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FY'93 ANNUAL PLAN FOR SITE CHARACTERIZATION

YUCCA MOUNTAIN PROJECT

January 31, 1993

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FISCAL YEAR (FY) 1993 ANNUAL PLAN FOR SITE CHARACTERIZATION

Enclosed is the FY 1993 Annual Plan for Site Characterization activities for the Yucca Mountain Site Characterization Project (YMP). The plan describes activities that support Surface-Based Testing (SBT) and testing in the Exploratory Studies Facility (ESF), for work funded under Work Breakdown Structure 1.2.3, Site Investigations. An overview of the planned SBT and ESF activities is presented, status of these activities summarized as of the beginning of the fiscal year, and anticipated products listed for FY 1993. The SBT and ESF testing goals for FY 1993 are also discussed in the context of the overall goals of the YMP. Appendices to the plan provide additional data on the status, prioritization, and funding of each work element funded for FY 1993, a look back at accomplishments for FY 1992, and a look forward to planned FY 1994 work scopes. Compilations of data for boreholes, trenches, and test pits planned for FY 1993 are also included in the appendices.

This annual plan is an implementation document of the Surface-Based Testing Coordination (SBTC) Management Plan (YMP/92-27), which describes the planning, integration, and coordination of all SBT and ESF activities to be conducted in FY 1993. The document represents the type of information that the Regulatory & Site Evaluation Division and the Civilian Radioactive Waste Management System Management and Operating Contractor Site Characterization Group have determined to be necessary in the planning and management of the site characterization activities. The SBTC Management Plan calls for the yearly development of an Annual Plan; the enclosed document is the first annual plan to be developed.

The Annual Plan is a "living" document that represents a "slice in time," and therefore includes information and schedules that can be changed as the work progresses. However, it is intended that application of the plan with respect to budget, schedule, and deliverables be done rigorously and necessary changes evaluated and documented thoroughly. In the interest of making the FY 1993 annual plan available in a timely manner, it is being distributed now, even though some of the data sheets in the appendices may be incomplete.

93-9484

2/11/93

Compilation of the draft FY 1994 Annual Plan, which is targeted for early April 1993, is underway. To assist us in making the FY 1994 plan an improved document, we would appreciate receiving feedback regarding the content of and data sources included in the FY 1993 plan.

If you have any questions, please contact Dennis R. Williams at (702) 794-7968.

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FY 1993 Annual Plan for
Site Characterization

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for SITE CHARACTERIZATION
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FY'93 ANNUAL PLAN
for SITE CHARACTERIZATION
YUCCA MOUNTAIN PROJECT

1.0 INTRODUCTION

This Annual Plan describes the activities supporting Surface-Based Testing (SBT) and testing in the Exploratory Studies Facility (ESF) planned by the Yucca Mountain Project Office (YMPO) for site characterization in Fiscal Year 1993 (FY'93). The Surface-Based Testing (SBT) program encompasses all activities that gather information using surface-based methods. These investigations include geologic mapping, drilling, trenching, field monitoring, field testing, laboratory testing, and geophysical surveys. The ESF Testing program consists of activities carried out underground within the ESF. Both the SBT and the ESF testing programs will gather data to contribute to the determination of the suitability of the Yucca Mountain Site. Activities in Work Breakdown Structure (WBS) 1.2.3 (Site Investigations) primarily fall into SBT activities, although some are in support of ESF construction. The ESF activities occur within WBS elements 1.2.2, 1.2.3, and 1.2.4.

The Plan discusses the SBT and ESF testing goals for FY'93 in the context of the overall goals of the Project. An overview of the planned SBT and ESF activities is presented, summarizing the status of these activities as of the beginning of the fiscal year, and the schedule for the year. Appendices to the Plan provide additional data on the status of each funded work element, as well as a linkage of the activities to licensing requirements, site suitability issues, and test prioritization evaluations regarding the contribution of the tests to Project goals.

This document is an implementation document of the Surface-Based Testing Coordination (SBTC) Management Plan (YMP/92-27), which discusses the planning, integration, and coordination of all SBT and ESF testing activities of the Site Characterization Program for Yucca Mountain. The organization and responsibilities for coordination of the site characterization activities are presented in that document.

The remainder of this Annual Plan is organized as follows:

Section 2.0:	Purpose and Scope
Section 3.0:	Approach - Strategy and Prioritization
Section 4.0:	Goals of the Site Investigations Activities for FY'93
Section 5.0:	Description of FY'93 Tests and Activities
Section 6.0:	Schedule for SBT and ESF Activities, Milestones, and Deliverables
Section 7.0:	Discussion of Variance of FY'93 Activities from Mission 2001
Section 8.0:	Coordination, Monitoring and Reporting of SBT Activities
Section 9.0:	Resource Requirements

2.0 PURPOSE AND SCOPE

The purpose of the SBT Annual Plan is to provide strategy and scheduling guidance for conducting surface-based and ESF testing activities and preparatory activities during the year. As such, it:

- presents a focused site characterization program for FY'93;
- provides the rationale for the conduct of each element of the program;
- stabilizes and integrates the SBT and ESF testing programs, in an attempt to mitigate and minimize inefficiencies of last-minute schedule changes;
- provides a overview framework within which more detailed planning, integration, and coordination of the site characterization activities can occur;
- is a document against which the progress of SBT and ESF testing activities can be monitored during the year;
- provides a concise compilation of data relevant to the coordination of SBT and ESF activities;
- provides a basis to anticipate FY'94 activities, and a means for planning for those activities;
- provides an overall time-line for anticipating the occurrence of events during the fiscal year; and
- provides a management tool from which the following year's activities can be planned.

The scope of the Annual Plan covers all data and sample collection, as well as support activities conducted or accessed, for site characterization. It also applies to testing conducted in the laboratories of Project Participants and subcontractors; and the monitoring, coordination, and integration of SBT and ESF testing, as defined in the SBTC Management Plan. This document is intended to provide guidance for all site investigations activities, and to focus activities in FY'93 on achieving these goals and priorities established for the year.

The SBT Annual Plan presents:

- the planned testing activities for FY'93;
- the goals and milestones of SBT and ESF testing for FY'93;
- the rationale for focusing on the selected activities;
- an overview of how the FY'93 SBT and ESF testing activities fit into the greater scope of the long-term Site Characterization Plan;
- a schedule of SBT and ESF activities for FY'93;
- a schedule of milestones and deliverables for FY'93;
- a listing and status of activities previously planned for FY'93 in the Mission 2001 plan andnt included in the present budget.

Site Investigations activities addressed by this Plan are:

- monitoring activities (e.g., seismicity, precipitation, water chemistry, etc.);
- borehole drilling, sampling, and testing;
- excavating of trenches and test pits;
- geologic mapping;
- laboratory testing;
- geophysical surveys;
- site studies supporting various design studies included in the YMPO FY'93 program;
- activities preparatory to various ESF testing activities; and
- site preparations for the above activities.

3.0 APPROACH - STRATEGY AND PRIORITIZATION

The DOE developed a comprehensive plan for site characterization, the Site Characterization Plan (SCP) (DOE, 1988) to comply with the Nuclear Waste Policy Act as Amended (1987), 10 CFR 60, and the appropriate siting guidelines in 10 CFR 960. The activities included in the SCP, and a relative schedule for accomplishing these activities, are captured in a Project Long-Range Plan (Yucca Mountain Site Characterization Project Cost and Schedule Baseline, DOE, 1991, [CR 91/069]) and are baselined in the Project Office document, the Site Characterization Plan Baseline (SCPB) (DOE, 1991). Site investigation activities to be accomplished in any fiscal year are based on a schedule of activities specified in the Yucca Mountain Project SCP as updated in the SCPB. The SCPB represents the SCP in its most current form; that is, all changes to the SCP are identified prior to implementation and recorded in this baseline document. The SCP is not updated. The formal notice and transmittal of program modifications is accomplished through the semi-annual progress reports.

During the spring and summer of 1992, the Yucca Mountain Project conducted a scoping, schedule, and cost analysis, called the Mission 2001 Study, of the Project Long-Range Plan. The aim of Mission 2001 was to validate the work scopes necessary for submitting a license application in 2001. The schedule of activities was modified as a result of the Mission 2001 analysis and a new long range plan, with yearly costs to accomplish the plan, was developed. After the study was completed, however, the FY'93 budget allocated by Congress was less than that outlined in the Mission 2001 study, requiring development of modified near-term schedules. This section provides a brief history of the budget and schedule development process and the guiding rationale for selecting site investigation activities (WBS 1.2.3) to be performed in FY'93.

3.1 Mission 2001 Strategy

The upper level objectives of the Mission 2001 Study were to evaluate progress of the Project and to develop an end-product oriented schedule that was integrated to include all necessary activities that would provide scientific information for a License Application (LA) in the year 2001. Planned activities for each Project WBS element were evaluated to ensure the proper work scope was planned to accomplish this goal.

