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MAR 26 1987

Mr. Robert Browning
Director, Division of Waste Management
Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Browning:

The Nevada Nuclear Waste Storage Investigations (NNWSI) project held a meeting on August 27-28, 1985 to discuss design and construction plans for the exploratory shaft facility (ESF). The comments and questions arising from that meeting along with comments on the draft Environmental Assessment (EA) have led DOE to consider proposed changes in the ESF.

A technical meeting to discuss the proposed changes in the ESF program and to solicit the views of NRC and the State has been scheduled for April 14-15, 1987 in the SAI Office, Valley Bank Center, Room 450, 101 Convention Center Drive, Las Vegas, NV, beginning at 8:30 am. The preparation of the meeting summary and statement of agreements may extend to Thursday, April 16 if necessary to complete the summary. The attachments provide the agenda and background information.

If you have any questions please contact me or Dr. Owen Thompson at 586-5003 (FTS 896-5003).

Sincerely,

James P. Knight, Director
Siting, Licensing and Quality
Assurance Division, Office
of Civilian Radioactive
Waste Management

Attachments

A. Agenda
B. Proposed changes to the NNWSI ESF, March 1987

cc: D. Vieth
J. Leahy (20)

H 1336

Encl. to 3/26/87 ltr. to Browning from Knight 102.2 1924 #32

10:45 - 11:15	Open - Caucus Time	ALL
11:15 - 12:15	Comments on Concerns - NRC comments - State comments - Other comments	 NRC State Others
12:15 - 1:30	Lunch	
1:30 - 2:30	Limitations of ESF as described in EA - Location of Surface facilities - Location of Main test level - Access to fault areas - Main test level development - Second shaft diameter	DOE
2:30 - 3:15	Discussion and Justification of Proposed Changes - Relocation of shafts and surface facilities - Change in depth of main test level - Addition of long drifts to faults - Increased main test level area drifting - Increased second shaft (ES-2) diameter	DOE
3:15 - 3:30	Preliminary Environmental Evaluation	DOE
3:30 - 4:30	Open - Caucus Time	ALL
4:30 - 5:30	Questions and Discussion - Preliminary NRC concerns	ALL
5:30 - 7:30	Dinner	
7:30 - 11:00	Open -Caucus Time as Needed	ALL

Wednesday, April 15, 1987

8:30 - 10:00	Exchange and Discussion - Items of concern identified on April 14 - Additional items of concern	ALL
10:00 - 10:30	Break	
10:30 - 11:30	Status of Open Item/Action Items - Status update from 1985 meeting and 1983 correspondence not covered this meeting - Future actions and follow-up activities	DOE/NRC
11:30	Closure of Formal Meeting	DOE/NRC
11:30 - 12:30	Lunch	
12:30 - 6:00	Preparation and Signing of Summary Meeting Minutes (To be extended to April 16, if necessary)	Reps from DOE/NRC/State

PROPOSED CHANGES TO THE
NEVADA NUCLEAR WASTE STORAGE INVESTIGATIONS PROJECT
EXPLORATORY SHAFT FACILITY

BACKGROUND PAPER

FOR THE

U.S. NUCLEAR REGULATORY COMMISSION

AND

THE STATE OF NEVADA

AGENCY FOR NUCLEAR PROJECTS

NUCLEAR WASTE PROJECT OFFICE

MARCH 1987

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Attachment A

Meeting on Proposed Changes to the Nevada Nuclear Waste Storage Investigation Exploratory Shaft Facility

Las Vegas, Nevada
April 14 and 15, 1987

Agenda

Objective of the Meeting

The Nevada Nuclear Waste Storage Investigations (NNWSI) Project will present a number of proposed changes to the ESF described in the final Environmental Assessment (EA). The objectives of the meeting are (i) to provide NRC and the State a description of these changes and the bases for the changes prior to initiating preliminary design of the facility, (ii) to solicit the views of the NRC and the State regarding the proposed changes and (iii) to reach agreement on the proposed changes or agree on follow-up actions needed to reach agreement.

April 14, 1987

8:30 - 8:45	Introduction - Welcome - Introduction of participants - Procedures to be followed - Scope and objectives of meeting - Review of agenda - Identification of Representatives to Prepare Summary	DOE/NRC/State
8:45 - 9:00	Background and Description of Proposed Changes - Meeting August 27-28, 1985 - Subsequent comments and questions - Proposed changes in ESF (since EA)	DOE
9:00 - 10:45	Concerns that Prompted Proposed Changes - Shaft location - Representativeness of site data - Configuration of main test area and size of shaft	DOE

1. INTRODUCTION

1.1 Background

The Nevada Nuclear Waste Storage Investigations (NNWSI) Project, during the last two years, has been involved in an intensive effort involving investigations and analyses, to develop a meaningful site characterization program. Based on that effort, the scientific staff, as well as the U.S. Department of Energy (DOE), believes that the Exploratory Shaft Facility (ESF) configuration, as shown in Figure 1, should be reassessed to ensure that it is sufficient to obtain the data required to provide answers to critical regulatory issues and to meet operational and industrial safety requirements. Comments presented to the NNWSI Project by the State of Nevada and the U.S. Nuclear Regulatory Commission (NRC) have been evaluated. Based on these comments, it is now recognized that the ESF configuration, as presented in the Yucca Mountain Environmental Assessment (EA) (DOE, 1986), contained significant limitations relative to sizing and siting. As a result, changes for the ESF configuration are being proposed. This document is provided so that the Project may obtain the views of the State and the NRC This will ensure that proposed changes will facilitate achievement of the answers to the questions that were raised, and will allow the DOE an opportunity to explain and support the basis for the changes in the context of the issues raised through the stated concerns. This document contains an overview and summary of the proposed changes determined to be important to achieving answers to the questions raised by the State and the NRC. In addition, it should be noted that environmental impacts of the proposed changes are within the environmental impacts reported in the final EA.

1.2 Proposed Changes

The changes that are proposed are outlined below. They are shown schemmatically on Figure 2.

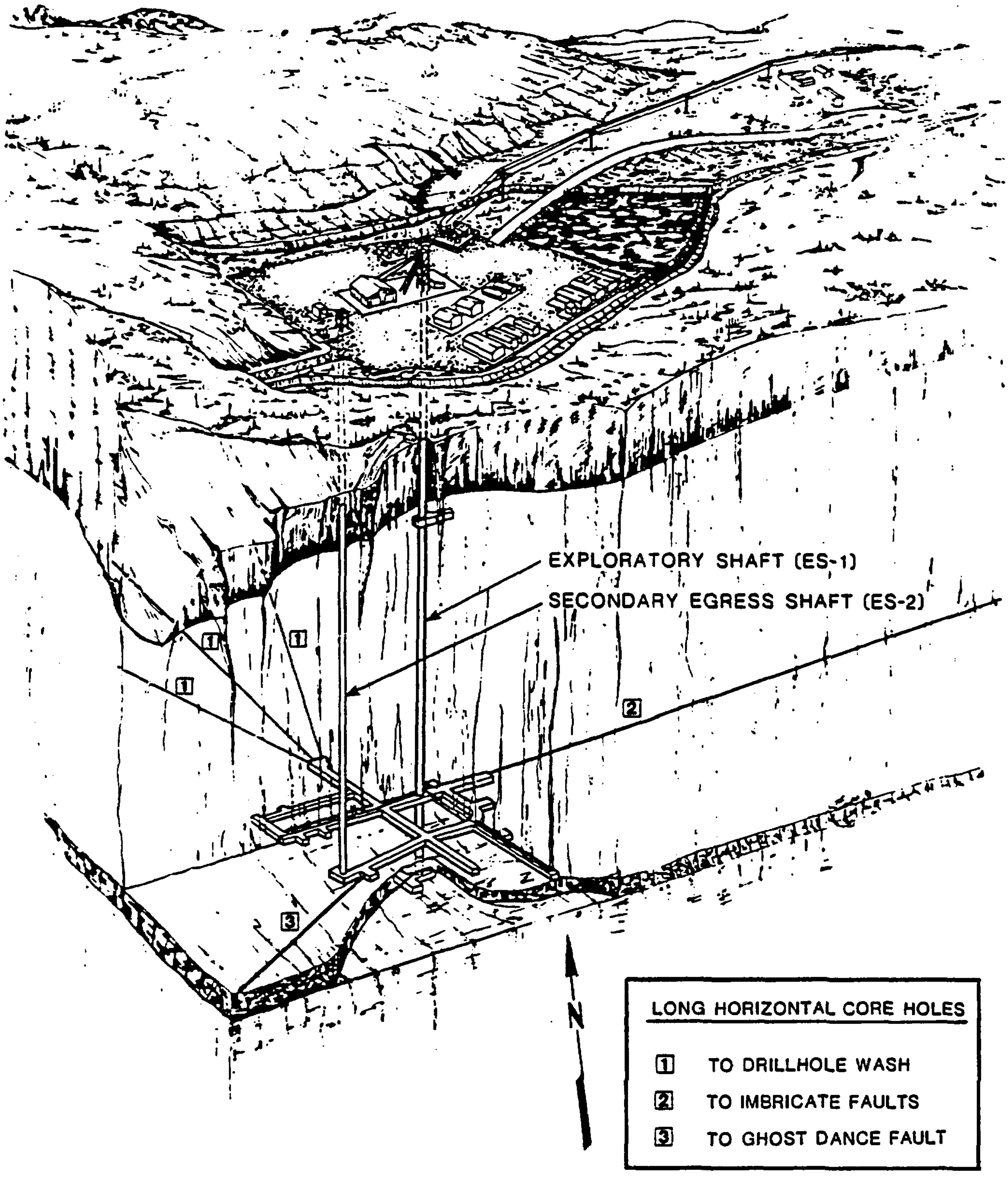
1) Relocation of the ESF exploratory shafts and surface facility approximately 440 feet to the northeast.

2) Relocation of the main test level from the 1200-foot level to approximately the 1020-foot level.

3) Construction of approximately 5600 linear feet of exploratory drifts to the fault areas (Ghost Dance fault, Drill Hole Wash and the Imbricate Normal Fault System).

