANCHOR-TO-BEDROCK PLUG	CONSTRUCTION PLUG WITH EFFECTIVE HYDRAULIC CONDUCTIVITY OF 10^{-5} TO 10^{-4} CM/SEC
SHAFT BACKFILL	EMPLACE BACKFILL WITH SATURATED HYDRAULIC CONDUCTIVITY OF 10^{-2} CM/SEC
STATION AND SHAFT PLUGS	CONSTRUCT PLUG WITH EFFECTIVE HYDRAULIC CONDUCTIVITY OF 10^{-6} TO 10^{-5} CM/SEC

LONG TERM DRAINAGE PERFORMANCE (CLOGGING POTENTIAL)

TOPICS

- THERMAL EFFECTS
- CHEMICAL EFFECTS
- MECHANICAL EFFECTS

LONG TERM PERFORMANCE (CLOGGING POTENTIAL)

(CONTINUED)

THERMAL EFFECTS EVALUATED TO DATE

- PERSPECTIVE
  - MAXIMUM SHAFT TEMPERATURE EXPECTED IS ABOUT 70°C
  - RELATIVELY RAPID DECREASE IN TEMPERATURE RISE WITH INCREASING DISTANCE FROM WASTE
- RESULTS TO DATE
  - MAXIMUM TEMPERATURE OF WATER WITHIN CALICO HILLS UNIT ABOUT 53°C
  - MINERALOGICAL TRANSITION OF ZEOLITES STARTS AT ABOUT 95°C
  - MODIFICATION OF SORPIVITY OF CALICO HILLS UNIT IS, THEREFORE, NEGLIGIBLE

LONG TERM DRAINAGE PERFORMANCE (CLOGGING POTENTIAL)

(CONTINUED)

CHEMICAL EFFECTS EVALUATED TO DATE

- EFFECTS OF WATER INTERACTION WITH LINER
  - DEPOSITION OF SOLIDS LIKELY TO BE LOCALIZED PHENOMENA BECAUSE
    - * PRECIPITATION OCCURS RAPIDLY AFTER GROUND WATER CONTACTS LINER
    - * PRECIPITATION OCCURS AS PROGRESSIVELY ADVANCING FRONT
    - * FRONTAL ADVANCE LIMITED TO REGION NEAR LINER

LONG TERM DRAINAGE PERFORMANCE (CLOGGING POTENTIAL)

(CONTINUED)

MECHANICAL EFFECTS EVALUATED TO DATE

- NO SPECIFIC ANALYSES COMPLETED TO DATE
- SOME DATA AVAILABLE FROM G-TUNNEL MEASUREMENTS ON HYDRAULIC CONDUCTIVITY OF FRACTURES
  - HEATED BLOCK TEST
  - EXCAVATION INVESTIGATIONS
- LIMITED THERMAL STRESSES EXPECTED IN SHAFT FILL AND MPZ

POTENTIAL EFFECTS OF INFILITRATION ON EXPLORATORY TESTING AROUND ES-1

INFILTRATION IS UNLIKELY TO HAVE SIGNIFICANT IMPACT ON EXPLORATORY TESTING BECAUSE

- OCCURRENCE IS LOW PROBABILITY BECAUSE OF SHAFT COLLAR ELEVATION AND DRAINAGE PLAN DEVELOPMENT IN ESF DESIGN

- DIVERSION OF INFILTRATION FROM SHAFT INTO TEST LEVELS WOULD BE UNLIKELY

- WATER UNLIKELY TO REACH EXPERIMENTS IN MAIN TEST LEVEL BECAUSE SLOPE OF DRIFTS IN MAIN TEST LEVEL WOULD DIVERT WATER TOWARD ES-1

SUMMARY/STATUS OF EFFORTS SUPPORTING DOE RESPONSE TO OBJECTION #4

- FINAL COMMENTS BEING INCORPORATED IN ES PERFORMANCE ANALYSIS REPORT (SAND85-0598)
- SOME ADDITIONAL EVALUATIONS BEING CONDUCTED TO SUPPORT SCP SECTION 8.4 (POTENTIAL FLOW AT CURRENT LOCATIONS, POTENTIAL FOR CLOGGING, SHAFT DEPTH, ETC.)
- RELATED TEXT FOR SECTION 8.4 BEING DEVELOPED

CURRENT DOE CONCLUSIONS REGARDING EXPLORATORY SHAFT LOCATIONS

- BASED UPON THE SHAFT RELOCATION IN 1987, IN RESPONSE TO NRC CONCERNS, DATA FROM THE COYOTE WASH AREA, PERFORMANCE ANALYSES CONSIDERING SCENARIOS RELATED TO WATER INFLOW, AND SEAL DESIGN CONCEPTS, THE SHAFT LOCATIONS ARE CONSISTENT WITH MEETING THE POSTCLOSURE PERFORMANCE OBJECTIVES FOR THE DISPOSAL SYSTEM AND WILL NOT AFFECT THE ABILITY TO ADEQUATELY CHARACTERIZE THE SITE.

NRC STAFF CONCERNS REGARDING QUALITY LEVEL ASSIGNMENTS FOR THE ESF

Attachment 1/2

INITIAL CONCERN:

- ESF DESIGN, AS PRESENTED IN THE CDSCP, WAS CLASSIFIED AS QUALITY LEVEL III
- AS A RESULT OF THE JULY 8, 1988 MEETING, DOE AGREED THAT Q.L. III WAS INAPPROPRIATE

ADDITIONAL CONCERN REQUIRING RESOLUTION:

- WHAT QUALITY LEVEL (I OR II) IS APPROPRIATE FOR CERTAIN DESIGN AND CONSTRUCTION ACTIVITIES?

THE APPROPRIATENESS OF ESF QUALITY LEVEL ASSIGNMENTS HAS BEEN RAISED NUMEROUS TIMES BY THE NRC STAFF IN THE PAST

- APRIL 14, 1983 LETTER FROM NRC TO DOE
- APRIL 19, 1985 NRC/DOE MEETING
- AUGUST 27-28 1985 NRC/DOE MEETING
- NOVEMBER 25, 1985 LETTER FROM NRC TO DOE
- APRIL 14-15, 1987 NRC/DOE MEETING
- APRIL 12, 1988 LETTER FORM NRC TO DOE

A QUALITY LEVEL I DESIGNATION INDICATES THE FOLLOWING:

- ITEMS AND ACTIVITIES RELATED TO ESF DESIGN AND CONSTRUCTION ARE IMPORTANT TO SAFETY OR WASTE ISOLATION (NNWSI 88-9 REV.0)
- ITEMS AND ACTIVITIES WILL PROVIDE SITE CHARACTERIZATION DATA (NNWSI 88-9 REV.0)
- ACTIVITIES RELATED TO SHAFT CONSTRUCTION MAY ADVERSELY IMPACT THE WASTE ISOLATION CAPABILITIES OF THE SITE (NUREG 1318)

QA FOR ESF DESIGN (CONTD)

* EXAMPLES OF POSSIBLE Q-LIST ITEMS AND ACTIVITIES ARE

  - DRILLING AND BLASTING
  - SHAFT SEALS
  - ANALYSIS OF IMPACT OF SHAFT LOCATION

DOE NEEDS TO PROVIDE ADEQUATE JUSTIFICATION THAT Q.L. ASSIGNMENTS ARE APPROPRIATE

CRITERIA:

- WILL SHAFT DESIGN AND CONSTRUCTION ADVERSELY AFFECT THE WASTE ISOLATION CAPABILITIES OF THE SITE?
- ARE ITEMS AND ACTIVITIES IMPORTANT TO SAFETY OR WASTE ISOLATION?
- WILL THE ITEM OR ACTIVITY PROVIDE SITE CHARACTERIZATION DATA?

