Department of Energy
Washington, DC 20585

November 14, 1994

Mr. Robert M. Bernero, Director
Office of Nuclear Material Safety and Safeguards
U. S. Nuclear Regulatory Commission
Washington, DC 20655-000

Dear Mr. Bernero:

This letter contains our completed response to your letter dated October 13, 1994 documenting the U.S. Nuclear Regulatory Commission (NRC) staff comment and questions regarding the Civilian Radioactive Waste Management System Management and Operating Contractor's (M&O's) Quality Assurance program and U.S. Department of Energy's (DOE's) oversight of the M&O's program. We provided you our initial response on October 17, 1994.

With respect to the comment in your letter regarding the engineering and QA program, you have raised valid issues that the DOE and M&O need to improve efforts to provide more timely and effective corrective actions. I want to assure you that we are taking your comment very seriously. DOE has evaluated the NRC comment and agrees that some of these problems are recurring. We recognize that the problems identified by our oversight activities and highlighted in NRC's Comment represent: design control implementation issues, design control and corrective action program effectiveness issues, and issues regarding the effectiveness of our organization to manage these programs.

Many of the specific comments have been addressed, but time is required to fully implement all corrective actions. Some of the immediate corrective actions are: 1) The M&O is realigning its Mined Geologic Disposal System (MGDS) Operations organization to strengthen the implementation of the M&O engineering activities in the areas of process performance monitoring and checking; 2) The DOE Yucca Mountain Site Characterization Office (YMSCO) and the M&O have each formed a team to perform an overview of the corrective actions and non-conformance reports related to design and construction activities to assure consistent and timely implementation of corrective actions; 3) The M&O has also established a team comprised of senior personnel external to the M&O with broad experience in engineering and nuclear quality

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assurance programs to evaluate M&O activities in these areas for programmatic weaknesses and for organizational effectiveness; and 4) The DOE Office of Quality Assurance (OQA) is taking steps to improve existing trending programs by establishing an OCRWM-wide trending program in which OQA will perform the data reduction and line organizations will propose and execute actions in response to the trends. This program is planned to be in place by July 1995.

Although the design control and corrective action problems are serious, we have taken action to ensure that all design products released for construction, including Design Package 2C, are acceptable. Before the design products were released for construction, all mandatory review comments were resolved. We have reviewed our remedial actions and are confident that we have a sound Design Package 2C against which construction is proceeding.

With respect to Question No. 1 of your letter regarding the differences between the various phases of design and construction proposed under the different phases of Design Package 2C, it is important to note that, as a complete design package, Design Package 2 (which includes packages 2A, 2B, and 2C) provides the overall architecture for the ESF subsurface system. As a package, Design Package 2 defines key features such as: transportation, ventilation, power, and ground support; detailed and performance specifications for the procurement of subsurface materials and components; and, the complete North Ramp excavation design drawings and specifications. Overall, Design Package 2 is the basis for all future subsurface design packages. With respect to the actual construction of the ESF, our response describes the phases of Tunnel Boring Machine (TBM) operations. It is emphasized that the Design Package 2C releases do not correspond one-to-one with the TBM operational phases.

With respect to Question No. 2 regarding potential impacts to the site, the performance of formal evaluations of potential impacts provide us with confidence that our activities are sufficiently controlled to in turn provide confidence that the site's waste isolation capability, and our ability to characterize the site, are not compromised. In addition to the discrete impact evaluations performed for ESF Design Package 2C under the Determination of Importance Evaluations (DIE) process, there are other considerations, such as the ESF Alternatives Study (SAND91-0025), that lead us to conclude that the activities underway do not represent a significant potential to adversely impact waste isolation or site characterization. We recognize, however, that these and other considerations are often difficult to extract from existing documentation in a manner that provides for straightforward verification that potential impacts have been adequately addressed. As a result, the DOE will, within 120 days, compile these and related considerations into a single explicit document that describes not only the steps taken and criteria used to identify and minimize potential impacts, but which also describes how the 10 CFR Part 60 requirements applicable to the ESF have been incorporated in the current design.

As will be discussed in our forthcoming response to the October 6, 1994 letter from Margaret Federline of your staff to Ronald Milner (Re: State of Nevada Concern on Pneumatic Pathways), we are sensitive to the State of Nevada's concerns that adequate controls are not in place to preclude the potential for loss of data. We are confident that we have adequately considered the pneumatic pathways issue in terms of potential site characterization impacts.

The evaluations performed in support of ESF Design Package 2C concluded that adequate margin existed in the schedule for the planned collection of test data and the penetration of the Paintbrush Tuff nonwelded - Tiva Canyon welded (PTn-TCw) contact by the TBM. To provide additional confidence that adequate data will be collected, we have applied a "hold", consistent with our process, on TBM operation beyond the upper PTn contact until data have been collected representing the passage of several barometric pressure fronts. Once these data have been collected, monitoring will continue and the hold on further tunnel excavation will be lifted. We anticipate, under normal operating conditions, to reach this point of excavation in approximately eight months.

With respect to Question No. 3 regarding the integration of the ESF, the Geologic Repository Operations Area (GROA), and the Surface-based Testing Program, we have provided a description (attached) of the conceptual design of the GROA and described how the individual design packages that are being prepared for the ESF relate to the repository design. We have also described our latest ESF design and testing strategy as it relates to the GROA design.

In summary, we believe our enclosed response addresses the issues you have raised in your October 13, 1994, letter. If you have any questions, or would like to discuss this further, we are ready to meet with your staff to continue discussions of these topics or other topics of concern. We look forward to your letter transmitting the results of your review, and your closure of these open items. Also, as has been the custom in the past, for your staff to gain confidence in our program, I encourage them to observe any of our activities, and we will continue to work towards resolution of their comment and questions.

If you have any questions, or if you wish to discuss this matter, please contact me at (202) 586-6842.

Sincerely,

Ronald A. Milner

for Daniel A. Dreyfus, Director
Office of Civilian Radioactive
Waste Management

Enclosure:
U.S. DOE Response to U.S. NRC Staff Comment and Questions Regarding the Quality Assurance Program for a High-Level Waste Repository, Letter dated October 13, 1994

cc:
R. Loux, State of Nevada
T.J. Hickey, NV Legislative Committee
J. Meder, NV Legislative Counsel Bureau
M. Murphy, Nye County, NV
D. Bechtel, Clark County, NV
P. Niedzielski-Eichner, Nye County, NV
B. Mettam, Inyo County, NV
V. Poe, Mineral County, NV
F. Mariani, White Pine County, NV
R. Williams, Lander County, NV
L. Fiorenzi, Eureka County, NV
J. Hoffman, Esmeralda County, NV
C. Schank, Churchill County, NV
L. Bradshaw, Nye County, NV
W. Barnard, NWTRB
E. Lowry, NV Indian Environmental Coalition
R. Holden, National Congress of American Indians
M. Knapp, USNRC
J. Holonich, USNRC

ENCLOSURE

U. S. DEPARTMENT OF ENERGY RESPONSE
TO
U.S. NUCLEAR REGULATORY COMMISSION STAFF
COMMENT AND QUESTIONS REGARDING THE QUALITY ASSURANCE
PROGRAM FOR A HIGH-LEVEL WASTE REPOSITORY,
LETTER DATED OCTOBER 13, 1994

NRC COMMENT

Based on the findings from recent U. S. Department of Energy (DOE) quality assurance (QA) audits of the Civilian Radioactive Waste Management and Operations (M&O) contractor, the U. S. Nuclear Regulatory Commission staff is concerned that the M&O QA program is not being effectively implemented in a manner that will assure acceptability of the Exploratory Studies Facility (ESF). In addition, at this time, the NRC staff questions DOE and the M&O's ability to implement a program to correct the problems identified. Finally, although the concerns are based on findings from DOE audits, surveillance, and design reviews, the recurrence of problems and the inability to correct them erodes the NRC's confidence in DOE's oversight of the M&O's QA program.

Basis

- The basic philosophy of the NRC is that the safety of any nuclear facility is the responsibility of the operator. As such, DOE is the primary party responsible for ensuring that a high-level waste repository meets the requirements of 10 CFR Part 60. In order to gain confidence that DOE is fulfilling its responsibilities in an acceptable manner, the NRC requires DOE and its contractors to establish and execute a QA program for those structures, systems, and components important to safety and waste isolation. This QA program should provide measures to assure structured and systematic methods exist for: 1) obtaining data; 2) performing analyses; 3) preparing designs; and 4) providing supporting documentation for the NRC licensing decisions. Effective implementation of a QA program is intended to show that work was done properly, and the design will acceptably perform its function. As part of the NRC licensing process, the NRC staff needs to acquire the necessary confidence that the ESF is being acceptably designed, and will be built consistent with an approved design.

- Construction being performed by DOE at the ESF could cause irreparable adverse effects on DOE's ability to perform site characterization or maintain the waste isolation capability of the site. Without an effectively implemented QA program, the staff does not have confidence that DOE will include all necessary considerations in the ESF design, or identify and correct problems. Examples include: 1) drifting that will be part of the geologic repository operations area too close to a fault; 2) ramp constructed at an improper angle; or 3) an incorrect seismic acceleration used in the structural analysis.

- The August 20, 1993, letter from the staff to DOE expressed concern with findings from DOE audits of the M&O's QA program. The findings demonstrated a lack of effective implementation of the M&O's QA program. Because of this, the staff requested the DOE provide a rationale for continuing ESF PPA design work being conducted by the M&O. The letter also requested that DOE submit a detailed plan for corrective actions for the M&O design deficiencies that were identified during audits and surveillances.

- Although the staff found the Design Control Improvement Plan (DCIP) submitted in response to the August 20, 1993, letter acceptable, the NRC staff noted in its March 30, 1994, letter that acceptable and effective implementation of the DCIP still needed to be demonstrated. Subsequently, findings identified by DOE QA audits and design reviews since development of the DCIP demonstrated a recurrence of earlier problems. Therefore, at this time, the NRC staff does not have confidence that DOE and the M&O can effectively implement the "Management Plan for Resolving QA Issues Resulting from M&O and DOE Audits/Surveillances" developed in response to the latest findings on the M&O QA program.

- DOE and the M&O have not effectively trended and integrated findings from different review activities such as QA audits and design reviews in determining trends, root causes, and recurrence of problems. At the August 30, 1994, QA meeting, DOE reported that it did not see a recurrence of problems based on its analysis of Corrective Action Reports (CARs) from QA audits. It did not, however, consider similar findings from design reviews conducted on Design Packages 2A, 2B, and 2C. For example, as part of its observation of the design review for packages 2A and 2B, the NRC staff raised a concern about the lack of conservatism from the design reviews in determining whether similar concerns existed on the M&O's QA program.

- The M&O continued to conduct design work on Design Package 2C, even though DOE and M&O QA audits and surveillances had found recurring deficiencies in the M&O's QA program. Only after DOE indicated that it would issue a stop work order as a result of findings on Design Package 2C did the M&O withdraw the design package. In addition, although minor in effort, the M&O continues to conduct design work on other ESF Design Packages.

- DOE continued to allow work to proceed on Design Package 2C, and it still does allow design work to be done on other ESF design packages. This has been done despite numerous significant and repetitive findings on the M&O's QA program. In addition, DOE has not ensured that the M&O corrective action program required under Criterion 16 of its QA plan is being effectively implemented, or that root cause and trending analyses are identifying the reason for the problems. During the June 1994 DOE Audit of the M&O, DOE mentioned the M&O Trend Program as being ineffective in obtaining corrective action of identified trends.

- Problems continue to be found with tracing the flowdown of design requirements from 10 CFR Part 60 to design specifications. This concern was raised 1) in 1989 as part of the basis for Objection 1 of the Site Characterization Analysis; 2) by the NRC on-site representative in May 1993; and 3) most recently, by the DOE audit team in CAR-074. It also serves as another example of DOE's lack of effective integration in evaluating all findings from various reviews.

Recommendation

In order to build the staff's confidence that DOE and the M&O can develop and implement a QA program, it will be necessary for DOE to demonstrate that the work which has been or will be done is acceptable. Because DOE and the M&O have not demonstrated that they can effectively implement a "get well" program, the staff recommends that DOE allow the NRC an opportunity to determine the acceptability of DOE work prior to the start of any ESF construction that could impact site characterization or the waste isolation capability of the site. The acceptability of the get-well program will be determined based on observations of DOE reviews and audits as well as independent evaluations. In addition, the staff will gain confidence that the get-well program is effective if DOE demonstrates that the process under which the ESF is designed and constructed is identifying and correcting problems.

In addition, DOE should demonstrate that the work on Design Package 2C is acceptable. This should be done by conducting any necessary QA audits, design reviews, or readiness reviews that are needed to demonstrate the acceptability of the work. The number and significance of findings from these reviews can serve as a basis for demonstrating the acceptability of the process and design. DOE also should demonstrate that design work on other design packages is acceptable given the problems identified.

DOE RESPONSE TO NRC COMMENT

Introduction

The U. S. Department of Energy (DOE) agrees that U. S. Nuclear Regulatory Commission Staff (NRC) has raised valid comments about the Civilian Radioactive Waste Management System, Management and Operating Contractor (M&O) Quality Assurance (QA) and design program, and DOE's oversight of the program. The DOE understands the issues raised by the NRC and actions have been taken to address the comments. We recognize that the problems identified by our oversight activities and highlighted in NRC's comment represent: design control implementation issues; design control and corrective action effectiveness issues; and issues regarding the effectiveness of our organization to manage these programs. This response will address corrective actions taken and planned, the acceptability of Design Package 2C as well as other design packages, and the DOE QA trending program.

Actions Relative to M&O Program and DOE's Oversight of M&O's Program

In July 1994, at the time of the DOE performance-based audit of Design Package 2C when it became evident that there were a number of implementation deficiencies, the M&O took actions to remove Design Package 2C from review by the DOE and evaluated the situation. The M&O established a plan (see attached "Management Plan for Resolving QA Issues Resulting from M&O and DOE Audits/Surveillances, August 25, 1994") to assure, through additional reviews in the design process, that Design Package 2C products would be in full compliance with QA program requirements. The DOE Yucca Mountain Site Characterization Office (YMSCO) Engineering and Field Operations team in conjunction with DOE's Office of Quality Assurance (OQA) performed a review of M&O activities associated with the M&O Management Plan.

The M&O and DOE OQA evaluated all open design related Corrective Action Requests (CARs) generated by OQA for impact to Design Package 2C. For those CARs that impact Design Package 2C, OQA verified that any remedial actions that impact the design output documents were complete and acceptable before the design documents were released for construction.

M&O QA is meeting with M&O line management on a weekly basis to establish the latest status regarding implementation of corrective actions on all open CARs (DOE CARs and M&O CARs).

The YMSCO and OQA have also formed a Quality and Design Improvement Team (QADIT) to perform an independent overview of CARs and Nonconformance Reports related to design/construction activities to determine if there are any adverse trends that warrant further actions, and to identify areas that need improvement. In addition, the OQA is also evaluating the corrective actions taken/being taken on each CAR issued against the M&O, and will assure that effective and timely corrective action necessary to perform work is taken.

Additionally, the M&O is realigning its Mined Geologic Disposal System (MGDS) Operations organization (see attached MGDS Operations organization charts) to strengthen the implementation of the M&O Exploratory Studies Facility (ESF), Repository, and Waste Package Design functions and the Engineering Assurance function.

In response to previously identified M&O design control process and implementation problems, the M&O established an Engineering Assurance (QA program compliance) function to perform additional in-line reviews of the engineering product as products are actually being developed. This Engineering Assurance function is being expanded and included as part of the Product Integrity organization. This new group would report directly to the MGDS Operations Manager and would be expanded to include a senior engineering manager with three sub-groups: Engineering Assurance; Product Technical Integrity/Cost Effectiveness; and Statistical Analysis. The Product Integrity group would be accountable for reviewing all types of products developed within the MGDS Operations organization (not just MGDS Development as it now exists). This group would serve as advisors to all the MGDS offices doing quality affecting work. They would be tasked with identifying quality concerns early and helping the MGDS offices address these issues before the issues become problems. When this organizational change is in place, quality issues will be identified early and be prevented from becoming QA problems. This Product Integrity group will be reviewing the product development throughout the product sequence as described above.

The MGDS Development organization is consolidating the surface and subsurface design functions, as well as creating a new Product Checking function. MGDS Development would then have four departments: ESF Design, Repository Development, Waste Package Development, and Product Checking. This reorganization will provide one engineering manager for each of the major products and a group whose sole function is to check design products. Under the present organization, a design engineer has a dual responsibility for originating design and also for checking other engineer's design work. This dual function has not been as effective as desired. With the implementation of the proposed realignment, the design personnel working in the new Product Checking department would have the responsibility for checking the design products generated by the design originators; therefore, they would be focused on checking alone. This realignment will clearly increase emphasis on the checking function. The design process sequence would remain: produce design product; check design product; inter-discipline review; design review; design verification; management approval; and DOE acceptance.

The M&O has also established a team comprised of senior personnel external to the M&O with broad experience in engineering and nuclear quality assurance programs to evaluate M&O activities in these areas for whether there are any programmatic weaknesses and for organizational effectiveness. This team will provide formal recommendations to the M&O Nevada Site Manager, and will evaluate the effectiveness of corrective actions implemented to address the recommendations.

The NRC has also commented that DOE needs to improve efforts to provide more effective corrective actions. DOE has evaluated the NRC comments and agrees

that some of the recent problems are recurring. YMSCO is taking the necessary action to establish accountability within their line management whereby timely corrective action will be addressed. Corrective action commitments and requests for extension will be carefully evaluated by YMSCO line management and OQA prior to acceptance.

Design Package 2C and Other Design Packages Comments

Although the design control and corrective action problems are serious, we have taken action to ensure that all design products released for construction, including Design Package 2C, are acceptable. Before the design products were released for construction, all mandatory review comments were resolved. We have reviewed our remedial actions and are confident that we have a sound Design Package 2C against which construction is proceeding. For example, the M&O and DOE OQA have evaluated all open related CARs for impact to Design Package 2C. For those CARs that impact Design Package 2C, verification of remedial actions that impact the design output documents was complete and acceptable before the design documents were released for construction.

The additional reviews added to the design process for Design Package 2C will continue to be implemented for other design package development until corrective action verification has assured effectiveness of actions to prevent recurrence.

DOE will verify that investigative actions taken to determine the extent of the deficiencies, including determining impact on previously released design products, is effective. DOE is also verifying whether corrective actions taken to prevent recurrence of problems has been effective. These verifications are being accomplished via CAR follow-up verifications, audits, and surveillances. These activities will also determine the effectiveness of procedural implementation. The NRC will be provided notification of these activities and is encouraged to observe the activities.

DOE QA Trending Program

DOE OQA performs QA Program trending evaluations in accordance with OCRWM QAP 18.3, Revision 0. This current process does not include trending of deficiency reports generated by affected organizations, such as the M&O. DOE OQA is taking additional steps to establish an OCRWM wide trending program whereby standard forms for reporting non-conformance and deficiencies (CAR form) are used and one organization, OQA, performs the trending. This program is planned to be in place by July 1995. This program will require timely corrective actions for adverse trends or patterns that are detected, and will provide for the evaluation of the effectiveness of these corrective actions.

Conclusion

DOE understands the serious nature of the NRC comments, and is taking measures to ensure corrective actions are being taken and will be taken to address these comments. The DOE has evaluated this situation and problems are being identified and resolved with management commitment and quality improvement. Additional actions that are required will be made on DOE's part and on the part of the M&O.

COMMENT 1 RESPONSE
ATTACHMENTS

1) MANAGEMENT PLAN FOR RESOLVING QA ISSUES RESULTING FROM M&O AND DOE AUDITS/SURVEILLANCES, AUGUST 25, 1995

2) M&O MGDS OPERATIONS ORGANIZATION CHART

Management Plan for Resolving QA Issues
Resulting from M&O and DOE Audits/Surveillances
August 25, 1994

The following reviews will be initiated immediately. The results of the initial portions of each review area will determine the overall schedule to satisfactorily resolve management concerns. This plan will be applied to all in-progress and future QA work. The initial primary focus will be on the QA portion of Package 2C that applies to Phase I (initial testing of the TBM). Concurrently, the remaining portion of the QA portion of Package 2C will be worked (required reviews, revisions, checking and verification). Attachment 3 is a list of the contents of the 2C partial release package along with a projected schedule.