4) Expansion of the main test level complex by approximately 2500 linear feet of drifts.

5) Increasing the second shaft (ES-2) from a 6-foot to a 12-foot, inside finished diameter.



REFERENCE: DOE/RW-0073 (YUCCA MOUNTAIN ENVIRONMENT ASSESSMENT)

Figure 1. Three Dimensional Illustration of the Exploratory Shaft Facility (Reference Final EA).

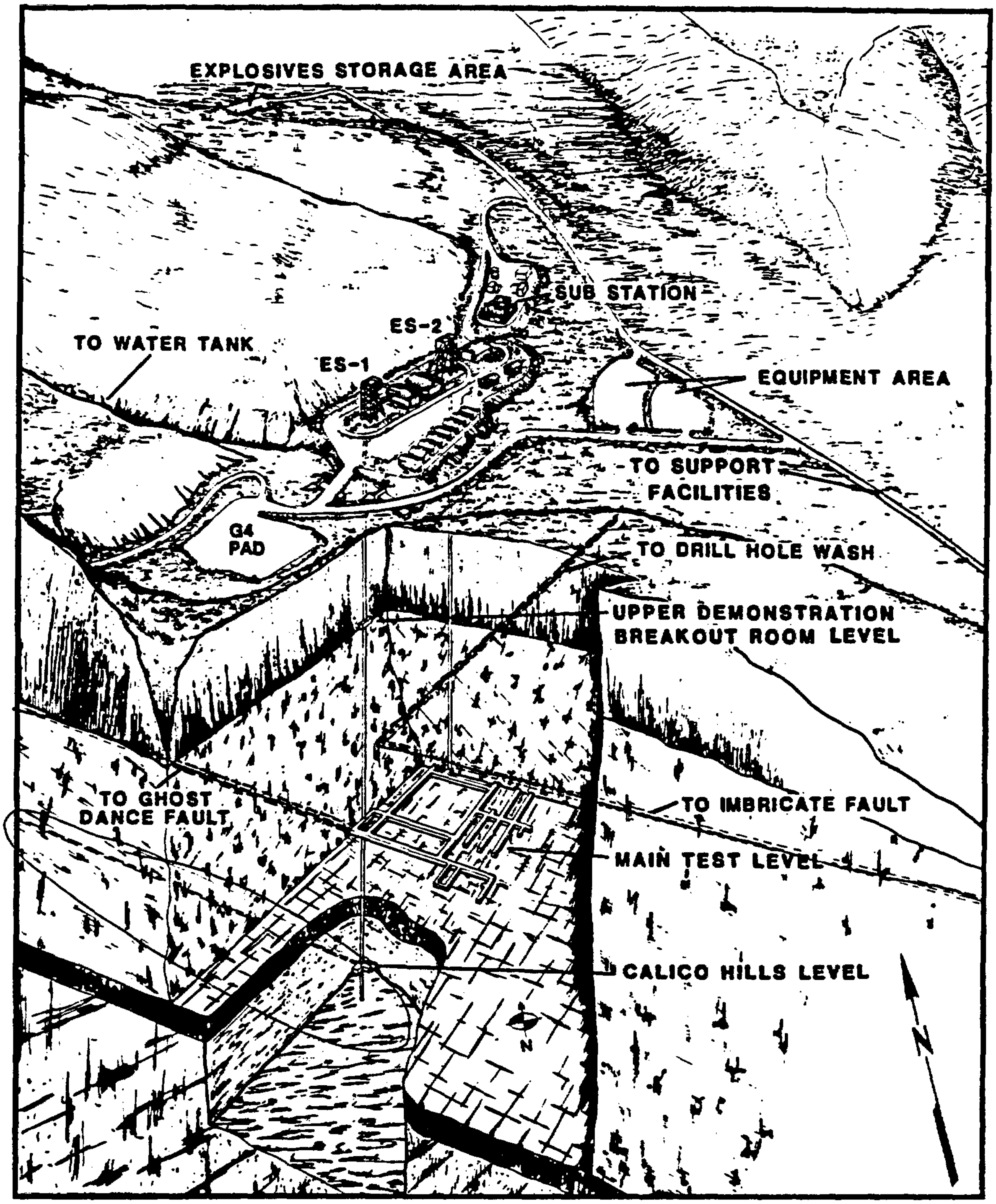


Figure 2. Three Dimensional Illustration of the Exploratory Shaft Facility (Proposed Location).

2. CONCERNS THAT PROMPTED PROPOSED CHANGES

The ESF and repository concepts were formally presented in the draft EA and released to the State and the public in December 1984. The proposed ESF concept was a compact configuration of drifts and testing areas that were designed with consideration of a modest expenditure and consistent with the concept originally proposed by NRC. The details of the initial concept remained essentially unchanged in the final EA (see Figure 1).

Since release of the draft EA, the NNWSI Project has received significant comments from the State and the NRC concerning the description of Yucca Mountain, the location of the exploratory shafts, and the natural processes that are occurring within the mountain. The NNWSI Project provided information to the NRC relative to the design for the ESF as presented in the EA, together with a performance analysis of the potential impacts on the hydrologic processes that could be associated with the shaft and its construction. This analysis resulted in a significant number of questions from the NRC regarding the bases for decisions, and the bases for demonstrating, with reasonable assurances, that the regulatory requirements can be met. Further, as scientists continued to develop the details of their testing program, the initial optimism regarding the potential success of experimental plans was not considered to be fully justified.

The questions that led to the proposal to change the facility configuration and test program are as follows:

1) With the concepts and proposed exploration methods that were current at the time of the EA publication, will it be possible to obtain the information that is required to adequately characterize the site?

2) Will the measurements made in the proposed ESF be representative of conditions and processes throughout the repository?

3) If an expanded scientific investigation effort is required, are the proposed shafts capable of providing the functions and capacity to accomplish the task in a safe manner?

These high-level concerns have a direct influence on specific facility designs. Concerns relative to the latter are summarized in the following sections.

2.1 Concerns associated with shaft location

During review of the exploratory shaft (ES) performance analysis, NRC staff expressed concern about the location of the shaft in the alluvial fill of Coyote Wash (Vieth, 1985a, 1985b). The NRC analysis indicated the potential for channeling of water runoff over the ES location and the eventual erosion of the alluvial fill. NRC staff believe that a more prudent approach would be to set the shaft collar in hard rock outside the flow channels. This action would minimize the likelihood of concern relative to potential flow of water around the shaft resulting from preferential channeling.

2.2 Concerns associated with representativeness of site characterization data

2.2.1 Test horizon selection

The NRC questioned whether measurements made in the ESF would be representative of the characteristics of the entire repository block (NRC-NNWSI, 1985). The NRC stated that uncertainties exist relative to the Topopah Spring unit and, thus, the unit will have to be investigated during site characterization before a position can be established regarding horizon suitability. The question of representativeness involves several areas of the ESF program. The first was whether the repository horizon would actually include rock of the same strata in which the ESF would be located at the 1200-foot level, since the lithologic strata of Yucca Mountain slopes from west to east with approximately a 6 percent grade. Second, if the experiments at the 1200-foot level were pursued, then the rock with potentially better characteristics (low lithophysae-cavity content and relatively less fractured) would have been utilized for the test; it might then be argued that the rock mass characteristics at that level would not be considered representative of the majority of the repository horizon.

2.2.2 Understanding of variation in site characteristics on test horizon

Data and analyses to date have established that the Topopah Spring strata are nonhomogenous. It is recognized that the properties and characteristics will vary with location. Based on measurements made on core samples and a general understanding of the site, the view is held by the scientists and engineers supporting the Project that these variations are not likely to result in problems from a waste isolation or construction viewpoint. However, NRC staff has indicated that the underground area of the ESF, approximately 11 acres, is an extremely small fraction of the repository underground area (approximately 1820 acres), and it is not clear that observations about the underground, based on this area of sampling, would be considered representative of the range to be encountered. The NRC is specifically concerned with having adequate substantiation for the conclusion that sufficient lateral extent is available for waste emplacement (DOE, 1986). They are also concerned that the area not suitable for waste emplacement, because of the presence of minor faults and breccia, is probably not concentrated at one location; rather, it may be distributed in segments throughout the host rock. The random location of these areas may deter complete utilization of the remainder of the host rock, and thus could further reduce the potentially available usable area. The Nevada Bureau of Mines and Geology (DOE, 1986) is also concerned that Yucca Mountain is criss-crossed by numerous faults and fractures and that planned studies of these fractures are not detailed enough to determine whether some of these might be active in the future or whether they might break the integrity of the site.

The issue in understanding the geology of the host rock is not the value of the experimentally determined parameters themselves, but where they exist in the statistical distribution of values or within the range of uncertainties. If the long horizontal core holes cannot be successfully drilled and the drifts are not extended, then there would be limited information about the horizon on which to establish the range of uncertainties. The recurring theme in comments by the State and the NRC is the need to better define the degree of uncertainty and range of conditions in the subsurface environment.

There are also significant differences in viewpoint between participants of the NNWSI Project, NRC staff and contractors, the State and its contractors, and even consultants to the Office of Geologic Repositories (OGR) relative to the hydrological behavior of the site. Many issues exist, such as nominal flow of water in fractures and faults, the postulated existence of numerous perched water zones, variations of ground-water composition, unusually high salt content of water, and different flow paths. All of these issues will have to be satisfactorily resolved and it is the consensus view of the scientists supporting the Project that long (up to approximately 2000 linear feet), small-diameter core holes (3.125 inches) drilled with water would not provide sufficient or adequate data necessary to help resolve the issues.

The definition of the hydrologic characteristics of the unsaturated zone and the variation of these characteristics is one point that is critical to the evaluation of Yucca Mountain as a repository site. A model of the unsaturated zone and its nominal characteristics was presented in the draft EA. Significant comments on this model were received, especially with regard to the uncertainty of the actual conditions within the unsaturated zone. The Desert Research Institute of Nevada is concerned that the site proposed by the DOE constitutes an extremely complex and difficult environment to confidently characterize and that the moisture regime in this proposed environment is still essentially unknown (DOE, 1986).