RESULTS:

- QUALITY ASSURANCE LEVEL ASSIGNMENT SHEETS (QALAS)
- Q-LIST AND QUALITY ACTIVITIES LIST FOR THE ESF
- OTHER JUSTIFICATION

WITH RESPECT TO ESF Q.L. ASSIGNMENTS

DOE COMMITTED, DURING THE JULY 8, 1988 MEETING, TO DISCUSS THE FOLLOWING AT TODAY'S MEETING:

- THEIR PROPOSED RESOLUTION
- THE SCHEDULE FOR RESOLUTION

WHEN JUSTIFICATION IS PROVIDED, THE NRC STAFF

WILL MAKE A DETERMINATION ON ITS ADEQUACY

THE APPROPRIATENESS OF QA LEVEL ASSIGNMENTS FOR THE DESIGN AND CONSTRUCTION OF THE ESF

PRESENTED BY
PETE KARNOSKI

Attachment 13

QUALITY ASSURANCE LEVEL APPROPRIATENESS OUTLINE

1. EXPLAIN BACKGROUND OF HOW QA LEVELS ARE ASSIGNED
2. CURRENT STATUS OF QA LEVEL ASSIGNMENTS
3. JUSTIFICATION FOR QA LEVEL ASSIGNMENTS WITH EXAMPLES
4. PLANS FOR INCORPORATING Q-LIST REQUIREMENTS

U.S. DEPARTMENT OF ENERGY

OCRWM

Nevada Nuclear Waste Storage Investigations PROJECT

OGR

Nevada Nuclear Waste Storage Investigations Project

NNWSI-SOP-02-02

Revision 1

Assignment of Quality Assurance Levels to NNWSI Activities and Items

Nevada Operations Office

UNITED STATES DEPARTMENT OF ENERGY

PAGE ____ OF ____
QALAS NO. _____
REV. NO. _____
WBS NO. _____

QA LEVEL ASSIGNMENT CHECKLIST
(SOP-02-02 REFERENCE PARAGRAPH)

STEP	CHARACTERISTIC	LEVEL
1	DOES THE ITEM OR ACTIVITY INVOLVE OR AFFECT PUBLIC RADIOLOGIC HEALTH AND SAFETY? YES →	I
2	DOES THE ITEM OR ACTIVITY INVOLVE WASTE ISOLATION? YES →	I
3	DOES THE ITEM OR ACTIVITY INVOLVE OR AFFECT RETRIEVABILITY? YES →	I
4	IS THE INTENDED PURPOSE OF THIS ACTIVITY TO PROVIDE DATA FOR A LICENSE APPLICATION? YES →	I
5	CAN THE FAILURE OF THE ITEM OR ACTIVITY CAUSE A FAILURE OF A QA LEVEL I ITEM, OR IRRETRIEVABLE LOSS OF QA LEVEL I DATA? YES →	I
6	DOES THE ACTIVITY INVOLVE A DESIGN PHASE WHICH IS TO BE CONDUCTED IMMEDIATLY PRIOR TO APPLICATION FOR A NRC LICENSE; PROCUREMENT OR CONSTRUCTION? YES →	I
7	CAN THE ITEM OR ACTIVITY HAVE A MAJOR IMPACT ON NON-RADIOLOGICAL OR OCCUPATIONAL HEALTH AND SAFETY? YES →	II
8	IF THE ITEM OR ACTIVITY WERE TO FAIL OR IS PERFORMED INADEQUATELY COULD REPOSITORY WORKERS BE EXPOSED TO RADIATION OR RADIOACTIVE CONTAMINATION LEVELS IN EXCESS OF THE LIMITS EXPRESSED IN 10 CFR 20? YES →	II
9	DOES THE ITEM OR ACTIVITY HAVE A MAJOR IMPACT ON THE NON-RADIOLOGICAL OPERATION, RELIABILITY OR MAINTAINABILITY OF ENGINEERED SYSTEMS, STRUCTURES OR COMPONETS? YES →	II
10	DOES THE ITEM OR ACTIVITY INVOLVE A DESIGN PHASE FOR WHICH THE PRINCIPLE PURPOSE IS TO CONDUCT A COMPARATIVE TECHNICAL ANALYSIS OF ALTERNATIVES? YES →	II
11	CAN THE ITEM OR ACTIVITY CAUSE MAJOR COST OVERRUN OR SCHEDULE SLIPPAGE? YES →	II
→	LEVEL III WHEN ALL THE ANSWERS TO ALL THE QUESTIONS ABOVE IS "NO".	

QUALITY LEVEL I ITEMS/ACTIVITIES

- IMPORTANT TO PUBLIC RADIOLOGICAL HEALTH AND SAFETY
- IMPORTANT TO WASTE ISOLATION
- IMPORTANT TO RETRIEVABILITY
- PROVIDE DATA FOR A LICENSE APPLICATION
- FAILURE COULD CAUSE FAILURE OF QA LEVEL I ITEM OR IRRETRIEVABLE LOSS OF DATA
- DESIGN PHASE IMMEDIATELY PRIOR TO LICENSE APPLICATION OR PROCUREMENT/CONSTRUCTION

QUALITY LEVEL II ITEMS/ACTIVITIES

- FAILURE COULD EXPOSE WORKERS TO RADIOLOGICAL HAZARDS IN EXCESS OF LIMITS GIVE IN 10 CFR 20
- MAJOR IMPACT ON OCCUPATIONAL HEALTH AND SAFETY
- MAJOR IMPACT ON OPERATION, RELIABILITY OR MAINTAINABILITY OF SYSTEMS, STRUCTURES AND COMPONENTS
- INVOLVES A DESIGN PHASE WHEREIN COMPARATIVE ANALYSES OF ALTERNATIVES ARE CONDUCTED
- MAJOR COST OR SCHEDULE IMPACT

QUALITY LEVEL III ITEMS/ACTIVITIES

THOSE ITEMS AND ACTIVITIES THAT DO NOT QUALIFY FOR AN ASSIGNMENT OF QUALITY LEVEL I OR II

QA REQUIREMENTS ACCORDING TO QA LEVEL

QUALITY LEVEL I

APPROPRIATE REQUIREMENTS OF NNWSI QA PLAN APPLY WITHOUT ALLOWANCE FOR DEVIATION

QUALITY LEVEL II

APPROPRIATE REQUIREMENTS OF NNWSI QA PLAN APPLY

- PROVISIONS FOR JUSTIFIABLE DEVIATIONS
- NNWSI QAP SECTION IV "PROCUREMENT DOCUMENT CONTROL" DIFFERS IN DETAILED REQUIREMENTS DEPENDING ON QA LEVEL