In the process of validating the scope, cost and schedule of each participant's activities in WBS element 1.2.3 (Site Investigations), assumptions about technical and budgetary requirements were made. First, the contribution of each individual site investigation activity to the collection and analysis of data required for LA was assessed. Then schedules for data acquisition were reviewed for timely input to geologic, hydrologic, geochemical and climate models, and were validated. In general, it was assumed that activities in the current long-range plan were necessary and met the objectives of site characterization as defined in the Project SCPB. Further, as in the SCP, it was assumed that in conducting the identified studies that data necessary for preparation of the Site Recommendation Report and geotechnical information necessary for the EIS would be available. The drilling schedule developed in March 1992 by the DOE Regulatory and Site Evaluation Division (RSED) was fixed for this analysis, with the exception of acceleration of boreholes required to support ESF design requirements.

The only budgetary constraint imposed on the Mission 2001 analysis was for FY'93; the budgets for FY'94 to FY'2001 were not fixed. The resulting work plan, the Long Range Plan (LRP) reflect budget and schedule for necessary work to be accomplished. Each participant evaluated the work scopes and budgets to ensure that each activity would be performed in the most cost effective manner to support the Mission 2001 goals. The Project budget for the plan utilized the Congressional Budget Request for FY'93 ($243 million [M]), plus a proposed Supplemental Request ($75 M) for a total Project budget of $318 M. The supplemental request was to allow for tunneling equipment to be procured a year earlier than previously scheduled, allowing subsurface excavation and testing to also begin a year earlier than previously planned. The resulting budget for Site Investigations (WBS 1.2.3) was roughly $67 M for FY'93; subsequent years were schedule and requirements driven.

A new framework for an overall summary schedule for the site investigation program was developed during the Mission 2001 exercise (Figure 3-1). This framework highlights the iterative structure of the site characterization process, with time-phased data consolidation points established to support high-level milestones and performance assessment cycles. The bi-yearly work consolidation into the descriptive physical models referred to in Figure 3-1 provides the opportunity to ensure that the site investigations are acquiring the information needed to resolve performance and design issues.

In the course of the Mission 2001 Study, several activities were identified as missing from the previous Project Long-Range Plan. These activities included all in situ testing in the Calico Hills (in the ESF); therefore budget allocation for this testing was included in the Mission 2001 plan, increasing the overall Site Investigations cost. Other missing activities identified in the course of the Mission 2001 validation included the requirement for periodic input into the Annotated Outline supporting the LA, and Site Evaluation Analysis reports required by Performance Assessment. Therefore funding was included for these activities.

3.2 Current FY'93 Strategy

Shortly after the Mission 2001 validation exercise was completed, DOE was given a Project budget for FY'93 of $244.7 M, $73 M less than that estimated in the Mission 2001 study. Concurrent with the reduced funding, DOE Headquarters directed that a strategy be developed focusing the resources of the Project and the OCRWM Program on the earliest possible determination of the suitability of the Yucca Mountain Site. The approach for early determination of site suitability is based on a 1992 systematic review of previously identified data needs--the Early Site Suitability Evaluation (ESSE). Suitability issues of most concern in the near term include those for which lower-level findings cannot yet be elevated to higher level findings.[1] As both disqualifying conditions and qualifying conditions[2] are required to be evaluated, these were further prioritized for study in that order. As only one geoscientific disqualifying condition remained to be with insufficient information for analysis (ground-water travel-time), this was given high priority.

As part of the focus on early site suitability, a shift in funds has been directed to the early initiation of underground construction to support underground testing. DOE directed that Project funds be shifted to support initiation of an accelerated ESF in FY'93. Specifically, the guidance was to purchase a Tunnel Boring Machine (TBM) in FY'93 and begin site preparation work associated with construction of the north portal area and the TBM launch chamber for the ESF. These underground observations will provide information on the thermal, mechanical, and moisture characteristics of the repository horizon. This information is also required to complete the site suitability evaluation in terms of substantially qualifying conditions. Significant costs and construction time are required to provide the necessary underground access to accomplish these studies.

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[1] A higher-level finding is made when the judgement is that new information is unlikely to change the conclusion regarding the qualifying or disqualifying condition. A lower-level finding is made when new information could change the conclusion.

[2] Disqualifying and qualifying conditions include: 1) Postclosure Guidelines: system guideline, geohydrology, geochemistry, rock characteristics, climatic changes, erosion, dissolution, postclosure tectonics, human interference: natural resources, and human interference: postclosure site ownership and control; and 2) Preclosure Guidelines: radiological safety guidelines, guidelines for environmental quality, socioeconomic impacts and transportation, and guidelines for ease and cost of siting, construction, operation and closure.

These two areas of highest priority, determination of site suitability and development of the ESF, were considered first in establishing the FY'93 work plan. Remaining funding was to be used to achieve a balanced program. Because of the large capital expenditure required for the purchase of the TBM, operating dollars for non-ESF related activities were expected to decrease from their FY'92 level and the projected Mission 2001 FY'93 budget in some program areas.

Given the lower funding level and the objective to achieve progress toward early evaluation of site suitability by first addressing potentially disqualifying conditions as described in 10 CFR 960, then addressing qualifying conditions at Yucca Mountain, RSED established nine specific funding priorities for the Site Investigations program. The nine priorities are:

- -- Priority 1: ESF Design Support
- -- Priority 2: Collection of Irretrievable Data
- -- Priority 3: ESF Testing
- -- Priority 4: Ground Water Travel Time Disqualifier
- -- Priority 5: Other Unsuitability Studies
- -- Priority 6: Seismic Hazards
- -- Priority 7: Issue Resolution Activity
- -- Priority 8: Model Development
- -- Priority 9: Other SCP Activities

Each of the over 150 activities in WBS 1.2.3 was then assigned into the above Site Investigations priorities, with many activities supporting more than one priority (Table 3.1). A detailed description of each priority, its goals and components (individual activities) is provided in Section 4.0. A budget of $52.395 M that was subsequently allocated to WBS 1.2.3 provides for the full completion of activities in priorities 1 to 4, with each activity funded in its highest priority designation, and partial completion of activities in priorities 5 to 7. Table 3.2 includes the funding for the activities constituting the $52.395 M budget allocation. The impact of incomplete funding of planned FY'93 activities is further discussed in Section 7.0.

4.0 GOALS OF THE SITE INVESTIGATION ACTIVITIES FOR FY'93

The priorities listed above reflect the overall goals of the FY'93 Site Investigations program. These goals are to:

- -- Support preparation of the north portal area and support initiation of tunneling (launch chamber and high-wall construction) in FY'93 (Priority 1);

- -- Continue collection of data that would otherwise be lost from on-going monitoring and test programs (Priority 2);

-- Complete preparation for the initiation of testing in the ESF once construction begins in FY'94 (Priority 3);

-- Collect additional hydrologic data to address the issue of ground water travel time, a potential disqualifying condition for the site (Priority 4);

-- Continue collection of data to assess the suitability of the site through investigations of other qualifying conditions (Priority 5);

-- Continue collection of data to assess seismic hazards issues (Priority 6);

-- Continue collection of data to address issues for which issue resolution reports are being prepared (Priority 7);

-- Continue model development (Priority 8); and

-- Continue data collection for other activities identified in the SCPB, but not appearing in the above priorities (Priority 9).

The funded WBS elements identified for each of the priorities are listed below. As mentioned above, some elements are listed in more than one priority and were funded in the highest priority area. Data sheets describing each activity are included in Appendix A.

4.1 Priority 1: ESF Design Support

Components of this Priority primarily address site investigation activities that directly support ESF Design Package 1A. Funding for each participant's Coordination and Planning (C&P) activities are also included in this priority because C&P functions are necessary for support of any activity. ESF design support provided through surface based testing activities include the collection and analysis of rock properties data (structure, lateral distribution, physical properties, etc.) necessary for TBM design, ramp gradient evaluation, and finalization of ESF design. Studies regarding potential health concerns associated with tunnel excavation (e.g., the presence of fibrous minerals) is also included in this priority. The site investigation activities (WBS 1.2.3) that support ESF design are:

1.2.3.1	Coordination and Planning
1.2.3.2.1.1.1	Mineralogy, Petrology, and Rock Chemistry of Transport Pathways
1.2.3.2.6.2	Soil and Rock Properties of Potential Location of Surface Facility
1.2.3.2.7.1.3	Laboratory Determination of Mechanical Properties of Intact Rock
1.2.3.2.7.1.4	Laboratory Determination of Mechanical Properties of Fractures
1.2.3.2.8.4.2	Location and Recurrence of Faulting near Proposed Surface Facilities

1.2.3.5.1	Sample Management Facility
1.2.3.5.2.1	Common-to-Drilling Support for Ramp Holes
1.2.3.5.2.2.	Engineering, Design, and Drilling Support
1.2.3.5.3.20	Surface Facilities Drill Holes

4.2 Priority 2: Collection of Irretrievable Data

Several long term monitoring programs have been established at Yucca Mountain; some have been in place for up to ten years. Collection of otherwise irretrievable data (such as meteorologic, seismological, hydrologic monitoring, and long-term thermal and geochemical tests) are to be pursued so that long-term compromises to a more balanced program are minimized. Loss of these data would result in a significant gap in data that may be detrimental to a site evaluation determination and potential development of a license application and environmental impact statement. Also, on-going long-term studies, such as geochemistry tests, would be adversely impacted if not funded to completion. Disruption of these ongoing tests would ultimately produce an overall cost growth within the project upon reinitiation of the testing programs. The WBS 1.2.3 activities falling into this priority are:

1.2.3.1	Coordination and Planning
1.2.3.2.1.1.2	Mineralogical and Geochemical Alteration
1.2.3.2.1.2.2	Kinetics and Thermodynamics of Mineral Evolution
1.2.3.2.5.5.2	Characterization of Igneous Intrusive Features
1.2.3.2.8.3.4	Effects of Local Site Geology on Surface and Subsurface Motions
1.2.3.2.8.4.1	Historic and Current Seismicity
1.2.3.2.8.4.10	Geodetic Leveling
1.2.3.3.1.1.1	Precipitation and Meteorological Monitoring for Regional Hydrology
1.2.3.3.1.1.2	Runoff and Streamflow
1.2.3.3.1.2.1	Unsaturated Zone Infiltration
1.2.3.3.1.3.1	Site Saturated Zone Ground-Water Flow System
1.2.3.4.1.2.1	Batch Sorption Studies
1.2.3.4.1.2.2	Biological Sorption and Transport
1.2.3.4.1.3.1	Dissolved Species Concentration Limits
1.2.3.4.1.4.1	Dynamic Transport Column Experiments
1.2.3.4.1.4.2	Diffusion

4.3 Priority 3: ESF Testing

With preparations underway in FY'93 for the start of ESF construction, it is necessary to complete planning for specific testing and monitoring activities that will take place as soon as construction starts. Site investigation activities include preparation for geologic mapping of the ESF and development of contingency plans for encountering perched water and faults underground. It is also necessary to begin planning for tests to be conducted in the ESF in FY'94 as the ESF is constructed. Specific activities in WBS 1.2.3 that support ESF testing include:

1.2.3.1	Coordination and Planning: ESF Test Planning
1.2.3.2.1.1.1	Mineralogy, Petrology, and Rock Chemistry of Transport Pathways
1.2.3.2.2.1.2	Structural Features within the Site Area
1.2.3.2.7.1.1	Laboratory Thermal Properties
1.2.3.2.7.1.2	Laboratory Thermal Expansion Testing
1.2.3.3.1.2.2	Water Movement Tracer Tests
1.2.3.3.1.2.4	Percolation in the Unsaturated Zone - ESF Study
1.2.3.5.2.3	Integrated Data Acquisition System (IDAS)

4.4 Priority 4: Ground Water Travel Time Disqualifier

The Early Site Suitability Evaluation (ESSE) study identified Ground Water Travel Time as the outstanding disqualifying site condition, for which inadequate data have been collected to make a determination. Given the Project emphasis on determination of early site suitability, it is essential that hydrology data be collected on this issue in a timely manner. The following activities support the collection of additional data to address this issue:

1.2.3.1	Coordination and Planning: Preparation of Test Planning Packages and Job Packages
1.2.3.2.1.1.1	Mineralogy, Petrology, and Rock Chemistry of Transport Pathways
1.2.3.2.1.1.2	Mineralogical and Geochemical Alteration
1.2.3.3.1.1.3	Regional Groundwater Flow System
1.2.3.3.1.2.1	Unsaturated Zone Infiltration
1.2.3.3.1.2.2	Water Movement Tracer Tests
1.2.3.3.1.2.3	Percolation in the Unsaturated Zone - Surface-based Study
1.2.3.3.1.2.4	Percolation in the Unsaturated Zone - ESF Study
1.2.3.3.1.2.7	Unsaturated Zone Hydrochemistry
1.2.3.3.1.2.8	Fluid Flow in Unsaturated Zone Fractured Rock
1.2.3.3.1.2.9	Site Unsaturated Zone Modeling and Synthesis
1.2.3.3.1.3.1	Site Saturated Zone Groundwater Flow System
1.2.3.3.1.3.2	Saturated Zone Hydrochemistry
1.2.3.3.1.3.3	Saturated Zone Hydrologic System Synthesis and Modeling
1.2.3.4.1.3.2	Colloid Behavior
1.2.3.4.1.4.1	Dynamic Transport Column Experiments
1.2.3.4.1.5.1	Retardation Sensitivity Analysis
1.2.3.5.1	Sample Management Facility
1.2.3.5.2.1	Common-to-Drilling (necessary support activities)
1.2.3.5.2.2	Engineering, Design, and Drilling Support
1.2.3.5.3.3	Natural Infiltration Drillholes and Construction
1.2.3.5.3.5	Unsaturated Zone, Vertical, and Seismic Profiling and Prototype Drillholes and Tests

4.5 Priority 5: Other Unsuitability Studies

This priority addresses those specific activities deemed necessary to investigate and understand the other potentially disqualifying conditions and qualifying conditions specifically identified in 10 CFR Part 960. The following WBS 1.2.3 activities focus on those conditions leading to the assessment of the suitability of the site:

1.2.3.1	Coordination and Planning
1.2.3.2.1.1.1	Mineralogy, Petrology, and Rock Chemistry of Transport Pathways
1.2.3.2.1.1.2	Mineralogical and Geochemical Alteration
1.2.3.2.2.1.1	Vertical and Lateral Distribution of Stratigraphic Units in the Site Area
1.2.3.2.2.2.1	Systematic Acquisition of Site-Specific Subsurface Information
1.2.3.2.2.2	Three-Dimensional Rock Characteristics Models
1.2.3.2.5.1.1	Probability of a Volcanic Eruption
1.2.3.2.5.1.2	Effects of a Volcanic Eruption Penetrating the Repository
1.2.3.2.5.5.1	Characteristics of Volcanic Features
1.2.3.2.8.4.3	Quaternary Faulting within 100 km of Yucca Mountain
1.2.3.2.8.4.6	Quaternary Faulting within the Site Area
1.2.3.3.1.1.1	Precipitation and Meteorological Monitoring for Regional Hydrology
1.2.3.3.1.1.2	Runoff and Streamflow
1.2.3.3.1.2.1	Unsaturated Zone Infiltration
1.2.3.3.1.2.2	Water Movement Tracer Tests
1.2.3.3.1.2.6	Gaseous Phase Movement in the Unsaturated Zone
1.2.3.3.1.2.7	Unsaturated Zone Hydrochemistry
1.2.3.3.1.2.10	Prototype Hydrologic Tests that Support Multiple Site Characterization Activities
1.2.3.3.1.3.1	Site Saturated Zone Groundwater Flow System
1.2.3.4.1.1	Groundwater Chemistry Model
1.2.3.4.1.2.1	Batch Sorption Studies
1.2.3.4.1.2.2	Biological Sorption and Transport
1.2.3.4.1.2.3	Sorption Models
1.2.3.4.1.3.1	Dissolved Species Concentration Limits
1.2.3.4.1.3.2	Colloid Behavior
1.2.3.4.1.4.1	Dynamic Transport Column Experiments
1.2.3.4.1.4.2	Diffusion
1.2.3.4.1.5.1	Retardation Sensitivity Analysis
1.2.3.5.3.19	Volcanic Drillholes
1.2.3.6.2.1.1	Modern Regional Climate
1.2.3.6.2.1.2	Paleoclimate Study of Lake, Playa, and Marsh Deposits
1.2.3.6.2.1.3	Climatic Implications of Terrestrial Paleoecology
1.2.3.6.2.1.4	Paleoenvironmental History of Yucca Mountain
1.2.3.6.2.1.6	Future Regional Climate and Environments
1.2.3.6.2.2.1	Quaternary Regional Hydrology

1.2.3.7.2.1	Natural Resources Assessment
1.2.3.9	Special Studies - Geophysical Logging
1.2.3.10	Altered Zone Characterization

4.6 Priority 6: Seismic Hazards

The seismic hazards issue was identified as a priority area for a variety of reasons. Significant motivators include (1) the Little Skull Mountain earthquake that occurred at the site in June 1992, (2) a resulting directive received from the program director to address seismic hazards, and (3) the seismic hazard methodology report included in the general regulatory strategy for site suitability assessment and due at the end of FY'93. In addition, there is recognition of a need to finish the seismic hazard studies in time to provide input into ESF design. The following WBS 1.2.3 activities support the resolution of the seismic hazards issue:

1.2.3.1	Coordination and Planning
1.2.3.2.2.1.1	Vertical and Lateral Distribution of Stratigraphic Units in the Site Area
1.2.3.2.2.1.2	Structural Features within the Site Area
1.2.3.2.5.3.2	Effects of Tectonic Events on Changes in the Water Table
1.2.3.2.5.5.2	Characterization of Igneous Intrusive Features
1.2.3.2.8.3.4	Effects of Local Site Geology on Surface and Subsurface Motions
1.2.3.2.8.4.1	Historic and Current Seismicity
1.2.3.2.8.4.2	Location and Recurrence of Faulting near Proposed Surface Facilities
1.2.3.2.8.4.3	Quaternary Faulting within 100 km of the Site
1.2.3.2.8.4.4	Quaternary Faulting within Northeast-trending Fault Zones
1.2.3.2.8.4.5	Detachment Faults
1.2.3.2.8.4.6	Quaternary Faulting within the Site Area
1.2.3.2.8.4.10	Geodetic Leveling
1.2.3.2.8.4.12	Tectonic Models and Synthesis
1.2.3.5.3.22	In situ stress drillholes and tests and Quaternary Fault Trenches
1.2.3.6.2.1.4	Paleoenvironmental History of Yucca Mountain