1.0 CAR Analysis (All Open CARs)

1.1 Assign responsibility for analysis
M&O QA will identify all open CARs and will coordinate and document line responsibility(s). Where practical, those CARs not applicable to the QA portion of Package 2C will be so noted. The final tabulation will be utilized to initiate the action in 1.2.

1.2 Develop corrective action for open CARs
Corrective action for each CAR, beginning with the QA portion of Package 2C, will be developed. Where multiple organizational identities are involved, the designated lead from 1.1 above will coordinate the corrective action.

1.3 M&O QA and DOE QA reaction
The lead from 1.1 above will discuss the proposed corrective action with M&O QA. Clearly the proposed action must be comprehensive and meaningful enough to completely resolve the concern beginning with the QA portion of Package 2C. Once agreement is reached between the lead and M&O QA on DOE CARs, the DOE QA will be asked to comment. As indicated previously, the QA portion of Package 2C will be done first.

1.4 Implement corrective action
Once appropriate QA agreement has been received, corrective action will be initialized by the appropriate manager in conjunction with the results from 2.0, 3.0, 4.0, and 5.0, beginning with the QA portion of Package 2C. This action will take place prior to actual documentation of corrective action on the CAR form.

2.0 Items corrected during the recent audits/surveillances

2.1 Assign responsibility for analysis for similar problems
M&O QA will identify all items corrected during the June 1994 DOE Compliance Audit, the M&O Surveillance which followed the Compliance Audit, and the DOE Performance Audit which was concluded on July 29, 1994. Coordinating and documenting line responsibilities will follow with the final tabulation serving as the initializing document for 2.2. Where practical, those items not applicable to the QA portion of Package 2C will be so noted.

2.2 Review products for similar problems
Beginning with the QA portion of Package 2C, the responsible line organization will review all applicable products for similar problems.

2.3 Develop corrective action as required
Where applicable, corrective action will be developed beginning with the QA portion of Package 2C.

2.4 Implement corrective action
Revision of the products which are in error, etc., will be initialized by the appropriate manager in conjunction with the results from 1.0, 3.0, 4.0, and 5.0, beginning with the QA portion of Package 2C.

3.0 Design Process Review

3.1 Develop detailed flow chart
Utilizing the detailed flow charts for the QAPs, develop a detailed flow chart for the overall design process beginning with the requirements hierarchy development and ending with the specification and drawing preparation.

3.2 Review CARs, etc., for process problems
Utilizing the list developed under 1.1, identify all CARs which point to design process concerns.

3.3 Develop process revisions as required
Based on the process concerns identified, prepare design process revisions as appropriate. Focus initially on concerns that specifically apply to the QA portion of Package 2C. Any process problems which result in product problems will be discussed with corrective actions resulting. M&O QA and DOE QA reaction will be sought as appropriate with the resulting corrective actions carried out by the appropriate manager in conjunction with the results from 1.0, 2.0, 4.0, and 5.0, beginning with the QA portion of Package 2C. Assure detailed design process flow chart from 3.1 is appropriately revised.

3.4 Change the procedures as required
Implement changes identified in 3.3.

3.5 Train the affected personnel as required
Instigate classroom training for all procedure revisions resulting from this process review. Utilize the revised detailed design process flow chart to explain the problem(s) and the solution(s).

4.0 Classification Process Review

4.1 Develop detailed flow chart for classification process
Utilizing the detailed design process flow chart from 3.0, lay out the required steps for our classification process.

4.2 Review CARs, etc., for classification problems
Identify the CARs, items corrected during the audits/surveillances, etc., which involve classification problems.

4.3 Develop revision(s) to the procedures as required
Utilizing the flow chart from 4.1 identify any revision(s) needed to the process and in turn to the procedure(s). Any process problems which result in product problems will be discussed with corrective actions resulting. M&O QA and DOE QA reaction will be sought as appropriate with the resulting corrective actions carried out by the appropriate manager along with the results from 1.0, 2.0, 3.0, and 5.0, beginning with the QA portion of Package 2C.

4.4 Change the revisions
Revise the procedure(s) per 4.3.

4.5 Train the affected personnel as required
Instigate classroom training for all procedure revisions resulting from this process review. Utilize the revised classification flow chart for the classification process to explain the problem(s) and the solution(s).

5.0 Product Quality Review

5.1 Line organization review
The responsible Office Manager will identify an internal team to look at our products to determine whether or not they are in compliance with the QA procedures, beginning with the QA portion of Package 2C. Attachment 1 documents the makeup of each internal team. This is to be a 100% review. The checker of a particular product is not to perform this review on products previously checked by him/her.

5.2 Independent review

The responsible Office Manager will identify an external team (not from the Subsurface organization) to perform the same review discussed in 5.1. Attachment 1 documents the makeup of each external team. QA, along with the Surface Design organization, are the primary sources of personnel for the independent design team.

5.3 Consolidation/analysis of results

Once complete, the review teams from 5.1 and 5.2 will consolidate their results. An effectiveness analysis of the two reviews will be conducted with the results applied as required. Any product problems will be discussed with corrective actions resulting.

5.4 Implement corrective action

M&O QA and DOE QA reaction will be sought as appropriate with the resulting corrective actions carried out by the appropriate manager along with the results of 1.0, 2.0, 3.0, and 4.0, beginning with the QA portion of Package 2C.

6.0 Culture Review

6.1 Root cause determination/recommendation/development

An evaluation will be done to determine what the root cause(s)/recommendation(s) are for the perceptions that: 1) we have too much schedule pressure resulting in unnecessary mistakes, and 2) our workers are not paying attention to detail, again resulting in unnecessary mistakes.

The following potential root cause elements will be included in this evaluation:

- Too much paralleling of work
- Just in time design scheduling
- Inadequate estimation of time required to perform the work
- Must meet precise date mentality
- Too many unrelated work activities initiated during design process
- Technical quality comes before QA compliance
- Constantly changing procedures, etc.
- Lack of senior management involvement in process/product development
- Too much work for too few people

- 60-70 hour work week for a sustained period of time for some individuals
- Lack of attention to detail to QA procedure compliance.

6.2, 6.3 Develop QA program briefing/training; brief M&O personnel
The following minimally will be addressed in this briefing:

- The CAR process in enough detail that all personnel understand their purpose and how we should apply them. Cover clearly when CARs, even when remedial action has been taken on a problem, but it is unknown if this touches other areas
- The importance of verbatim compliance or paying attention to detail
- Allow time during briefing for all personnel to have the opportunity to address why our QA program violations continue
- How to handle appropriately the auditor interface, what your obligations are, and what your preparation should be.

7.0 Management Plan Closure

7.1 1.0, Documentation of objective evidence
A tabulation of all CAR analyses and resulting corrective actions will be developed beginning with the analyses and corrective actions applicable to the QA portion of Package 2C. Additionally, copies of the formal submittals to M&O QA and DOE QA will be included.

7.2 2.0, Documentation of objective evidence
A tabulation of all applicable analyses and any resulting corrective actions from previously closed audits/surveillances will be developed beginning with the analyses and corrective actions applicable to the QA portion of Package 2C.

7.3 3.0, Documentation of objective evidence
The design process review action will be documented showing the recommended adjustments/enhancements to the process. Any applicability to previously generated design products or in-process design products will be documented beginning with the QA portion of Package 2C. Any resulting changes to procedures will be documented at the appropriate time in the implementation of the plan.

7.4 4.0, Documentation of objective evidence
The classification process review action will be documented showing the recommended adjustments/enhancements to the process. Any applicability to previously generated

design products or in-process design products will be documented beginning with the QA portion of Package 2C. Any resulting changes to procedures will be documented at the appropriate time in the implementation of the plan.

7.5 5.0, Documentation of objective evidence
A documentation package will be assembled showing team membership (both line organization review team and the independent review team) along with the problems/ concerns/corrective actions identified by each team beginning with the QA portion of Package 2C.

7.6 6.0, Documentation of objective evidence
A documentation package will be developed which will document all analyses and resulting actions associated with the culture review. Plans for future followup reviews will also be included.

7.7 Summary Report
For each phase of this plan all objective evidence will be summarized with an appropriate statement of acceptability. This will form the basis for management to determine if the appropriate products should be recommended for approval by DOE beginning with the QA portion of Package 2C.

Reference Attachment 2 for key assignments and schedules for the actions in 1.0 through 7.0.

A situation or briefing room will be set up in the 5th floor conference room. Status on all actions will be available on a daily basis. A 4:30 p.m. meeting will be held each day in this conference room to update status.

ATTACHMENT 1
PRODUCT QUALITY REVIEW TEAM ASSIGNMENTS

Line Organization Review (Internal)	
Design	Clark / Garrett / Golien / Herold / Kiefer / Myers / Naaf / Rogers / Saunders / Steinhoff
Requirements Hierarchy	Ashe / Ashlock / Peters / Teraoka
TIEs	Agnew / Boone / Hastings / Houseworth / Simms
WIEs	Agnew / Boone / Hastings / Houseworth / Simms
DIEs	Boone / Hastings / Houseworth / Peters / Quittmeyer / Simms
Independent Review (External)	
Design	French / Heiner / O'Keefe / Salchak / White / Zinkevich
Requirements Hierarchy	Jenkins / Law
TIEs	French / Heiner / O'Keefe / Salchak / White / Zinkevich
WIEs	French / Heiner / O'Keefe / Salchak / White / Zinkevich
DIEs	French / Heiner / O'Keefe / Salchak / White / Zinkevich

8/25/94

ATTACHMENT 2 9/01/94

ACTIVITY	Schedule for QA Portion of Partial Release of 2C		Schedule for Remainder of QA Portion of 2C		Schedule for All Other Products		ASSIGNMENTS						
	Start	Complete	Start	Complete	Start	Complete	QA	Support Operations	Design	WIEs	TIEs	Hierarchy Flowdown	DIEs
1.0 CAR Analysis													
1.1 Assign responsibility for analysis	7/29/94	8/01/94 (A)	7/29/94	8/01/94 (A)	TBD	TBD	Willis	Stafford	Segrest/Saunders	Younker/Houseworth	Statton	Geer/Rindskopf	Geer/Hastings
1.2 Develop corrective action for open CARs	7/29/94	8/24/94 (A)	8/17/94	9/15/94 (A)	TBD	TBD	Willis	Stafford	Segrest/Saunders	Younker/Houseworth	Statton	Geer/Rindskopf	Geer/Hastings
1.3 Get M&O QA review/comments/agreement	8/01/94	8/30/94	8/17/94	9/22/94 (A)	TBD	TBD	Willis	Stafford	Segrest /Saunder	Younker/Houseworth	Statton	Geer/Rindskopf	Geer/Hastings
Get DOE QA comments/agreement	7/29/94	8/31/94	8/17/94	10/10/94 (A)	TBD	TBD	Willis	Stafford	Segrest/Saunders	Younker/Houseworth	Statton	Geer/Rindskopf	Geer/Hastings
1.4 Implement corrective action	7/29/94	8/31/94	8/17/94	10/10/94 (A)	TBD	TBD	Willis	Stafford	Segrest/Saunders	Younker/Houseworth	Statton	Geer/Rindskopf	Geer/Hastings
2.0 Items corrected during recent audits/surveillances													
2.1 Assign responsibility for analysis for similar problems	7/29/94	8/01/94 (A)	7/29/94	8/01/94 (A)	TBD	TBD	Willis	Stafford	Segrest/Leonard	Younker/Houseworth	Statton	Geer/Rindskopf	Geer/Hastings
2.2 Review products for similar problems	7/29/94	8/10/94 (A)	7/29/94	8/10/94 (A)	TBD	TBD	Willis	Stafford	Segrest/Leonard	Younker/Houseworth	Statton	Geer/Rindskopf	Geer/Hastings
2.3 Develop corrective action as required	7/29/94	8/12/94 (A)	7/29/94	8/12/94 (A)	TBD	TBD	Willis	Stafford	Segrest/Leonard	Younker/Houseworth	Statton	Geer/Rindskopf	Geer/Hastings
2.4 Implement corrective action	7/29/94	8/17/94 (A)	7/29/94	8/17/94 (A)	TBD	TBD	Willis	Stafford	Segrest/Leonard	Younker/Houseworth	Statton	Geer/Rindskopf	Geer/Hastings
3.0 Design Process Review													
3.1 Develop detailed flow chart	7/29/94	8/12/94 (A)	7/29/94	8/12/94 (A)	7/29/94	8/08/94 (A)	Willis/Arth	–	Segrest (Lead) Bailey	Younker/Houseworth	Statton	Geer/Rindskopf	Geer/Hastings
3.2 Review CARs, etc., for process problems	7/29/94	8/14/94 (A)	7/29/94	8/14/94 (A)	7/29/94	8/08/94 (A)	Willis/Arth	–	Segrest (Lead) Bailey	Younker/ Housewort	Statton	Geer/Rindskopf	Geer/Hastings
3.3 Develop process revisions as required	7/29/94	8/26/94 (A)	7/29/94	8/26/94 (A)	7/29/94	8/26/94 (A)	Willis/Arth	–	Segrest (Lead) Bailey	Younker/Houseworth	Statton	Geer/Rindskopf	Geer/Hastings
3.4 Change the procedures as required	8/26/94	11/01/94	8/26/94	11/01/94	9/30/94	TBD	Willis/Arth	–	Segrest (Lead) Bailey	Younker/Houseworth	Statton	Geer/Rindskopf	Geer/Hastings
3.5 Train the affected personnel as required	9/01/94	11/01/94	9/01/94	11/01/94	TBD	TBD	Willis/Arth	–	Segrest (Lead) Bailey	Younker/Houseworth	Statton	Geer/Rindskopf	Geer/Hastings
4.0 Classification Process Review													
4.1 Develop detailed flow chart	7/29/94	8/08/94 (A)	7/29/94	8/08/94 (A)	7/29/94	8/08/94 (A)	Willis	–	Segrest/Peters	–	–	–	Geer (Lead) Hastings
4.2 Review CARs, etc., for classification problems	8/01/94	8/26/94 (A)	8/01/94	8/26/94 (A)	8/01/94	8/26/94 (A)	Willis	–	Segrest/Peters	–	–	–	Geer (Lead) Hastings
4.3 Develop revision(s) to the procedures as required	N/A	N/A	N/A	N/A	9/30/94	TBD	Willis	–	Segrest/Peters	–	–	–	Geer (Lead) Hastings
4.4 Change the procedures	N/A	N/A	N/A	N/A	TBD	TBD	Willis	–	Segrest/Peters	–	–	–	Geer (Lead) Hastings
4.5 Train the affected personnel as required	N/A	N/A	N/A	N/A	TBD	TBD	Willis	–	Segrest/Peters	–	–	–	Geer (Lead) Hastings)

ACTIVITY	Schedule for QA Portion of Partial Release of 2C		Schedule for Remainder of QA Portion of 2C		Schedule for All Other Products		ASSIGNMENTS						
	Start	Complete	Start	Complete	Start	Complete	QA	Support Operations	Design	WIEs	TIEs	Hierarchy Flowdown	DIEs
5.0 Product Quality Review													
5.1 Line organization review	8/01/94	8/08/94 (A)	8/01/94	8/08/94 (A)	TBD	TBD	Willis	Stafford	Segrest	Younker	Statton	Geer	Geer
5.2 Independent review	8/01/94	8/08/94 (A)	8/01/94	8/08/94 (A)	TBD	TBD	Willis	Stafford	Segrest	Younker	Statton	Geer	Geer
5.3 Consolidation/analysis of results	8/05/94	8/08/94 (A)	8/05/94	8/08/94 (A)	TBD	TBD	Willis	Stafford	Segrest	Younker	Statton	Geer	Geer
5.4 Implement corrective action	8/10/94	8/25/94 (A)	8/10/94	8/25/94 (A)	TBD	TBD	Willis	Stafford	Segrest	Younker	Statton	Geer	Geer
6.0 Culture Review													
6.1 Root Cause: Recommendation/development	N/A	N/A	N/A	N/A	8/01/94	TBD	Justice	Stafford	Segrest	Younker/Williamson	–	–	–
6.2 Develop QA program briefing/training	N/A	N/A	N/A	N/A	TBD	TBD	Justice	Stafford	Segrest	Younker/Williamson			
6.3 Brief/train affected M&O personnel	N/A	N/A	N/A	N/A	TBD	TBD							
7.0 Management Plan Closure													
7.1 1.0, Documentation of Objective Evidence	8/15/94	8/29/94	9/15/94	10/17/94	TBD	TBD	Willis	Stafford	Segrest	Younker	Statton	Geer	Geer
7.2 2.0, Documentation of Objective Evidence	8/15/94	8/29/94	9/15/94	10/17/94	TBD	TBD	Willis	Stafford	Segrest	Younker	Statton	Geer	Geer
7.3 3.0, Documentation of Objective Evidence	8/15/94	8/29/94	9/15/94	10/17/94	TBD	TBD	Willis	Stafford	Segrest	Younker	Statton	Geer	Geer
7.4 4.0, Documentation of Objective Evidence	8/15/94	8/29/94	9/15/94	10/17/94	TBD	TBD	Willis	Stafford	Segrest	Younker	Statton	Geer	Geer
7.5 5.0, Documentation of Objective Evidence	8/15/94	8/29/94	9/15/94	10/17/94	TBD	TBD	Willis	Stafford	Segrest	Younker	Statton	Geer	Geer
7.6 6.0, Documentation of Objective Evidence	N/A	N/A	N/A	N/A	TBD	TBD	Willis	Stafford	Segrest	Younker	Statton	Geer	Geer
7.7 Summary Report	8/24/94	8/29/94	9/15/94	10/17/94	TBD	TBD	Willis	Stafford	Segrest	Younker	Statton	Geer	Geer

ATTACHMENT 3

2C Partial Release Package
Contents and Projected Schedule

1. Contents:

- Design Inputs Lists for Drawings and Specifications

- Specifications:
  Contractor Quality Control/Quality Assurance BAB000000-01717-6300-01400
  Subsurface General Construction BAB000000-01717-6300-01501
  Summary of Work Package 2C BAB000000-01717-6300-01014

- Drawings:
  Overall Subsurface Layout TS Level Plan BABEAD000-01717-2100-40100
  TS North Ramp Layout General Arrangement Plan and Profile
  BABEAD000-01717-2100-40104
  TS North Ramp Excavation Layout Profile - Sheet 1 of 7
  BABEAD000-01717-2100-40110
  TS North Ramp Excavation Layout Plan - Sheet 1 of 10
  BABEAD000-01717-2100-40120

- DIE:
  Determination of Importance Evaluation for Package 2C
  BAB000000-01717-2200-00005

- TIE:
  Test Interference Evaluation for Tunnel Boring Machine (TBM) Operation, Utilities Installation and Support for TBM Operation for Construction of the North Ramp of the Exploratory Studies Facility - Design Package 2C
  BABFA0000-01717-2200-00001, Rev. 1

- WIE:
  Waste Isolation Evaluation: Construction Water for Package 2C Excavation of the ESF North Ramp BABE00000-01717-2200-00008, Rev. 00

  Waste Isolation Evaluation: Tracers, Fluids, and Materials for use in the Package 2C Exploratory Studies Facility Construction BA0000000-01717-2200-00007, Rev. 00