QUALITY LEVEL III

THOSE MANAGERIAL, ADMINISTRATIVE, SCIENTIFIC, ENGINEERING, COMMERCIAL AND LABORATORY PRACTICES THAT ARE COMMONLY USED BY THE NNWSI PROJECT PARTICIPANT

DESIGN PHASE QA LEVEL ASSIGNMENTS

QUALITY LEVEL ASSIGNMENTS ARE GIVEN TO DESIGN PHASES TO CONTROL THE OVERALL DESIGN EFFORT. DURING OR PRIOR TO DESIGN PHASES, INDIVIDUAL ITEMS AND ACTIVITIES ARE GIVEN QA LEVEL ASSIGNMENTS, WHICH INCLUDE DESIGN, PROCUREMENT AND CONSTRUCTION. THESE SPECIFIC QALAS MAY BE A HIGHER OR LOWER LEVEL THAN THE DESIGN PHASE, BUT BECAUSE THEY ARE BASED ON A TECHNICAL EVALUATION OF THE KNOWN DETAILS OF THEIR SUBJECTS, THEY TAKE PRECEDENCE OVER THE DESIGN PHASE QA LEVEL ASSIGNMENT.

ESF TITLE I-PRELIMINARY DESIGN PHASE

QUALITY LEVEL II

THE DESIGN PHASE THAT INVOLVES THE COMPARATIVE TECHNICAL ANALYSIS OF ALTERNATIVES/METHODS/EQUIPMENT TO DETERMINE WHICH ALTERNATIVE/METHOD/EQUIPMENT IS PREFERRED, SHALL BE ASSIGNED A QA LEVEL OF II PRIOR TO EXECUTION. WHERE A PARTICULAR ITEM CAN BE IDENTIFIED AND DEFINED DURING THIS PHASE, A SEPARATE QA LEVEL ASSIGNMENT MAY BE MADE FOR THAT ITEM. ONCE THE QA LEVEL FOR SUCH AN ITEM IS IDENTIFIED AND APPROVED, DESIGN PROCUREMENT AND CONSTRUCTION ACTIVITIES SHALL BE GOVERNED BY THE QA LEVEL ASSIGNED TO THE ITEM.

ESF TITLE II-DEFINITIVE DESIGN PHASE

QUALITY LEVEL I

THE DESIGN PHASE THAT INVOLVES THE PREPARATION OF DETAILED DESIGN DOCUMENTS (SUCH AS DRAWINGS, SPECIFICATIONS, AND ANALYSES) WILL BE ASSIGNED A QA LEVEL OF I. ONE OF THE PURPOSES OF THIS DESIGN PHASE IS TO DEFINE ITEMS THAT WILL BE PROCURED AND/OR CONSTRUCTED AS A RESULT OF THE DESIGN ACTIVITY. THE DEFINITION OF ITEMS INCLUDES A DETAILED DESCRIPTION OF THEIR FUNCTION AND INTER-RELATIONSHIPS. AS THE DESIGN PHASE PROCEEDS, AND THE QA LEVEL FOR ITEMS IS IDENTIFIED AND APPROVED, DESIGN, PROCUREMENT, AND CONSTRUCTION ACTIVITIES SHALL BE GOVERNED BY THE QA LEVEL ASSIGNED TO THE ITEM.

EXHIBIT 1

QUALITY LEVEL ASSIGNMENT SHEET (QALAS)

NNWSI QUALITY ASSURANCE LEVEL ASSIGNMENT

Items/Activities	QA Level	QA Criteria	Technical Justification
Title I Design	II	1,2,3	As directed by DOE/NNPO per NNWSI-SDP-02-02, Rev. 1
Phase for the		5,6,15	Interim Change Notice, dated 5/9/86, Paragraph 5.2.2d
Exploratory		16, 17	
Shaft Facility		18	
(WBS 1.2.6.1			
thru 1.2.6.7)			
			This QALAS is valid only until the detailed QALAS
			are submitted.

APPROVALS Signature and Date

PM: DOE for T.J. McGee

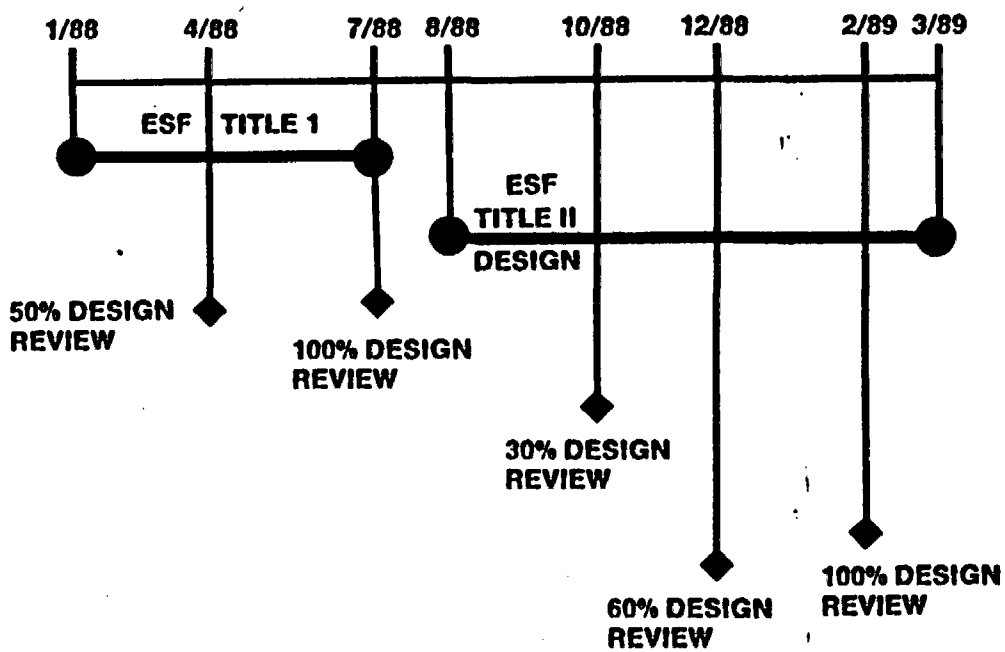
PROJECTIVE POM: [illegible] G. Paul G. Shelin