4.7 Priority 7: Issue Resolution

DOE has adopted a regulatory strategy that identifies key issues to be addressed in the ultimate licensing process. Studies identified in Priority 7 contribute to the preparation of papers and topical reports discussing these issues and their disposition. Issues that were actively addressed in FY'92 include erosion, volcanism, and the origin of specific calcite silica deposits. For FY'93, the plan is to complete these initiatives started in FY'92 and to initiate a similar effort for the issue of seismic hazard assessment. The goal is to provide the data necessary for resolution of all four issues. The WBS 1.2.3 activities that address these issue resolution areas are:

1.2.3.1	Coordination and Planning
1.2.3.2.1.1.1	Mineralogy, Petrology, and Rock Chemistry of Transport Pathways
1.2.3.2.1.1.2	Mineralogical and Geochemical Alteration
1.2.3.2.2.1.1	Vertical and Lateral Distribution of Stratigraphic Units in the Site Area
1.2.3.2.2.1.2	Structural Features within the Site Area
1.2.3.2.5.1.1	Probability of a Volcanic Eruption
1.2.3.2.5.1.2	Effects of a Volcanic Eruption Penetrating the Repository
1.2.3.2.5.3.2	Effects of Tectonic Events on Changes in the Water Table
1.2.3.2.5.5.1	Characteristics of Volcanic Features
1.2.3.2.5.5.2	Characterization of Igneous Intrusive Features
1.2.3.2.8.3.4	Effects of Local Site Geology on Surface and Subsurface Motions
1.2.3.2.8.4.1	Historic and Current Seismicity
1.2.3.2.8.4.2	Location and Recurrence of Faulting near Proposed Surface Facilities
1.2.3.2.8.4.3	Quaternary Faulting within 100 km of the Site
1.2.3.2.8.4.4	Quaternary Faulting within Northeast-trending Fault Zones
1.2.3.2.8.4.5	Detachment Faults
1.2.3.2.8.4.6	Quaternary Faulting within the Site Area
1.2.3.2.8.4.10	Geodetic Leveling
1.2.3.2.8.4.12	Tectonic Models and Synthesis
1.2.3.6.2.1.4	Paleoenvironmental History of Yucca Mountain

4.8 Priority 8: Modelling

This priority responds to the need for geoscientific models. These models include conceptual models and descriptions, and subsequently computer models sufficient to describe conditions and behavior at the site. These models are necessary in both the planning of continuing site investigation activities and in performance assessment. Activities identified under this priority are those specifically focused on development of models and model concepts:

1.2.3.1	Coordination and Planning
1.2.3.2.2.1.1	Vertical and Lateral Distribution of Stratigraphic Units in the Site Area
1.2.3.2.2.2	Three-Dimensional Rock Characteristics Models
1.2.3.2.5.3.2	Effects of Tectonic Events on Changes in the Water Table
1.2.3.2.8.4.12	Tectonic Models and Synthesis
1.2.3.3.1.1.4	Regional Hydrologic Systems Synthesis and Modeling
1.2.3.3.1.2.2	Water Movement Tracer Tests
1.2.3.3.1.2.8	Fluid Flow in Unsaturated Zone Fractured Rock
1.2.3.3.1.2.9	Site Unsaturated Zone Modeling and Synthesis
1.2.3.3.1.3.1	Site Saturated Zone Groundwater Flow System
1.2.3.3.1.3.2	Saturated Zone Hydrochemistry
1.2.3.3.1.3.3	Saturated Zone Hydrologic System Synthesis and Modeling

1.2.3.4.1.1	Groundwater Chemistry Model
1.2.3.4.1.2.1	Batch Sorption Studies
1.2.3.4.1.2.2	Biological Sorption and Transport
1.2.3.4.1.2.3	Sorption Models
1.2.3.4.1.3.1	Dissolved Species Concentration Limits
1.2.3.4.1.3.2	Colloid Behavior
1.2.3.4.1.5.1	Retardation Sensitivity Analysis
1.2.3.4.2	Geochemical Modeling

4.9 Priority 9: Other SCP Activities

This priority includes those activities included in the initial long range plan for implementation in FY'93, but not captured in the preceding specifically focused priorities. The funded priority 9 activity is:

1.2.3.7.2.1	Natural Resource Assessment

5.0 DESCRIPTION OF FY'93 TESTS AND ACTIVITIES

The site investigation activities can be identified as those that support surface-based testing, and the actual testing and data-gathering activities. The first group includes:

- Drilling
- Trenching
- Test Pit Excavation
- Pavement Clearing

Coordination of these efforts requires the scheduling of preactivity environmental and archeological surveys, the integration of the testing needs of multiple organizations as well as engineering feasibility concerns, and the assurance that information obtained is commensurate with the needs of the overall program plan while the activity progresses. This process is defined as "work scope consolidation" and represents the management approach to implementation of the overall study program.

Other WBS 1.2.3 activities involve field or laboratory data-gathering activities that also may involve a work scope consolidation effort, as well as the monitoring and evaluation of the progress of data analysis and reporting. These include:

- Geologic Mapping
- Geophysical Studies/Logging
- Field Hydrologic Tests
- Field Geotechnical Studies
- Field Monitoring Activities
- Laboratory Tests/Analyses
- Model Development

Other site investigation efforts include support activities for on-going studies and actions to address specific needs that arise. These include:

- the development of study plans for SBT and ESF tests and activities and the coordination of their review
- the development of the Annotated Outline for preparation of the license application
- issue resolution studies
- management, coordination and planning

The specifics and status of these planned field and laboratory activities within each of the above groupings are discussed in the following sections; Table 5-1 presents an index showing the activity area in which each WBS element is represented. The WBS numbers and anticipated start dates of the activities involving surface disturbing actions or requiring environmental permits are presented on Tables 5-2a through 5-2f. The data collection and analysis for the different site investigation activities is reflected in the list of FY'93 milestones and deliverables (Tables 6-1a and 6-1b) and are described in more detail in the data sheets in Appendix A.

The overall goals of the FY'93 Site Investigations program were stated in Section 4.0. The activities outlined in this FY'93 Annual Plan are intended to support the following accomplishments:

- Geotechnical information necessary for ESF portal facility development and design of the North Ramp.

- Completion of preparatory efforts for site characterization studies to be conducted in the North Ramp of the ESF.

- Completion of the first deep borehole in the unsaturated zone (UZ), and the start of drilling of the second UZ borehole.

- Initiation of groundwater testing to underestand ground water travel time in the saturated zone (a site disqualifying condition).

- Completion of the drilling program for the study of natural infiltration into the unsaturated zone.

- Completion of a major seismic reflection survey across the site, such that locations of targets for geologic drilling may be established.

- Completion of trench excavations and geologic mapping in Midway Valley to support seismic hazard assessments.

- Development of a stratigraphic model of the repository block.

5.1 Drilling

Drilling activities in FY'93 are planned at the borehole locations listed below, utilizing four drill rigs (the LM-300, CME 850, and two Joy rigs). These activities are summarized on Table 5-2a.

Unsaturated Zone	Neutron	ESF Ramp Boreholes
UZ-16	N-32	NRG-6
UZ-14	N-35	NRG-2
	N-57	NRG-3
	N-58	NRG-4
	N-59	NRG-5
	N-61	SRG-5
	N-62	
	N-39	

Locations of the above boreholes are shown on Figure 5.1 and presented on Table 5-3, which also lists their proposed depth, the planned drilling method, core size, and proposed finished hole diameter. Additional details about borehole construction, drilling, and proposed tests for each planned borehole are included in Appendix B.

5.1.1 UZ Boreholes

The primary purposes of the UZ boreholes are to (1) measure matrix and fracture hydrologic properties of the unsaturated zone, (2) add information to the geologic framework data base; and (3) conduct geophysical logs/tests to further characterize the structure and stratigraphic interval penetrated by the borehole. Both core and cuttings are collected from the holes. The holes are subsequently logged for lithologic and structural data and alteration features. Samples obtained are examined for evidence of alteration of minerals in the rock matrix and fractures to facilitate evaluation of the history of hydrologic flow through the unsaturated zone. This is done specifically to assess the depth to which bomb-pulse Chlorine, Cl-36 has penetrated into the bedrock at the site. Planned geophysical logging for UZ-16 is listed on Table 5-6. Geologic and structural data obtained from the core and the geophysical logging will be used in the selection of intervals for subsequent testing in the borehole. These data, and also that from the planned vertical seismic profiling (VSP) will be used in developing the hydrologic and geologic models of the site.

Borehole UZ-16 is being drilled primarily for purposes of conducting VSP studies. Prior to grouting in the geophones to conduct the VSP tests, the open borehole will be used to conduct air permeability testing, gas sorption tests, and to collect gas samples. It is anticipated that drilling of UZ-16 will be completed in May, 1993; and that the gas flow testing and sampling activities, conducted prior to the VSP survey, will be completed this

fiscal year. The VSP activities are planned to start at the beginning of FY'94. Analysis of data collected during these tests is discussed in more detail in Section 5.8.1.