The Nevada Department of Conservation and National Resources believe that additional testing is required to establish percolation rates in the fracture networks of the host rocks and a more refined analysis of the fracture flow should be accomplished after site characterization (DOE, 1986).

The NRC suggests (DOE, 1986) that in planning the underground testing facility, the DOE should consider use of long drifts for site characterization for the following reasons: (1) use of only horizontal and inclined holes drilled from underground testing areas may not yield sufficiently detailed information about geology, hydrology, or geochemistry; i.e., short holes are not likely to have sufficient penetration into the formation, and long holes are difficult to drill, hard to control, and may not provide sufficient exploration data; and (2) lithophysae, faults, and brecciated zones may be better exposed in the surfaces of long drifts.

An issue that has arisen that requires characterization is the ability of the underground/openings to withstand the ground shocks resulting from nuclear weapons tests. Comments received from the Nevada Bureau of Mines and Geology (DOE, 1986) and Nevada Senator Chic Hecht (Hecht, 1986) express concern that tectonic strain release has been associated with underground nuclear testing and that an assessment should be made of the likelihood of explosion-induced faulting at Yucca Mountain.

Concerns related to specific potential fault areas are discussed in the following sections.

2.2.2.1 Concerns at Ghost Dance Fault

The first and most important feature to examine is the Ghost Dance fault, a structural feature that will be present in the center of the proposed repository area. This is a critical feature for a number of reasons, the first being that it is a potentially transmissive zone for movement of water from the surface to the water table. If water exists along this fault zone, it is expected to be moving faster than in the matrix. The State has suggested that the hydrologic model proposed for the unsaturated zone is too optimistic and that there could be substantial quantities of water moving down this fault. They have used Rainier Mesa as an analogy and stated that Yucca Mountain is likely to have similar characteristics. The Nevada Desert Research Institute (DOE, 1986) believes that not enough data have been presented (or are available) either in the draft EA or in the cited references to judge the validity of the adopted conceptual model. The NNWSI Project believes that Yucca Mountain and Rainier Mesa are significantly different.

A second critical data set related to the Ghost Dance fault that would come from direct observations, would be the analysis of the deposits that might occur in the fault zone. A mechanism, known as tectonic or seismic pumping, has been suggested that could cause water from a lower depth to move up the faults. Deposits in the Bow Ridge fault and other surface features indicate that this phenomenon is one of several possibilities (the two primary possibilities are geothermal source of water or desert soil formation processes).

2.2.2.2 Concerns at Drill Hole Wash

The second geologic structure that needs to be examined is the area under Drill Hole Wash. This is important from two viewpoints; the first is the actual nature of the geologic structure and the second is the hydrologic character of the area itself. The next major geomorphic feature north of Drill Hole Wash is Yucca Wash, which is presumed to be a surface expression of a fault. Previous drilling in Drill Hole Wash by the NNWSI Project has been inconclusive in terms of determining whether the wash is truly associated with a fault.

The evaluation of the structural character of Drill Hole Wash is important in that this structure represents the proposed northern boundary of the repository. This boundary was proposed based on the assumption that it was a fault zone and would represent a structural situation that could present difficulties in mining and long-term stability of openings. If there is not a fault in this area and/or if this area is found to have only minimal unfavorable characteristics of a fault or fracture zone (as was experienced in the welded tuff in G-Tunnel), then the block that is to be used for the repository could be substantially increased.

On the surface, Drill Hole Wash (because of its topographical characteristics) serves to concentrate surface waters and channel them along a specific path. It can be reasoned that the infiltration of water along this structure would be increased through the general mass action effects. Therefore, understanding the hydrologic characteristics of this area is critical since it is a location where higher than average flux rates could occur. Examining this area will be essential to answering the Nevada Bureau of Mines and Geology concerns, especially relative to seasonal change and movement of water down a fracture zone. The Nevada Bureau of Mines and Geology believes that tuffs at Yucca Mountain contain many tectonic-caused fractures, along which water could move in a matter of days (DOE, 1986).

2.2.2.3 Concerns with the Imbricate Normal Fault System

The third geologic feature that needs to be examined is the Imbricate Normal Fault System on the eastern side of Yucca Mountain. Like the Drill Hole Wash area to the north, the eastern boundary of the repository will be determined by a fault zone. Unlike the Drill Hole Wash area, however, this fault zone is known to exist. Unknown factors relative to this fault zone include the thickness of the fault zone, the angle of dip of the fault structure, the exact location of that structure at the repository depth and, as with the other fault areas, its hydrologic characteristics and potential for transmitting water. Determination of the location at depth of the fault zone is critical to evaluating the eastern boundary and size of the proposed repository. In addition, evaluation of any deposits in the fault zone as a basis for evaluating other processes at the site is critical. Since these faults are in close proximity to the Bow Ridge fault, which contains the calcite-silica deposits, evaluating them at depth for such deposits would help resolve questions concerning the mechanisms that produce the deposits.

2.3 Concerns associated with the configuration of the main test area and shaft size

Once it had been established that it was important to consider other means of evaluating the fault formations (i.e., drifting in lieu of core drilling) and addressing the concerns regarding representativeness, it was critical to determine whether the existing facility design was sufficient to allow this work to be accomplished. In studies and subsequent reviews by the NNWSI Project relative to ESF configurations (assuming increased drifting) numerous questions had to be answered, including the following:

1) Concerns relative to the size of the main test level.

   a. Is the ESF underground configuration for scientific tests compatible with requirements for handling large volumes of muck from the construction of long drifts without interference?

   b. What size drifts would be required to characterize the site with regard to engineering, construction, testing, and safety questions?

   c. How would ESF underground layout be changed to be compatible with the repository conceptual design layout, and provide enough flexibility to accommodate additional testing needs.

2) Concerns relative to the shaft sizes.

   a. Are there safety problems associated with the expanded drifting program?

   b. Could the proposed ventilation-system design and shaft limitations provide the required ventilation capacity?

   c. Will larger equipment for mining exploratory drifts require larger shafts?

   d. Is hoisting capacity sufficient to prevent the system from being "muck bound"?

   e. Do the shaft sizes provide enough flexibility to accommodate additional testing needs?

In evaluating such questions, it was determined that the expansion of the ESF was driven mainly by the proposed drifting to the fault areas and the increase in flexibility in the test area locations. Drifting to the fault areas will significantly increase the amount of muck to be removed through the Main Test Level. It is planned that the drifts will be excavated by the same techniques that will be used for the shafts, namely the drill/blast/muck method. This will require an increase in the Main Test Level complex to isolate (buffer) the tests from the drift excavation operation. These concerns lead to the evaluations of the shaft sizing for ES-2. It must be remembered that all personnel, equipment, and materials required underground must come down the shaft. The evaluation focused on activities that are continuous, as well as activities that are one-time events. The factors that were considered as a result of these concerns are as follows:

1) Main test level complex.

   a. Requirements for obtaining necessary data.
   b. Potential interference between data collection and construction operations.

2) Shaft size.

   a. Constructability of the shaft.
   b. Ventilation requirements.
   c. Size of equipment for mining.
   d. Muck handling requirements.
   e. Materials for operation and construction.
   f. Capability of getting people in and out safely during emergency conditions, and meeting established safety codes.
   g. Flexibility to adjust to evolving test needs.

3. LIMITATIONS OF EXPLORATORY SHAFT FACILITY DESCRIBED IN THE ENVIRONMENTAL ASSESSMENT

Given the concerns from the NRC, the State of Nevada, and from the NNWSI Project technical staff discussed in the previous section, the NNWSI Project had to determine if the ESF described in the EA could provide the information needed to resolve these concerns. After an evaluation of each concern, it became apparent that the ESF was limited in its ability to provide the information necessary to resolve the concerns being raised. This section discusses these limitations and the following section describes the changes to the ESF that have been proposed to minimize the limitations.

3.1 Location of the ESF surface facilities

The location proposed in the EA for the ESF is a relatively flat area in Coyote Wash. Because of potential shaft flooding, the site would require a raised pad constructed of alluvial fill brought in from a nearby "borrow" area. This engineered site would limit our understanding of the shaft performance and could potentially provide misleading site characterization information. Collar construction and the upper shaft liner/rock wall interface would not be representative of repository shafts which are to be constructed on the natural terrain. Information necessary for characterization of this interface and development of an understanding of potential water flow around the shaft would be questionable.

3.2 Location of the ESF main test level

The proposed horizon for testing in the ESF, as stated in the draft and final EA, was 1200 feet below the surface. This horizon was identified in 1982 as the target horizon. It should be noted that because the strata of Yucca Mountain dip from west to east, the repository will also be similarly inclined. While there is no recognized physical impact of an inclined repository on waste isolation or structural stability, such an inclination does present certain difficulties from an operational and safety viewpoint. As a result of the effort to reduce the degree of inclination along which the repository would be constructed, the repository conceptual design, developed subsequent to the ESF target horizon selection, indicates that the level at which the repository actually crosses the ESF would be at about 1020 feet below the surface (approximately 180 feet above the initial proposal). The characteristics, in terms of fracture frequency and lithophysae content at the 1020-foot level, do not appear to be as good as they are at the 1200-foot level. The 1020-foot level may have lower fracture frequency and higher lithophysae content than the 1200-foot level strata. However, at the 1020-foot level, the higher lithophysae cavity content will probably have a less favorable influence on rock-mass characteristics than the comparatively favorable influence of a lower fracture frequency. This situation raised two points. The first was whether the repository horizon would actually include rock of the same strata in which the ESF would be located at the 1200-foot level. At this time, based on the level of detail available, it is not possible to answer that question in a positive sense without a high degree of uncertainty. Second, if the experiments at the 1200-foot level were pursued, then the rock with potentially better characteristics would have been utilized for the test, and it might be argued that the rock-mass characteristics at that level would not be considered representative of the majority of the repository horizon. With this situation, the DOE could be criticized for biasing the results of the test through the careful selection of the sampled volume. A similar view has been voiced previously by NRC staff, regarding measurements made utilizing core samples.