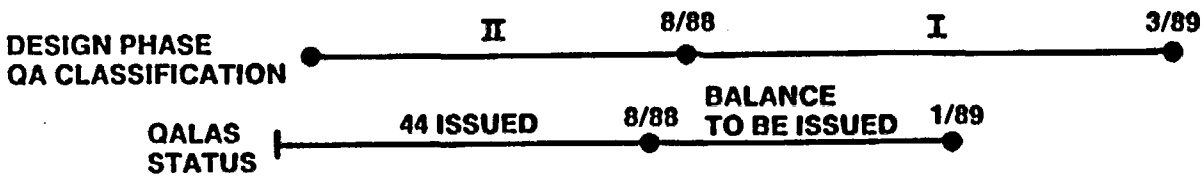
NNPO POM: [illegible] 8/25/86

TPO: [illegible] 8-27-86

NNPO MGR: [illegible] 8-28-86

SCHEDULE


1/88
4/88
7/88
8/88
10/88
12/88
2/89
3/89
ESF TITLE 1
ESF
TITLE II
DESIGN
50% DESIGN REVIEW
100% DESIGN REVIEW
30% DESIGN REVIEW
60% DESIGN REVIEW
100% DESIGN REVIEW


DESIGN PHASE
QA CLASSIFICATION
II
8/88
I
3/89
QALAS
STATUS
44 ISSUED
8/88
BALANCE
TO BE ISSUED
1/89

EXPLORATORY SHAFT FACILITY
QUALITY ASSURANCE ASSIGNMENTS ISSUED

LEVEL I

QALA NUMBER	TITLE
1.2.6-0001	FLUID CONTROL
6.2.2-0011	UNINTERRUPTED POWER SUPPLY SYSTEMS INCLUDING INSTALLATION AND TESTING
6.3.1-0007	HALON FIRE PROTECTION SYSTEM FOR IDS SURFACE STRUCTURE

EXPLORATORY SHAFT FACILITY
QUALITY ASSURANCE ASSIGNMENTS ISSUED

LEVEL II

QALA NUMBER	TITLE
1.2.6-0006	ROCKBOLTS AND WIRE MESH
1.2.6-0007	CONCRETE, GROUT (IF REQUIRED) ANCHOR BOLTS, EMBEDDED PLATES IN SHAFT LINER, HITCHES AND BROW
1.2.6-0011	ES-1 & ES-2 SHAFT INTERNALS, BUNTONS, GUIDES, SHIMS, MUCK BULKHEAD AND BRACKETS
1.2.6-0012	ES-1 & ES-2 CAGE AND MUCK SKIP
6.2.2-0009	SWITCHGEAR AND POWER DISTRIBUTION SYSTEM FOR STANDBY EQUIPMENT INCLUDING CONDUITS, CABLES, PANELS, BREAKERS, AND SWITCHES
6.2.2-0010	STANDBY GENERATORS, INCLUDING TRANSFER SWITCHES CONDUIT, CABLE, FUEL TANKS AND PIPING
6.4.1-0004	ES-1 COLLAR, SAFETY DOORS AND BARRIERS

EXPLORATORY SHAFT FACILITY QUALITY ASSURANCE ASSIGNMENTS ISSUED

LEVEL II
(CONTINUED)

QALA NUMBER	TITLE
6.4.1-0005	ES-1 SHAFT, LINER, COLLAR, AND OPENINGS FOR SHAFT STATIONS
6.4.2-0001	ES-1 HOIST, ELECTRICAL, MECHANICAL, STRUCTURAL, INCLUDING MOTOR, DRUM, OPERATOR CAB AND WIRE ROPE
6.4.2-0002	ES-1 HEADFRAME, INCLUDING STEEL STRUCTURE, SHEAVES SCROLL, LADDER, STAIRS, AND BARRIERS
6.4.2-0003	ES-1 MUCK CHUTE, AIR CYLINDERS AND ACCESSORIES
6.4.2-0004	ES-2 SHAFT LINER COLLAR AND OPENING FOR SHAFT STATION
6.5.2-0002	ES-2 HOIST, ELECTRICAL, MECHANICAL, STRUCTURAL, INCLUDING MOTOR, DRUM, OPERATOR CAB AND WIRE ROPE
6.5.2-0003	ES-2 HEADFRAME, INCLUDING STEEL STRUCTURE, SHEAVES, SCROLL, LADDER, STAIRS AND BARRIERS

EXPLORATORY SHAFT FACILITY
QUALITY ASSURANCE ASSIGNMENTS ISSUED

LEVEL II
(CONTINUED)

QALA NUMBER	TITLE
6.5.2-0004	ES-2 MUCK CHUTE, AIR CYLINDERS AND ACCESSORIES
6.7.1-0002	SUBSURFACE POWER DISTRIBUTION SYSTEM, INCLUDES PRIMARY AND STANDBY POWER SYSTEM
6.7.1-0011	SUBSURFACE EMERGENCY LIGHTING SYSTEM
6.7.1-0012	SUBSURFACE VENTILATION SYSTEM
6.7.1-0015	SUBSURFACE MINE WASTE WATER COLLECTION SYSTEM

EXPLORATORY SHAFT FACILITY QUALITY ASSURANCE ASSIGNMENTS NOT ISSUED

LEVEL I

QALA NUMBER	TITLE
1.2.6-0004	EXPLOSIVES PROCUREMENT
1.2.6-0008	ZONE BOXES ES-1, ES-2
1.2.6-0009	TERMINATIONS
6.7.1-0003	WATER METERING AND TRACER SYSTEM
6.7.1.0009	HALON FIRE PROTECTION SYSTEM
6.7.1-0014	SUBSURFACE FIRE PROTECTION SYSTEM

EXPLORATORY SHAFT FACILITY QUALITY ASSURANCE ASSIGNMENTS NOT ISSUED

LEVEL II

QALA NUMBER	TITLE
1.2.6-0005	ES-1 & ES-2 CONTROLLED BLASTING
1.2.6.0010	HIGH PRESSURE AIR FOR ODEX DRILLING
1.2.6-0013	DESIGN ACTIVITY FOR THE EXPLORAOTRY SHAFT FACILITY
6.2.2-0007	WATER TANK AND FIRE PROTECTION LOOP AND PIPING
6.2.2-0008	CIRCUIT BREAKER, ISOLATION SWITCH AND TRANSFORMER (69KV-4.16KV)
6.3.1-0004	FIRE PROTECTION SYSTEM-SHOP, WAREHOUSE & TRAILERS ES-1 & ES-2 HOIST HOUSES
6.3.1-0005	HOIST FOUNDATIONS
6.3.1-0008	EXPLOSIVES MAGAZINES
6.4.1-0002	ES-1 COLLAR MUCK WALL

EXPLORATORY SHAFT FACILITY QUALITY ASSURANCE ASSIGNMENTS NOT ISSUED

LEVEL II
(CONTINUED)

QALA NUMBER	TITLE
6.4.2-0004	ES-1 SHAFT BELL SYSTEM
6.5.1-0001	ES-2 COLLAR MUCK WALL
6.5.1-0002	ES-2 COLLAR SAFETY DOORS AND BARRIERS
6.5.2-0005	ES-2 SHAFT BELL SYSTEM
6.6.2-0001	SHOTCRETE, CONCRETE, GROUT, ANCHOR BOLTS AND EMBEDDED PLATES
6.7.1-0010	LIFE SAFETY ALARM SYSTEM
6.7.1-0016	SUBSURFACE COMPRESSED AIR DISTRIBUTION SYSTEM
6.7.2-0002	MINE PLANT AIR COMPRESSORS