Drilling of UZ-16 with the LM-300 rig was in progress at the beginning of FY'93; upon completion of UZ-16, anticipated in May '93, the LM-300 rig will begin drilling UZ-14 for the remainder of the FY. Collection of samples and core while drilling UZ-14 will be comparable to the sampling program for UZ-16.

5.1.2 Neutron Boreholes

The neutron boreholes provide the means to measure natural infiltration rates, water content, and evapotranspiration rates in the surficial materials at Yucca Mountain under present climatic conditions. The holes are constructed in both bedrock and alluvium, to depths of about 50 to 300 feet. The holes are cased, and geophysical logs are run in the holes through the casing (see Table 5-6). Both core and cuttings are collected from the holes. The water and gas content of the core is measured, and the moisture potential in the holes is monitored with a neutron probe (Section 5.10).

The location of the planned neutron boreholes is shown on Figures 5.1and 5.4. Boreholes N-32, N-35, and N-57 were completed in the first quarter of FY'93. Boreholes N-58 to N-62 are concentrated in a drainage southeast of Yucca Mountain. Borehole N-39 is an experimental hole located in the alluvial area of Jackass Flat.

5.1.3 ESF Ramp Boreholes

The ramp boreholes planned for FY'93, shown on Figure 5.1, will provide information on rock conditions along the proposed alignments of the north and south access ramps of the ESF. The boreholes are located about 40 feet laterally from the alignments, and penetrate to below the planned depth of the ramps. Boreholes NRG-2 and NRG-3 are planned to be angled to maximize obtained information on (1) regional joint and fracture systems; and (2) the Bow Ridge fault, the imbricate fault zone, respectively. Borehole NRG-5 is planned to intersect the proposed Drillhole Wash fault.

These boreholes will be drilled using the CME-850 and the Joy-2 drilling rigs. Boreholes NRG-6 and SRG-5 will be continuously cored; the others will be cored at selected intervals, including the ramp interval. Casing will be utilized to sufficient depths to ensure hole stability, and geophysical logs run (Table 5-4). Geologic logs for the boreholes will be prepared based on the examination of the core and obtained cuttings, as appropriate.

Samples of the core will be tested in the laboratory to assess thermal/mechanical properties. The geologic and thermal/mechanical stratigraphy will be analyzed to determine the contact between two welded units in the Topopah Springs Formation the (TSw1/TSw2 contact). This

horizon determines the alignment and grade of the ramp. These data are required for the 50 percent design completion date for the north ramp at the end of April, 1993.

5.2 Trenching

Trenches are excavated to assess the timing and amount and nature of displacement along identified Quaternary faults. These data will provide input to the assessment of seismic hazard at the site and ultimately the seismic design of engineered structures. Trenching activities in FY'92 focused on faults in Midway Valley and other faults having scarps in Quaternary deposits within the site area. A high priority was assigned to activities necessary to complete the Midway Valley trenches along the eastern face of Exile Hill by early FY'93 because the area of interest will be buried by the pad at the north portal entrance of the ESF.

The planned trenching locations/studies for FY'93 are shown on Figures 5.3 and 5.4 and listed in Table 5-2b. Information regarding the planned location, size and specific studies to be conducted in the trenches are presented in Appendix C.

Midway Valley

- Complete fault evaluation studies in Trenches MWV-T5 and MWV-7b , in the area of the Surface Facilities before they are backfilled to allow construction of north portal pad;
- Excavate Trench MWV-T8 across the surface projection of a geophysical anomaly east of the road to the pad. It is anticipated that this will complete the field studies under this study plan;
- Bow Ridge fault: excavate trench BFR-T1 across the Midway Valley fault zone in the southwest corner of Midway Valley.

Site Area

- Paintbrush Canyon fault: possibly excavate one trench (MWV-T3) across the fault in the northeastern corner of Midway Valley, at the base of Alice Ridge.
- Solitario Canyon fault: 1) cleaning of an arroyo wall where the south-central branch of the fault is exposed (SCF-T2); 2) excavate a trench at the base of the Yucca Mountain escarpment, and 3) possibly excavate two to three small trenches (SCF-T4 to SCF-T6) across the central segment of the fault.
- Windy Wash fault: possibly excavate a trench (WWF-T1) across the southern end of the fault;
- Fatigue Wash fault: excavate a trench (FWF-T1) across the central section of the fault;

NE-Trending Faults

- Probably excavate one trench (RVF-T1) in Central Rock Valley, south of Skull Mountain, or possibly in southwestern Rock Valley at the northwest edge of the Specter Ranges.

100 km radius

- Excavate two trenches across the Bare Mountain fault along the east side of Bare Mountain.

Additional cleanup work is anticipated at existing trenches or exposures, including west side, Busted Butte; existing trenches on northern Solitario Canyon fault (GA1A, GA1B), Pagony Wash fault (12); and possibly parts of Stagecoach Road trenches (SCR-T1, SCR-T3).

5.3 Test Pit Excavations

Approximately 50 test pits were excavated in FY'92 in Midway Valley to 1) evaluate foundation conditions at the anticipated north ramp surface facility structures, and 2) evaluate surface faulting potential in this area. A pit in volcanic rock on Fran Ridge (Pit No. 1) was also expanded and deepened for fracture analyses.

In FY'93, a total of about 90 test pits are anticipated to be excavated for Site Investigations studies, and in support of the ESF activities at the North Portal. Data sheets for the test pits are included in Appendix C. Less than ten test pits are planned in support the ESF construction and engineering design activities (Figure 5.2):

- one or two test pits are anticipated at the proposed location for booster pumps that will be used pump water from the water pipeline from the J-13 well to a storage tank on Exile Hill, above the north portal area; and
- four to six test pits are expected to be excavated in the area of the proposed leach field for percolation tests.

Approximately 80 additional test pits are proposed in support of Site Investigation studies related to the volcanic hazards assessment. Approximately 40 test pits are planned in the vicinity of Sleeping Butte (Figure 5.4) to examine the exposed volcanic stratigraphy. A similar number of pits (i.e., 40) are anticipated in Crater Flat, in the vicinity of Black, Red, and Little cones. The information derived from these studies is applicable to the site suitability issue of volcanic hazards, discussed in Section 5.13.

5.4 Pavement Clearing

Pavements are areas where the bedrock is stripped of surficial colluvial debris to enable the study of bedrock structure. In FY'92, pavements were cleared at NRG-1 and on Fran Ridge near Pit No. 1. The cleaning of aeolian deposits overlying the Paintbrush Canyon fault along the western side of Busted Butte in FY'92 was also referred to as 'pavement mapping'.

In FY'93, an arroyo wall may cleaned south of the main crest of Yucca Mountain, as discussed above in Section 5.2, as part of the seismic hazard evaluation of the Solitario Canyon fault zone.

5.5 Geologic Mapping

Geologic mapping activities planned for FY'93 are aimed at a number of the priority issues: they support the development of the ESF, assessment of disqualifying conditions, the Program Director's Seismic Action Plan, and issue resolution. Planned mapping studies are:

- use both conventional and photogrammetric methods to map exposures at the north portal of the ESF as the launch chamber is excavated.
- map stratigraphic, petrologic and structural features at the north portal site and along the north ramp alignment to provide geotechnical input to ramp design and construction
- continue detailed mapping along the Ghost Dance fault
- map the geology of the northeast corner of the site area
- map the geology of western Yucca Mountain and northern Crater Flat
- continue mapping, sampling and analysis to understand the isotopic, geochemical and lithostratigraphic characteristics of the stratigraphic reference section along Highway 95
- develop a second stratigraphic reference section in the Paintbrush Canyon area
- continue mapping of fracture networks to support geomechanical, hydrological, and geochemical models of the site
- continue transect sampling to support scoping studies for the systematic acquisition of site-specific subsurface information
- map the Miocene/Paleozoic contact in the Calico Hills to evaluate proposed detachment faults
- use published sources and field mapping to produce a geologic map of the Beatty-Bare Mountain area focused on proposed detachment faults
- complete geologic strip mapping of Yucca Mountain fault zones
- continue examination of faults at Busted Butte
- conduct reconnaissance mapping of Rock Valley fault system
- complete surficial map of Bare Mountain fault
- compile from published and unpublished sources a Quaternary fault map for the area within 100 km of Yucca Mountain

- evaluate Death Valley / Furnace Creek / Stateline fault zones using existing data and geologic mapping.
- compile from published maps and reports a regional geologic map of the Death Valley / Amargosa Desert region
- complete the Quaternary map of Midway Valley
- continue geochronology studies of the Lathrop Wells volcanic center
- complete mapping of the basalt at Buckboard Mesa
- compile final geologic maps of the Lathrop Wells, Sleeping Butte, and basalt units of Crater Flat on topographic maps for volume calculations
- conduct field studies in the Cima and Lunar Crater volcanic fields to support geochronology studies
- map surface deposits of Yucca Mountain using air-photos and field data.
- use digital landscape model and aerial and satellite image maps of Yucca Mountain to develop morphometric landscape maps to show areas where potentially high-magnitude flooding or debris flow hazards may exist; field check to identify sites for more detailed study.
- use remote sensing images and vegetation modeling to produce phase 2 vegetation maps