Civilian Radioactive Waste Management System
Management and Operating Contractor

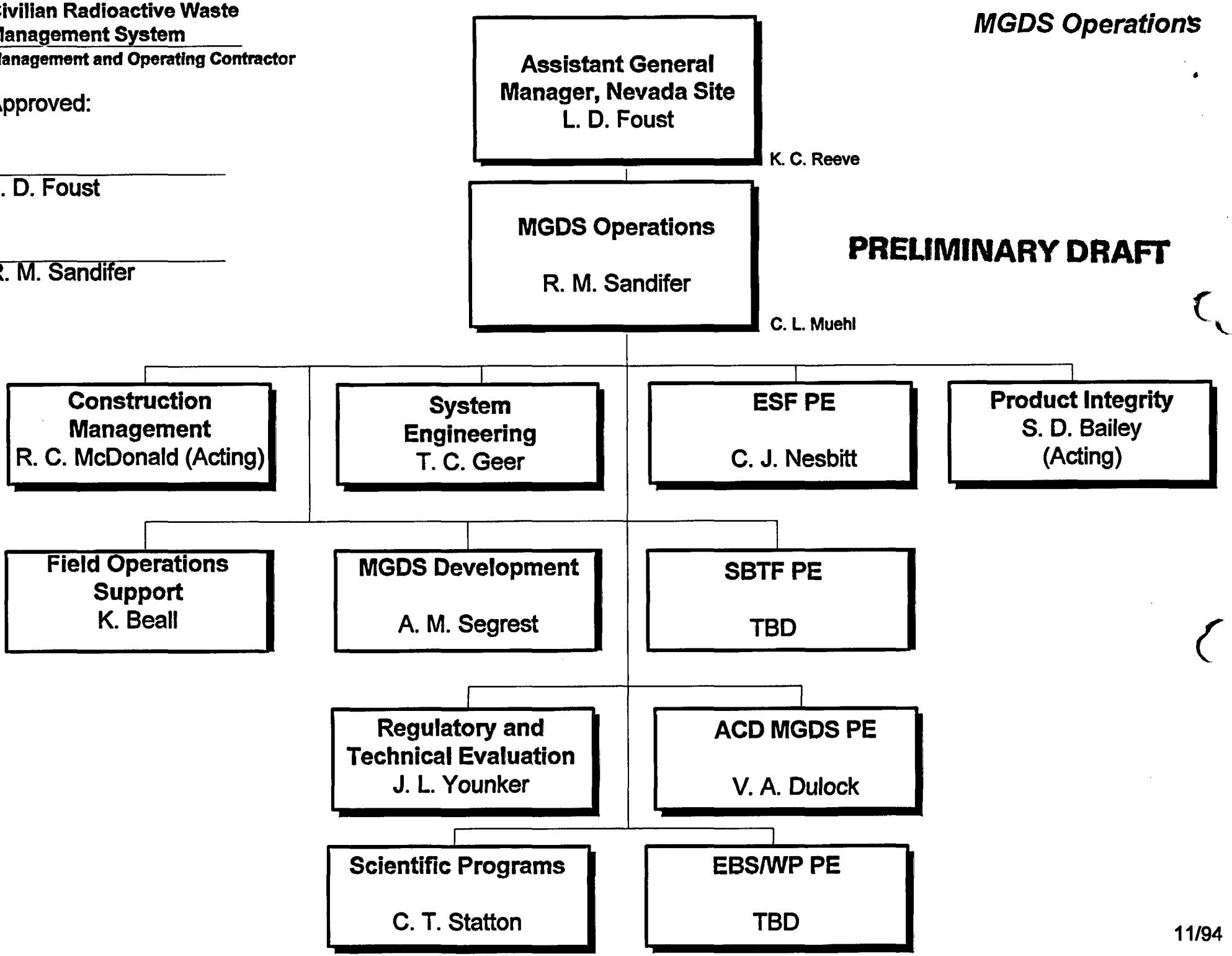
Approved:

L. D. Foust

R. M. Sandifer

MGDS Operations

PRELIMINARY DRAFT



11/94

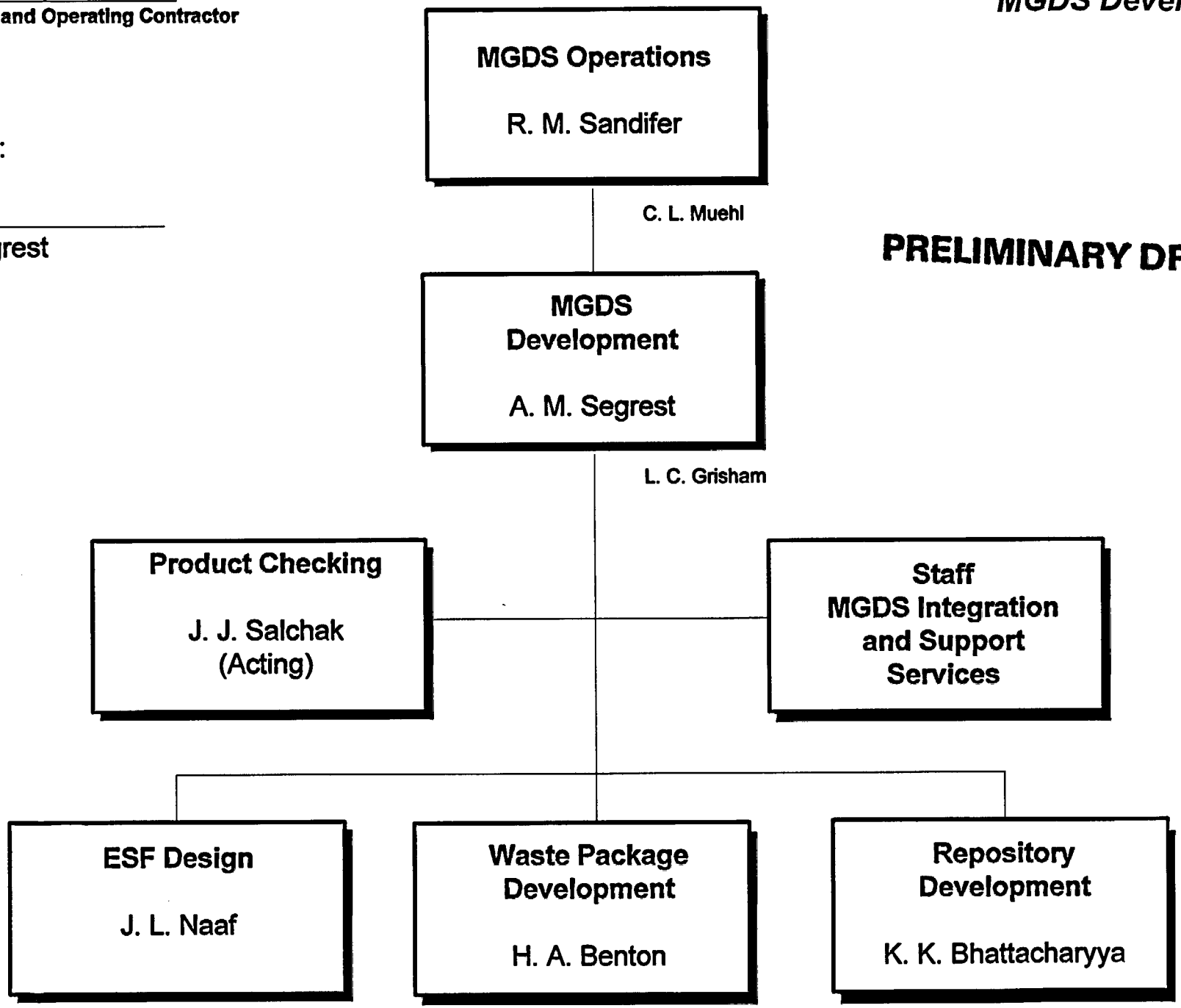
Civilian Radioactive Waste
Management System
Management and Operating Contractor

MGDS Operations
MGDS Development

Approved:

A. M. Segrest

PRELIMINARY DRAFT



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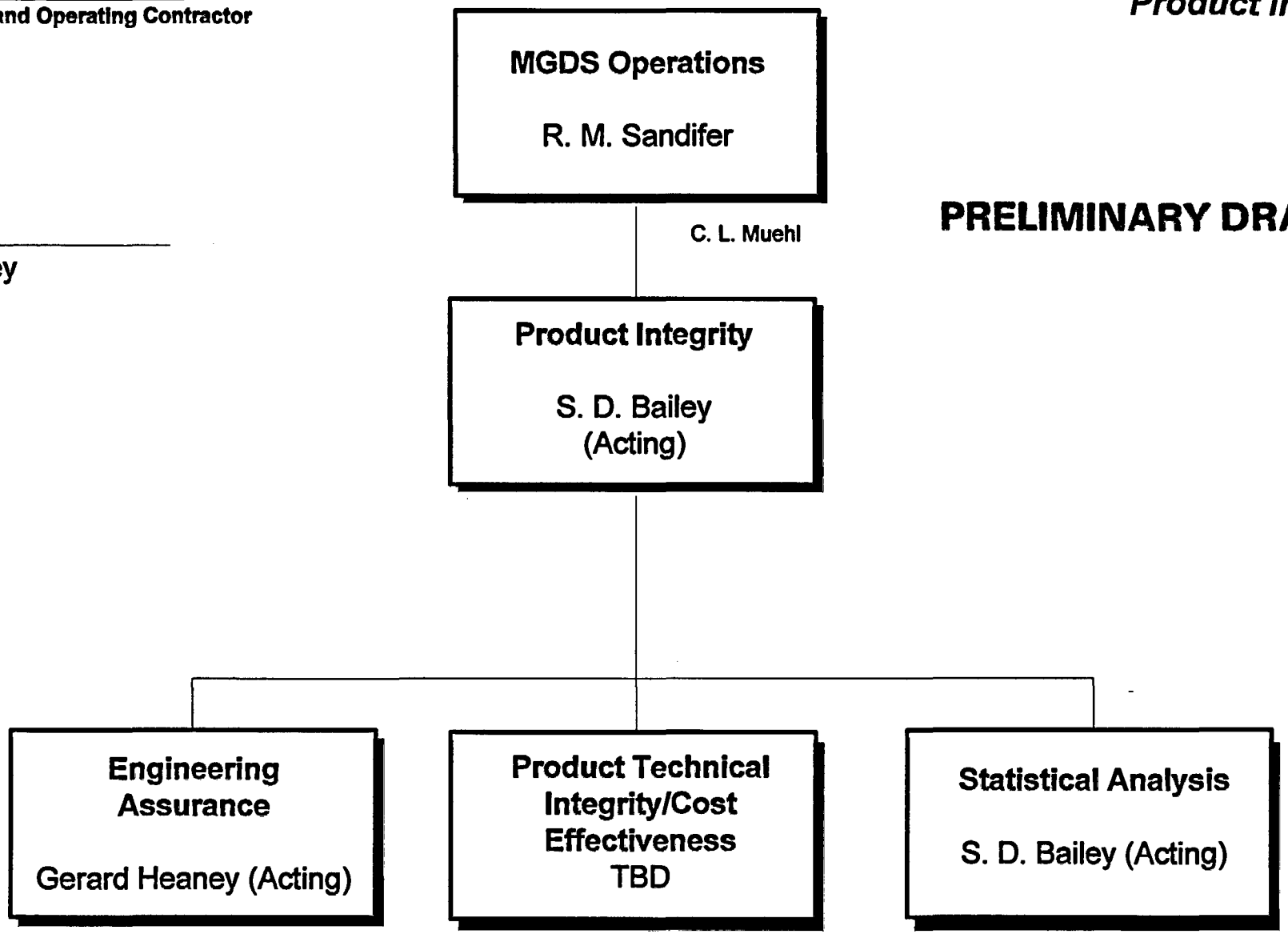
Civilian Radioactive Waste
Management System
Management and Operating Contractor

MGDS Operations
Product Integrity

Approved:

S. D. Bailey

PRELIMINARY DRAFT



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2. Projected Schedule:

Major Milestone	Completion Projected	Completion Actual
CAR Analysis		
• Complete initial draft of corrective action	8/03/94	8/24/94
• M&O QA Concurrence	8/04/94	8/30/94
• DOE QA Concurrence	8/26/94	---
• Implement Corrective Action	8/26/94	---
Items corrected during recent audits/surveillances		
• Develop corrective action as required	8/03/94	8/12/94
• Implement Corrective Action	8/08/94	8/17/94
Design Process Review		
• Develop process revision(s) and any resulting 2C product revisions as required	8/08/94	8/26/94
• Change the procedures as required	N/A	9/01/94
Classification Process Review		
• Develop process revision(s) and any resulting 2C product revisions as required	N/A	N/A
• Change the procedures as required	N/A	N/A
Product Quality Review		
• Complete line organization review with required revisions to 2C identified	8/08/94	8/08/94
• Complete independent review with required revisions to 2C identified	8/08/94	8/08/94
• Implement corrective action	8/18/94	8/25/94
Culture Review	8/01/94	TBD
Management Plan Closure		
• Document all objective evidence	8/26/94	---
• Complete summary report	8/26/94	---

NRC QUESTION 1

What are the differences between the various phases of design and construction proposed under the different phases of Design Package 2C?

Basis

- In telephone calls and meetings with the U. S. Department of Energy (DOE), the staff understood that DOE would implement the design and construction of Design Package 2C in phases. Within each phase, certain design and construction work would be completed. Because some of the terminology and activities for the phases have been unclear and evolving, DOE needs to provide the staff with written documentation that will allow the staff to fully understand the work that will be conducted in the various phases of Design Package 2C. This information is needed so the staff can review DOE's response to Question 2 regarding potential adverse impacts on site characterization or the waste isolation capability of the site.

Recommendation

DOE should provide a description of the work, including design and construction, that will be completed in each phase of Design Package 2C. This information should relate the completion of construction to significant site features such as the Bow Ridge Fault, or issues raised on ESF construction such as pneumatic pathways.

DOE RESPONSE TO NRC QUESTION 1

During the Title II design development for the Exploratory Studies Facility (ESF), the YMSCO adopted a phased design approach in an effort to provide logically packaged design products (drawings and specifications) to the constructor that would allow the commencement of construction activities prior to the completed ESF design. These design products were designated as Design Packages. Two (2) of these design packages are for surface construction activities and 8 are for subsurface construction activities. The following is a listing of the ESF Design Packages (See attached ESF Figure for locations):

Design Package	Design Package Description
1	North Portal Site Preparation and Surface Facilities
2	North Ramp Excavation - Surface to Topopah Spring Level (TSL)
3	South Portal Site Preparation and Surface Facilities
4	South Ramp Excavation - Topopah Spring Level (TSL) to Surface
5	North Ramp Excavation to Calico Hills Level (CHL)
6	South Ramp Excavation to Calico Hills Level (CHL)
7	Calico Hills Level (CHL) Drifting
8	Topopah Spring Level (TSL) Drifting
9	Topopah Spring Level (TSL) - Main Test Area (MTA)
10	Optional Shaft

During the Fiscal Year (FY) 1992 annual planning process, DOE planning guidance maintained a fundamental requirement for an overall balanced program. This principle relied on optimizing a combination of scientific investigations, ESF development, environmental programs, public outreach, etc., rather than focusing all available resources on a single activity such as the ESF. In order to maintain this balance within the available and projected funding profiles, it was determined that certain ESF design packages could be further broken down into smaller work-scope groupings that would still allow the ESF to maintain design and construction momentum and progress without sacrificing the initial logic, sequencing, and primary packaging of the design and construction activities. For example, Design Package 1, North Portal Site Preparation and Surface Facilities, was divided into the following groupings.

Design Package 1: North Portal Site Preparation and Surface Facilities	
1A	North Portal Pad, Tunnel Boring Machine (TBM) Starter Tunnel, TBM Procurement Specifications, Utilities, and Surface Switch Gear Building
1B	Additional Surface Facilities Including: Change House and Portal Control Facility
1C	Additional Surface Facilities and Utilities for TBM Operations Support
1D	Additional Surface Facilities and Utilities for ESF Site Support
1E	Final ESF Surface Facilities for ESF Operations

With respect to the NRC question regarding the differences between the various phases of design and construction proposed under the different phases of Design Package 2C, it is important to note that, as a complete design package, Design Package 2 (which includes packages 2A, 2B, and 2C) provides the overall architecture for the ESF subsurface system. As a package, Design Package 2 includes: key design features such as; transportation, ventilation, power, and ground support; detailed and performance specifications for the procurement of subsurface materials and components; and, the complete North Ramp excavation design drawings and specifications. Overall, Design Package 2 is the basis for all future subsurface design packages. As noted above, like Design Package 1, Design Package 2 was also split into logical groupings that allowed for continued ESF progress in a balanced program. Specifically, Design Package 2 was segregated into the following groupings.

Design Package 2: North Ramp Excavation - Surface to Topopah Spring Level (TSL)	
2A	Key Subsurface Studies and Evaluations Including: Transportation, Ventilation, Power, Ground Support, Etc.
2B	Subsurface Procurement Specifications
2C	North Ramp Excavation Design Including: Waste Isolation Evaluations (WIE's), Test Interference Evaluations (TIE's), and Determination of Importance Evaluations (DIE's)

Design Package 2C is being released in smaller products as the drawings and specifications are reviewed, verified, accepted, and released for construction. There is a limited correlation between the Design Package 2C products being released and the phased TBM operations, as described below. Design Package 2C is being released in the following segments:

Initial line & grade drawings, and general construction specifications (2C-1)

Rock bolts, accessories, remaining line and grade drawings and specification, and the majority of the utility systems drawings and specifications (2C-2)

Steel Sets and associated furnishings, drawings and specifications (2C-3)

Balance of the package (2C-4)

The start of TBM Phase 1 - Testing, was enabled by the release of the first segment of Design Package 2C. This segment included 4 line & grade drawings and 3 specifications. TBM Phase 1 can proceed as far as 12 meters.

The release of the next 2 Design Package 2C segments containing rock bolt and steel set drawings and specifications will allow the start of TBM Phase 2 - Shakedown. After this point, the TBM phases are defined not by subsequent Design Package 2C releases, but by the arrival and installation of equipment. TBM Phase 3 - Limited Operations, begins with the installation of the geologic mapping platform. TBM Phase 4 - Sustained Operations, begins after the installation of the muck conveyor system.

For further clarification, it should be noted that during the ESF design development, several key events occurred that impacted the overall construct of the ESF.

First, in FY 1993, DOE developed the "Enhanced ESF Layout". This layout modified the existing ESF arrangement as part of an effort to both improve ESF constructability and enhance potential Geologic Repository Operations Area (GROA) flexibility. Site Characterization Progress Report No. 9 (DOE/RW-0434), pages 2.1-52 through 2.1-66, contains a description and rationale for the enhancement to the ESF/GROA concept. A summary of the rationale is given below:

The Enhanced ESF layout incorporates grades (slopes) in the access ramps and main drift of 3% or less. This maintains the option to use rail haulage in a potential co-located repository. This option was not available with the Title I concept, and is considerably more important given the heavier Multiple Purpose Canister (MPC) waste package concept.

The enhanced layout increases GROA design flexibility because the location of the TSL main drift adjacent and sub-parallel to the Ghost Dance Fault, and it being stratigraphically high in the TSw2 unit, (refer to ESF/GROA interface drawing, BC0000000-01717-2100-89104, attached, for a cross-section view of the TSL Main Drift) make it is easier for the GROA designers to exclude this drift, if desired, from a potential repository if subsequent design work indicates that the drift is not useful. It should be emphasized that the TSL Main drift is currently intended to be part of the potential repository, if constructed at the Yucca Mountain site.

Cross drifting within the potential repository horizon is done at the ends of the block, not through the center where it could impact GROA design flexibility.

Allows GROA layouts which do not require emplacement drifts to cross the Ghost Dance Fault. This was not a feature of the Title I ESF/GROA layout.

Increases the distance from the emplacement drifts to the water table.

A second key event was that, in FY 1994, DOE modified the overall approach to completing site characterization through the development the new Program Approach. While the new Program Approach represents an overall project strategy, and the specific ESF/GROA design impacts of the new Program Approach are essentially centered in Design Package 8, the key components of the new Program Approach relative to the ESF are:

The original Main Test Area (MTA) would be eliminated and replaced with appropriate alcoves extended from the ramps and TSL main drift.

Thermal testing originally planned in the Main Test Area (MTA) would be relocated to the north side of the North Ramp Extension.

The need for, and manner of, Calico Hills access is being re-visited in a systems engineering study during FY 1995

Excavation of some portions of the enhanced ESF layout would be deferred.

It has also been suggested that some of the NRC staff concerns regarding terminology such as, "implement the design and construction of Package 2C in phases", may be a result of discussions regarding the DOE phased approach to the start-up, shakedown and sustained operations of the TBM that occurs as Design Package 2C is implemented by the constructor. This phased approach is the result of a formal Readiness Review required by DOE to objectively demonstrate that all appropriate operational and safety related requirements are fully in place prior to sustained operation of the TBM. For clarification, the following information describes the phases of TBM operations. It is emphasized that the Design Package 2C releases do not correspond one-to-one with the TBM operational phases.