EXPLORATORY SHAFT FACILITY QUALITY ASSURANCE ASSIGNMENTS NOT ISSUED

LEVEL II
(CONTINUED)

QALA NUMBER	TITLE
6.7.2-0003	MINE PLANT VENT FANS AND DUCTWORK
6.7.2-0004	MINE PLANT WASTE WATER PUMPS
6.7.3-0001	ES-1 MANWAY (LADDER, DECK AND BARRIER), PIPE BRACKETS, VENT DUCT BRACKETS, AND CONDUITS
6.7.3-0002	STATION GATES, SAFETY PANELS AND MANWAY LADDERS
6.7.3-0003	STRUCTURAL STEEL FOR ES-1 SHAFT STATIONS
6.7.4-0001	ES-2 MANWAY PIPE BRACKETS VENT DUCT BRACKETS AND CONDUIT BRACKETS
6.7.4-0002	MUCK AND MONITOR BINS GRIZZLY, GATES AND SAFETY PANELS AT ES-2 LOADING POCKET
6.7.4-0004	STRUCTURAL STEEL FOR SHAFT STATION AT MAIN TEST LEVEL

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NNWSI QUALITY LEVEL ASSIGNMENT SHEET

EXPLORATORY SHAFT FACILITY

ES-1 SHAFT AND LINER

ITEM/ACTIVITY	QA LEVEL	TECHNICAL JUSTIFICATION
ES-1 Shaft, Liner, Collar, and Openings for Shaft Stations	II	The ES-1 shaft and liner will provide safe access to the underground portions of the ESF and be a means for emergency egress from the facility.

ASSOCIATED ACTIVITIES

Associated activities, such as design, procurement, and maintenance of items listed above shall be governed by the quality level assigned to those items.

APPLICABLE QA CRITERIA (NVO 196-17)

All 18 criteria apply except No. 12.

QA CRITERIA NOT SELECTED AND JUSTIFICATION

12. No special measuring or test equipment is involved in the construction of these items.

DEVIATIONS FROM SELECTED QA CRITERIA

8. Items will be identified through installation only. Acceptance of installations by inspection will confirm that the proper items were installed.
9. Items will deviate from Criteria 9 for processes such as installation, but will apply for special processes such as welding. Post installation inspection will confirm prope installation of items.

EXCEPTIONS

None

APPROVALS (Signature and Date)

WMPO TECH [signature] 3/18/88

WMPO PQM James Blayloch 3/21/88

WMPO BRANCH CHIEF [signature] 3/18/88

QALAS NO. 6.4.1-0005
ES-1 SHAFT, LINER, COLLAR AND OPENINGS FOR SHAFT STATIONS
QA LEVEL 2

- TECHNICAL EVALUATION USED IN DECISION PROCESS:
  - ES-1 SHAFT LINER NOT ON Q-LIST (SCP-CDR, APP. L-1)
  - ES-1 SHAFT LINER NOT RELIED ON FOR WASTE ISOLATION (SCP-CDR, CH. 7)(SANDIA LETTER, JULY 2, 1985)
  - ES-1 SHAFT LINER NOT IMPORTANT TO RETRIEVABILTY (SCP-CDR, APP. L-2)
  - ES-1 SHAFT LINER NOT AN ACTIVITY
  - ES-1 SHAFT LINER FAILURE WOULD NOT CAUSE IRRETRIEVABLE LOSS OF QA LEVEL I DATA
  - ES-1 SHAFT LINER NOT AN ACTIVITY

QA LEVEL ASSIGNMENT CHECKLIST

STEP	CHARACTERISTIC	LEVEL
1.	Does the item or activity involve or affect public radiologic health and safety? (Para. 5.2.1a) Yes →	I No
2.	Does the item or activity involve waste isolation? (Para. 5.2.1b) Yes →	I No
3.	Does the item or activity involve or affect retrievability? (Para. 5.2.1c) Yes →	I No
4.	Is the intended purpose of this activity to provide data for a license application? (Para. 5.2.1d) Yes →	I No
5.	Can the failure of the item or activity cause a failure of a QA level I item, or irretrievable loss of QA level I data? (Para. 5.2.1e) Yes →	I No
6.	Does the activity involve a design phase which is to be conducted immediately prior to application for a NRC license, procurement or construction? (Para. 5.2.1f) Yes →	I No
7.	Can the item or activity have a major impact on non-radiological or occupational health and safety? (Para. 5.2.2a) Yes →	II Yes
8.	If the item or activity were to fail or is performed inadequately could repository workers be exposed to radiation or radioactive contamination levels in excess of the limits expressed in 10CFR20? (Para. 5.2.2b) Yes →	II No
9.	Does the item or activity have a major impact on the non-radiological operation, reliability or maintainability of engineered systems, structures, or components? (Para. 5.2.2c) Yes →	II Yes
10.	Does the item or activity involve a design phase for which the principle purpose is to conduct a comparative technical analysis of alternatives? (Para. 5.2.2d) Yes →	II No
11.	Can the item or activity cause major cost overrun or schedule slippage? (Para. 5.2.2e & f) Yes →	II Yes

→ LEVEL III WHEN ALL THE ANSWERS TO ALL QUESTIONS ABOVE IS "NO".

DOCUMENT REVIEW SHEET

I.
ORIGINATING ORGANIZATION OF DOCUMENT: WMPO
DOCUMENT NO. 6.4.1-0005 REVISION 0 DATE: 6/25/87
DOCUMENT TITLE: ES-1 Shaft, Liner, Collar, and Openings for Shaft Stations
DATE RECEIVED: 6/25/87 COMMENTS REQUIRED DATE: 7/2/87
REVIEWED BY: J. Jardine J. Blaylock L. Skousen D. Irby
COMMENT SHEET FORWARDED TO: Rita Brogan ON _____ (DATE)
COMMENTS RESOLVED BY: _____ ON _____ (DATE)

II. REVIEWER'S COMMENTS			III. RESOLUTION			IV. REVIEWER'S DISPOSITION	
ITEM NO.	PAGE NO.	COMMENTS	ACCEPT	REJECT	REASON	ACCEPT	RE.
1	1	Deviate from Criteria 8 & 9 (see comment on QA-LA # 6.2.2-0009)	RJK 7/11/88		Deviations written for Criteria 8 & 9	G.A.J. 3/2/88	
2	1	I don't believe Criteria 12 applys. J. Jardine 7/8/87	RJK 7/11/88		Criteria 12 ex-cepted & justified.	G.A.J. 3/2/88	

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NNWSI QUALITY LEVEL ASSIGNMENT SHEET

EXPLORATORY SHAFT FACILITY

MINING AND ROCK EXCAVATION

ITEM/ACTIVITY	QA LEVEL	TECHNICAL JUSTIFICATION
ES-1 and ES-2 Controlled Blasting Including Drilling, Explosive Handling and Loading (See "Exceptions")	II	Minimize damage to the walls of ES-1 and ES-2 to maintain integrity of the rock mass.