Geologic maps that are planned to be completed in FY'93 include maps of:

- Geology of Midway Valley (final)
- Geology of the Death Valley region
- Quaternary faults within 100 km of Yucca Mountain (preliminary)
- Quaternary Fault Map for the Site (preliminary)
- Geology of the ESF North Portal exposures (data submittal)
- Northern Bare Mountain fault zone
- Northeast corner of the Site (preliminary)
- Western Yucca Mountain (preliminary)
- Northern Crater Flat (interim report)
- Tiva Canyon Fracture Networks
- Basaltic volcanic centers (preliminary)
- Calico Hills (final)

In addition, several activities involve development of map products based on borehole and outcrop data. For FY'93 these are:

- develop isopach and structural contour maps
- use existing surface transect and other data to create simulations of appropriate geologic units

Products from these activities are:

- stratigraphic model of the central Yucca Mountain block (working isopach and contour maps, cross-sections, fence diagrams, and 3-D perspective illustrations)

5.6 Geophysical Studies

Geophysical surveys to be conducted in FY'93 include both surface and borehole geophysics. Also included in this category is continuation of the seismic monitoring network (additional discussion of the seismic monitoring program is presented in Section 5.9). Specific planned geophysical activities are listed in Table 5-2c and include:

- approximately 35 mi (56 km) of seismic reflection/refraction surveying across Yucca Mountain (Figure 5.5); this survey will be accompanied by the collection of gravity and magnetic data along the proposed alignment;.
- vertical seismic profiling (VSP) in UZ-16;
- the expansion and continued operation of the Southern Great Basin Seismic Network to record local and regional earthquakes;
- the continued operation of portable seismic stations to record ground motions from aftershocks of the Little Skull Mountain earthquake in June, 1992;
- geophysical logging of boreholes drilled during the FY (Table 5-4),
- deployment of about 12 seismographs in boreholes and on the ground surface in the Yucca Mountain area to record ground motions and to monitor construction blasts from starter tunnel, starting around April, 1993,
- a shallow geophysical survey (seismic refraction or transient electromagnetic [TEM]) across the south end of the Windy Wash fault.
- a resurvey of existing first-order level lines that cross Yucca Mountain and several known Quaternary faults; and
- reoccupation of selected base-stations of the Southern Great Basin geodetic network, measuring altitude and position using global positioning satellite.

The seismic reflection, gravity and magnetic data will be analyzed as it is gathered to determine the best survey technique for gathering information on geologic contacts and subsurface structure. The identification of faults having no surface expression, and the determination of subsurface geometry of mapped faults will be supported by this activity. Seismograms of earthquakes and of construction blasts for the starter tunnel will be analyzed to assess the effects of local site conditions on seismic ground motion, and to develop and calibrate a theoretical ground motion model (Section 5.11). The geophysical logs obtained from boreholes will be interpreted for lithologic and stratigraphic characteristics, as well as for specific features that may guide the selection of testing intervals in subsequent borehole tests. The shallow geophysical data collected at the south end of Windy Wash fault will be interpreted to estimate the amount of offset of downfaulted Pliocene basalt flows to evaluate long term slip rates on the fault. The geodetic leveling data will be analyzed to assess contemporary rate of subsidence and uplift across Quaternary faults in the Yucca Mountain area, and within 100 km of the site.

The geophysical data anticipated to be available by the end of FY'93 include:

- a report of the results of the gravity survey in Midway Valley;
- preliminary raw stacks of seismic reflection profiling data;
- a report on the results of the geophysical survey across Windy Wash fault;
- quarterly reports on seismic activity in the region; and
- a report on the progress of geodetic leveling at Yucca Mountain.

A meeting with the NRC has been scheduled for June, 1993, to discuss progress in the geophysics studies, and to address comments made by the NRC regarding YMP's overall geophysics program.

5.7 ESF Testing

As discussed in Section 3.2, Site Characterization activities in FY'93 emphasize the initiation of underground construction of the Exploratory Studies Facility (ESF) to support underground testing. Construction activities scheduled for FY'93 (Table 5.1d) include:

- construction of the north ramp pad area,
- excavation of the north portal wall and slot,
- excavation of a 200-foot-long north ramp starter tunnel, and
- excavation of a test alcove off of the starter tunnel.

As the excavation activities proceed, geologic maps will be made of the newly created bedrock exposures. The mapping activity will emphasize lithologic and mineralogical changes, as well as the occurrence of fractures. Rock samples will also be collected while excavating for:

- Cl-36 analysis, to assess the amount of contamination that may occur to these samples by the construction activity;
- matrix hydrologic properties; and
- the identification of mineral alteration products in the rock matrix and along fractures to assess the movement of water through the unsaturated zone.

Other samples will be collected in support of hydrologic and hydrochemistry testing. These include:

- gas samples collected from short boreholes drilled into the wall of the tunnel the rock matrix and fractures as soon as it is safe to do so after the opening of a tunnel section;
- samples of perched water, if encountered, during the construction activities; and
- long-term gas samples collected from radial boreholes drilled in the test alcove.

The starter tunnel will provide the opportunity to evaluate the proposed testing and mapping methods that will later be used in the ESF, and to make modifications as needed prior to the start of the ESF in FY'94.

In addition to the activities described above, planning will continue for the future testing efforts that will occur in the ESF. This involves the scheduling and consolidation of testing activities planned both during and after tunnel construction; design of the test facilities to accommodate the needs of the planned tests; and development and final of study plans and procedures for conducting the tests.

5.8 Field Hydrologic Testing and Analyses

The field activities that support the collection of hydrologic data are summarized on Table 2-5e. Tests to be conducted in the unsaturated and saturated zones are summarized below.

5.8.1 Unsaturated Zone Hydrologic Tests

The tests to be conducted in the unsaturated zone include moisture content, water potential, gas flow and chemistry, percolation, permeability to water and air, temperature, ambient pressure, and measurements of dispersive and diffusive parameters. The boreholes in which these studies are planned to be conducted are included on the following table. Ponding studies will be conducted at borehole N-85 to assess rates and depths of infiltration under conditions of surface saturation. To the extent possible, test locations will be selected to allow for characterization of heterogeneity and scale dependencies of measurements.

BOREHOLE	TESTS						
	Air Permea bility	Gas Flow	N-probe	Pond-ing	Collect Gas Samples	Collect Liquid Samples	Conduct SEAmist Tests
UZ-6		X			X		
UZ-6s		X			X		
UZ-16	X				X	X	
Neutron Holes		X	X		X	(X)*	
40-Mile Wash			X				
Boreholes in ESF Starter Tunnel	X				X	(X)*	X
N-85			X	X		* water samples will be collected if perched water is encountered	

5.8.2 Saturated Zone

Monitoring of water levels will continue at existing water table (WT) wells and at wells in the Amargosa Desert. In addition, hydrologic testing of the saturated zone at the C-Well complex is planned to start in FY'93. These will include cross-hole hydraulic tests that will establish test intervals and durations for the subsequent tracer tests. Small diameter wells in Franklin Lake playa are being installed to collect additional data on the regional groundwater flow system. These tests are summarized below.

BOREHOLE	TESTS			
	Water Level Monitoring	Collect Water Samples	Pump Tests	Tracer Tests
C-Wells	X	X	X	X
Amargosa Desert	X	X	X	
All existing WT wells	X	X	X	

5.9 Field Geotechnical Studies

Field geotechnical tests were conducted in test pits at the north ramp facility in FY'92. Similar tests will be conducted at the geotechnical test pits, described in Section 5.3 for booster pumps and in the leach field area.

5.10 Field Monitoring Activities

Field monitoring activities that are on-going at the beginning of FY'93 include:

- Seismic Monitoring and Effects of Local Site Geology
- Precipitation Monitoring
- Runoff and Streamflow Monitoring
- Natural Infiltration Monitoring
- Water Table Monitoring

5.10.1 Seismic Monitoring and Effects of Local Site Geology

Monitoring of the Southern Great Basin Seismic Network (SGBSN) (about 55 stations) by the University of Nevada - Reno Seismology Laboratory is planned to continue through FY'93. Monitoring with several portable seismographs that were deployed in the vicinity of Yucca Mountain after the Little Skull Mountain earthquake in June, 1992 will also continue. Installation of an additional seismographic station near Barstow and seismic telemetry stations

is planned for FY'93 as upgrades to the SGBSN. About 12 additional seismographs will be located in the Yucca Mountain area, in boreholes and on the ground surface, to record local strong motion data.

5.10.2 Precipitation Monitoring

This category includes the monitoring of:

- the USGS weather station network
- daily weather patterns derived from National Weather Service charts and satellite data, and categorizing the patterns according to six distinctive North American weather types to estimate the frequency of precipitation-producing weather systems that directly affect Yucca Mountain;
- a collection gauge network of 120 gauges, which will be expanded and upgraded in FY'93;
- a tipping bucket network, which will be expanded by at least 20 stations in FY'93;
- evaporation pans;
- lightning strikes; and
- weather patterns that directly affects Yucca Mountain through the use of a time-lapse video surveillance system.

