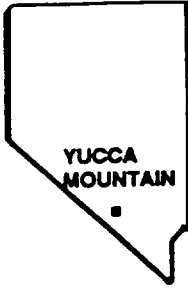


U.S. DEPARTMENT OF ENERGY

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**YUCCA MOUNTAIN
SITE CHARACTERIZATION
PROJECT**

**PLAN FOR THE PHASED
APPROACH TO ESF DESIGN
DEVELOPMENT AND
IMPLEMENTATION**



FEBRUARY 1991
UNITED STATES DEPARTMENT OF ENERGY

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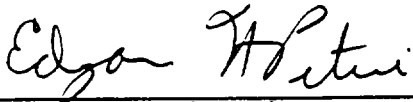
YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT

PLAN FOR THE PHASED APPROACH TO
ESF DESIGN DEVELOPMENT AND IMPLEMENTATION

FEBRUARY 1991

PLAN FOR THE PHASED APPROACH TO
ESF DESIGN DEVELOPMENT AND IMPLEMENTATION


Approved by:



Edgar H. Petrie, Director
Engineering and Development Division
Yucca Mountain Site Characterization
Project Office

3/1/91

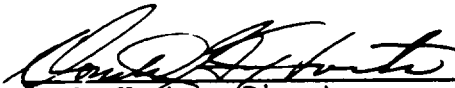
Date



C. P. Gertz, Associate Director
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3/1/91

Date



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Quality Assurance Division
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3/1/91

Date

YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT

PLAN FOR THE PHASED APPROACH TO ESF DESIGN DEVELOPMENT AND IMPLEMENTATION

EXECUTIVE SUMMARY

This plan has been prepared in response to an Office of Civilian Radioactive Waste Management (OCRWM) request to develop a phased approach to the ESF design development and implementation. The plan shows how the ESF design, construction and testing activities will be conducted using a phased approach.

The specific design, construction, and test packages as well as the tests described may change during the trade studies being performed in preparation for resumption of Title II design. These changes will be made/developed without modification to this plan, but will be documented in the plan to be provided for phased ESF Title II design and implementation.

The design priorities and sequence which will be followed during the preparation of the design packages for construction and testing (shown in Figure 1), are as follows:

1. Site Preparation and Portal of North Ramp
2. North Ramp from Portal to Topopah Spring (TS) Level
3. Site Preparation and Portal of South Ramp
4. South Ramp from Portal to TS Level
5. North Ramp from Calico Hills (CH) Turnout to CH Level
6. South Ramp from CH Turnout to CH Level
7. Full Length Drift at the CH Level
8. Full Length Drift at the TS Level
9. Main Test Level Core Area at the TS Level
10. Shaft at North End-Surface to TS Level

**PLAN FOR THE PHASED APPROACH TO ESF DESIGN
DEVELOPMENT AND IMPLEMENTATION**

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PLAN FOR THE PHASED APPROACH TO DESIGN
DEVELOPMENT AND ESF IMPLEMENTATION

1.0 INTRODUCTION

This plan has been prepared in response to an Office of Civilian Radioactive Waste Management (OCRWM) request to develop a phased approach to design development and ESF implementation in order to preserve flexibility and to take advantage of findings as data acquisition proceeds. (J. Bartlett memorandum to Acting Associate Director, Office of Geologic Disposal, RW-20, and Acting Associate Director, Office of Systems and Compliance, RW-30, "Completion of Exploratory Shaft Facility Design" dated February 12, 1991). More detailed plans for the phased design and construction of the ESF will be provided to OCRWM in September 1991.

1.1 PURPOSE

The purpose of this plan is to show how the ESF design, construction, and test activities will be conducted using a phased approach, in order to allow the program to consider newly obtained information, which may alter or change current designs, construction or testing strategies.

1.2 SCOPE

The scope of this plan is to briefly describe the key activities which will be performed during the ESF design, construction and testing.

The plan will, 1) discuss the development of, and a test planning basis for, a preliminary ESF design. 2) Discuss the logic of the phased approach to design/construction development, 3) identify the individual design/construction phases and the associated tests, and 4) identify participants, by area of responsibility.

2.0 DESIGN APPROACH

2.1 GENERAL

The ESF design will re-commence as follows;

A design study will be conducted by the ESF Architect/Engineer (AE) using Project controlled requirements documents, to develop a preliminary (reference) design which is consistent with the controlled site characterization testing program, and will form the basis for a

revised Title I design. The study will evaluate the favorable features of the highest ranked options identified in the ESF Alternatives Study Findings Report, and will incorporate these features to produce a design which will enhance the construction and performance of the underground test facility.

The transition from project controlled requirements to the OCRWM baselined requirements will be described in a plan to be provided by the Office of Systems and Compliance (OSC).