ASSOCIATED ACTIVITIES

Associated activities, such as design, procurement, and maintenance of items listed above shall be governed by the quality level assigned to those items.

APPLICABLE QA CRITERIA (NVO 196-17)

All except 11

QA CRITERIA NOT SELECTED AND JUSTIFICATION

11. No tests of blasting will occur at ES-1 and ES-2. The effects of blasting will be tested in G-Tunnel.

DEVIATIONS FROM SELECTED QA CRITERIA

3. Scientific investigation control does not apply.
4. Section 2.0 does not apply because this is QAL II.

EXCEPTIONS

Explosives Procurement - QALAS No. 1.2.6-0004

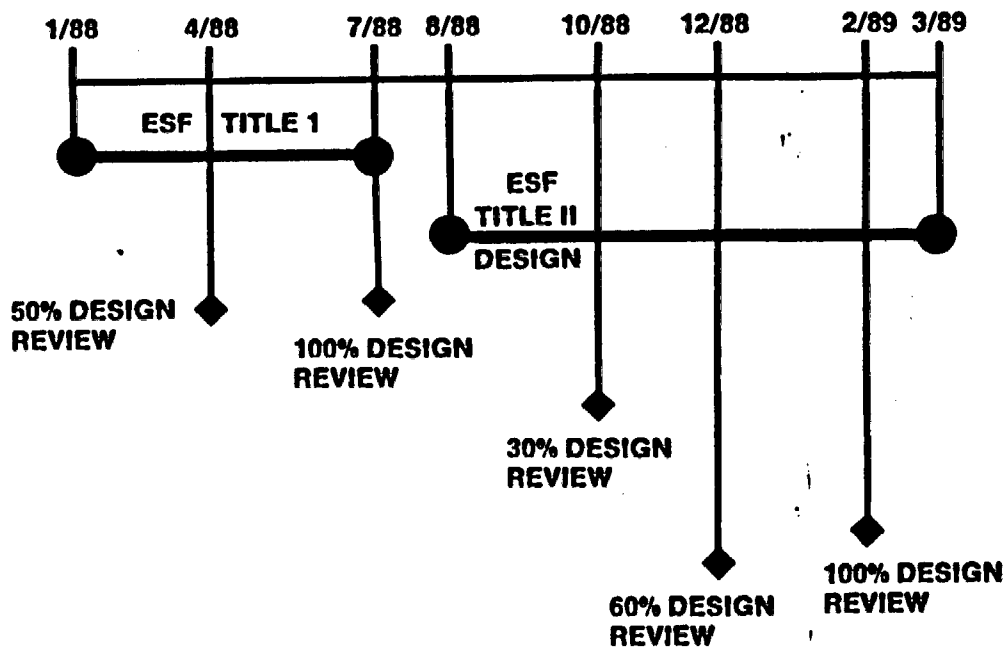
APPROVALS (Signature and Date)

WMPO TECH _____

WMPO PQM _____

WMPO BRANCH CHIEF _____

SCHEDULE


1/88
4/88
7/88
8/88
10/88
12/88
2/89
3/89
ESF TITLE 1
ESF TITLE II DESIGN
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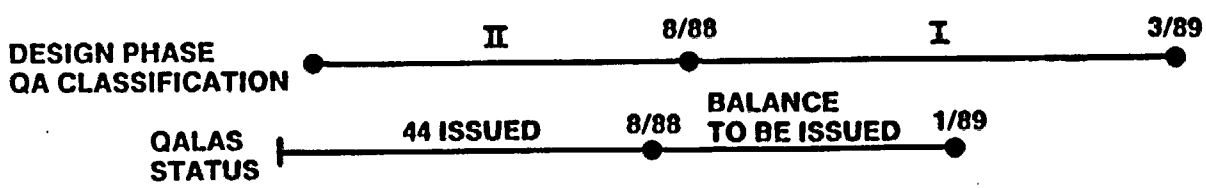
60% DESIGN REVIEW
100% DESIGN REVIEW


DESIGN PHASE QA CLASSIFICATION
II
8/88
I
3/89
QALAS STATUS
44 ISSUED
8/88
BALANCE TO BE ISSUED
1/89

QA LEVEL ASSIGNMENT CHECKLIST

STEP	CHARACTERISTIC	LEVEL	
1.	Does the item or activity involve or affect public radiologic health and safety? (Para. 5.2.1a) Yes →	I	N
2.	Does the item or activity involve waste isolation? (Para. 5.2.1b) Yes →	I	N
3.	Does the item or activity involve or affect retrievability? (Para. 5.2.1c) Yes →	I	N
4.	Is the intended purpose of this activity to provide data for a license application? (Para. 5.2.1d) Yes →	I	N
5.	Can the failure of the item or activity cause a failure of a QA level I item, or irretrievable loss of QA level I data? (Para. 5.2.1e) Yes →	I	N
6.	Does the activity involve a design phase which is to be conducted immediately prior to application for a NRC license, procurement or construction? (Para. 5.2.1f) Yes →	I	N
7.	Can the item or activity have a major impact on non-radiological or occupational health and safety? (Para. 5.2.2a) Yes →	II	Ye
8.	If the item or activity were to fail or is performed inadequately could repository workers be exposed to radiation or radioactive contamination levels in excess of the limits expressed in 10CFR20? (Para. 5.2.2b) Yes →	II	N
9.	Does the item or activity have a major impact on the non-radiological operation, reliability or maintainability of engineered systems, structures, or components? (Para. 5.2.2c) Yes →	II	Ye
10.	Does the item or activity involve a design phase for which the principle purpose is to conduct a comparative technical analysis of alternatives? (Para. 5.2.2d) Yes →	II	N
11.	Can the item or activity cause major cost overrun or schedule slippage? (Para. 5.2.2e & f) Yes →	II	Ye

→ LEVEL III WHEN ALL THE ANSWER TO ALL QUESTIONS ABOVE IS "NO".

DOCUMENT REVIEW SHEET

I.
ORIGINATING ORGANIZATION OF DOCUMENT: WMPO
DOCUMENT NO. 1.2.6-0005 REVISION 0 DATE: 7/24/87
DOCUMENT TITLE: Mining and Rock Excavation
DATE RECEIVED: 7/24/87 COMMENTS REQUIRED DATE: 8/7/87
REVIEWED BY: J. Jardine J. Blaylock L. Skousen D. Irby
COMMENT SHEET FORWARDED TO: Nita Brogan ON _____ (DATE)
COMMENTS RESOLVED BY: _____ ON _____ (DATE)

II. REVIEWER'S COMMENTS			III. RESOLUTION			IV. REVIEWER'S DISPOSITION	
ITEM NO.	PAGE NO.	COMMENTS	ACCEPT	REJECT	REASON	ACCEPT	REJECT
1	1	Delete "ASSOCIATED ACTIVITIES" section The subject of the QALA is an activity. The sentence doesn't fit.					
2	1	I am confused with respect to the word "Controlled" as it is used in the title of the activity. All blasting is controlled to some extent in order to achieve the desired results. Why is this blasting different? and How is it different. I suggest the word "Controlled" be deleted					
3	1	The technical justification doesn't match the reasoning on the reverse side of the sheet. The justification given implies concern for the integrity of the ...					