3.3 Access to the fault areas

The exploration method proposed in the EA for understanding the characteristics of the repository block was to drill long horizontal core holes. However, the constraints placed on this exploration method by the unsaturated zone are more significant than initially recognized. The ESF location was selected on the premise that it would be possible to drill horizontal core holes up to 2000 linear feet from the underground facility as the mechanism to sample a large volume of rock and to investigate three major features: the Ghost Dance Fault to the west, the subsurface structure of Drill Hole Wash to the north, and the characteristics of the imbricate normal faults to the east. It was initially understood that it would be possible to do the core drilling using conventional methods, i.e., with water as a drilling fluid. The objective of the effort was to retrieve core for the purposes of describing (1) the geologic structure and stratigraphy, (2) variation in geochemistry, and (3) variation in physical and mechanical properties of the rock. Eventually it was realized that, if the holes were drilled dry (with air), they could also be used to measure variation in hydrologic characteristics of the unsaturated zone. These measurements, which have a direct bearing on fluid flow rates and transport mechanisms, were considered by the NNWSI Project to be more important than retrieval of core. Drilling long core holes with air, however, has been tried in Topopah Spring rock at Fran Ridge in 1982, and found to be extremely difficult. The major limitations were the inability to retrieve required quantities of intact unaltered core, the inability to keep the holes open, and drill tool problems.

Drilling the core hole wet may provide cores that are adequate to support investigation of deposits on the fault, but, unfortunately, it would compromise any investigation to evaluate whether water was moving on the fault. Additionally, with the core hole, if the core is recovered, there would only be one sample to study. This could be difficult in view of the need to maintain archive samples.

An issue that needs to be addressed with respect to the Ghost Dance fault but that cannot be addressed through a horizontal core hole, is the nature of the fault zone and the degree of offset. If a repository is constructed at Yucca Mountain, the drifts will have to pass through the fault, and the potential complications of such construction and impact on waste package emplacement conditions cannot be addressed with horizontal core holes.

The lack of information with regard to representativeness under the original ESF concept would be most critical for those areas where structure and processes are suspected of being significantly different from the bulk of the formation. These areas would be the Ghost Dance fault, the area below Drill Hole Wash, and the imbricate normal faults.

It should be noted that some investigators believe that a horizontal core hole should be sufficient to obtain the required information about the imbricate normal faults. Before this view is accepted, it is necessary to review a situation experienced in the Climax Spent Fuel Test. A long horizontal core hole intersected a significant fault zone; however, after examination of the recovered core, the fault zone was not identified. Only after the drift was mined through the fault, was it observed and recognized. Subsequent examination of the core did not facilitate the observations or identification of this feature.

3.4 Main test level development

The main test level proposed in the EA was laid out to accommodate localized testing in various short drifts and alcoves. The mining of the test level would be essentially completed prior to extensive testing, and little interference from ongoing mining activities was expected. Because of its relatively small size, compatibility with the repository layout was not significant. This layout, however, presents limitations in the ability to increase both the size and number of test drifts in the test area and in the ability to mine long drifts out to the various faults that have been discussed previously. The layout also does not provide sufficient flexibility to allow for additional tests that may arise during site characterization.

3.5 Second shaft (ES-2) diameter

The ESF design as described in the EA is shown in Figure 1. This design consists of two shafts: one 12-foot diameter shaft (the first shaft) primarily for obtaining the data and underground operations support, and one 6-foot diameter shaft (the second shaft) primarily for emergency egress. The first shaft was designed to provide access to the geologic formation for the purpose of characterizing the subsurface environment and to provide the basic services necessary to build and operate a small underground facility in which scientific measurements would be made. While the depth of major scientific measurements was planned for the 1200-foot level, with additional breakout rooms at the 520-foot level and the 1400-foot level, the shaft would be sunk to a total depth of 1484 feet below the surface. This allows penetration of the tuffaceous beds of Calico Hills and in situ testing in the zeolite zone to investigate potential for retardation of radionuclides by various sorption processes. All support for mining (including ventilation) and scientific investigations for all three horizons (520 feet, 1200 feet, and 1400 feet) would have to be provided by this one 12-foot diameter shaft.

It should be specifically noted that the diameter of the first shaft (12 feet) was initially established in 1983, based on an understanding of the scientific measurements to be made in the shaft (at the 520-foot, the 1200-foot, and the 1400-foot horizons), the equipment to go underground, the personnel requirements, the material handling requirements, and, most importantly, the ventilation requirements. The size of the shaft and services to be provided through the shaft were considered to be fully compatible. The size of the second shaft defined in the EA was set (in 1984) at 6 feet, since it was only needed as a secondary egress shaft for safety as required by regulations.

Evaluation of the adequacy of the 12-foot diameter/6-foot diameter combination to meet the expanded characterization efforts proposed in Section 4, focused initially on the requirements for hoisting capacity, equipment delivery, and ventilation requirements. The analysis indicated that although the initial configuration of the 12-foot diameter shaft was sufficient to get materials and personnel underground, there would be complications involved when larger equipment was required underground, and the ventilation capacity would not be sufficient to meet the new requirements. Using a limited duct size, the horsepower requirements to provide sufficient ventilation to the working area for diesel equipment operation would have to be raised from 200 BHP to 1800 BHP. This would meet the ventilation requirement for the 1200-foot level only, and did not include the ventilation requirements for the 520-foot or 1400-foot horizons. The 6-foot diameter second shaft, therefore, limits the amount of testing and drifting which can take place in the facility.

4. DISCUSSION AND JUSTIFICATION OF THE PROPOSED CHANGES

Having completed extensive studies of the concerns expressed by the State of Nevada and the NRC, and having determined the limitations of the design proposed in the EA, NNWSI Project staff concluded that the following changes to the ESF configuration need to be made, and that views should be solicited from the NRC and the State of Nevada on this proposed course of action.

4.1 Relocation of shafts and surface facilities

The NNWSI Project proposes to move the location of the first and second shafts 440-feet to the northeast of the location proposed in the EA, as shown in Figure 3. This will remove these shafts and their associated facilities from the middle of Coyote Wash and place them on a cut-and-fill rock shelf located on the side of the hill which bounds the wash to the northeast. The shaft collars will be located on the cut portion of the shelf anchored directly in bedrock at the surface. This proposed change will remove any limitations resulting from the current design and should alleviate the concerns raised by the NRC regarding flooding, erosion, and flow of water around the area of the shaft liners. Placing the shafts collars directly on bedrock also reduces concerns about their stability as potential future repository components.

4.2 Change in depth of the main test level

The NNWSI Project proposes to raise the main test level breakout from 1200 feet to approximately 1020 feet below the top of the ES collar. This change allows the main test level, with its proposed extensive drifting, to be at the same level as the repository in that particular lateral location of the Topopah Spring Member, as shown on Figure 4. Making this change would assure that the bulk of the scientific and engineering measurements would be made in a portion of the rock actually located in the repository and would minimize the mining of test areas beneath the repository. The 1020-foot level may have a geologic structure representative of the least desirable area to be encountered during construction of the repository. This would ensure that the data obtained from underground testing are conservative and can be used to analyze the worst case scenarios for performance of the repository.

4.3 Addition of long drifts to the faults

The NNWSI Project proposes to delete the long core holes described in the EA and perform the scientific investigations using full size repository drifts mined to each of the three fault areas of concern. Figure 5 shows the proposed drift arrangement. The long drifts would be positioned so that they can be used in the repository if this site is selected as the first repository.

In view of the scientific requirement to minimize perturbation of ambient hydrologic conditions in the unsaturated zone as a result of exploration methods, and because of the need to sample a larger volume of rock and explore the formation, drifting was strongly recommended by NNWSI Project technical staff. The conclusion was that the alternative most likely to provide the information required, was to construct drifts to the locations of interest and sample the properties and characteristics of the rock along the way. The