Upon completion and issuance of the modified Title I Design Summary Report, it will be transmitted to OCRWM together with a plan for phased ESF Title II design and implementation. OCRWM will then review and accept the Title I Design Summary Report, the final ESF configuration, and the Title II design implementation plan.

The ESF Title II design, construction, and testing will be conducted in phases. This phased approach will allow the program to evaluate any newly acquired test data and determine if any modifications or changes to the existing designs or testing strategies are necessary prior to starting the next construction phase.

2.2 DESIGN PHASES

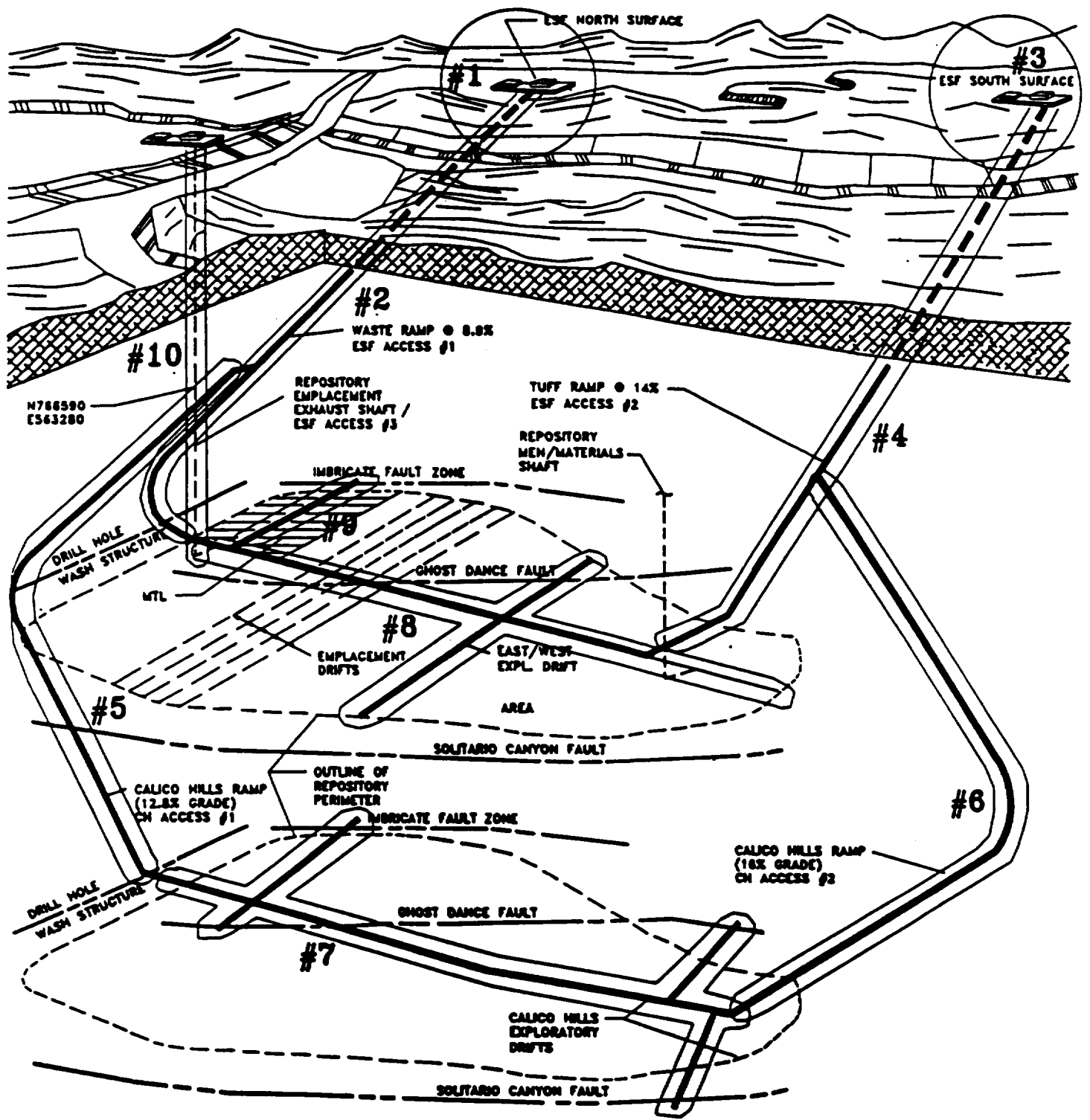
As indicated earlier, the design of the ESF will be conducted in phases. This will allow information from early testing to influence construction and testing of ongoing/following phases.

Figure 1 is a graphic representation of the option which contains the majority of the favorable features of the highest ranked options identified by the ESF Alternatives Study. It also incorporates the additional modifications recommended by the Office of Geologic Disposal (OGD). This option will be used as the reference design concept for commencing the design study. (It should be noted that trade studies will be performed to provide justification for any changes with respect to the highest ranked option.)