DOCUMENT REVIEW SHEET

I.
ORIGINATING ORGANIZATION OF DOCUMENT: WMPO
DOCUMENT NO. 1.2.6-0005 REVISION 0 DATE: 7/24/87
DOCUMENT TITLE: Mining and Rock Excavation
DATE RECEIVED: 7/24/87 COMMENTS REQUIRED DATE: 8/7/87
REVIEWED BY: J. Jardine J. Blaylock L. Skousen D. Irby
COMMENT SHEET FORWARDED TO: Nita Brogan ON _____ (DATE)
COMMENTS RESOLVED BY: _____ ON _____ (DATE)

II. REVIEWER'S COMMENTS			III. RESOLUTION			IV. REVIEWER'S DISPOSITION	
ITEM NO.	PAGE NO.	COMMENTS	ACCEPT	REJECT	REASON	ACCEPT	REJECT
		no comment. RLW 7/28/87			87-2127 ACTION Blaylock ~~ACTION~~ CC: Skousen ~~ACTION~~ CC: Irby ✓ CC: CC: CC: CC: REC'D IN WMPO 7/27/87		

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NNWSI QUALITY LEVEL ASSIGNMENT SHEET

EXPLORATORY SHAFT FACILITY

FLUID CONTROL

ITEM/ACTIVITY	QA LEVEL	TECHNICAL JUSTIFICATION
Fluid Control - Water Piped to the Site and Metered, used for Construction Operations like Dust Abatement and Fire Protection and for Testing, Human Consumption, and Sewage	I	Fluids used over the repository block must be controlled to minimize the effect on hydrologic site characterization tests.

APPLICABLE QA CRITERIA (NVO 196-17)

Sections 1, 2, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16, 17, and 18

QA CRITERIA NOT SELECTED AND JUSTIFICATION

Section 3 - "Scientific Investigation and Design Control" is not applicable because Fluid Control is neither a scientific activity or an item.

Section 14 - Inspection, test, and operating status is not applicable because Fluid Control is neither a scientific activity or an item.

DEVIATIONS FROM SELECTED QA CRITERIA

None

APPROVALS (Signature and Date)

WMPO TECH [signature] 7/1/87

WMPO POM [signature] 6/29/87

WMPO BRANCH CHIEF [signature] 5/4/87

QA LEVEL ASSIGNMENT CHECKLIST

STEP	CHARACTERISTIC	LEVEL
1.	Does the item or activity involve or affect public radiologic health and safety? (Para. 5.2.1a) Yes →	I
2.	Does the item or activity involve waste isolation? (Para. 5.2.1b) Yes →	I
3.	Does the item or activity involve or affect retrievability? (Para. 5.2.1c) Yes →	I
4.	Is the intended purpose of this activity to provide data for a license application? (Para. 5.2.1d) Yes →	I
5.	Can the failure of the item or activity cause a failure of a QA level I item, or irretrievable loss of QA level I data? (Para. 5.2.1e) Yes →	I
6.	Does the activity involve a design phase which is to be conducted immediately prior to application for a NRC license, procurement or construction? (Para. 5.2.1f) Yes →	I
7.	Can the item or activity have a major impact on non-radiological or occupational health and safety? (Para. 5.2.2a) Yes →	II
8.	If the item or activity were to fail or is performed inadequately could repository workers be exposed to radiation or radioactive contamination levels in excess of the limits expressed in 10CFR20? (Para. 5.2.2b) Yes →	II
9.	Does the item or activity have a major impact on the non-radiological operation, reliability or maintainability of engineered systems, structures, or components? (Para. 5.2.2c) Yes →	II
10.	Does the item or activity involve a design phase for which the principle purpose is to conduct a comparative technical analysis of alternatives? (Para. 5.2.2d) Yes →	II
11.	Can the item or activity cause major cost overrun or schedule slippage? (Para. 5.2.2e & f) Yes →	II

→ LEVEL III WHEN ALL THE ANSWER TO ALL QUESTIONS ABOVE IS "NO".

QALAS NO. 1.2.6-0001
FLUID CONTROL
QA LEVEL I (STEP 5)

- TECHNICAL EVALUATION USED IN DECISION PROCESS:
  - PROTECTION OF SITE CHARACTERIZATION DATA FOR HYDROLOGICAL TESTS AND CL^{36} TEST (STEP 5)
  - TEST CONSTRAINTS ON WATER USAGE GIVEN IN SDRD APPENDIX B, TEST DESCRIPTIONS

DOCUMENT REVIEW SHEET

ACTION Blaylock

I.

ORIGINATING ORGANIZATION OF DOCUMENT: WMPO

DOCUMENT NO. 1.2.6-0001 REVISION 0 DATE: 4/29/87

DOCUMENT TITLE: ESF - Fluid Control (OALAS)

DATE RECEIVED: 4/29/87 COMMENTS REQUIRED DATE: 5/13/87

REVIEWED BY: J. Jardine J. Blaylock D. Irby L. Skousen

COMMENT SHEET FORWARDED TO: Nita Brogan ON 5/4/87 (DATE)

COMMENTS RESOLVED BY: ON (DATE)

BEC'D IN WMPO

II. REVIEWER'S COMMENTS			III. RESOLUTION			IV. REVIEWER'S DISPOSITION	
ITEM NO.	PAGE NO.	COMMENTS	ACCEPT	REJECT	REASON	ACCEPT	REJECT
		No Comments L L Skousen 5/4/87					

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MAY 0 4 1987
CCF RECEIVED

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NNWSI QUALITY LEVEL ASSIGNMENT SHEET

EXPLORATORY SHAFT FACILITY

ROCK EXCAVATION FROM ES-1, ES-2, AND DRIFTS

ITEM/ACTIVITY	QA LEVEL	TECHNICAL JUSTIFICATION
Rockbolts and Wire Mesh	II	These items will serve as initial ground support in the shafts until liners are constructed, and in the drifts as ground support.

ASSOCIATED ACTIVITIES

Associated activities, such as design, procurement, construction and maintenance of the items listed above shall be governed by the quality level assigned to those items.

APPLICABLE QA CRITERIA (NVO-196-17)

All except 11, 12, and 14

QA CRITERIA NOT SELECTED AND JUSTIFICATION

11. Necessary tests shall be satisfied by manufacturers certification.
12. No measuring or test devices are required because these items do not constitute an operating system.
14. These items do not act as a system but as individual elements.

DEVIATIONS FROM SELECTED QA CRITERIA

3. Scientific investigation will not apply. The ground support design will be based upon engineering design control.
4. Only Section 1.0 applied because the subjects are Level II.
8. Parts C and B do not apply because the manufacturer will provide certified test results.
9. Process control of installation and operation does not apply. Inspection will confirm proper installation of these QA Level II items.