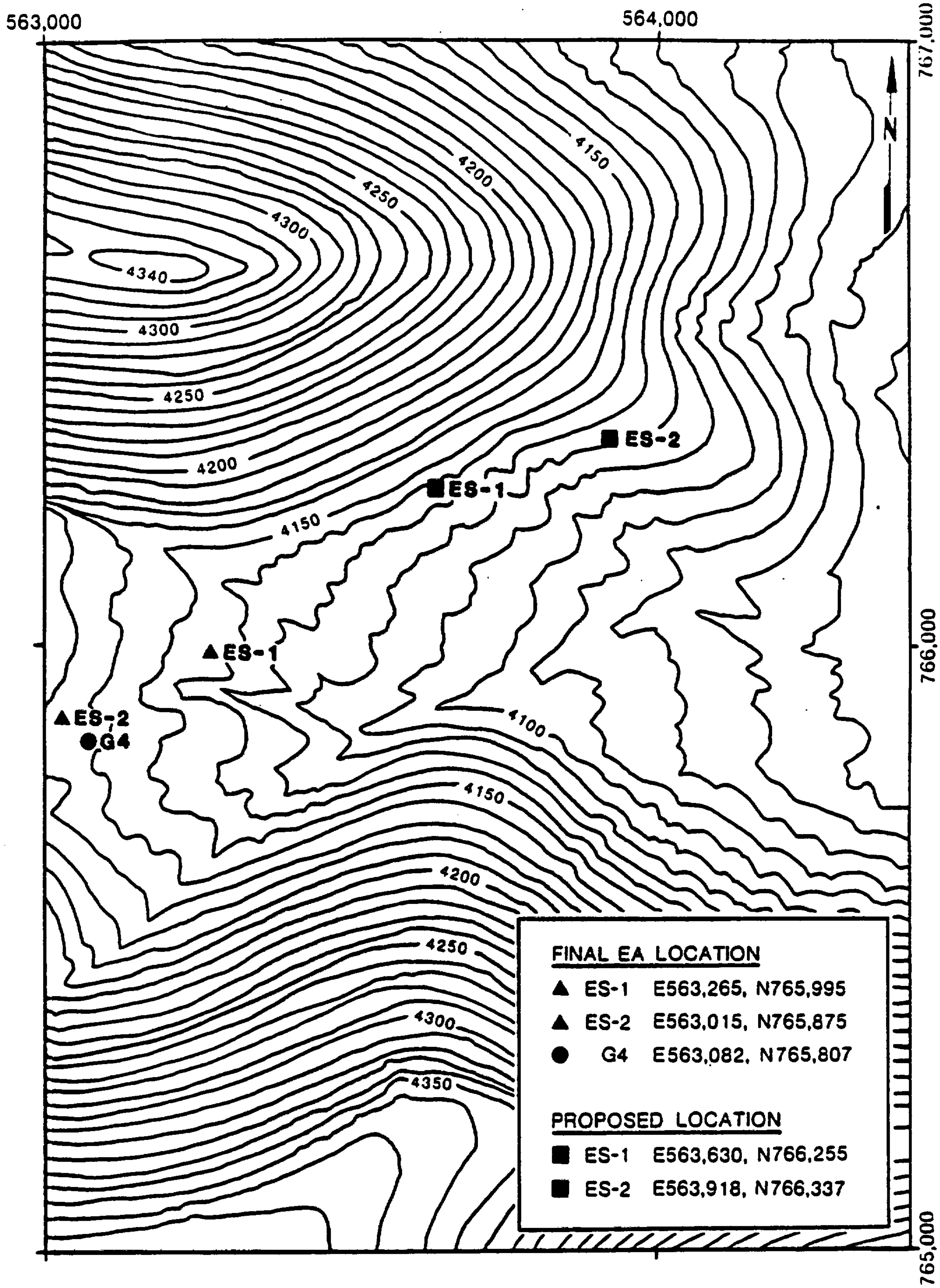


Figure 3. Comparative Illustration of the Final EA Versus the Proposed Exploratory Shaft Locations

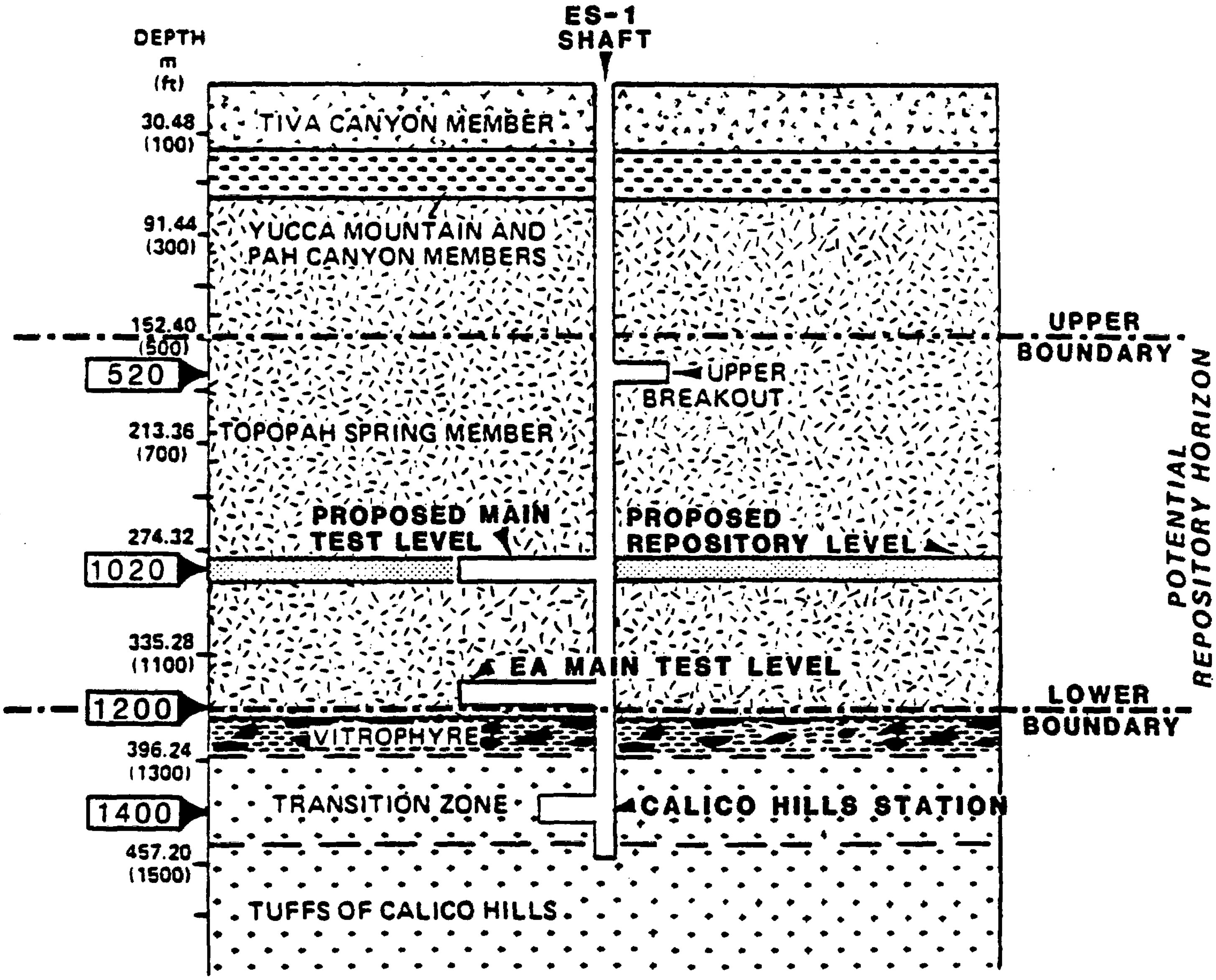


Figure 4. Comparative Illustration of the Final EA Versus the Proposed Main Test Level Location.

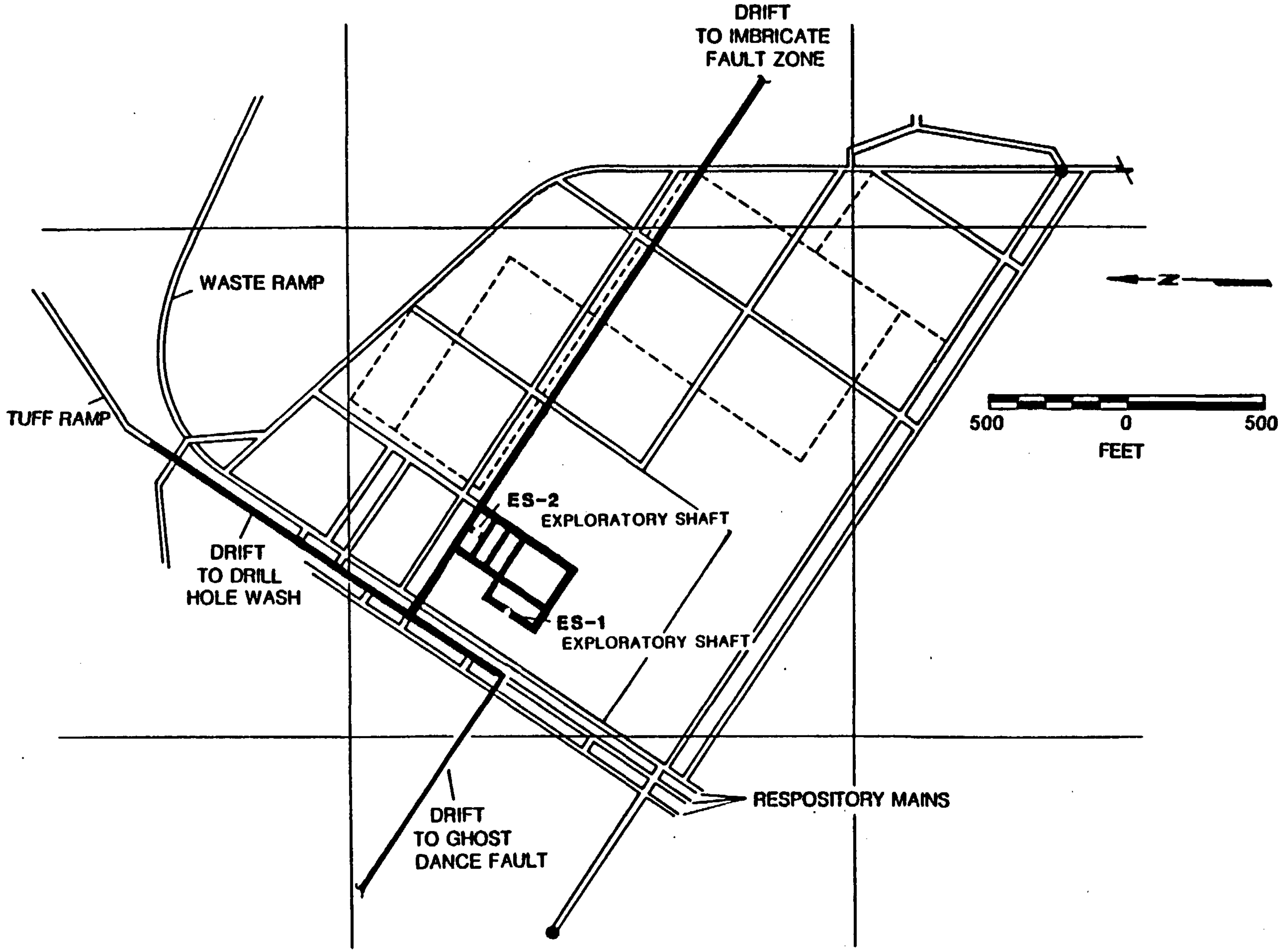


Figure 5. Relationship of ESF long drifts and the conceptual repository design.

proposed change represents an addition of approximately 5600 feet of exploratory drifts.

The use of drifts provides the opportunity to conduct direct observation of actual conditions. The proposed drifts will significantly increase observations of a number of different conditions to be encountered in the repository. The exploratory drift across the repository will be 3500 feet long, or 49 percent of the proposed repository width at that point. The exploratory drift down the center of the repository will be 2400 feet long or 20 percent of the proposed repository length. By contrast, the length of the drifts in the initial ESF represented only 4 percent of the distance across the repository, and 2 percent of the distance down the center. It should be noted that the location of the ESF is in the center of an area that is free of known structural features that could affect the subsurface hydrologic environment. By extending the drifts beyond the limits described in the EA, the conditions expected should range from nominal to those expected to be the worst. With direct access to this range of conditions, it will be easier to make direct observations and measurements of the hydrologic characteristics as they are encountered. Critical judgements will not have to be made on limited data obtained through small core holes that could be up to 2000 feet long.