An interpretative report on the significant meteorological events affecting Yucca Mountain will be written during FY'93; it will also contain the results of a deterministic analysis of synoptic weather patterns affecting the southwestern U.S.

5.10.3 Runoff and Streamflow Monitoring

Runoff monitoring in FY'93 will continue at approximately 12 continuous-recording stream gauges, 13 peak-flow sites, and 21 storage-type precipitation gauges. An additional 3 continuous-recording gauges are planned to be installed on Yucca Mountain to support the UZ natural infiltration study.

5.10.4 Natural Infiltration Monitoring

All neutron access bore holes constructed for the Project are logged with moisture meters at intervals of approximately six weeks, unless precipitation events occur that require increased frequency.

5.10.5 Water Table Monitoring

Water levels in about 12 periodic-network wells are measured monthly. Hourly water-level data are collected from about 18 zones in 12 wells, and continuous data are obrained in

various wells. All hourly water-level data are collected in real time, using data collection platforms. This allows for the monitoring of the network at any time to check for possible water-level excursions or malfunctions with the data recording equipment. Some of the transducers will be replaced during FY'93 as a standard maintenance procedure.

5.11 Laboratory Tests and Analyses

5.11.1 Hydrology

Two hydrology laboratory tests are planned for FY'93: Water Movement Test and Fluid Flow in Unsaturated Fractured Rock. The Water Movement Test activity will continue to analyze collected samples and review the obtained chlorine-36, chloride and bromide content of rock samples. This study is critical for the accelerated ESF initiative in FY'93 and provides information on isotope distributions to help quantify the percolation of precipitation in the unsaturated zone. During FY'93, Fluid Flow in Unsaturated Fractured Rock will simulate with numerical models the large-block prototype percolation experiment that was conducted during FY'92. The predictability of water and solute movement in variably saturated fractured tuff will be evaluated and will assist laboratory and field investigators in the design and interpretation of surface-based and ESF tests.

5.11.2 Soil and Rock Properties

Tests in the laboratory are performed on samples, collected from test-pits and borings to determine various physical and geotechnical properties of the ground at the proposed surface facilities site near the north portal. Results from these tests are specifically needed for foundation design for planned surface facilities.

Tests on the soil samples include determination moisture content and density values, gradation, triaxial and direct shear testing, consolidation testing and proctor densities. Tests on rock samples uniaxial compressive tests, triaxial and direct shear tests, direct tensile tests, sonic tests and other indirect tests such as the Brazilian, Point Load and Schmidt Hammer tests.

These laboratory tests were started toward the later part of FY'92 and are planned to be completed by April, 1993.

5.11.3 Geochemistry

Geochemical studies provide information of transport, sorption, and alteration of minerals and radionuclides in unsaturated and saturated media. Several of these studies provide information to support ESF design, performance assessment or issue resolution as indicated below. The geochemical tests scheduled for FY'93, and the responsible Participant, include:

- analyze fracture mineralogy from core, calcite geochemistry as a guide to past transport
- continue research on the issue of upwelling groundwater, analyze core, continue studies of zeolites, analysis of possible fast fluid pathways and transport processes
- begin second phase of long-term steam-heating studies of Yucca Mountain core samples to evaluate the effects of alteration to provide information for planning future tests in the ESF
- complete batch sorption measurements of Neptunium (Np) on crushed tuff samples under a range of conditions. Study Np and Plutonium (Pu) sorption, at a minimum, to provide support for Performance Assessment calculations regarding the performance of the repository in sorbing radionuclides.
- review Cl-36, chloride and bromide data to determine distribution of isotopes at Yucca Mountain
- prepare technical procedures,Test Planning Packages and Job Packages to support sample collection in the ESF
- continue to examine effects of microorganisms on radionuclide transport through unsaturated crushed tuff columns
- continue under-over-saturation, speciation experiments to assess solubility of radionuclides to support issue resolution, model development and to assess the performance of the proposed repository
- stage 1 studies on Pu colloid to determine the stability of waste element colloids under conditions characteristic of the repository and along flow paths from the repository and along flow paths from the repository to the accessible environment
- transport experiments to assess the potential for retardation
- diffusion studies to examine effective retardation of radionuclides by diffusive processes
- altered zone characterization studies to assess the effects of the repository on its performance to aid in design processes

5.11.4 Thermal Properties Testing

Tests are performed in the laboratory on core samples of rocks of the various thermomechanical units collected from surface-based as well as from ESF-based drillholes to determine various thermal properties such as thermal conductivity, heat capacity and coefficient of thermal expansion. Grain density and porosity are also measured to provide correlation between these two physical properties and thermal conductivity and heat capacity.

Results of these laboratory tests along with those of in situ tests are utilized to estimate the values of rock-mass thermal properties needed for repository design and performance assessment.

In FY'92 scoping studies were performed using samples from outcrops and previously obtained cores. The object of the scoping studies is to develop and calibrate the instrumentation and measuring system and to investigate the effect of various conditions such as saturation and temperature on the measure thermal properties.

Tests on core samples from the NRG ramp holes will be conducted as the core samples are received, in order to be used in the engineering design of the ramp. Tests of other surface-based holes may begin toward the end of FY'93. Scoping studies will also continue in FY'93.

5.11.5 Mechanical Properties Testing

Tests are carried out on samples of rocks of the various thermomechanical units to determine mechanical properties. Testing will be done on both intact rock samples as well as those containing natural and artificial fractures.

The study plan for the intact rock properties was submitted to NRC 6/21/91 and is being revised to conform to ESF configuration change. The study plan for the properties of fractures has not been submitted to the NRC.

In FY'92 scoping studies were performed to develop test procedures and investigate correlations with other rock properties and effects, if any, of other specific parameters. Limited tests were performed to study the time-dependent behavior of TSw2 tuffs.

Tests on core samples from the NRG ramp holes will be conducted as the core samples are received, in order to be used in the engineering design of the ramp. Tests of other surface-based holes are planned to begin toward the end of FY'93. Scoping studies will continue in FY'93.

5.12 Model Development

Site Investigations studies involved with model development and funded for FY'93 are listed in Table 5-1. The hydrology- and geochemistry- oriented models are expected to provide insight into the unsaturated and saturated zone at Yucca Mountain, chemical processes relating to Yucca Mountain, movement of water and gas in fractured media. The models refine our knowledge of flow in fractured, saturated and unsaturated media, and geochemical processes that may be used to assess the waste isolation capability of the site and support issue resolution. The following activities will be conducted in concert with model development and testing efforts scheduled for FY'93:

- stratigraphic model of the repository block
- use fracture network models to evaluate predictability of water in variably saturated fractured tuff

- evaluate site scale hydrologic, geologic and geochemical data pertinent to developing 3D, numerical model of Yucca Mountain unsaturated zone
- use TRINET, fracture network model to interpret results of hydraulic tests at the C-well complex
- study effects of fracture flow and fracture/matrix interactions on transport in the UZ
- the minimum K_d sorption strategy will be studied using steady flow models
- test hypothesis concerning pH stability because the chemistry of Yucca mountain groundwaters may change as pH changes
- submit milestone report on sorption models September, 1993
- verify, validate models to evaluate radionuclide transport from the repository to the accessible environment
- develop a model to predict ground motions that may be experienced at the site during an earthquake
- continue development of regional climatic model that will predict future climate change.

5.13 Study Plan Development and Review

Several study plans will be developed and/or reviewed during the FY'93. The emphasis is on those related to either ESF construction or testing. A schedule for study plan submittal to the NRC for the remainder of FY'93 is presented in Figure 5-5.

5.14 Annotated Outline

During FY'93, development of the Annotated Outline for preparation of the license application will be revised. The Annotated Outline provides a basis for the eventual development of the geologic repository license application and is prepared using the guidance contained in draft Regulatory Guide DG-3003 (Format and Content for the License Application for the High Level Waste Repository). It will be revised periodically during site characterization as comments are received from the NRC and as additional information becomes available from the site, design, and performance assessment programs.

For FY'93, the existing skeletal text in Chapter 3 (Natural Systems of the Geologic Setting) of the Annotated Outline will be revised. This revision will update the text to be consistent with the current understanding of the geologic setting of the site. The task is scheduled to be completed and submitted for internal review by June 18, 1993.

5.15 Issue Resolution Studies

Issue resolution is a process used to develop a common understanding between the DOE and the NRC of technical and programmatic issues related to the Yucca Mountain site. This process utilizes DOE/NRC interactions and formal reports, such as topical reports and NRC

staff positions, to develop a common understanding on specific issues. The DOE has identified several issues related to the site characterization program that will be addressed in FY'93. The following paragraphs define the primary issues that will be evaluated in FY'93, the focus of the issue resolution process and the schedule for completing each task.

5.15.1 Erosion

Regulation 10 CFR 60.122(c)(16) states that evidence of extreme erosion during the Quaternary period is a potentially adverse condition. Preparation of a topical report is planned for submittal to the NRC that will develop a position that extreme erosion is not present at the Yucca Mountain site. The report will contain sufficient data and analyses of erosional processes at the site to support the position that the potentially adverse condition is not present. The final report is scheduled to be submitted to the NRC in January of 1993.