TBM Phase 1: Testing

TBM Phase 1 was developed to provide the necessary operational and safety prerequisites for the constructor to test the TBM prior to full TBM operations. During this phase, the TBM was assembled, inspected, analyzed, moved into the North Ramp starter tunnel, and allowed to excavate up to approximately 12 meters. The excavation permitted in this phase provided the opportunity to test, evaluate, and adjust TBM equipment and operator performance.

TBM Phase 2: Shakedown

TBM Phase 2 was developed to incorporate requirements identified during Phase 1 and to allow the TBM to excavate the North Ramp at a limited rate since all of the TBM systems are not yet in place and operational. Systems not yet in place would include the mapping platform, the muck conveyor system, and the permanent utility systems. Mapping will be performed by scientific personnel stationed at specific locations on the TBM, excavated muck will be removed by rail haulage, and the TBM will operate using temporary utilities. Additionally, this phase also provides the opportunity to continue testing, evaluation, and adjustments to TBM equipment and operator performance.

TBM Phase 3: Limited Operations

TBM Phase 3 incorporates any additional requirements identified in Phase 2 and continues North Ramp excavation with the inclusion of scientific testing from the mapping platform with its associated operational and safety requirements. As in the previous phases, TBM equipment and operator performance testing, evaluations, and adjustments will be identified and incorporated. Muck removal during this phase continues to be handled by rail haulage.

TBM Phase 4: Sustained Operations

TBM Phase 4 incorporates any remaining requirements identified in Phase 3 and continues excavation with the inclusion of the permanent utilities and the muck conveyor system, and their associated operational and safety requirements. TBM equipment and operator performance continue to be evaluated and adjusted as required to ensure safe and compliant operations.

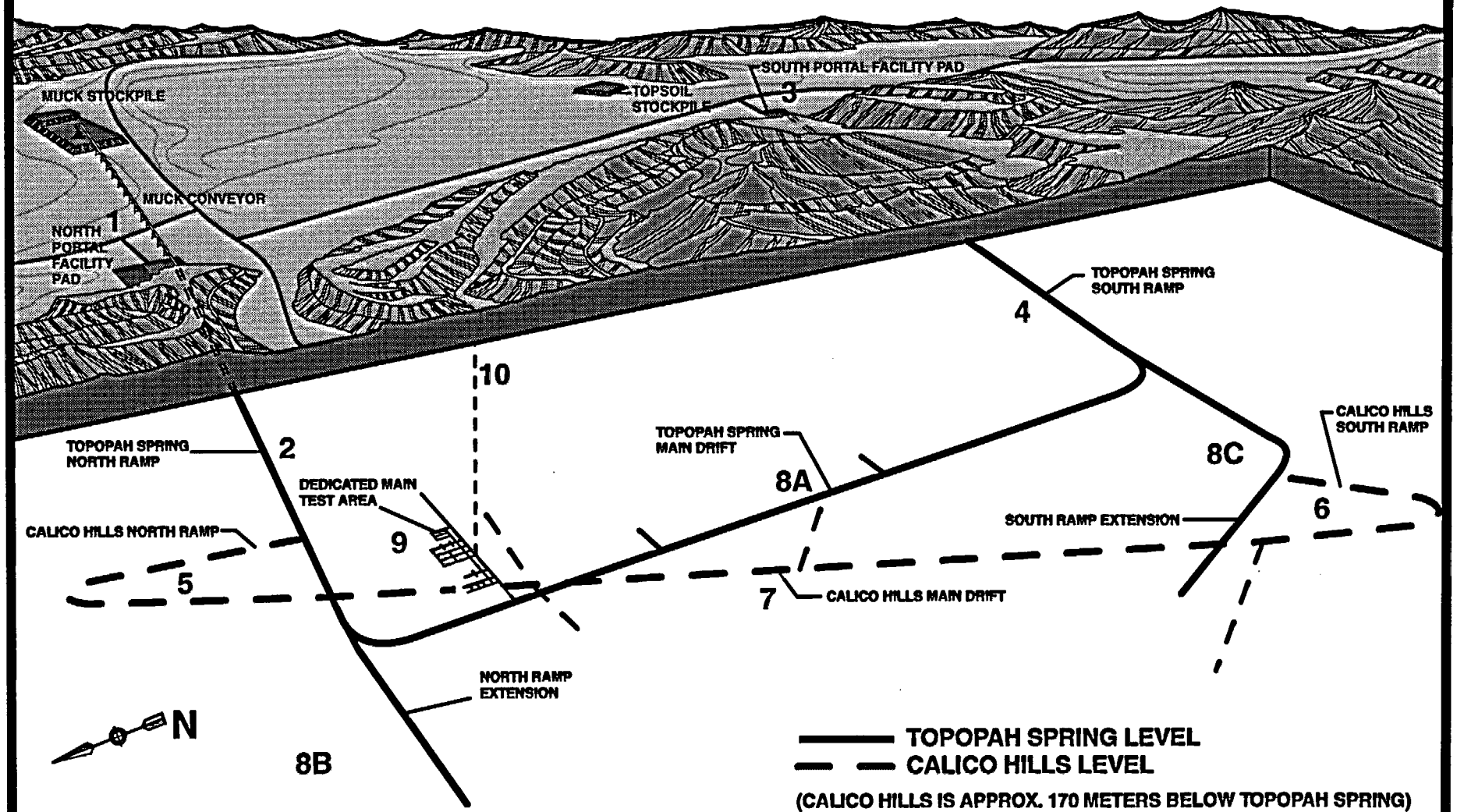
Finally, and as indicated by the discussion above, the "phased" release of Design Package 2C, and the "phased" operation of the TBM, are strictly logistical in nature. The "phasing" of these releases are tied to the schedules for release of design products and operation of the TBM, and are not tied to significant site features, to an increased potential for site characterization or waste isolation impacts, or to any specific construction issues (such as the NRC staff's example of the pneumatic pathways concern). A mechanism is in place for identifying potentially critical test interferences and/or potential impacts to waste isolation. This mechanism is the performance of site impact evaluations, consisting of Determination of Importance Evaluations (DIEs), Waste Isolation Evaluations (WIEs), and Test Interference Evaluations (TIEs). For Design Package 2C, these analyses have been performed (DIE BAB000000-01717-2200-00005. Rev. 02 for ESF Design Package 2C) and have indicated that no "holds" are necessary from impacts that are tied to specific tunneling progress. QA controls on construction and operation within the North Ramp are applied throughout the tunnel, based on the results of these site impact evaluations. These evaluations are performed, and appropriate controls applied, in the interest of limiting potential impacts to the extent practical in accordance with 10 CFR Part 60.15 (c) (1).

QUESTION 1 ATTACHMENTS

1) FIGURE - ESF FIGURE SHOWING DESIGN PACKAGE NUMBERS AND LOCATIONS

2) ESF/GROA INTERFACE DRAWING, BC0000000-01717-2100-89104 REV. 0

EXPLORATORY STUDIES FACILITY DESIGN



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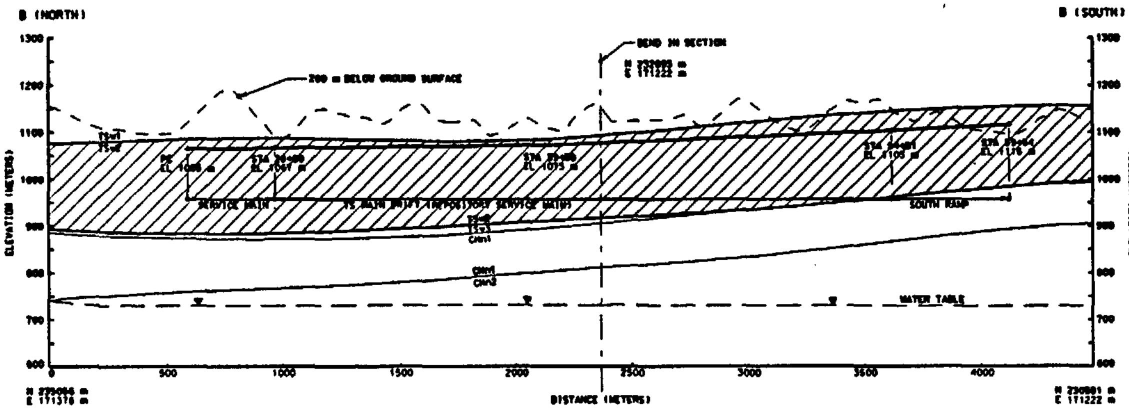


SECTION B

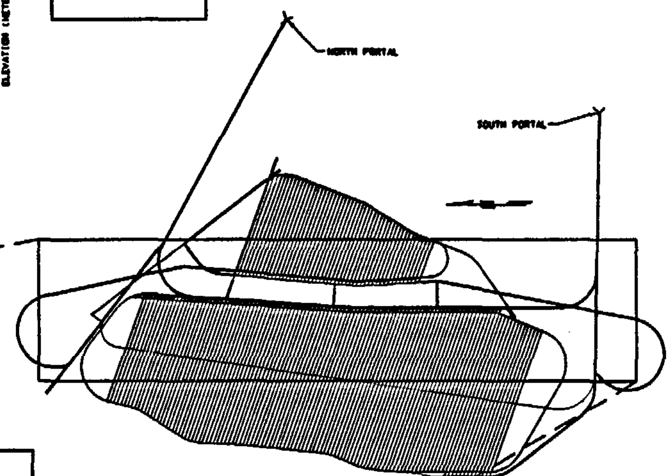
SCALE: HORIZ= 1:10000 VERT= 1:5000

REFERENCE STRATIGRAPHY UNIT NAME (DESIGNATOR)

- UPPER PAINTBRUSH NONWELDED UNIT (PTn)
- TOPOPAH SPRING WELDED UNIT LITHOPHYSAE-RICH (TSw1)
- TOPOPAH SPRING WELDED UNIT LITHOPHYSAE-POOR (TSw2)
- TOPOPAH SPRING WELDED UNIT, VITROPHYRE (TSw3)
- CALICO HILLS AND LOWER PAINTBRUSH NONWELDED UNIT (CHn1)
- CALICO HILLS AND LOWER PAINTBRUSH NONWELDED UNIT (CHn2)

NOTES:

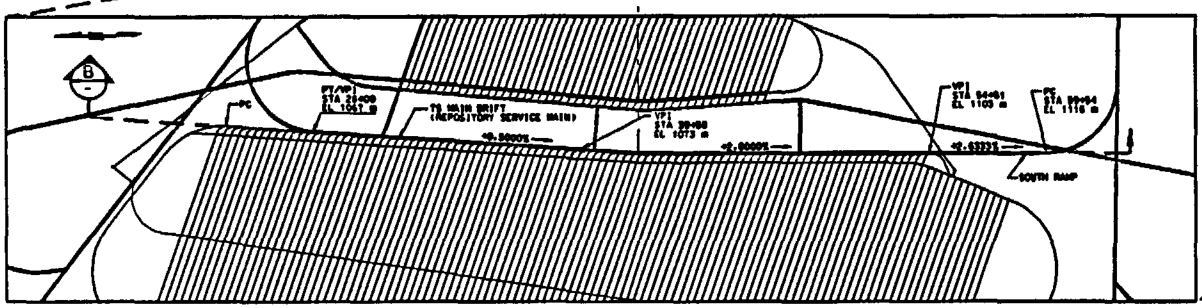
1. STATIONS AND ELEVATIONS SHOWN ARE ROUNDED TO NEAREST INTEGER VALUE. REFER TO BC0000000-01717-2100-89100 (SHT 1 OF 6) FOR MORE PRECISE DATA.
2. GEOLOGICAL AND OTHER BACKGROUND INFORMATION SHOWN ON SECTION HAS BEEN DIGITIZED FROM IGIS/CALMA PLOT NO. YMP-94-013.0 PROVIDED BY EG&G.
3. THE CONCEPTUAL REPOSITORY IS CURRENTLY ON THE Q-LIST BY DIRECT INCLUSION. THEREFORE, THIS DRAWING IS A QA DOCUMENT. BUT THE SPECIFIC CLASSIFICATION IN ACCORDANCE WITH QAP-2-3 IS TBD.



ESF/REPOSITORY INTEGRATED CONCEPTUAL LAYOUT (SEE BC0000000-01717-2100-89100)

PLAN

SCALE: 1:20000



ENLARGED PARTIAL PLAN

SCALE: 1:10000

GRAPHIC SCALE 1:10000

DESIGN INPUTS

DESCRIPTION AND RATIONALE FOR ENHANCEMENT TO THE BASELINE ESF CONFIGURATION B00000000-01717-0200-00083, REV 01

SURFACE FAULT TRACES PROJECTED TO REPOSITORY HORIZON BC0000000-01717-0200-00002, REV 00

ESF/REPOSITORY INTERFACE LAYOUT-COORDINATE GEOMETRY ANALYSIS BC0000000-01717-0200-00001, REV 00

ESF/REPOSITORY INTERFACE-INTEGRATED LAYOUT DESCRIPTION BC0000000-01717-0200-00003, REV 00, FIGURE 10-6

CONCEPTUAL

U.S. DEPARTMENT OF ENERGY
Yucca Mountain Site Characterization Project
M&O Civilian Radioactive Waste Management System MANAGEMENT & OPERATING CONTRACTOR

REPOSITORY ADVANCED CONCEPTUAL DESIGN
SECTION "B" ALONG TS MAIN DRIFT (REPOS SERV MAIN) ESF/GROA INTERFACE-5 OF 6

R REGAN	
B ROGERS	
B STANLEY	
R BHATTACHARYYA	
P MCKIE	

SIZE: D — BC0000000-01717-2100-89104-00

SCALE: AS NOTED — T00-132 — 1.2.4 — INTFC/89104.DGN

NRC QUESTION 2

What are the impacts to site characterization and the waste isolation capability of the site that are associated with the completion of work under Design Package 2C? At what point in the construction of the ESF north ramp is there the potential to impact site characterization and the waste isolation capability of the site?

Basis

- The staff needs to fully understand the construction work that will be completed by the operation of the TBM, and its potential to impact site characterization or the waste isolation capability of the site. Without this information, the staff is unable to determine the point beyond which construction should not proceed without DOE and the M&O having demonstrated effective implementation of a quality assurance program. Examples of where site characterization could be impacted include recent concerns raised on pneumatic pathways.

Recommendation

DOE should provide the requested information along with its rationale for where site characterization or the waste isolation capability of the site could be impacted. If DOE determines that there is no impact from work being completed for Design Package 2C, it should provide justification.

DOE RESPONSE TO QUESTION 2

As discussed in the response to Question 1, ESF Package 2C consists of TBM excavation of the North Ramp to the Topopah Spring level (i.e., to the bottom of the ramp), along with drill-and-blast excavation of various alcoves, and emplacement of ground support and ESF utilities. As a result of the Design Package 2C DIE, DOE has minimized potential for impact to the site in accordance with regulatory requirements. DOE applies controls based on the DIE's determination of potential impacts and the importance of the items that could be impacted. Because of the conservatism in these evaluations, QA controls are applied throughout the excavation. It is important to note that there is no specific demarcation point beyond which a potential for waste isolation and test interference impacts is expected to increase, because DOE has provided, and will continue to provide, for limiting these impacts throughout the entire excavation.

In addition to the specific impact evaluations made in the DIE for ESF Design Package 2C, other considerations have been made throughout the evolution of the entire ESF design. These other considerations have been documented in the ESF Alternatives Study (SAND91-0025) and the ESF Enhanced Layout Analysis (B00000000-01717-0200-00089, Revision 01). These evaluations considered several GROA and waste isolation related issues which have provided a basis for selecting the final configuration of the ESF excavation. These additional considerations are presented in more detail below.

Potential Impacts and Associated Control Requirements

The DIE for ESF Design Package 2C analyzes and documents the potential impacts associated with the excavation, and associated activities, of Design Package 2C. This analysis considers both the potential for construction of the North Ramp to impact the site's waste isolation characteristics, as well as the potential for North Ramp construction to disrupt or otherwise impact critical site characterization tests. Based on the conclusions of the DIE, specific QA controls are allocated to the design package, in order to provide confidence that these potential impacts are minimized and/or mitigated.

For example, based on requirements derived from WIEs, the use of organic material is minimized. These requirements have led to specific design solutions that preclude the use of organic-based grout for installation of rockbolts, and the use of a shotcrete mixture that does not contain organic accelerators or retarders. This control is derived primarily from a very conservative WIE calculation whose goal is to avoid perturbation of the natural background organic concentration by more than 10%. Measurements of the aqueous geochemical composition indicate that natural variations exceed 10% of the average background. Insufficient site characterization data exist as yet to quantify the actual impact of the emplacement of any additional

organic material within the natural barrier. Because our limits are based on the goal of not perturbing the natural system beyond the observed natural variability, we believe we have applied a conservative set of controls. This example is representative of the kinds of conservatism employed in our impact evaluations.

Another example of impact-related controls is the test-interference-related prohibition on the use of chlorides in the North Ramp without consultation and concurrence of the Test Coordinator. As above, this control is based on a conservative assessment of the potential impact of the use of such material. In this case, it is the potential interference with Cl-36 measurements that drives the requirement.

Perhaps the best example of controls applied in the interest of limiting adverse impacts is the "hold" currently in place on the use of diesel equipment for the Design Package 2C excavation. Removing the hold is contingent on the completion of tests which will provide in-situ data on diesel emissions and impacts within the North Ramp. This data will be used to provide a basis for controlling the use of such equipment in subsequent excavations.

As will be discussed in our response to the October 6, 1994 letter from Margaret Federline of your staff to Ronald Milner (Re: State of Nevada Concern on Pneumatic Pathways), we are confident that we have adequately considered the pneumatic pathways issue in terms of potential site characterization impacts. The evaluations performed in support of ESF Design Package 2C concluded that adequate margin existed in the schedule for the planned collection of test data and the penetration of the PTn-TCw contact by the TBM.

In the Total System Performance Assessments (TSPA) conducted to date, it is generally the waste package lifetime and the Engineered Barrier System (EBS) release rate which control the release of gaseous radionuclides to the accessible environment, rather than the gaseous phase velocities and resulting travel times themselves. Consequently, the performance assessment models have not found the PTn unit to be a significant barrier to radionuclide release. We are sensitive, however, to the State of Nevada's concerns that adequate controls are not in place to preclude the potential for loss of data. We have therefore applied a "hold" on TBM operation beyond the upper PTn contact until data have been collected for several pressure fronts. As the largest pressure fronts occur in the winter months, the first of the pressure monitoring systems (in NRG-7a) has been installed and is gathering data as of early November 1994. A second system (in NRG-6) is scheduled for installation in mid-November. These instrument arrays will record pressure change responses to atmospheric changes above, within, and below the PTn unit. Once the initial data have been collected, monitoring will continue, but the hold on further tunnel excavation will be lifted. We anticipate, under normal operating conditions, reaching this point of excavation in approximately eight months. We will also maintain communication through the onsite representative with respect to potential changes to this schedule.

We believe our QA processes are adequate to provide confidence that other potential waste isolation and test interference impacts have been identified and controlled sufficiently to meet the requirements of 10 CFR Part 60.15 (c) (1).

Rationale

The DIE process is designed to meet the requirements of 10 CFR Part 60.15 (c) (1), which requires that adverse impacts to the potential repository are limited to the extent practical. The DIE is an input to each design package, and is actually used to define the applicability of the QA program to specific drawings and specifications. Each DIE includes input evaluations that are specific to potential impacts to the site's waste isolation characteristics (WIEs) and to the ability to collect representative site characterization test data (TIEs). These evaluations provide for establishing QA controls on site-disturbing activities.