EXCEPTIONS

None

APPROVALS (Signature and Date)

WMPO BRANCH CHIEF [signature] 2/3/88

WMPO TECH [signature] 2/3/88

WMPO PQM James Blaylock 2/2/88

QA LEVEL ASSIGNMENT CHECKLIST

STEP	CHARACTERISTIC	LEVEL	
1.	Does the item or activity involve or affect public radiologic health and safety? (Para. 5.2.1a) Yes →	I	N
2.	Does the item or activity involve waste isolation? (Para. 5.2.1b) Yes →	I	N
3.	Does the item or activity involve or affect retrievability? (Para. 5.2.1c) Yes →	I	N
4.	Is the intended purpose of this activity to provide data for a license application? (Para. 5.2.1d) Yes →	I	N
5.	Can the failure of the item or activity cause a failure of a QA level I item, or irretrievable loss of QA level I data? (Para. 5.2.1e) Yes →	I	N
6.	Does the activity involve a design phase which is to be conducted immediately prior to application for a NRC license, procurement or construction? (Para. 5.2.1f) Yes →	I	N
7.	Can the item or activity have a major impact on non-radiological or occupational health and safety? (Para. 5.2.2a) Yes →	II	Y
8.	If the item or activity were to fail or is performed inadequately could repository workers be exposed to radiation or radioactive contamination levels in excess of the limits expressed in 10CFR20? (Para. 5.2.2b) Yes →	II	N
9.	Does the item or activity have a major impact on the non-radiological operation, reliability or maintainability of engineered systems, structures, or components? (Para. 5.2.2c) Yes →	II	N
10.	Does the item or activity involve a design phase for which the principle purpose is to conduct a comparative technical analysis of alternatives? (Para. 5.2.2d) Yes →	II	N
11.	Can the item or activity cause major cost overrun or schedule slippage? (Para. 5.2.2e & f) Yes →	II	Y

→ LEVEL III WHEN ALL THE ANSWERS TO ALL QUESTIONS ABOVE IS "NO".

QALAS NO. 1.2.6-0006
ROCK BOLTS AND WIREMESH (GROUND SUPPORT)
QA LEVEL II

- TECHNICAL EVALUATION USED IN DECISION PROCESS:
  - ROCK BOLTS AND WIREMESH NOT ON Q-LIST (SCP-CDR, APP. L-1)
  - ROCK BOLTS AND WIREMESH NOT RELIED ON FOR WASTE ISOLATION (SCP-CDR, CH. 7)
  - ROCK BOLTS AND WIREMESH NOT IMPORTANT TO RETRIEVABILITY (SCP-CDR, APP. L-2)
  - ROCK BOLTS AND WIREMESH NOT AN ACTIVITY
  - ROCK BOLTS AND WIREMESH FAILURE WOULD NOT CAUSE IRRETRIEVABLE LOSS OF QA LEVEL I DATA
  - ROCK BOLTS AND WIREMESH NOT AN ACTIVITY

DOCUMENT REVIEW SHEET

I.
ORIGINATING ORGANIZATION OF DOCUMENT: WMPO
DOCUMENT NO. 1.2.6-0006 REVISION 0 DATE: 6/30/87
DOCUMENT TITLE: Rockbolts and Wire Mesh
DATE RECEIVED: 6/30/87 COMMENTS REQUIRED DATE: 7/7/87
REVIEWED BY: J. Jardine J. Blaylock L. Skousen D. Irby
COMMENT SHEET FORWARDED TO: Nita Brogan ON _____ (DATE)
COMMENTS RESOLVED BY: _____ ON _____ (DATE)

II. REVIEWER'S COMMENTS			III. RESOLUTION			IV. REVIEWER'S DISPOSITION	
ITEM NO.	PAGE NO.	COMMENTS	ACCEPT	REJECT	REASON	ACCEPT	REJECT
1	1	Under "TECHNICAL JUSTIFICATION" delete the word "permanent" describing ground support. These items are not permanent they will be removed or replaced as time goes by.	RJK 7/24/87		Agree	JHJ 8/4/87	
2	1	Criteria 5 was not selected. Criteria 5 is "Instructions, Procedures and Dwgs" and it does apply to these items. The given justification does not fit or suffice.	RJK 7/24/87		Agree	JHJ 8/4/87	
3	1	Justification for the non selection of Criteria 14 is not adequate. I agree it should not apply but not for the reasoning given. These	RJK 8/4/87		Will revise to read Not component.	JHJ 8/4/87	

QUALITY LEVEL ASSIGNMENTS PERSPECTIVE ON THE DEVELOPMENT OF THE Q-LIST

- NEXT REVISION OF NNWSI QAP WILL REQUIRE PROCEDURES BE CONSISTENT WITH NUREG 1318, "TECHNICAL POSITION ON ITEMS AND ACTIVITIES IN THE HLW GEOLOGIC REPOSITORY PROGRAM SUBJECT TO QUALITY ASSURANCE REQUIREMENTS"

  ESTIMATED RELEASE: MID AUGUST, 1988

- FIRST DRAFT NNWSI PROCEDURE (AP 5.12Q) FOR DETERMINING Q-LIST ITEMS/ACTIVITIES IS CURRENTLY UNDERGOING PROJECT QA REVIEW AND WILL BE CONSISTENT WITH NUREG 1318

  ESTIMATED RELEASE: MID SEPTEMBER, 1988

- SCP CDR APPENDICES F AND L REPRESENT THE CURRENT NNWSI USE OF PROBABILISTIC RISK ASSESSMENT (PRA) TECHNIQUE FOR DETERMINING ITEMS IMPORTANT TO SAFETY
  - NO ESF Q-LIST ITEMS WERE IDENTIFIED
  - ANALYSES MUST BE REVISITED AS DESIGN MATURES

Attachment 14

DOE DOCUMENTS REQUESTED BY NRC IN CONJUNCTION WITH THE
JULY 18-19, 1988 NRC/DOE ESF MEETING

- Subsystem Design Requirements Document (SDRD) and all updates
- Current draft of SAND85-0598, "Analyses to Evaluate the Effect of the Exploratory Shaft on Repository Performance of Yucca Mountain"
- Impact Analysis (cited as to be completed August 15, 1988 on page 16 of T. Hunter package)
- Test Requirements for ESF Experiments (cited as complete on page 7 of J. Tillerson package concerning NRC CDSCP Objection 3)
- Layout Constraints to Working Group 7 (cited as complete on page 7 of J. Tillerson package concerning NRC CDSCP Objection 3)
- ESF Fluids and Materials Study (cited as in press on page 5 of J. Tillerson package concerning NRC CDSCP Objection 4)
- Evaluation Supporting SCP Section 8.4 (cited as in progress on page 5 of J. Tillerson package concerning NRC CDSCP Objection 4)
- ESF Title I Design Report (when complete)
- Report on Effects of Ventilation on Drying of Rock (referenced in presentation by T. Hunter)