The specific design, construction, and test packages as well as the tests described may change during the trade studies being performed in preparation for resumption of Title II design. These changes will be made/developed without modification to this plan, but will be documented in the plan provided for phased ESF Title II design and implementation.

The design priorities and sequence which will be followed during the preparation of the design packages for construction and testing (shown in Figure 1), are as follows:

1. Site Preparation and Portal of North Ramp
2. North Ramp from Portal to Topopah Spring (TS) Level
3. Site Preparation and Portal of South Ramp
4. South Ramp from Portal to TS Level
5. North Ramp from Calico Hills (CH) Turnout to CH Level



NOTE: THIS IS PICTORIAL ONLY AND NOT DRAWN TO SCALE

NOTE: DESIGN, CONSTRUCTION, AND TESTING PHASES SHOWN ---

#2

REFERENCE DESIGN CONCEPT FOR COMMENCING STUDY

FIG. 1

6. South Ramp from CH Turnout to CH Level
7. Full Length Drift at the CH Level
8. Full Length Drift at the TS Level
9. Main Test Level Core Area at the TS Level
10. Shaft at North End-Surface to TS Level

Each design phase corresponds with a construction/testing phase, beginning with surface preparation and portal development and proceeding through exploratory drifting and main test level development on the TS Level.

Before Title II design begins, those aspects of the test program which may be affected by a change in ESF configuration must be identified. These determinations will be predicated on various Project Office assessments of data needs and testing priorities, and will be documented in the Site Characterization Program Baseline (SCPB) developed by the Regulatory and Site Evaluation Division (RSED). Consistent with the Project's Test and Evaluation Plan (T&EP) and SCPB, test planning packages will be produced which compile and interrelate technical testing bases, test descriptions, and test controls. Test planning packages will provide the prioritized basis for specific test requirements for ESF design. This process will begin during pre-Title II design studies, and will continue through phased ESF design and construction/testing.

Test planning and associated test-related support of phased design elements will emphasize the flexibility to accommodate changes in construction and testing for each phase. This flexibility recognizes that data gathered from early construction phases may indicate the necessity to expand, or modify test program elements. Development of the phased design will proceed without interruption, but will be capable of incorporating later adjustments if construction and/or testing programs require modification as a result of ongoing data evaluation.

Early design emphasis (Phases 1-4) will be on the north and south ramp accesses. Phases 1 and 3, site preparation and portal development of the north and south ramps, involve site leveling and grading to accommodate the construction and operation of the portals. These phases include the design of support buildings, facilities and utilities. Phases 2 and 4 (north and south ramps from portals to TS involve the design, construction and testing of the north and south ramps to the TS level. Declined ramps will provide access to the TS level, including construction and test-related utilities and support. Testing requirements for these design phases will be prioritized, as will development of detailed test planning and identification of construction support and test controls. The tests currently identified in the SCPB which are planned in the primary science ramp (north ramp; Phase 2), during construction include the following:

1. Multi-purpose Borehole (MPBH) (may be replaced by engineering investigation boreholes for ramp accesses)

2. Geologic Mapping
3. Short Radial Boreholes
4. Hydrochemistry
5. Mineralogy/Petrology (sampling)
6. Matrix Hydrologic Properties (sampling)
7. Chlorine-36 (sampling)
8. Hydrologic Properties of Major Faults (Bow Ridge Fault and Drill Hole Wash Structure)
9. Perched Water (if encountered).

NOTE: The validity of the list of tests shown above is dependent on the RSED review and approval of the SCPB.

Several tests proposed or planned in the ramp will be deferred until after construction and other prioritized ESP testing activities have been completed. These deferred ramp tests are:

1. Upper Demonstration Breakout Room
2. Heater Experiment in TSw1
3. Overcore Stress
4. Vertical Seismic Profiling
5. Long Radial Boreholes Test (status and scope TBD for ramp accesses; depends on construction of MPBH)
6. Intact Fractures
7. Excavation Effects (status and scope TBD for ramp accesses)
8. Shaft Convergence (status and scope TBD for ramp accesses).

For the south ramp (Phase 4), the only testing proposed or planned during ramp construction are Geologic Mapping, Perched Water (if encountered), and Hydrologic Properties of Major Faults (if encountered).