The Design Package 2C DIE is based on the evaluation criteria found in the line procedures associated with DIEs, WIEs, and TIEs (NLPs-2-0, -3-16, and -3-17, respectively). These procedures include consideration of impacts to Q-Listed items (including natural barriers) based on review of evaluation questions such as:

> Does the activity introduce Tracers, Fluids, or Materials (TFMs) which could adversely impact QA items?
>
> This criterion has the most potential for generating control requirements, because the use of TFMs is most often associated with potential impacts. Later questions are associated with specific impacts; in addition, a global control is applied on the recording and reporting of any TFMs that are consumed (i.e., purposely emplaced or spilled and not recovered) in the tunnel.
>
> Can the activity result in changes to hydrological characteristics of natural barriers by creating significant ponding or the possibility for drainage into the underground facility in such a way that could alter water (or gas-phase as appropriate) movement or saturation near potential waste emplacement sites, along potential aqueous radionuclide pathways, or along potential gaseous radionuclide pathways?
>
> For example, there are very specific controls on the use of construction water underground, and on the maintenance of a "water balance" designed to enable tracking of quantities consumed.
>
> Can the activity result in the introduction of fluids or other materials that might affect or alter geochemical characteristics near potential waste emplacement sites, or along gaseous or aqueous radionuclide pathways?
>
> Evaluation under this criterion is primarily responsible for the establishment of controls associated with the use of organics as discussed above.

Can the activity affect mechanical or thermal characteristics of natural (or engineered) barriers?

This criterion is responsible for the conclusion that TBM excavation, where practical, is preferable in terms of impact to the natural barrier, to drill-and-blast excavation.

Can the activity impact or bias required site characterization tests in an unpredictable way, or required site characterization tests that cannot be repeated?

These criteria, and the more detailed criteria used to perform the evaluations which answer these questions, are responsible for controls applied to limit test interference impacts.

As discussed above, we have applied a systematic process to the evaluation of potential impacts to waste isolation and site characterization, and believe that, as a result of the process, have minimized these potential impacts. Beyond the discrete impact evaluations performed for ESF Design Package 2C under the DIE process, there are a number of other considerations that lead us to conclude that the activities underway today do not represent a significant potential to adversely impact waste isolation or site characterization.

These other considerations have evolved during the design of the ESF and conduct of its activities. Examples of these considerations follow.

1. Criteria from 10 CFR Part 60, including applicable repository criteria, are allocated hierarchically from the Civilian Radioactive Waste Management System Requirements Document, through the MGDS Requirements Document, to the Site Design and Test Requirements Document (SD&TRD), and finally to the ESF Design Requirements Document. The Repository Design Requirements Document shares with the SD&TRD the MGDS Requirements Document as a parent document.

2. The ESF Alternatives Study (SAND91-0025) considered several GROA- and waste-isolation-related issues. Some examples of these are:

   Excavation method - mechanical excavation was selected as the primary means of excavation, based in part on consideration of geomechanical impacts;

   Number of accesses - fewer accesses was viewed as most favorable;

   Prevention of gravity flow pathways from emplacement areas to the Calico Hills unit;

Maximization of distance from the emplacement level to the water table;

Avoidance of emplacement drifts crossing the Ghost Dance Fault.

At the time, the highest-rated ESF option (Option 30) met all but two of thirteen features identified as favorable to consideration of alternatives.

3. The ESF Enhanced Layout Analysis (B00000000-01717-0200-00089, Revision 01) uses as its primary criterion the maintenance of GROA design flexibility and enhancement of GROA performance. It provides for the adoption of the features discussed above (i.e., those features not embodied by Option 30) while maintaining the other desirable features. In addition, the conventional rail haulage option for GROA waste handling was maintained by the enhancement. Preserving an option for rail haulage became more important after the adoption of the MPC concept. Further additional flexibility was provided by the placement of the Topopah Spring Level Main Drift; its new location - high in the TSw2 unit and relatively close to the Ghost Dance Fault - makes it possible to exclude this drift from subsequent GROA designs (if necessary) without materially impacting other GROA concepts.

4. The site characterization testing schedule acknowledges, and in fact is partly based on, ESF construction schedules (see our response to Question 3).

5. Changes to repository design are controlled as interfaces to ESF design through ESF/GROA interface constraints that are actually referenced in terms of ESF design requirements and ESF/GROA interface drawings [ESF Design Requirements Document, Appendix A].

6. As discussed above, we have implemented within our QA design control procedures a process (the DIE process, including consideration of waste isolation and test interference impact evaluations) for evaluation of site impacts on an activity-specific basis. These evaluations are produced by a Systems Engineering organization responsible for integrating impact considerations with design requirements. The controlled inputs to design are based on evaluations performed by the organization which provides an interface to the testing community, and by the organization responsible for performing TSPA.

These additional considerations and other formal evaluations of potential impacts provide confidence that our activities are sufficiently controlled to in turn provide confidence that the site's waste isolation capability, and our ability to characterize the site, are not compromised. This conclusion applies not only to discrete elements of design and construction, but to the facility as a whole.

We recognize, however, that these and other considerations are often difficult to extract from existing documentation in a manner that provides for straightforward verification that potential impacts have been adequately

addressed. As a result, DOE will, within 120 days, compile these and related considerations into a single explicit document that describes not only the steps taken and criteria used to identify and minimize potential impacts, but which also describes how 10 CFR Part 60 requirements applicable to the ESF have been incorporated into the current design.

Further, DOE commits to revise this document for each major design package, as required, in order to provide continuing assurance that impacts are adequately addressed, not only from a discrete perspective, but in an integrated fashion as design progresses. This analysis will not replace the DIE process, which evaluates specific designs and activities, but will supplement it to address broader ESF issues which may be affected by changes in repository design, test requirements, or other significant considerations.

Conclusion

In conclusion, we have applied a systematic process to the evaluation of potential impacts to waste isolation and site characterization. We believe that this process, when combined with the considerations made during the development of the overall ESF design, has minimized potential impacts. We have concluded, therefore, that as a result of the controls applied throughout the excavation, there is no specific demarcation point associated with the excavation of the North Ramp beyond which the potential for impacts is expected to increase. In recognition of the State of Nevada's concerns over the potential penetration of the PTn-TCw contact prior to adequate pneumatic pathways data, however, we have placed a "hold" on TBM operations beyond this point until that data is collected.

NRC QUESTION 3

a) What is the current reference conceptual design for the geologic repository operations area (GROA)?

b) What is the current ESF design and testing strategy?

c) What is the current control mechanism to ensure compatibility and integration among the GROA conceptual design and the ESF, including design, construction, operation and the proposed testing strategy?

Basis

- In order to ensure that ongoing ESF design and construction do not impact the ability to meet 10 CFR Part 60 requirements for future repository, DOE needs to have considered at least a conceptual design of the GROA in designing the ESF. The staff has requested in its letters dated March 24, 1993, and August 20, 1993, a description of DOE's conceptual GROA design so it can confirm that DOE is incorporating repository design considerations into the ESF. To date, DOE has not provided the requested information.

- If Yucca Mountain becomes the site for the repository, construction of the ESF north ramp will determine the horizon for the main drift of the underground facility. Because DOE is beginning construction of the ESF north ramp, and it is the staff's understanding that over a third of it will be completed prior to Spring 1995, the staff needs to have an understanding of how the ESF relates to the various GROA options under consideration.

- DOE is completing the Title II design of the ESF in individual packages rather than as a complete facility. Because of this, DOE needs to ensure tight control of interfaces among the individual design packages as well as integration with the conceptual design of the GROA options. DOE has not shown the staff that it is fully considering the interfaces among individual packages or their relationship to the GROA.

- The location of in situ tests is continuing to change even as the TBM has started excavating the rock. The acceptability of the ESF design cannot be judged in isolation, without a reference test plan.

Recommendations

(1) DOE should provide a description of the conceptual design of the GROA that shows how the individual design packages being prepared fore the ESF relate to the repository design.

(2) DOE should provide the latest thinking on its testing strategy and in situ test locations.

DOE RESPONSE TO NRC QUESTION 3

Pursuant to the NRC's recommendation, the following discussion provides a description of the conceptual design of the GROA and shows how the individual design packages being prepared for the ESF relate to the repository design.

ESF/Repository Interface Drawings

The current GROA layout is depicted in six ESF/Repository Interface Drawings. These drawings are numbered BC0000000-01717-2100-89100 through 89105, Rev 0 (see attached drawings). The GROA concept is more fully described in a recent document, "Initial Summary Report for Repository/Waste Package Advanced Conceptual Design" B00000000-01717-5705-00015 Rev. 0. The report noted above containing Alternative Conceptual Design (ACD) information is an interim document detailing results of work performed through mid-FY 1994. The repository ACD effort is ongoing, and a final ACD report is planned for issue in mid-FY 1997. The GROA layout shown in the ACD report shows subtle differences from the 6 baseline ESF/GROA interface drawings. This is because the GROA design is still in process and evolving. The baseline ESF/GROA drawings will be updated during FY 1995 to reflect the most current GROA concept.

Coincident ESF/Repository Excavations

The portions of the ESF layout which coincide with potential repository excavations are the ESF North Ramp (Repository Waste Ramp), ESF South Ramp (Repository Development Ramp), the ESF Main TSL Drift (Repository Service Main), and the ESF North and South Ramp Extensions (Repository accesses to both the upper and lower blocks). These 5 segments are planned to be excavated as part of the ESF. The repository waste ramp would correspond to ESF Design Package 2 (ESF North Ramp); the repository Development Ramp, ESF Design Package 4 (ESF South Ramp); the repository Service Main, ESF Design Package 8A (ESF Main TSL Drift). The North Ramp Extension (NRE), ESF Design Package 8B, and the South Ramp Extension, ESF Design Package 8C will provide access to both the upper and lower blocks of the GROA layout. The figures at the end of this section following the ESF / GROA interface drawings show the ESF layout and the Repository concept respectively. Comparison of the figures will yield an understanding of the physical relationship between the ESF and GROA.

Project Interfaces

The DOE recognizes that it has experienced difficulty in providing a cohesive explanation of the interfaces between the major parts of the site characterization effort, [i.e., the ESF, GROA, and Surfaced Based Testing (SBT) programs]. This effort is complicated both by the evolving nature of the concepts and the fact that interfaces are defined in several different project documents. DOE has established a Technical Baseline Working Group to develop an improved presentation of the projects technical baseline. This presentation will take the form of a top level summary document which will replace the current Site Characterization Program Baseline document (SCPB). This revised SCPB will contain summary descriptions of the ESF, GROA, and SBT

concepts and interfaces, and how the SBT and ESF programs will be incorporated into the GROA.

The current GROA concept is different in many respects from that which was presented in the DOE's Site Characterization Plan (SCP) of December 1988. Some of the major differences are addressed in summary below:

Excavation Method

The SCP GROA was to be developed exclusively using the drill and blast excavation method. The current GROA is planned to be developed by mechanical means (primarily TBM). Drill and blast will be used only where mechanical means cannot be applied.

Emplacement Mode

The SCP GROA incorporated waste packages vertically emplaced in boreholes drilled into the floor of the emplacement drifts. The current GROA concept shows an "In-Drift" emplacement mode in which packages are emplaced on the floor of the emplacement drift, on either a rail mounted cart or in a cradle centered in the drift.

Waste Package Concept

The SCP waste package concept was a small, thin walled (approximately 10 mm) package containing 4 Boiling Water Reactor (BWR) and 3 Pressurized Water Reactor (PWR) spent fuel assemblies and weighing approximately 6 tons (7 tons). In contrast, the Multi-Purpose Canister (MPC) with its disposal overpack will have a wall thickness of approximately 120 mm; and contain 12 to 21 PWR assemblies, or 24 to 40 BWR assemblies; and weigh as much as 68 tons (75 tons).

Primary Transport Mode

The SCP GROA concept called for ramps with grades of up to 16% and slopes within the emplacement block in excess of 5%. For this reason, the primary transport mode was rubber tired vehicles. The current GROA concept maintains all grades, both in ramps and within the emplacement blocks, to less than three percent. This enhancement allows the use of standard rail haulage for both service and waste transport.

Fault Avoidance Strategy

The SCP GROA made no attempt to avoid known faulting within the repository block. The Ghost Dance Fault would be penetrated 50 to 75 times by the SCP GROA layout. The Current GROA concept avoids, to the extent practical, penetration of major fault structures.

Thermal Loading Strategy

The SCP GROA layout was developed based on an Areal Heat Loading of 57 kW/Acre. The current repository advanced conceptual design effort has not yet

defined a thermal loading. Instead, both low thermal loading (equivalent to approximately 25 kW/Acre) and high thermal loading (approximately 100 kW/Acre) options are being carried forward and evaluated.

With respect to control mechanisms ensuring compatibility of MGDS components (part c of question 3), these are discussed below.

Design

The interface drawings noted above are incorporated by reference in Appendix A.2 of the Exploratory Studies Facility Design Requirements (ESFDR) document. By this mechanism, the ESF designers are "officially" made aware of the repository configuration. Applicable requirements, from 10 CFR Part 60 and elsewhere, are captured in the ESFDR and are utilized as inputs to the design by the ESF design staff.

Construction/Operation

All activities associated with construction and/or operation of the ESF are subject to evaluation under the DIE system as discussed in our response to Question 2. This process has been in place and operational since before the start of surface site preparation activities at the North Portal in 1992, and all ESF activities have been evaluated. The DIE for any given portion of the ESF serves as an input to virtually every analysis, drawing and specification produced by the ESF design staff. The requirements and restrictions which are placed on construction activities by the DIE process are flowed down from the DIE, via the ESF design staff's development of construction specifications and drawings, to the constructor. Requirements are then imposed on the constructor. To date, 14 ESF-related DIEs have been performed, and are listed below:

ESF North Portal Pad
ESF Storm Water System
Starter Tunnel Steel Arch Section
ESF Rock Storage Area
Starter Tunnel Drill & Blast Section
ESF Switch Gear Building
ESF Change House and Shop Building
Waste Water and Sewage Collection System
'H' Road Improvements
ESF Water Supply System
ESF Water Distribution System
Compressed Air & Standby Power Systems
69 kV Power System
Package 2C (All components)

Testing

Interface between the ESF testing program and the ESF design organization is handled through the Test Coordination Office (TCO). The TCO is managed by Los Alamos National Laboratory (LANL). As portions of the ESF enter Title II design, the ESF designers request, by letter to the TCO, detailed information

on the logistical needs of the Principal Investigators for the tests planned for that portion of the ESF. The request will include approximate location, size of alcove needed (if any), utility requirements, special conditions (these could include such things as not using shotcrete or grouted rockbolts within a certain distance of a proposed test area). Locations are considered approximate because, while it may be known that a test alcove will be located precisely on the contact between two geologic units, it is not known, prior to excavation, precisely at what station in the tunnel that unit contact will be encountered.

Flowdown of 10 CFR Part 60 Design Requirements

As part of the design process, DOE has also identified applicable 10 CFR Part 60 requirements and is addressing them in the design. While the NRC has partly agreed that the DOE is addressing these requirements, (resolution of NRC's SCA Comment 128, NRC letter dated November 2, 1992, and remaining open SCA Comment 130), the NRC continues to express concerns with the traceability of flow down of the 10 CFR Part 60 design requirements. The DOE has also expressed similar concerns in CAR-YM-94-074, which was later issued as CAR-YM-94-100, which further indicates the difficulty in piecing together the evidence that requirements flow down is being performed. The NRC is still tracking this concern via SCA Comment 130 and the portion of SCA Comment 128 that was transferred to SCA Comment 130. The flowdown of 10 CFR Part 60 requirements, in general, is satisfactory. Resolution of CAR YM-94-100 should assist in resolving the NRC Open Item.

The DOE committed to addressing the applicable GROA design requirements in the ESF design as part of planned activities in response to SCP Objection 1. The integrated evaluation of the ESF-Repository performance was addressed in the ESF Alternatives Study. That document clearly shows that post closure repository design requirements were important discriminators in the selection of the current ESF-Repository Concept. Specifically, decisions to eliminate shaft penetration to the Calico Hills unit, and the selection of mechanical excavation techniques in preference to conventional methods were driven by GROA performance concerns. These decisions reflect limiting impacts on the site to the extent practicable.

The SCP contains the initial DOE strategies and performance measures for the GROA performance objectives and additional design requirements. These requirements and performance measures have been addressed in the ESF design, particularly in the ESF Alternatives Study and the study examining the reconfiguration of the ESF and GROA, "Description and Rationale for Enhancement to the Baseline ESF Configuration". Additionally, ESF-Repository performance is assessed in the DIE process, providing documented evidence that the design is being examined for conformance to repository design requirements.

Other decisions affecting the configuration of the ESF have been examined in light of repository design requirements. The change in inclination of the waste ramp and main TSL drift was driven by operational needs for waste package handling as well as knowledge of rock conditions. Re-examination of existing core and data from new bore holes indicated that the preferred target

horizon was slightly higher than previously thought. Also, the reconfiguration of the facility was done in a way to allow sufficient flexibility to preclude an impact on the ability to develop and license a repository at Yucca Mountain.

All activities undertaken at the site are evaluated for waste isolation related impacts. This includes fluids and materials controls which are traceable directly to 10 CFR Part 60 additional design criteria.

The following discussion provides the latest thinking on its testing strategy and in situ test locations.

Testing Strategy

In response to questions regarding DOE's latest thinking on its testing strategy and in situ test locations, the following discussion is provided. Also provided (attached) are: Tables 1, Summary Table of Planned ESF Tests: Table 2, Consolidated ESF Test Programs; Table 3, In Situ Test Locations and Implementation Logistics for ESF Tests / Programs; and, Figure 1, ESF Test Program Locations which contain information on the ESF testing program content and schedule.

Following selection of the two-ramp ESF configuration by the ESF Alternatives Study in 1991, the SCP-based underground test program was formally refined to support test implementation in the ramp/drift systems. The redefined test program was baselined in preliminary Test Planning Package (TPP) 91-5 and in the ESF Title I Design. These documents outlined the full scope of the underground test program and established general locations, test durations, and support requirements for all ESF tests. The current prioritization and sequencing strategy for the Site Investigation Program has been established pursuant to the DOE's new Program Approach.

In restructuring the Site Investigation Program as part of the new Program Approach, a series of higher level findings have been scheduled to form the basis for a Technical Site Suitability assessment in FY 1998. The description and schedule for these higher level findings have been presented in the Draft 5-Year Plan (prepared for the Office of Management and Budget) dated October 1994. Technical Site Suitability, as described in this plan, addresses those suitability conditions outlined in 10 CFR Part 960 evaluations of which depend upon information gathered by current site investigation activities, deferring consideration of other suitability conditions (environmental quality, transportation, and socioeconomic impacts) until the full suitability determination is completed accompanying the Site Recommendation Report scheduled for preparation in FY 2000/2001 time frame.

Sequencing of underground test activities evolved concurrently with the deliberations leading to the Program Approach. The elements of this multi-faceted implementing strategy are:

Place near-term emphasis on those tests (primarily fluid transport properties) that will enable DOE to make a technical site suitability determination by the end of 1998 in accordance with DOE's siting guidelines (10 CFR Part 960);

Continue to perform tests and collect data necessary to prepare an EIS in FY 2000 and, if the site is determined to be suitable, submit an application to the NRC by FY 2001, under 10 CFR Part 60, seeking a license authorizing construction of the repository. The detailed facilities design will be completed subsequent to the application but prior to start of construction;

Develop a waste package design that will perform its substantially complete containment function for a period well in excess of the allocated 1000 years; and,

Design and implement a performance confirmation testing program at an early date as required by 10 CFR Part 60 and take advantage of the results in firming up the thermal management options prior to submitting an application for license amendment to receive waste. Continue performance confirmation monitoring over a lengthened operational period and select the final emplacement scheme on the basis of the results of these observations.

The implementing strategy is based on the premise that the knowledge base developed in the process leading to a technical site suitability determination in FY 1998 will be followed, if the site is suitable, by subsequent ongoing intensified observations and testing in the ESF and elsewhere allowing a safety analysis report to be prepared and an ▪application to construct▪ to be submitted to NRC by FY 2001.

The first of the above elements of the implementing strategy is the primary rationale behind the prioritization of the testing program over the next five years (including FY 1995). The most important item necessary to support a technical suitability determination is considered to be those characteristics of Yucca Mountain used to predict its response in the area of fluid transport in the far-field during the postclosure period. Thus, as explained below in the listing of ESF testing activities planned for the immediate future, the contact radial borehole tests and the tests to characterize the hydrologic properties of the major faults are of highest priority. The locale for these two types of tests are the first seven alcoves which will be constructed near where the ESF tunnel intersects either major faults or the contacts between two different units of rock.

The above ESF tests, together with air flow monitoring in boreholes, cross-hole air permeability testing, pump tests in the saturated zone and a number of other tests for matrix and fracture hydrologic properties are designed to characterize the mountain with respect to the distribution of bulk permeability and the impact of geologic features, such as faults, on transport properties. These characterizations will enable predictions by radionuclide transport models to be made with acceptable level of confidence in the calendar year 1997-1998 time frame.