It should be noted that if the construction of drifts is pursued, additional benefits in the area of engineering and construction methods, beyond the scientific investigations, would be achieved. These benefits would include the working experience gained in the construction of passageways through a wider variety of rock conditions (characterization of safety considerations related to structural stability). This characterization effort would provide excellent insight into the variety of real site conditions to be encountered, and allow for economic engineering solutions to potential problems early in the effort. Additionally it would provide for a number of openings through a broader variety of conditions in the mountain and resolve the concern of the NRC (DOE, 1986) regarding reliance on rock classification systems in the design of the underground support system for repository openings.

Since requirements would exist to mine the rock using a minimum of water, an oppurtunity would be afforded to define working environments, to develop dust suppression methods, and establish ventilation requirements at an early stage. This is a critical item in view of the potential health (industrial safety) hazards of high-silica dust levels in the air.

Another engineering aspect of the site characterization effort related to construction of drifts would be the acquisition of data related to the stability of the underground/openings configuration. This would facilitate the characterization of the effects of seismic stimulation caused by nuclear weapons tests at the Nevada Test Site on the engineered structure. In a real sense, the long drifts provide an opportunity for early performance confirmation type studies. The effort would focus on characterizing the impact of ground shock on the rock and the engineered-structure characteristics, through a wide variety of site conditions, for drifts representative of configuration expected to be encountered in the repository. The data achieved from this study should provide a basis for defining the degree to which the engineered structure could be affected by the nuclear weapons tests.

With the addition of the drifts, the relative fraction of the rock examined would be increased, as noted earlier. There would be significant operational advantages to data collection in that it would not have to be done using a very long, small-diameter hole. Repair, maintenance, and reliability of instruments would be greatly facilitated. It would increase the probability that the testing period would be utilized for testing, not interrupted by extended downtime for repair of instruments. In addition to measurements made with instruments, it will be possible for scientists and engineers to make direct observations of conditions and processes that exist in the formation. Selection and collection of samples for laboratory measurements can be accomplished on a more informed basis than that resulting from having to selectively choose from the samples that survive a dry, horizontal coring operation in a long hole. Using the drift construction approach increases the confidence and understanding of the representativeness of the results from the test conducted in the ESF. The increase in confidence results from the ability to conduct direct observation in the selection of samples, and the potential for a larger population of samples to be measured. The information obtained from direct observation will improve the statistical and physical basis for the conclusions reached relative to the suitability of the entire horizon.

In addition to measurements of the actual characteristics in these areas, other determinations about the known deviations from normal can be made. Observations and determinations regarding the Ghost Dance fault, the implication of Drill Hole Wash, and the imbricate normal faults can be made that will affect the nominal geologic and hydrologic models of the site and thereby support or change the concept of the norm and range of uncertainties at Yucca Mountain.

The NNWSI Project believes that the best way to demonstrate the difference between the Rainier Mesa analogy proposed by the State and the hydrologic behavior of Yucca Mountain is to mine a drift westward to the Ghost Dance fault for the following reasons: (1) to allow for direct observation, (2) to collect water samples (if water is present in sufficient quantities to collect), and (3) to make other more sophisticated measurements relative to water movements. The objective of such measurements would be to clarify the conditions and processes at Yucca Mountain as a basis for supporting the hydrologic model for the unsaturated zone and confirming the view of the representative character of the hydrologic environments. Direct investigation of the fault at depth may help resolve the origin of deposits that might occur in the fault zone that have been hypothesized to be a result of seismic pumping. Geologically, the proposed drift may make it possible to evaluate the time frame of the last fault movement and the magnitude and nature of that movement.

The NNWSI Project believes the best way to evaluate the nature of the geologic structure and the hydrologic character of the Drill Hole Wash area, would be the construction of a drift through the subsurface of Drill Hole Wash allowing for direct observation and evaluation of the conditions as stated earlier, previous drilling has been inconclusive in determining the presence and extent of faulting in the area.

A drift to the imbricate normal fault area, along with direct observation, would be the method that would have the highest reliability for providing the information required to understand the hydrologic characteristics of the area. It is also the evaluation of the scientists and engineers that drifts are required for them to be confident that the fault features have indeed been located. If this location is not significantly different than the bulk of the rock, the views about representativeness of the conditions and the results of tests in the ESF can be strongly bolstered.

In summary, NNWSI Project scientists and engineers participating in the evaluation of Yucca Mountain believe that construction of drifts to the areas of investigation is imperative. In their view, this is a far better basis for building a case for the licensing arena than having no data or only limited data obtained through long (2000-foot), small-diameter core holes.

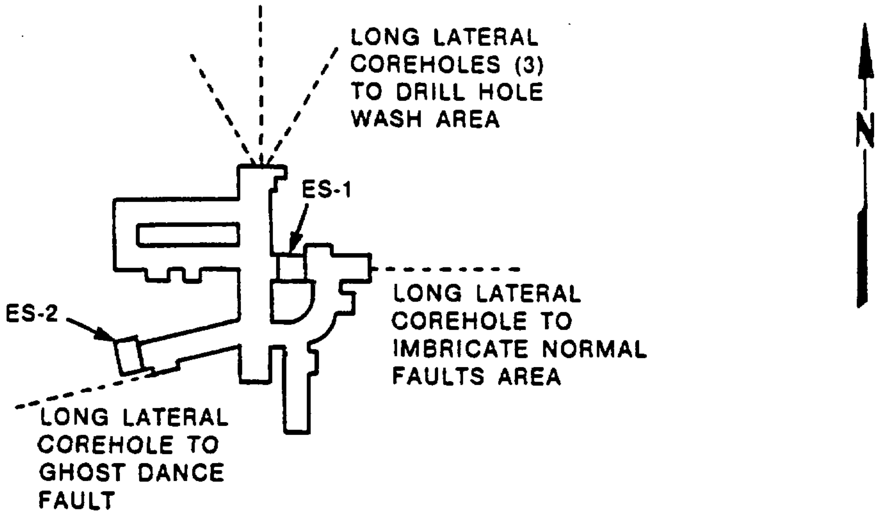
4.4 Increase in main test level area drifting

As stated earlier, the main test level concept proposed in the EA was a compact configuration of drifts and test areas designed to meet preliminary test requirements and provide a concept that could be built with a modest expenditure. The NNWSI Project proposes to reconfigure the main test level to accommodate the current test requirements and provide facilities to support the additional drifting proposed. The proposed layout would also minimize the impact of construction of the drifts on concurrent main test level testing, ensure compatibility with the repository conceptual design, add support facilities, and provide flexibility to the facility. The resultant layout increases drift length in the main test level area from 1500 feet to 4000 feet, as shown in Figure 6. The test room areas, shown in Figure 6, are only conceptual illustrations which will, most likely, evolve into a different configuration as the design process evolves.

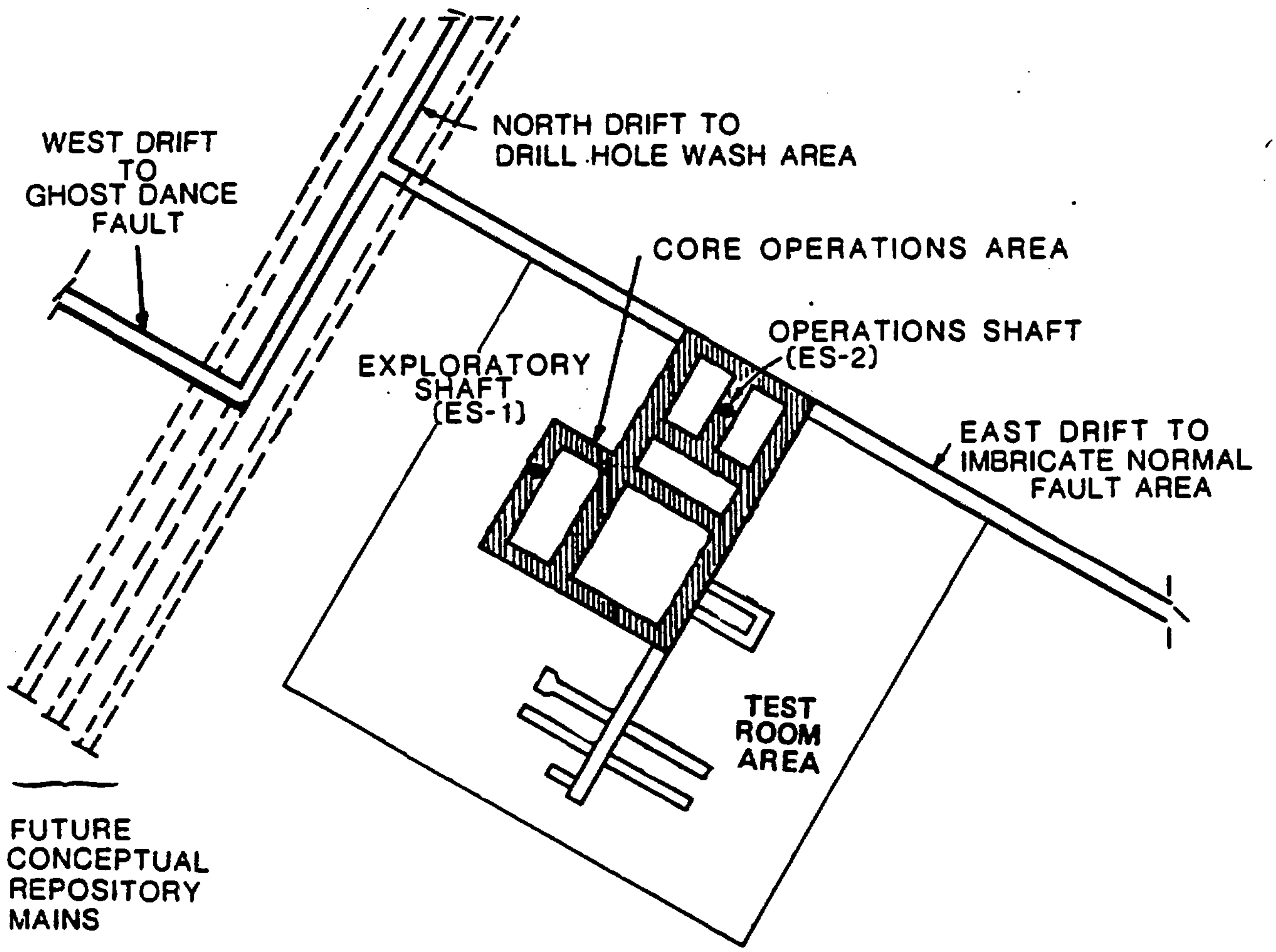
The addition of three long exploratory drifts imposed new requirements on the main test level area. The layout of the area was modified to utilize the second shaft as an operations shaft for removal of muck and transport of men and materials involved in the construction of the long drifts. In order to provide for concurrent testing and construction activities, the test area layout was reconfigured to allow separation of mining and muck removal activities from the scientific investigation ongoing in ES-1 and the test areas of the main test level.