Phases 5 and 6 are the extensions of the north and south ramps from the CH turnouts to the CH level. Declined ramps will be designed to provide access to the CH geologic unit, including construction utilities and support to the required tests. Tests proposed or planned during construction of Phase 5 (north ramp) include the following:

1. Geologic Mapping
2. Short Radial Boreholes
3. Hydrochemistry
4. Mineralogy/Petrology (sampling)
5. Matrix Hydrologic Properties (sampling)
6. Chlorine-36 (sampling)
7. Hydrologic Properties of Major Faults (Drill Hole Wash Structure)
8. Perched Water (if encountered)

Deferred tests proposed or planned after construction and after other prioritized ESF testing activities have been completed include:

1. Vertical Seismic Profiling
2. Long Radial Boreholes Test (status and scope TBD for ramp accesses)
3. Intact Fractures
4. Excavation Effects (status and scope TBD for ramp accesses)

For the CH ramp extension in the south (Phase 6), the only tests currently proposed or planned are Geologic Mapping, Perched Water (if encountered), and Hydrologic Properties of Major Faults (if encountered).

Drifting and testing on the CH level (Phase 7) will include a drift connecting the north and south ramps, and lateral drifts to selected areas of geologic interest. Design will consider construction and operational utilities to support required tests. The testing program for the CH level is currently being defined. Testing will be initiated during construction, and will continue after construction is complete. Tests currently proposed or planned include:

1. Geologic Mapping
2. Hydrologic Properties of Major Faults
3. Bulk Permeability
4. Mineralogy/Petrology (sampling)
5. Matrix Hydrologic Properties (sampling)
6. Chlorine-36 (sampling)
7. Perched Water (if encountered)
8. Hydrochemistry
9. Vertical Seismic Profiling
10. Diffusion
11. Intact Fractures
12. Overcore Stress

Other testing activities being evaluated for inclusion in the CH test suite include geomechanical and geochemical tests such as plate loading and migration studies. The finalization of the CH test program is an early priority in ESF design and planning.

Phase 8 will address the full length drifting on the TS level, including drifting east and west across the block. A drift connecting the north and south ramps at the TS will be designed, including construction and operational utilities to support the required tests. Additional drifting and associated utilities and test support will provide east-west exposure, including a southern Ghost Dance Fault intercept. Tests currently proposed or planned for the TS drifting phase include:

1. Geologic Mapping
2. Bulk Permeability
3. Hydrologic Properties of Major Faults
4. Perched Water (if encountered)
5. Mineralogy/Petrology (sampling)
6. Matrix Hydrologic Properties (sampling)
7. Chlorine-36 (sampling)
8. Intact Fractures
9. Plate Loading
10. Vertical Seismic Profiling
11. Ground Support Monitoring
12. Evaluation of Mining Methods
13. Equipment/Development
14. Rock Mass Strength
15. Air Quality/Ventilation
16. Monitoring Drift Stability

Phase 9 includes operational design and construction of those openings required to support the required tests at the main test level core area on the TS level. Tests currently proposed or planned for the main test level core area include:

1. Lower Demonstration Breakout Room
2. Geologic Mapping
3. Mineralogy/Petrology (sampling)
4. Sequential Drift Mining
5. Canister Scale Heater
6. Heated Block
7. Thermal Stress
8. Heated Room
9. Equipment/Development
10. Plate Loading
11. Rock Mass Strength
12. Evaluation of Mining Methods
13. Ground Support Monitoring
14. Monitoring of Drift Stability
15. Air Quality/Ventilation
16. Engineered Barrier
17. Seals
18. Overcore Stress
19. Matrix Hydrologic Properties (sampling)
20. Percolation
21. Bulk Permeability
22. Perched Water (if encountered)
23. Diffusion
24. Chlorine-36 (sampling)

The ESF design will include an optional shaft (Phase 10) which would be constructed in the north, extending from the surface to the TS level near the main test level core area. The shaft would expose the geologic strata overlying the TS level. The shaft will be located at the potential repository emplacement exhaust shaft, but will be constructed only if required for collection of test information to augment characterization data obtained from the ramps.

3.0 RESPONSIBILITIES

The Office of Geologic Disposal (OGD) Engineering and Development Division (E&DD), is responsible for the overall administrative control of the ESF design activities. The Regulatory and Site Evaluation Division (RSED) is responsible for development and control of the site characterization testing program.

Technical and Management Support Services (T&MSS) under the direction of OGD E&DD, will assist E&DD in the guidance, management, and monitoring of the design activities.

Raytheon Services Nevada (RSN), the ESF Architect/Engineer is responsible for the design of the ESF, which includes the preparation of design drawings and construction specifications for both the surface facilities and the underground test facility.

The Los Alamos National Laboratory (LANL) Test Managers Office (TMO) is responsible for consolidating the testing inputs from the test community. The Principal Investigators (PI's) from the United States Geological Survey (USGS), LANL, Sandia National Laboratories (SNL) and Lawrence Livermore National Laboratory (LLNL), will identify their testing needs, and from these needs the TMO will develop test facility requirements for use by the A/E in developing the design.