The heat driven response of the near-field will play a role in the performance of the waste package as well as that of the far-field. Tests have been planned in which volumes of host rock will be heated to investigate the effect of heat on the mechanical, hydrologic and geochemical response of the near-field rock, and the simultaneous interaction of these processes. These thermal tests were originally planned to be performed in a dedicated area in the northeast part of the block. Although there are operational advantages in having most of the tests performed in one dedicated area, representativeness of data will be better served if the tests are geographically distributed. Thus, the current thinking is to field each individual test in an alcove off the ESF tunnel(s) in locations where observed geologic conditions are deemed suitable for the specific test.

The various thermal tests in the ESF described in the SCP are being reevaluated at this time. One consolidated thermal test in an alcove in the host rock can be started within a few months of the ESF tunnel reaching the TSw2 unit. The initial testing phase should provide added input to the closure of preclosure performance issues of operability and drift stability. Continuation of thermal testing through calendar year 2000/2001 and 2004/2005 time frames would yield results relative to the heat driven near-field coupled processes in time for a license application to construct, and later support a license amendment submittal to accept waste.

The referenced ESF testing plan is contained in TPP 91-5 prepared by the ESF Test Coordination Office in May 1991. This document enumerates all the activities in the ESF that were planned to be performed, if deemed necessary, in support of the testing program described in the SCP. Table 1 (attached) lists these activities from TPP 91-5, grouped into a number of consolidated planning categories. A few of the activities from TPP 91-5 are excluded from Table 1 as indicated by the footnote under the table.

Table 2 (attached) gives a consolidated list of the ESF Test/Program currently planned to be implemented in the near term. The right hand column of this table lists the major milestone report from the program 5-Year Plan (FY 1995-1999) to which each ESF test will provide input/support. These milestone reports are either technical basis reports to support specific higher level findings associated with the goal of technical site suitability determination in FY 1998 or a license application to construct in FY 2001. All ESF activities support the license application even if not so stated in the right hand column of Table 2. This column illustrates the fact that resolving the geohydrology/transport issues is an important objective of near term ESF testing/activities.

Table 3 (attached) summarizes the ESF testing strategy by defining the location and current schedule for initiation of the testing activities in conjunction with the new Program Approach. The attached figure following the tables depicts the location of various near term testing activities superimposed onto the current ESF configuration.

QUESTION 3 ATTACHMENTS

1) ESF/REPOSITORY INTERFACE DRAWINGS NUMBERED BC0000000-01717-2100-89100 THROUGH 89105, REV 0. (6)

2) FIGURE ENHANCED ESF LAYOUT - TOPOPAH SPRING LEVEL (PICTORIAL)

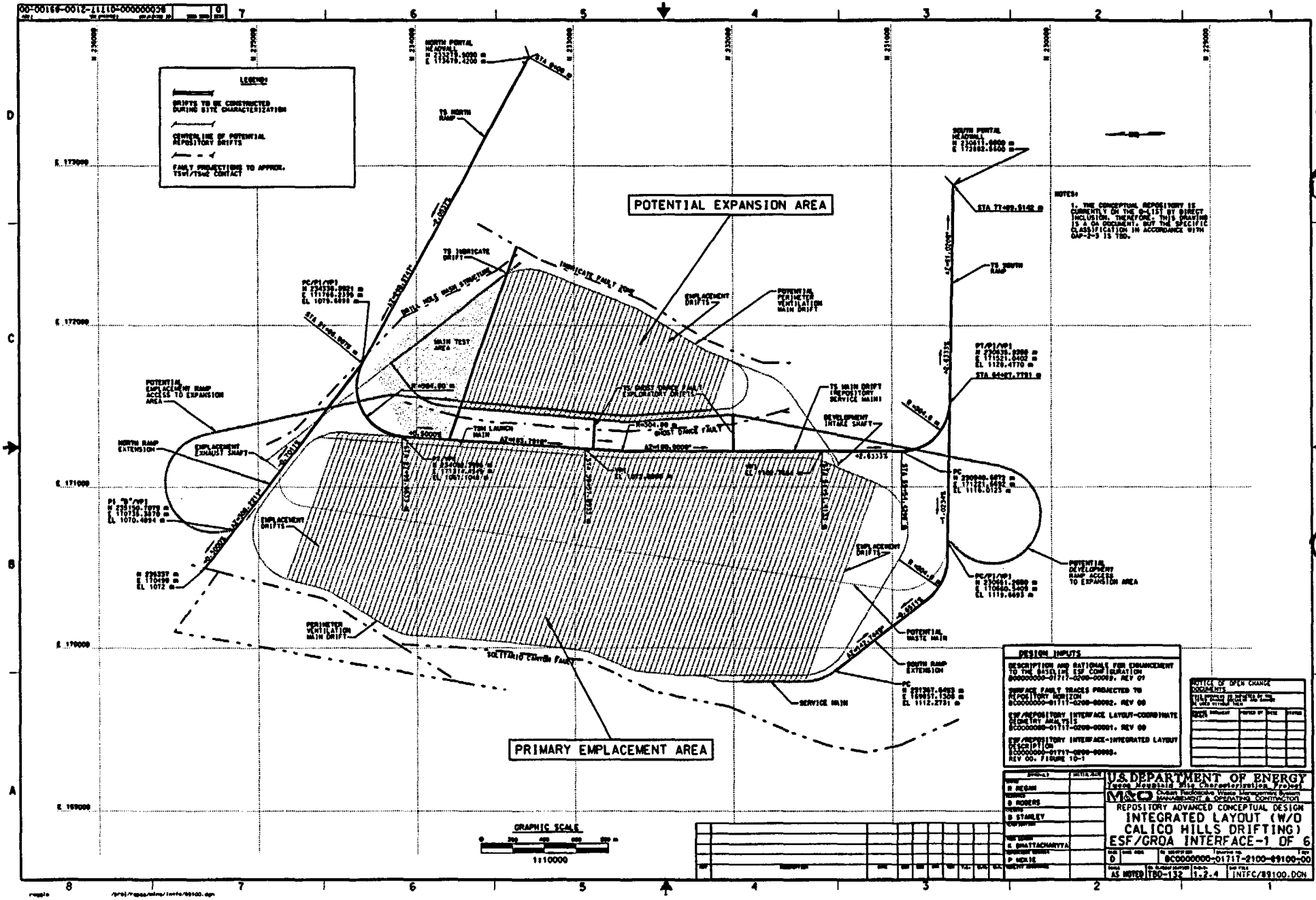
3) FIGURE ESF / REPOSITORY LAYOUT CURRENT INTERFACE CONCEPT (PICTORIAL)

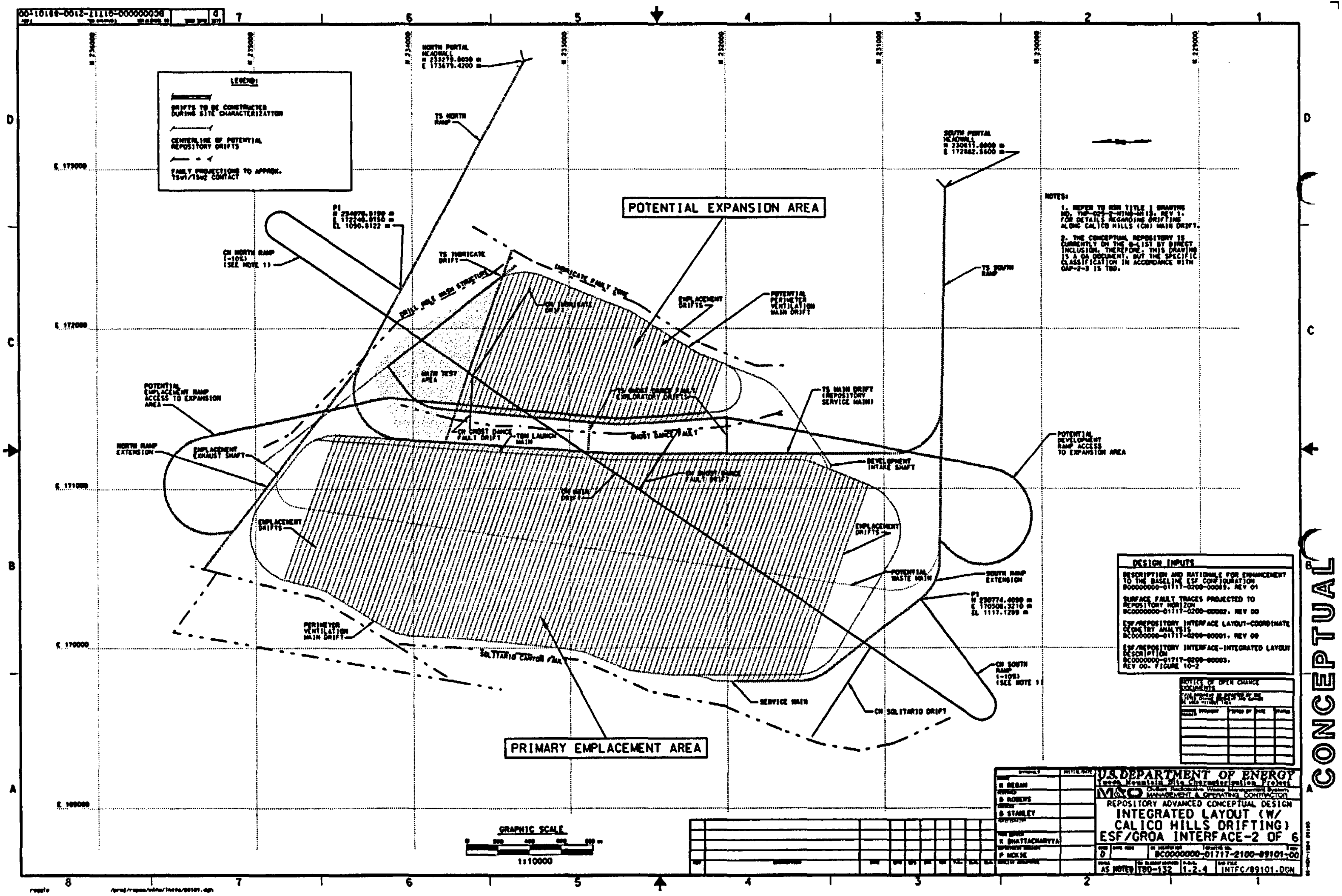
4) TABLE 1 SUMMARY TABLE OF PLANNED ESF TESTS

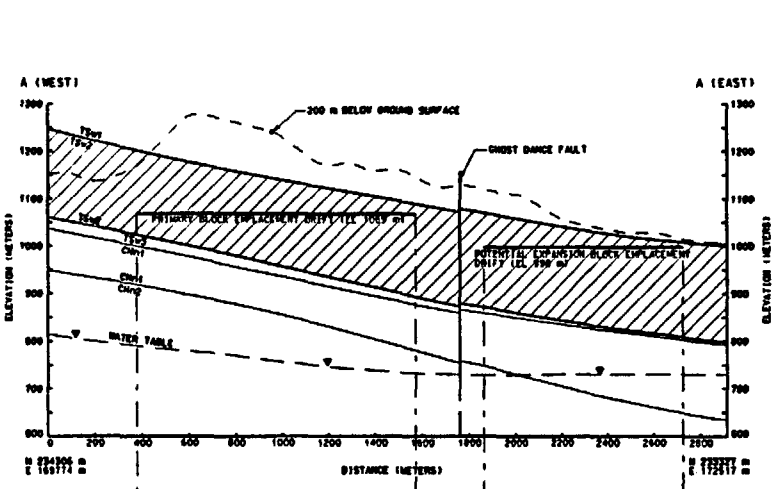
5) TABLE 2 CONSOLIDATED ESF TEST PROGRAMS

6) TABLE 3 IN SITU TEST LOCATIONS AND IMPLEMENTATION LOGISTICS FOR ESF TESTS / PROGRAMS

7) FIGURE ESF TEST PROGRAM LOCATIONS

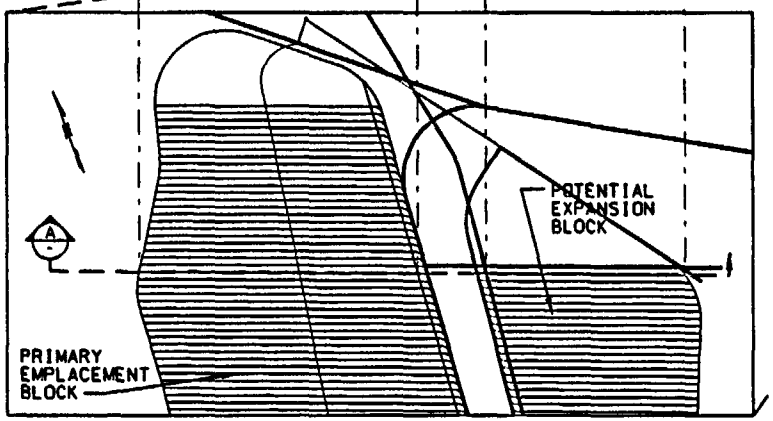

POTENTIAL EXPANSION AREA
PRIMARY EMPLACEMENT AREA
LEGEND
NOTES:
1. THE CONCEPTUAL REPOSITORY IS CURRENTLY ON THE G-4 T/F BY DIRECT INCLUSION. THEREFORE, THIS DRAWING IS A QA DOCUMENT. BUT THE SPECIFIC QA CLASSIFICATION IN ACCORDANCE WITH QAP-2-3 IS TBD.
DESIGN INPUTS
GRAPHIC SCALE
1:10000
U.S. DEPARTMENT OF ENERGY
Yucca Mountain Site Characterization Project
M&O Civilian Radioactive Waste Management System MANAGEMENT & OPERATING CONTRACTOR
REPOSITORY ADVANCED CONCEPTUAL DESIGN
INTEGRATED LAYOUT (W/O CALICO HILLS DRIFTING)
ESF/GROA INTERFACE-1 OF 6
BC0000000-01717-2100-89100-00
AS NOTED
TBD-132
1:2.4
INTFC/89100.DGN
CONCEPTUAL


LEGEND:
DRIFTS TO BE CONSTRUCTED DURING SITE CHARACTERIZATION
CENTERLINE OF POTENTIAL REPOSITORY DRIFTS
FAULT PROJECTIONS TO APPROX. TSw1/TSw2 CONTACT
POTENTIAL EXPANSION AREA
PRIMARY EMPLACEMENT AREA
NORTH PORTAL HEADWALL
TS NORTH RAMP
SOUTH PORTAL HEADWALL
TS SOUTH RAMP
CH NORTH RAMP (-10%) (SEE NOTE 1)
CH SOUTH RAMP (-10%) (SEE NOTE 1)
TS IMBRICATE DRIFT
CH IMBRICATE DRIFT
IMBRICATE FAULT ZONE
DRILL HOLE WASH STRUCTURE
EMPLACEMENT DRIFTS
POTENTIAL PERIMETER VENTILATION MAIN DRIFT
MAIN TEST AREA
TS GHOST DANCE FAULT EXPLORATORY DRIFTS
TS MAIN DRIFT (REPOSITORY SERVICE MAIN)
CH GHOST DANCE FAULT DRIFT
TBM LAUNCH MAIN
GHOST DANCE FAULT
POTENTIAL EMPLACEMENT RAMP ACCESS TO EXPANSION AREA
NORTH RAMP EXTENSION
EMPLACEMENT EXHAUST SHAFT
CH MAIN DRIFT
DEVELOPMENT INTAKE SHAFT
POTENTIAL DEVELOPMENT RAMP ACCESS TO EXPANSION AREA
POTENTIAL WASTE MAIN
SOUTH RAMP EXTENSION
PERIMETER VENTILATION MAIN DRIFT
SOLITARIO CANYON FAULT
SERVICE MAIN
CH SOLITARIO DRIFT
NOTES:
1. REFER TO RSN TITLE I DRAWING NO. YMP-025-2-MING-MI13, REV 1, FOR DETAILS REGARDING DRIFTING ALONG CALICO HILLS (CH) MAIN DRIFT.
2. THE CONCEPTUAL REPOSITORY IS CURRENTLY ON THE Q-LIST BY DIRECT INCLUSION. THEREFORE, THIS DRAWING IS A QA DOCUMENT, BUT THE SPECIFIC CLASSIFICATION IN ACCORDANCE WITH QAP-2-3 IS TBD.
DESIGN INPUTS
DESCRIPTION AND RATIONALE FOR ENHANCEMENT TO THE BASELINE ESF CONFIGURATION B00000000-01717-0200-00089, REV 01
SURFACE FAULT TRACES PROJECTED TO REPOSITORY HORIZON BC0000000-01717-0200-00002, REV 00
ESF/REPOSITORY INTERFACE LAYOUT-COORDINATE GEOMETRY ANALYSIS BC0000000-01717-0200-00001, REV 00
ESF/REPOSITORY INTERFACE-INTEGRATED LAYOUT DESCRIPTION BC0000000-01717-0200-00003, REV 00, FIGURE 10-2
NOTICE OF OPEN CHANGE DOCUMENTS
GRAPHIC SCALE
1:10000
U.S. DEPARTMENT OF ENERGY
Yucca Mountain Site Characterization Project
M&O Civilian Radioactive Waste Management System MANAGEMENT & OPERATING CONTRACTOR
REPOSITORY ADVANCED CONCEPTUAL DESIGN
INTEGRATED LAYOUT (W/ CALICO HILLS DRIFTING) ESF/GROA INTERFACE-2 OF 6
BC0000000-01717-2100-89101-00
AS NOTED
TBD-132
1.2.4
INTFC/89101.DGN
R REGAN
D ROBERTS
D STANLEY
K BHATTACHARYYA
P MCKIE
CONCEPTUAL



SECTION A

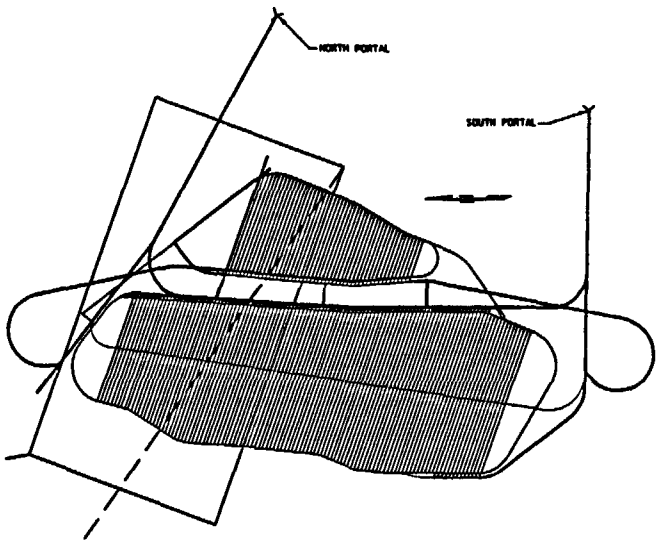
SCALE: HORIZ= 1:10000
VERT= 1:5000



ENLARGED PARTIAL PLAN

SCALE: 1:10000

REFERENCE STRATIGRAPHY UNIT NAME (DESIGNATOR)
UPPER PAINTBRUSH NONWELDED UNIT (PTn)
TOPOPAH SPRING WELDED UNIT LITHOPHYSAE-RICH (Tpwt)
TOPOPAH SPRING WELDED UNIT LITHOPHYSAE-POOR (Tpw2)
TOPOPAH SPRING WELDED UNIT, VITROPHYRE (Tpw1)
CALICO HILLS AND LOWER PAINTBRUSH NONWELDED UNIT (CHn1)
CALICO HILLS AND LOWER PAINTBRUSH NONWELDED UNIT (CHn2)



ESF/REPOSITORY INTEGRATED CONCEPTUAL LAYOUT (SEE BC0000000-01717-2100-89100)

PLAN

SCALE: 1:20000

NOTES:

1. STATIONS AND ELEVATIONS SHOWN ARE ROUNDED TO NEAREST INTEGER VALUE. REFER TO BC0000000-01717-2100-89100 (SHT 1 OF 5) FOR MORE PRECISE DATA.
2. GEOLOGICAL AND OTHER BACKGROUND INFORMATION SHOWN ON SECTION HAS BEEN DIGITIZED FROM SCE/CALMA PLOT NO. THP-84-012.0 PROVIDED BY DOE.
3. THE CONCEPTUAL REPOSITORY IS CURRENTLY ON THE QA-LIST BY DIRECT INCLUSION. THEREFORE, THIS DRAWING IS A QA DOCUMENT, BUT THE SPECIFIC CLASSIFICATION IN ACCORDANCE WITH QAP-3-5 IS TBD.