With the increase in drifting, it is important that the ESF can be integrated into a future repository if Yucca Mountain is selected. The integration of the ESF into the evolving repository design is an ongoing activity whose objective is to minimize the impact of the ESF on the repository.

The proposed design of the test area will accommodate the needs for separation of the various tests. While there is improved understanding of the testing requirements and methods, there is a strong likelihood that further improvement in understanding will occur, and further changes to the ESF layout and test program may be required. Therefore, the proposed layout provides sufficient flexibility to accomodate future changes.



FINAL EA MAIN TEST LEVEL (1500 LINEAR FEET) PLAN



PRELIMINARY ILLUSTRATION OF THE MAIN TEST LEVEL (4000 LINEAR FEET)* PLAN
*NOT INCLUDING DRIFTS TO FAULT AREAS

Figure 6. Comparative Illustration of the Final EA Versus the Proposed Main Test Level Arrangement.

4.5 Increase in second shaft (ES-2) diameter

The evaluation of the ESF shaft requirements was made by an ad hoc committee of experienced mining engineers and NNWSI Project staff. Studies were performed by Sandia National Laboratories and their contractor, Parsons, Brinkerhoff, Quade & Douglas (Blejwas, 1986a, 1986b) to determine optimum shaft sizes and ventilation requirements for the expanded underground facility. The basic criterion for specifying the shaft size was the determination of the smallest size capable of meeting all programmatic, operational, and safety requirements. Figure 7 presents a matrix resulting from the studies performed, which shows a comparison of shafts and identifies those configurations that were determined to be acceptable. The results of the evaluation was that the original 12-foot exploratory diameter shaft to 1484 feet, be maintained as originally specified. It was recommended that the conveyances be changed to a cage-over-skip configuration. It was further recommended that the 6-foot diameter second shaft be increased to 12-foot diameter, to provide the necessary ventilation capacity, and that a cage-over-skip conveyance be included to handle the muck in the exploratory drift mining operation. The revised design provides sufficient ventilation capacity to meet projected requirements and contingency for increased capacity (to handle the potential high-silica dust situation that would arise from dry or nearly dry mining). The flexibility to increase ventilation capacity is essential if it becomes necessary to conduct experimentation dust control. There is sufficient muck and material handling capacity to allow full support without impinging on the hoisting capability of the first shaft, which is dedicated to the scientific investigations. With the proposed design for the conveyance in the shaft, there would be no difficulty in getting the mining equipment down the shaft. The shaft was sized so that it would be possible to get the equipment down the shaft with conventional disassembly.

N = NOT ACCEPTABLE
M = MARGINAL
A = ACCEPTABLE

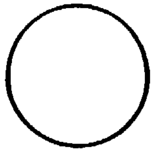
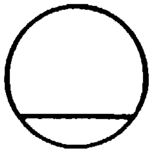
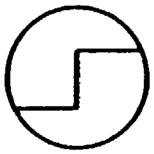
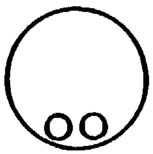
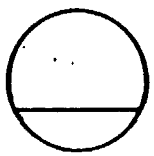
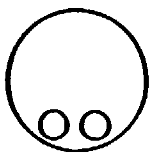
SPECIAL NOTES	Ø (FT) SHAFT CONFIG.	8 FT Ø	10 FT Ø	12 FT Ø	14 FT Ø	15 FT Ø
REQUIRES THAT BOTH SHAFTS BE CONNECTED		CONSTRUCTION N VENTILATION N MUCK A EQUIPMENT A MATERIALS A PEOPLE A	CONSTRUCTION M VENTILATION N MUCK A EQUIPMENT A MATERIALS A PEOPLE A	CONSTRUCTION A VENTILATION N MUCK A EQUIPMENT A MATERIALS A PEOPLE A	CONSTRUCTION A VENTILATION N MUCK A EQUIPMENT A MATERIALS A PEOPLE N	CONSTRUCTION A VENTILATION N MUCK A EQUIPMENT A MATERIALS A PEOPLE A
PLENUM IS 17% OF CROSS SECTION		CONSTRUCTION N VENTILATION N MUCK A EQUIPMENT N MATERIALS A PEOPLE A	CONSTRUCTION M VENTILATION N MUCK A EQUIPMENT N MATERIALS A PEOPLE A	CONSTRUCTION A VENTILATION N MUCK A EQUIPMENT A MATERIALS A PEOPLE A	CONSTRUCTION A VENTILATION A MUCK A EQUIPMENT A MATERIALS A PEOPLE A	CONSTRUCTION A VENTILATION A MUCK A EQUIPMENT A MATERIALS A PEOPLE A
		CONSTRUCTION N VENTILATION N MUCK A EQUIPMENT N MATERIALS A PEOPLE A	CONSTRUCTION M VENTILATION N MUCK A EQUIPMENT N MATERIALS A PEOPLE A	CONSTRUCTION A VENTILATION N MUCK A EQUIPMENT N MATERIALS A PEOPLE A	CONSTRUCTION A VENTILATION A MUCK A EQUIPMENT N MATERIALS A PEOPLE A	CONSTRUCTION A VENTILATION A MUCK A EQUIPMENT N MATERIALS A PEOPLE A
30" Ø VENTILATION DUCTS CONSTRUCTION		CONSTRUCTION N VENTILATION N MUCK A EQUIPMENT N MATERIALS A PEOPLE A	CONSTRUCTION M VENTILATION N MUCK A EQUIPMENT A MATERIALS A PEOPLE A	CONSTRUCTION A VENTILATION N MUCK A EQUIPMENT A MATERIALS A PEOPLE A	CONSTRUCTION A VENTILATION N MUCK A EQUIPMENT A MATERIALS A PEOPLE A	CONSTRUCTION A VENTILATION N MUCK A EQUIPMENT A MATERIALS A PEOPLE A
PLENUM IS 25% OF CROSS SECTION		CONSTRUCTION N VENTILATION N MUCK A EQUIPMENT N MATERIALS A PEOPLE A	CONSTRUCTION M VENTILATION N MUCK A EQUIPMENT N MATERIALS A PEOPLE A	CONSTRUCTION A VENTILATION A MUCK A EQUIPMENT A MATERIALS A PEOPLE A	CONSTRUCTION A VENTILATION A MUCK A EQUIPMENT A MATERIALS A PEOPLE A	CONSTRUCTION A VENTILATION A MUCK A EQUIPMENT A MATERIALS A PEOPLE A
42" Ø VENTILATION DUCTS CONSTRUCTION		CONSTRUCTION N VENTILATION A MUCK A EQUIPMENT N MATERIALS A PEOPLE A	CONSTRUCTION M VENTILATION A MUCK A EQUIPMENT N MATERIALS A PEOPLE A	CONSTRUCTION A VENTILATION A MUCK A EQUIPMENT A MATERIALS A PEOPLE A	CONSTRUCTION A VENTILATION A MUCK A EQUIPMENT A MATERIALS A PEOPLE A	CONSTRUCTION A VENTILATION A MUCK A EQUIPMENT A MATERIALS A PEOPLE A

Figure 7. Acceptability Matrix for AD Hoc Group Comparison of Sizing Studies for the Second Shaft.

5. PRELIMINARY ENVIRONMENT EVALUATIONS

To assess the impact of the proposed revisions to the ESF design, construction approach, and schedule on the conclusions reached in the EA, a preliminary evaluation was conducted between the EA (as the reference case) and the proposed changes in each of the technical areas listed in the EA to assess the incremental impacts of those proposed changes. The environmental impact analyses of the EA presented a range of values using a reasonable but conservative approach to impact evaluation, and this same approach was applied in the preliminary analysis of the proposed revision. The results of the EA analysis and the preliminary analysis were compared to determine whether the revised design, construction approach, and schedule would result in impacts not bounded by the range of impacts as reported in the EA. It was determined that the proposed changes will result in reductions in impact in some areas, no change in others, and some minor additional impacts to the environment from the revised and expanded construction requirements. The conclusion of the preliminary evaluation is that increased impacts are minimal, do not contribute to the degradation of the environment, and are within the impacts analyzed in the EA. The results of this preliminary evaluation and comparison are summarized in the following sections for each of 12 separate impact areas. Figure 8 shows the facilities which were considered in the evaluation.

1) Geology. The two site characterization activities discussed under the geology discipline in the EA that have a potential for environmental impact are ESF excavation and the use of licensed radiation sources for geophysical logging studies. Both of these activities were expected to result in a zero residual impact once standard operating practices were employed for either the reference design or the proposed changes.

2) Hydrology. The change in location of the exploratory shafts, and surface support facilities impacts caused by modification of natural drainage in the area, are alleviated since the two shafts and surface facilities have been relocated from a natural drainage area to a higher elevation on a ridge. This change in location leaves Coyote Wash undisturbed and the drainage tributaries in their natural condition. The final cut and fill operations and final expansion plans for the rock-storage pile are undefined, but are expected to result in an additional but insignificant environmental impact in the concentration of local runoff.