DESIGN INPUTS

DESCRIPTION AND RATIONALE FOR ENHANCEMENT TO THE BASELINE ESF CONFIGURATION BC0000000-01717-0200-00089, REV 01

SURFACE FAULT TRACES PROJECTED TO REPOSITORY HORIZON BC0000000-01717-0200-00002, REV 00

ESF/REPOSITORY INTERFACE LAYOUT-COORDINATE GEOMETRY ANALYSIS BC0000000-01717-0200-00001, REV 00

ESF/REPOSITORY INTERFACE-INTEGRATED LAYOUT DESCRIPTION BC0000000-01717-0200-00003, REV 00, FIGURE 10-3

NOTICE OF DESIGN CHANGE DOCUMENTS

DESIGNED	DRAWN	CHECKED
R REGAN		
D ROGERS		
D STANLEY		
K BHATTACHARYYA		
P MCKIE		

GRAPHIC SCALE

1:10000

U.S. DEPARTMENT OF ENERGY
Yucca Mountain Site Characterization Project
M&O Civilian Radioactive Waste Management System MANAGEMENT & OPERATING CONTRACTOR

REPOSITORY ADVANCED CONCEPTUAL DESIGN
SECTION "A" THROUGH INTEGRATED LAYOUT
ESF/GROA INTERFACE-3 OF 6

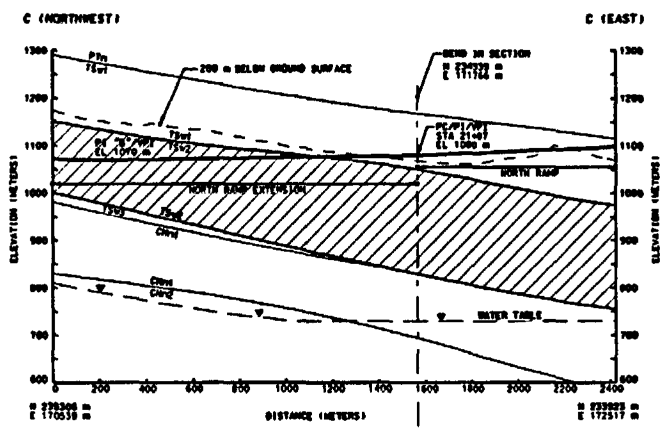
BC0000000-01717-2100-89102-00

SCALE: AS NOTED | TBD-132 | 1:2.4 | INTFC/89102.DGN

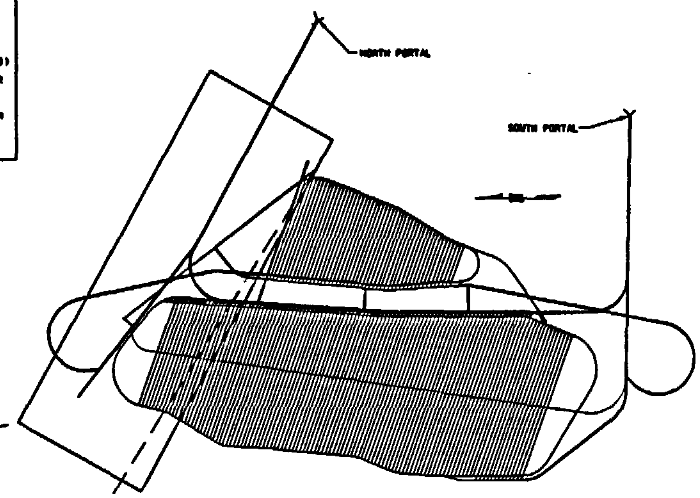
CONCEPTUAL

BC0000000-01717-2100-89103-00

REFERENCE STRATIGRAPHY UNIT NAME (DESIGNATOR)
UPPER PAINTBRUSH NONWELDED UNIT (PTn)
TOPOPAH SPRING WELDED UNIT LITHOPHYSAE-RICH (TSw1)
TOPOPAH SPRING WELDED UNIT LITHOPHYSAE-POOR (TSw2)
TOPOPAH SPRING WELDED UNIT, VITROPHYRE (TSw3)
CALICO HILLS AND LOWER PAINTBRUSH NONWELDED UNIT (CHn1)
CALICO HILLS AND LOWER PAINTBRUSH NONWELDED UNIT (CHn2)

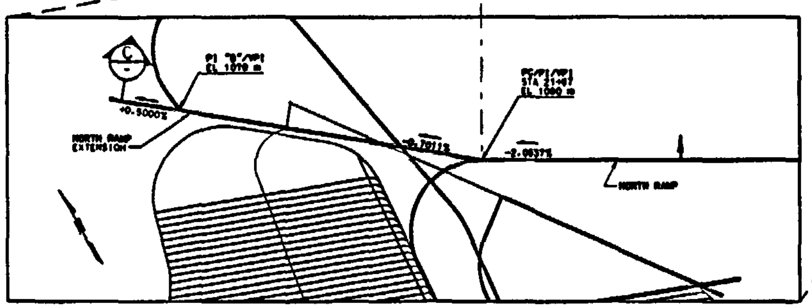


SECTION C
SCALE: HORIZ= 1:10000 VERT= 1:5000



ESF/REPOSITORY INTEGRATED CONCEPTUAL LAYOUT (SEE BC0000000-01717-2100-89100)

PLAN
SCALE: 1:20000



ENLARGED PARTIAL PLAN
SCALE: 1:10000

GRAPHIC SCALE
1:10000

NOTES:

1. STATIONS AND ELEVATIONS SHOWN ARE ROUNDED TO NEAREST INTEGER VALUE. REFER TO BC0000000-01717-2100-89100 (SHT 1 OF 6) FOR MORE PRECISE DATA.
2. GEOLOGICAL AND OTHER BACKGROUND INFORMATION SHOWN ON SECTION HAS BEEN DIGITIZED FROM IGIS/CALMA PLOT NO. YMP-94-020.0 PROVIDED BY SCAC.
3. THE CONCEPTUAL REPOSITORY IS CURRENTLY ON THE Q-LIST BY DIRECT INCLUSION. THEREFORE, THIS DRAWING IS A QA DOCUMENT, BUT THE SPECIFIC CLASSIFICATION IN ACCORDANCE WITH QAP-2-3 IS TBD.

DESIGN INPUTS
DESCRIPTION AND RATIONALE FOR ENHANCEMENT TO THE BASELINE ESF CONFIGURATION B00000000-01717-0200-00003, REV 01
SURFACE FAULT TRACES PROJECTED TO REPOSITORY HORIZON BC0000000-01717-0200-00002, REV 00
ESF/REPOSITORY INTERFACE LAYOUT-COORDINATE GEOMETRY ANALYSIS BC0000000-01717-0200-00001, REV 00
ESF/REPOSITORY INTERFACE-INTEGRATED LAYOUT DESCRIPTION BC0000000-01717-0200-00003, REV 00, FIGURE 10-4

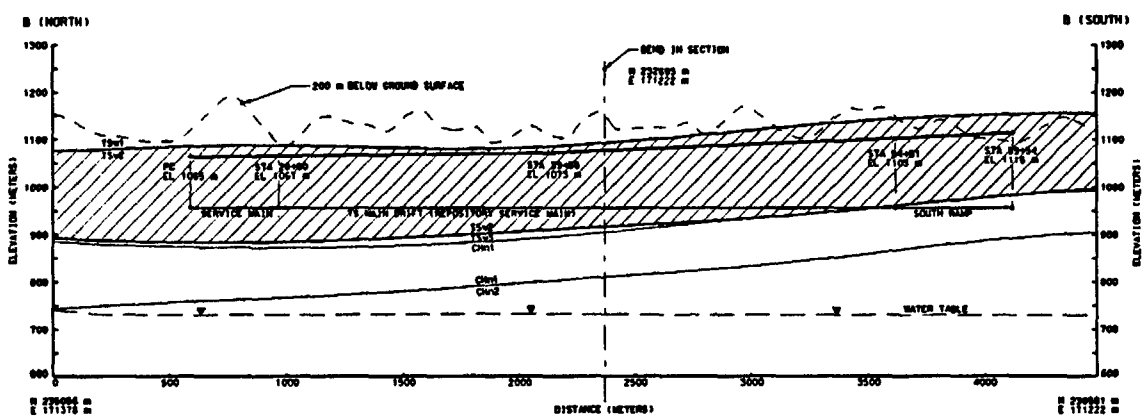
R REGAN
D ROBERTS
B STANLEY
K BHATTACHARYYA
P MCKIE

U.S. DEPARTMENT OF ENERGY
Yucca Mountain Site Characterization Project
M&O Civilian Radioactive Waste Management System MANAGEMENT & OPERATING CONTRACTOR

REPOSITORY ADVANCED CONCEPTUAL DESIGN
SECTION "C" ALONG NORTH RAMP AND EXTENSION
ESF/GROA INTERFACE-4 OF 6

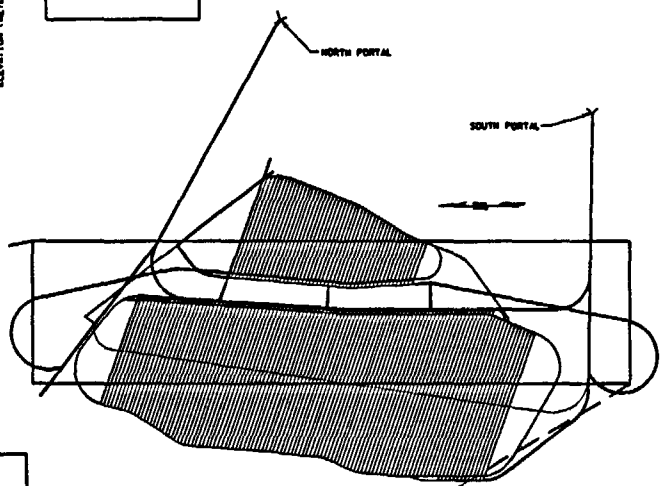
0 | BC0000000-01717-2100-89103-00
AS NOTED | TBD-132 | 1.2.4 | INTFC/89103.DGN

CONCEPTUAL



SECTION

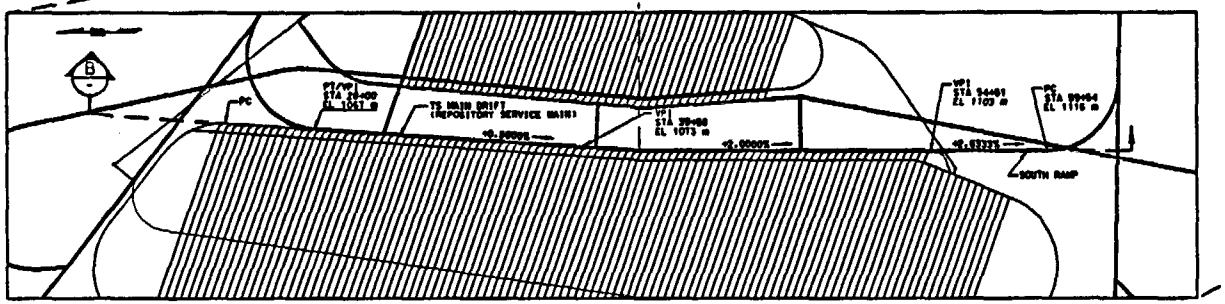
SCALE: HORIZ= 1:10000
VERT= 1:5000



ESF/REPOSITORY
INTEGRATED CONCEPTUAL LAYOUT
(SEE BC0000000-01717-2100-89100)

PLAN

SCALE: 1:20000



ENLARGED PARTIAL PLAN

SCALE: 1:10000

GRAPHIC SCALE

1:10000

NOTES:

1. STATIONING AND ELEVATIONS SHOWN ARE ROUNDED TO NEAREST METER VALUE. REFER TO BC0000000-01717-2100-89100 (SHT 1 OF 6) FOR MORE PRECISE DATA.
2. GEOLOGICAL AND OTHER BACKGROUND INFORMATION SHOWN ON SECTION HAS BEEN DIGITIZED FROM GIS/CALMA PLOT NO. YMP-94-013.0 PROVIDED BY SAIC.
3. THE CONCEPTUAL REPOSITORY IS CURRENTLY ON THE C-LIST BY DIRECT INCLUSION; THEREFORE, THIS DRAWING IS A QA DOCUMENT. BUT THE SPECIFIC CLASSIFICATION IN ACCORDANCE WITH QAP-2-3 IS TBD.

REFERENCE STRATIGRAPHY UNIT NAME (DESIGNATOR)

UPPER PAINTBRUSH NONWELDED UNIT (PTn)

TOPOPAH SPRING WELDED UNIT LITHOPHYSAE-RICH (TSw1)

TOPOPAH SPRING WELDED UNIT LITHOPHYSAE-POOR (TSw2)

TOPOPAH SPRING WELDED UNIT, VITROPHYRE (TSw3)

CALICO HILLS AND LOWER PAINTBRUSH NONWELDED UNIT (CHn1)

CALICO HILLS AND LOWER PAINTBRUSH NONWELDED UNIT (CHn2)

DESIGN INPUTS

DESCRIPTION AND RATIONALE FOR ENHANCEMENT TO THE BASELINE ESF CONFIGURATION BC0000000-01717-0200-00089, REV 01

SURFACE FAULT TRACES PROJECTED TO REPOSITORY HORIZON BC0000000-01717-0200-00002, REV 00

ESF/REPOSITORY INTERFACE LAYOUT-COORDINATE GEOMETRY ANALYSIS BC0000000-01717-0200-00091, REV 00

ESF/REPOSITORY INTERFACE-INTEGRATED LAYOUT DESCRIPTION BC0000000-01717-0200-00003, REV 00, FIGURE 10-5

NOTICE OF OPEN CHANGE DOCUMENTS

ITEM	DESCRIPTION	ISSUED BY	DATE	STATUS

R REGAN		
D ROGERS		
B STANLEY		
K BHATTACHARYYA		
P MOHR		

U.S. DEPARTMENT OF ENERGY
Yucca Mountain Site Characterization Project
M&O Civilian Radioactive Waste Management System
MANAGEMENT & OPERATING CONTRACTOR

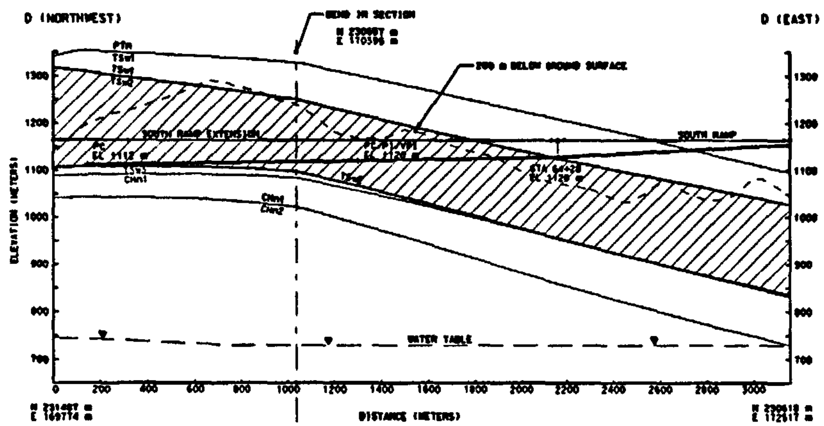
REPOSITORY ADVANCED CONCEPTUAL DESIGN

SECTION "B" ALONG TS MAIN DRIFT (REPOS SERV MAIN) ESF/GROA INTERFACE-5 OF 6

REV	DOCUMENT NO.	SHEET NO.	REV
0	BC0000000-01717-2100-89104-00		

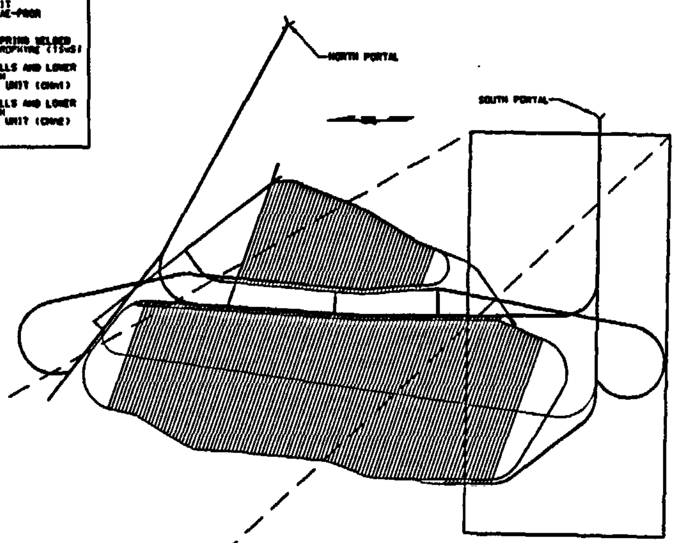
SCALE	QA CLASSIFICATION	U.S.	DWG FILE
AS NOTED	TBD-132	1.2.4	JNTFC/89104.DGN

CONCEPTUAL



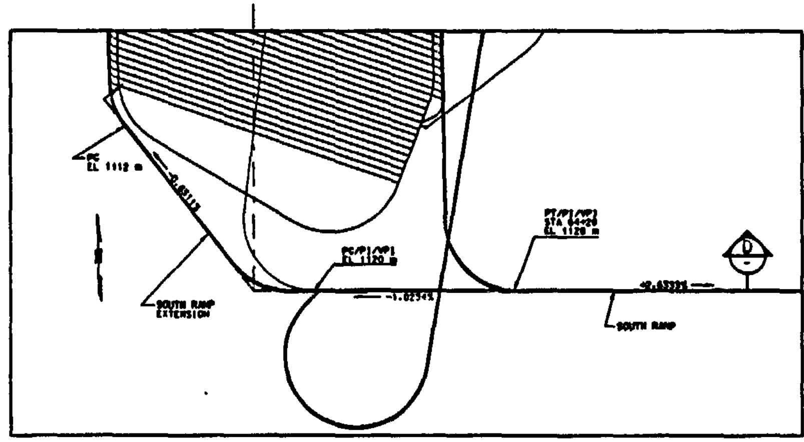
SECTION D
SCALE: HORIZ= 1:10000
VERT= 1:5000

REFERENCE STRATIGRAPHY UNIT NAME (DESIGNATOR)
UPPER PAINTBRUSH NONWELDED UNIT (PTn)
TOPOPAH SPRING WELDED UNIT LITHOPHYSAE-RICH (TSw1)
TOPOPAH SPRING WELDED UNIT LITHOPHYSAE-POOR (TSw2)
TOPOPAH SPRING WELDED UNIT, VITROPHYRE (TSw3)
CALICO HILLS AND LOWER PAINTBRUSH NONWELDED UNIT (CHn1)
CALICO HILLS AND LOWER PAINTBRUSH NONWELDED UNIT (CHn2)



ESF/REPOSITORY
INTEGRATED CONCEPTUAL LAYOUT
(SEE BC0000000-01717-2100-89100)

PLAN
SCALE: 1:20000



ENLARGED PARTIAL PLAN
SCALE: 1:10000

GRAPHIC SCALE
1:10000

NOTES:

1. STATIONS AND ELEVATIONS SHOWN ARE ROUNDED TO NEAREST INTEGER VALUE. REFER TO BC0000000-01717-2100-89100 (SHT 1 OF 6) FOR MORE PRECISE DATA.
2. GEOLOGICAL AND OTHER BACKGROUND INFORMATION SHOWN ON SECTION HAS BEEN DIGITIZED FROM IGIS/CALMA PLOT NO. YMP-84-021.0 PROVIDED BY EG&G.
3. THE CONCEPTUAL REPOSITORY IS CURRENTLY ON THE Q-LIST BY DIRECT INCLUSION. THEREFORE, THIS DRAWING IS A QA DOCUMENT. BUT THE SPECIFIC CLASSIFICATION IN ACCORDANCE WITH QAP-2-3 IS TBD.