3) Land use. The proposed ESF location has changed a few hundred feet from the reference location, but the approximately 20 acres will remain entirely on Federal lands. This results in no change in impacts to land use.

4) Surface Soils. The total disturbed acreage of surface soils from site characterization surface preparation for the reference design was found to result in a negligible impact once standard operating practices were employed. The proposed changes to the ESF will result in a slightly larger disturbed area due mainly to the increased size of the rock-storage pile. The use of standard operating practices is still expected to be implemented. With regard to the larger areal surface used for the proposed design, the additional acreage that would be disturbed is still small

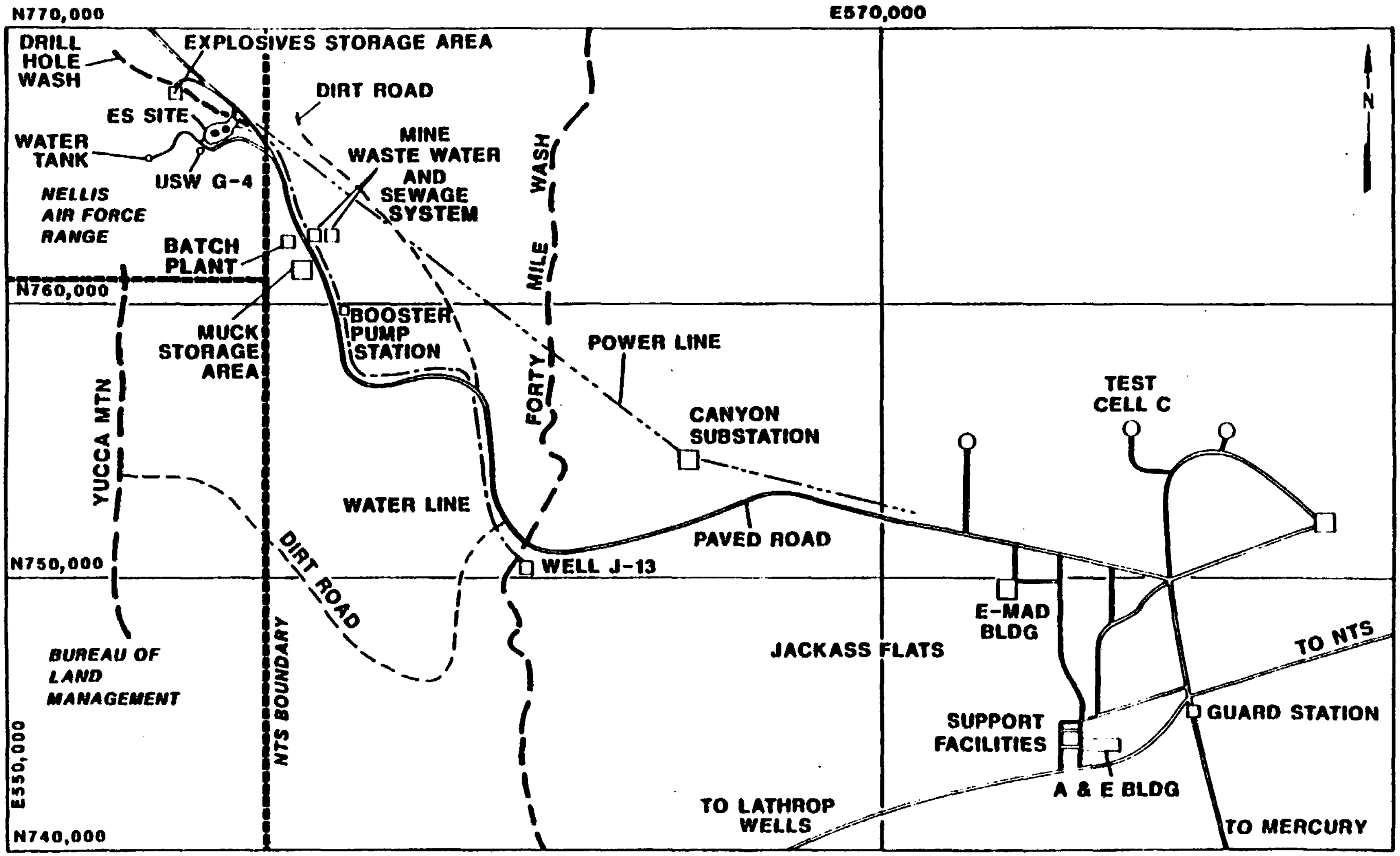


Figure 8. Proposed location of facilities utilized during Exploratory Shaft Facility construction and testing.

compared with the relatively undisturbed land and surface soils in the surrounding region and is deemed to be insignificant.

5) Ecosystems. Impact to ecosystems is associated with site characterization activities through the removal of wildlife habitat as a result of larger areal extent of surface soil disturbance. The differences resulting from the proposed change are minor and not considered significant. Therefore, overall differences in impacts are considered insignificant.

6) Air quality. An emphasis on the air quality analysis presented in the EA was to determine whether pollutant emissions from site characterization (both gaseous and particulate) were of sufficient magnitude to result in application of Prevention of Significant Deterioration (PSD) regulations. For comparative purposes, therefore, the re-evaluation of the modified ESF design and construction approach considered if the emissions resulting from the current ESF schedule/configuration would approach or exceed these threshold levels.

   a. Increase in rock storage pile size. Proposed changes in ESF design would result in the rock storage pile being larger than envisioned in the EA (5 acres versus 1.5 acres). While this increased size increases the potential for wind erosion and resuspension of material on the pile, such emissions are considered fugitive and are not included in determining PSD applicability. Therefore, the change in impacts is listed as insignificant, in terms of the conclusions presented in the EA, because those conclusions related to PSD applicability would not change as a result of the increase in rock-storage pile size.

   b. Reduction in cut and fill volumes. By moving the location of the shafts from within Coyote Wash to the bench north of the wash, a reduction in the amount of cut and fill needed in preparation of the site was achieved. This reduction, from 92,600 cubic yards to 67,000 cubic yards, will reduce emissions associated with cut and fill operations.

   c. Increase in the amount of shaft and drift excavation. The increase in drifting will result in an increase in the volume of muck (mined material) from 38,000 cubic yards to 160,000 cubic yards. However, the emission calculations performed for this activity (in evaluating the schedule change) indicate that this increase does not, in and of itself or in combination with other activities, change the findings presented in Chapter 4 of the EA relative to PSD applicability.

   d. Change in schedule of activities. Although both the reference and proposed schedules cover the same time period, the reference design has very little activity overlap, whereas the new proposal does have activity overlap. Accounting for the overlap in the proposed construction schedule and summing the emissions for the 12 consecutive months with the highest emission rates, results in an annual total of approximately 40 tons of particulate. This is still below the 250 ton per year threshold level and the change is considered insignificant in terms of the conclusions reached in Chapter 4 of the EA.

e. Change in ES-2 diameter and mining method. The switch from raise-boring the secondary egress shaft to drill/blast/muck and the increase in shaft diameter from 6 to 12 feet does represent an increase in emissions from this activity. However, the existence of emissions due to excavation of ES-2, either alone or in combination with other activities, does not change the finding that ESF excavation emissions will not exceed the PSD threshold level and thereby require adherence to PSD regulations. Therefore, although emissions do increase, this increase is considered insignificant.

f. Preliminary analysis of the air quality impacts associated with the current ESF schedule. An analysis was performed that consisted of calculating the particulate emissions from a reasonable 24-hour activity scenario and, using the air quality analysis presented in Chapter 5 of the EA, calculating a 24-hour average particulate concentration. This preliminary analysis indicates that the 24-hour ambient particulate standard of 150 milligrams per cubic meter would not be exceeded as a result of ESF activities.

7) Noise. The proposed plan could have two drills operating simultaneously, which may increase resultant noise. The resultant noise level increase will be less than 3 dba, but will increase the impact zone to wildlife from 0.6 kilometer (0.4 miles) to approximately 0.8 to 1 kilometer (0.5 to 0.6 miles). Blasting will remain at the same quantity of explosive per discharge. Hence no increase in the maximum instantaneous noise level is anticipated. Although ventilation requirements (CFM) will increase four fold, no incremental noise is anticipated as Occupational Safety and Health Administration regulations will limit noise levels, and maximum noise levels were used in the EA.

8) Aesthetics. Although some additional facilities are proposed, and additional drilling machinery will be brought in to support ES-2 activities, none of these facilities will be visible from major population centers or from public recreation areas. While some limited visibility is provided from public highways and some portions of Amargosa Valley, overall visual impact is not considered significant.

9) Archaeological, cultural, and historical resources. Current policy regarding these resources requires preconstruction surveys, and as standard operating practice, avoidance whenever possible. Where sites cannot be avoided, they will be salvaged, and the findings documented. Thus, the proposed changes to ESF configuration and location are not considered to present a potential for significant impact.

10) Socioeconomics. The socioeconomic analysis included in the EA contained a number of subsections: economic conditions (employment and materials), population density and distribution, community services, social conditions, and fiscal and government structure. This preliminary analysis did not find any areas where impacts decreased, nor any areas where the additional impacts would be potentially significant.

11) Transportation. The change in maximum onsite workers would increase from 147 to 183. As stated in the EA, it is expected that a percentage of the ESF construction staff will come from the existing Nevada Test Site (NTS) workforce. Therefore, it is assumed that a total of 90 workers will be added to this existing workforce for construction of the ESF. Under worst case assumptions (as used in the EA for this particular point) 90 new workers could mean 90 new vehicles on U.S. 95 during the evening rush hour. This number represents a degradation of the level of service between S.R. 160 south to the Mercury interchange. Traditionally, NTS workers travel by existing bus transportation and little impact is expected as worker population increases or decreases.

12) Radiological concerns. The increase in radon/radon daughter product release will be proportional to the increase in the volume of excavated tuff. The volume excavated will increase by a factor of 6 to 7, thus the offsite release will increase by this same factor. Based on this estimate, the population doses are small, and less than the projected for normal mining activity; thus, no significant impact is projected and further analysis is not required.

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