DESIGN INPUTS

DESCRIPTION AND RATIONALE FOR ENHANCEMENT TO THE BASELINE ESF CONFIGURATION
B00000000-01717-0200-00009, REV 01

SURFACE FAULT TRACES PROJECTED TO REPOSITORY HORIZON
BC0000000-01717-0200-00002, REV 00

ESF/REPOSITORY INTERFACE LAYOUT-COORDINATE GEOMETRY ANALYSIS
BC0000000-01717-0200-00001, REV 00

ESF/REPOSITORY INTERFACE-INTEGRATED LAYOUT DESCRIPTION
BC0000000-01717-0200-00003, REV 00, FIGURE 10-6

CONCEPTUAL

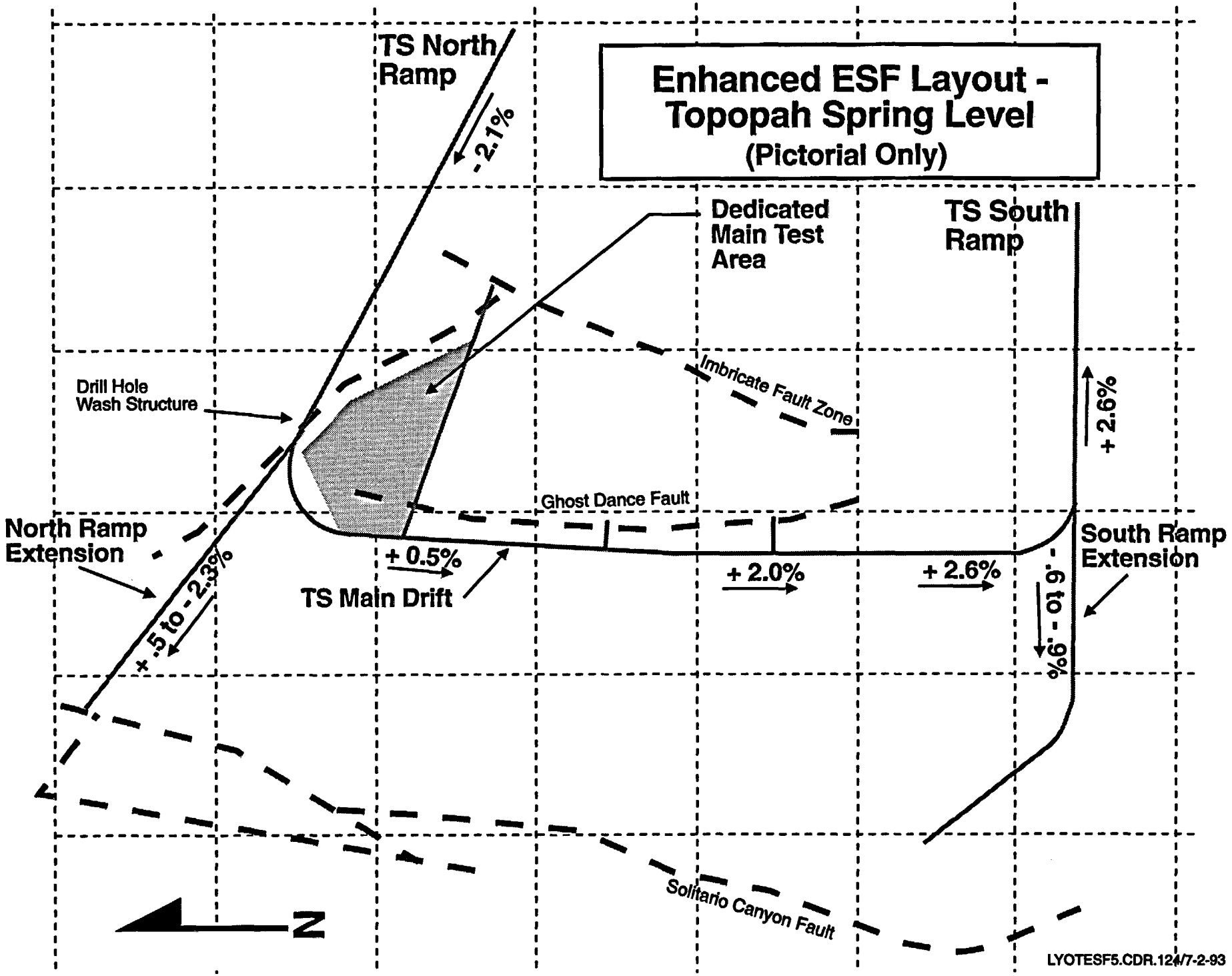
R REGAN
D ROGERS
D STANLEY
K BHATTACHARYYA
P MCKIE

U.S. DEPARTMENT OF ENERGY
Yucca Mountain Site Characterization Project
M&O Civilian Radioactive Waste Management System MANAGEMENT & OPERATING CONTRACTOR

REPOSITORY ADVANCED CONCEPTUAL DESIGN
SECTION "D" ALONG SOUTH RAMP AND EXTENSION
ESF/GROA INTERFACE-6 OF 6

SIZE D
BC0000000-01717-2100-89105-00
SCALE AS NOTED
TBD-132
1.2.4
INTFC/89105.DGN

/proj/rupes/mmo/intfc/89105.dgn


Enhanced ESF Layout -
Topopah Spring Level
(Pictorial Only)
TS North Ramp
-2.1%
Dedicated Main Test Area
TS South Ramp
Drill Hole Wash Structure
Imbricate Fault Zone
+ 2.6%
Ghost Dance Fault
North Ramp Extension
+ .5 to - 2.3%
+ 0.5%
TS Main Drift
+ 2.0%
+ 2.6%
- .6 to - .9%
South Ramp Extension
Solitario Canyon Fault
N
LYOTESF5.CDR.124/7-2-93

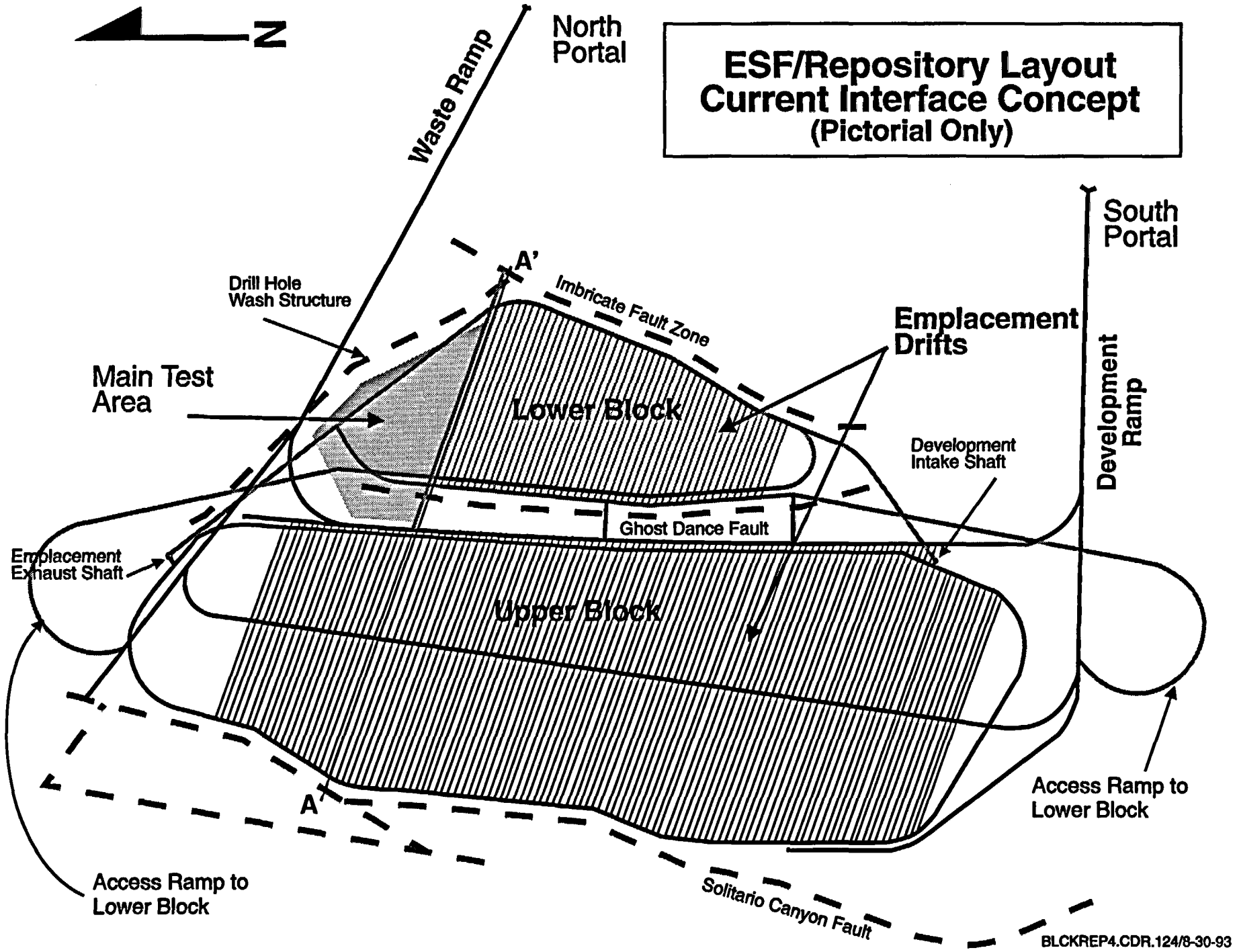

N
North Portal
Waste Ramp
ESF/Repository Layout
Current Interface Concept
(Pictorial Only)
South Portal
A'
Drill Hole
Wash Structure
Imbricate Fault Zone
Emplacement
Drifts
Main Test
Area
Lower Block
Development
Ramp
Development
Intake Shaft
Ghost Dance Fault
Emplacement
Exhaust Shaft
Upper Block
A
Access Ramp to
Lower Block
Access Ramp to
Lower Block
Solitario Canyon Fault
BLCKREP4.CDR.124/8-30-93

TABLE 1: SUMMARY TABLE OF PLANNED ESF TESTS GROUPED BY CONSOLIDATED PROGRAM (SOURCE: ESF TPP 91-5)

SCP TEST ACTIVITY	SCP§ REFERENCE NUMBER	SCP PROGRAM NAME
*Consolidated Sampling**		
• Chloride & Chlorine-36 Measurements of Percolation at YM	8.3.1.2.2.2.1	Geohydrology
• Matrix Hydrologic Properties Testing	8.3.1.2.2.3.1	Geohydrology
• Petrologic Stratigraphy of the Topopah Spring Member	8.3.1.3.2.1.1	Geochemistry
• Mineral Distribution Between Host Rock and Accessible Environment	8.3.1.3.2.1.2	Geochemistry
• Fracture Mineralogy Studies of the ESF	8.3.1.3.2.1.3	Geochemistry
• History of Mineralogic and Geochemical Alteration of YM	8.3.1.3.2.2.1	Geochemistry
• Biological Sorption and Transport	8.3.1.3.4.2	Geochemistry
• Laboratory Tests (Thermal & Mechanical) Using Samples	See Note 1	Thermal & Mech. Rock Prop.
• Repository Horizon Rock-Water Interaction	8.3.4.2.4.4.2	Waste Package Characteristics
Intact-Fracture Test	8.3.1.2.2.4.1	Geohydrology
Percolation Tests in the ESF	8.3.1.2.2.4.2	Geohydrology
Radial Borehole Tests in the ESF	8.3.1.2.2.4.4	Geohydrology
Bulk Permeability Test in the ESF	8.3.1.2.2.4.3	Geohydrology
Excavation Effects Test	8.3.1.2.2.4.5	Geohydrology
Perched-Water Testing in the ESF	8.3.1.2.2.4.7	Geohydrology
Hydrochemistry Tests in the ESF	8.3.1.2.2.4.8	Geohydrology
Hydrologic Properties of Major Faults Encountered in the ESF	8.3.1.2.2.4.10	Geohydrology
Diffusion Test in the ESF	8.3.1.2.2.5.1	Geohydrology
Field Scale Experiments to Study Radionuclide Transport at YM	8.3.1.3.7.2.2	Geochemistry
Underground Geological Mapping	8.3.1.4.2.2.4	Rock Characteristics
Seismic Tomography/Vertical Seismic Profiling at the ESF	8.3.1.4.2.2.5	Rock Characteristics
*Construction Monitoring**		
• Access Convergence Test at the ESF	8.3.1.15.1.5.1	Thermal & Mech. Rock Prop.
• Evaluation of Mining Methods	8.3.1.15.1.8.1	Thermal & Mech. Rock Prop.
• Monitoring of Ground Support Systems	8.3.1.15.1.8.2	Thermal & Mech. Rock Prop.
• Monitoring Drift Stability	8.3.1.15.1.8.3	Thermal & Mech. Rock Prop.
*Thermal/Mechanical Properties**		
• Heater Experiment in TSw1	8.3.1.15.1.6.1	Thermal & Mech. Rock Prop.
• Canister-Scale Heater Experiment	8.3.1.15.1.6.2	Thermal & Mech. Rock Prop.
• Yucca Mountain Heated Block	8.3.1.15.1.6.3	Thermal & Mech. Rock Prop.
• Thermal Stress Measurements	8.3.1.15.1.6.4	Thermal & Mech. Rock Prop.
• Sequential Drift Mining	8.3.1.15.1.5.3	Thermal & Mech. Rock Prop.
• Heated Room Experiment	8.3.1.15.1.6.5	Thermal & Mech. Rock Prop.
• Plate Loading Tests	8.3.1.15.1.7.1	Thermal & Mech. Rock Prop.
• Rock-Mass Strength Experiment	8.3.1.15.1.7.2	Thermal & Mech. Rock Prop.
• Overcore Stress Experiment in the ESF	8.3.1.15.2.1.2	Thermal & Mech. Rock Prop.
Air Quality and Ventilation Experiment	8.3.1.15.1.8.4	Thermal & Mech. Rock Prop.
In Situ Testing of Seal Components	8.3.3.2.2.3	Seal Characteristics
*Near-Field Hydrologic/Geomechanical Properties**		
• Mechanical Attributes of the Waste Package Environment	8.3.4.2.4.3	Waste Package Characteristics
• Repository Horizon Near-Field Hydrologic Properties	8.3.4.2.4.4.1	Waste Package Characterisitcs

NOTE:
1) 8.3.1.15.1.1.1; 8.3.1.15.1.1.2; 8.3.1.15.1.1.3; 8.3.1.15.1.2.1; 8.3.1.15.1.3.1; 8.3.1.15.1.3.2; 8.3.1.15.1.4.1; 8.3.1.15.1.4.2
2) ESF locator test names (Calico Hills Test, Demonstration Breakout Room) are not separately listed.
3) *Multi-Purpose Borehole Test* (Optional ESF Shaft Test) is not listed.
4) *Development and Demonstration of Required Equipment Test* is not currently planned.

* Consolidated Test Program Name

TABLE 2: CONSOLIDATED ESF TEST PROGRAMS

CATEGORIZED BY LICENSE APPLICATION AND MAJOR SITE SUITABILITY REPORTS SUPPORTED* (SOURCE: OMB 5-YEAR PLAN [PROGRAM APPROACH])

ESF TEST/PROGRAM	LICENSE APPLICATION AND TECHNICAL BASIS REPORTS SUPPORTING HIGHER LEVEL FINDINGS
Consolidated Sampling	• Geochemistry/Post Closure Rock • Characteristics Geohydrology/Transport • Preclosure Rock Characteristics • Technical Site Suitability
Intact-Fracture Test	• Geohydrology/Transport • Technical Site Suitability
Percolation Tests in the ESF	• Geohydrology/Transport • Technical Site Suitability
Radial Borehole Tests in the ESF/ Bulk Permeability Test in the ESF	• Geohydrology/Transport • Technical Site Suitability
Excavation Effects Test	• Geohydrology/Transport • Technical Site Suitability
Perched-Water Testing in the ESF	• Geohydrology/Transport • Technical Site Suitability
Hydrochemistry Tests in the ESF	• Geohydrology/Transport • Technical Site Suitability
Hydrologic Properties of Major Faults Encountered in the ESF	• Geohydrology/Transport • Technical Site Suitability
Diffusion Test in the ESF	• Geohydrology/Transport • Technical Site Suitability
Field Scale Experiments to Study Radionuclide Transport at YM	• Geohydrology/Transport • Technical Site Suitability • License Application
Underground Geological Mapping	• Preclosure Rock Characteristics • Technical Site Suitability • Geochemistry/Postclosure Rock Characteristics
Seismic Tomography/Vertical Seismic Profiling at the ESF	• Preclosure Rock Characteristics
Construction Monitoring	• Preclosure Rock Characteristics • Technical Site Suitability • Reasonably Available Technology
Thermal/Mechanical Properties	• Total System Performance Assessment • Preclosure Rock Characteristics • Geochemistry/Postclosure Rock Characteristics • Technical Site Suitability • License Application
Air Quality and Ventilation Experiment	• Total System Performance Assessment • License Application
In Situ Testing of Seal Components	• Total System Performance Assessment • License Application • Reasonably Available Technology
Near-Field Hydrologic/Geomechanical Properties	• Total System Performance Assessment • License Application

* The tests and Test Programs identified in the left column primarily support License Application development or the technical basis reports identified in the right column.

TABLE 3: IN SITU TEST LOCATIONS AND IMPLEMENTATION LOGISTICS FOR ESF TESTS/PROGRAMS

(SOURCES: SITE PROGRAM ANNUAL PLAN 1994 & 1995, OMB 5-YEAR PLAN)

YEARS IN PARENTHESIS INDICATE INITIAL START (PLANNED OR ACTUAL) OF TEST OR FIRST PROGRAM COMPONENT

I. CONSTRUCTION PHASE (NON-DEFERRABLE) TESTS CONDUCTED IN TBM ENVELOPE

• Consolidated Sampling	(1993)
• Perched Water Testing in the ESF (Contingency)	(1993)
• Hydrochemistry Tests in the ESF	(1995)
• Underground Geological Mapping	(1993)
• Construction Monitoring	(1993)

II. CONSTRUCTION PHASE (NON-DEFERRABLE) TESTS IN ALCOVES

• Consolidated Sampling	(1994)
• Radial Borehole Tests in the ESF	(1994)
• Hydrochemistry Tests in the ESF	(1994)
• Hydrologic Properties of Major Faults Encountered in the ESF	(1995)
• Underground Geological Mapping	(1994)
• Construction Monitoring	(1994)

III. DEFERRED (POST "INITIAL LOOP") TESTS IN THE ESF RAMPS/MAIN DRIFT

• Consolidated Sampling	(1997)
• Excavation Effects Test	(1997)
• Intact-Fracture Test in the ESF	(1997)
• Seismic Tomography/Vertical Seismic Profiling at the ESF	(1997)
• Construction Monitoring	(1997)
• Air Quality and Ventilation Experiment	(1996)
• In Situ Testing of Seal Components	(1998)

IV. IN SITU ALCOVE TESTS IN THE CORE TEST AREA/RAMP EXTENSIONS (TSw2)
(Including Deferred Ramp Alcoves)

• Consolidated Sampling	(1994)
• Radial Borehole Tests in the ESF	(1994)
• Hydrochemistry Tests in the ESF	(1994)
• Hydrologic Properties of Major Faults Encountered in the ESF	(1995)
• Underground Geological Mapping	(1994)
• Construction Monitoring	(1994)
• Percolation Tests in the ESF	(1996)
• Thermal/Mechanical Properties	(1996)
• Near-Field Hydrologic/Geomechanical Properties	(1997)

V. PLANNED TESTS IN CALICO HILLS NONWELDED UNIT (All Tests TBD)

- Underground Geological Mapping
- Consolidated Sampling
- Field Scale Experiments to Study Radionuclide Transport at YM *
- Intact-Fracture Test
- Percolation Tests in the ESF
- Radial Borehole Tests in the ESF/Bulk Permeability Tests in the ESF
- Hydrochemistry Tests in the ESF
- Diffusion Test in the ESF
- In Situ Testing of Seal Components

* First Phase of Field Testing

Figure 1

ESF TEST PROGRAM LOCATIONS