5.15.2 Origin of Calcite-Silica Deposits

Various origins have been proposed for the calcite-silica deposits found in Trench 14 and on the western slope of Busted Butte. Four types of depositional models have been proposed to explain the origin of these deposits; these include precipitation 1) as the result of pedogenic processes, 2) from cold springs, 3) from hydrothermal springs, and 4) as the result of seismic pumping. If models involving upwelling of ground water are viable, then potentially adverse condition 10 CFR 60.122(c)(122), Potential for the water table to rise sufficiently to saturate an underground facility in the unsaturated zone, may be present at the site. During FY'93, a technical report will be completed to document the methodologies used to analyze data collected from Trench 14 and Busted Butte. This report will be submitted to the NRC for their review of the appropriateness of these methodologies for evaluation of similar calcite-silica deposits in the site area. This report is scheduled to be finalized in April of 1993.

5.15.3 Seismic Hazard

Regulation 10 CFR 60 does not provide guidance on how to develop seismic design criteria for a repository. In the absence of clear regulatory guidance, the issue of seismic design and the effects of the presence of Quaternary faults will remain uncertain from a regulatory perspective. In FY'93, a Topical Report proposing a methodology for developing seismic design criteria is planned; the final report is scheduled to be submitted to the NRC for review in September of 1993.

5.15.4 Volcanism

Igneous activity since the start of the Quaternary period 10 CFR 60.122(c)(15) is known to be present in the vicinity of the site. Because basaltic volcanism has occurred as infrequent, small-volume events throughout the Quaternary, the evaluation of the risks from a basaltic igneous event is one of the major focuses of site characterization and related performance

assessment activities. NRC agreement is being sought regarding an acceptable methodology for quantifying the probability and consequence calculations for volcanic disruption of the repository. This will address related Site Characterization Assessment (SCA) open items (comments) from the NRC and NRC review comments on Study Plan 8.3.1.8.1.1. The milestone for this task will be completion of a technical report in September of 1993 on the probability of volcanism affecting the repository. Technical activities to support resolution of NRC comments on the proposed study plans addressing volcanism are planned.

Technical support required to define issue resolution action plans for ground-water travel time and definition of the disturbed zone are also planned during FY'93.

6.0 SCHEDULE OF SITE CHARACTERIZATION MILESTONES AND DELIVERABLES

The schedule for the initiation of the above FY'93 site investigation activities that may involve surface-disturbing work at the site, or the use of contractors or site engineers, is presented on Tables 5-1a to 5-1f . These tables present the planned scheduling of rigs, crews (if applicable), preactivities and coordination meetings for each surface-based testing activity. Further explanation of the approach represented by the preparation for field activities is presented below in Section 8.0. One of the purposes of presenting these schedules in the Annual Plan is to permit Participants and the preactivity support personnel (e.g., the environmental group, those assembling TPP/JPs) a preview of anticipated activities for the year, so that they can plan accordingly.

Baseline Milestones and Deliverables for the FY'93 site investigation activities are listed by WBS number on Table 6-1a, and by month on Table 6-1b. Deliverables that have not been completed for FY'92 are listed on Table 6-2.

7.0 DISCUSSION OF VARIANCE OF FY'93 ACTIVITIES FROM MISSION 2001

The long-range plan developed in the Mission 2001 study identified Site Investigations efforts for FY'93 requiring funding of $67 million. The FY'93 budget allocated for Site Investigations was $52 million for a net difference of $15 million. The $15 million underfunding of Site Investigations activities results in the delay or deferral of several activities. Table 7.1 lists the activities identified in the Mission 2001 plan that were underfunded or unfunded in the FY'93 budget. The amount the individual activities are underfunded is presented as well as a brief discussion of impacts on the long-range plan. The most significant impact on the ability to achieve the long-range goals of site investigations is the deferral of procurement of another drill rig, and the inability to support a multiple shift drilling schedule. In addition to being the most costly items in the site investigations budget, drilling is the starting point of many field investigations. Inability to complete boreholes impacts subsequent data collection and scientific analysis. Another significant impact of underfunding is on the development of models describing rock chemistry, geostatistical

models supporting analysis of ground water travel time and total system performance assessment, and geochemical models. Other areas of underfunding that will impact the long-term ability of achieving site investigations goals are in climatology and resource assessment. All underfunded activities will be assessed in the development of the FY'94 annual plan.

8.0 MANAGEMENT AND COORDINATION OF SITE CHARACTERIZATION ACTIVITIES

This section describes the management process that will be used during implementation of the work outlined in this Annual Plan. Management includes processes for integrated planning, scheduling and budgeting, as well as those for monitoring progress and reviewing results of site characterization activities.

In any given fiscal year, the planning process begins with the translation of both long-term and annual programmatic goals into specific activities to be achieved. The process then defines a schedule for those identified activities, and any ancillary activities necessary to assure timely completion of planned activities, and allocates the resources required to conduct them. Progress is monitored continually with monthly reporting and reviews. Success in achieving goals is measured by the completion of discrete products or deliverables. The process ends with the review of work products, to ensure they fulfill their intended goals. The results are then assimilated into the master plan for site characterization studies, and archived into the project files.

In the past, planning and scheduling activities, as well as the determination of resource requirements, have been the responsibility of several groups-- management, facilitators, implementors and archivists. As the program has grown in both work volume and complexity, these activities can no longer be splintered among many groups, but must become the responsibility of a single entity.

The planning and management process for site investigation activities for FY'93 and beyond is discussed in the Site Characterization Management Plan and an overview of the process is shown on Figure 8.1. The Site Characterization Management Organization (SCMO), which consists of DOE and M&O personnel, and is chaired by the Director of RSED or the designated Branch Chief, has been established to carry out this function. In addition to planning and scheduling responsibilities, the SCMO carries the responsibility of integration of all site investigation activities into a coherent program. This program must serve not only the site characterization testing needs, but also the needs of other parts of the program such as design and performance assessment. The SCMO has the responsibility of soliciting advice from the various project groups and committees (e.g., the Technical Advisory Group (TAG), the Sample Oversight Committee (SOC), the Technical Integration Group (TIG), and assimilating their advice into a coherent program consistent with the greater goals of the YMP. The SCMO has the further responsibility of facilitating the implementation and achievement of the program plan.

This overview description of the management and coordination of site characterization activities is supplemented by more detailed discussion in the following documents: the Test and Evaluation Plan provides the framework for the development of study plans, test-control documents, the handling of samples, the implementation of tests including necessary facilities construction, and the evaluation of data derived from tests. The coordination, monitoring and reporting of SBT activities is further discussed in the SBTC Management Plan (YMP 92-27); the coordination, monitoring and reporting of ESF testing and related activities will be addressed in an ESF Test Coordination Management Plan. Taken together, these management and test coordination activities describe the process for implementing the testing program outlined in this annual plan.

The overall approach to implementing the management process is described in subsequent paragraphs in this section. These include: an overview of planning activities, implementation activities, which include development of consolidated work scope descriptions, compilation of documentation for all necessary prerequisites for the actual implementation of various field activities, monitoring of progress, and technical evaluation and archiving of results.

8.1 Planning Activities

The planning process for the site investigation program begins with establishing a Long Range Plan (LRP). The LRP represents the translation of the SCP into a logical sequenced form for execution. The LRP was revised during the Mission 2001 Study, and will become the new project baseline in summer 1993. The LRP will require updating annually in response to mismatches between available and required resources and mismatches between anticipated and actual results of the investigative activities.

Study Plans are prerequisites to initiating any study activity. A schedule for sequencing the production of Study Plans is being developed in response to the new LRP. Specifically this effort includes the identification of the necessary responses to comments on the overall SCP by oversight groups. Study plan development, review and approval schedules, as well as the schedule for submittal and acceptance by the NRC, are being monitored for activities planned for implementation in FY '93.

The planning process includes the translation of segments of the LRP, consistent with annual budgets and prior achievements, into an Annual Plan. The annual plan represents the near-term executable portion of the LRP commensurate with available budgets and resources, and is responsive to near-term project goals. This document, the FY '93 Annual Plan, represents the first such near term work plan to be produced in this form.

The annual planning process begins with the understanding of near term program and project goals as articulated by Program and Project Management. These goals are translated into study programs and specific study activities by the SCMO and various advisory groups. As

the goals established are often greater in magnitude than the budgets and resources available, prioritization is required for the actual allocation of work. The planning and prioritization process utilized for FY'93 is described in Section 3 of this Annual Plan.

8.2 Implementation Activities

The implementation of site characterization activities described in the Annual Plan involves the coordination and integration of the various study activities within the site investigation program. This activity is shown on figure 8.1 as the second step in the overall management process.

To achieve cost efficient implementation of site investigation activities, multiple goals are established for many of the field activities. Given that multiple purposes exist for many of the planned activities, and that multiple Principle Investigators (PIs) are required to fulfill those purposes, conflicts are expected to arise in the test specific plans/requirements pursuant to those goals.

To assure that the dominant goals of the studies are achieved, and to minimize the potential for compromises in both the technical content and scheduled completion dates of studies planned, a "work scope consolidation" task has been defined. This effort provides for the identification of the dominant goals of the activity and the discussion of other achievements that may also be accomplished from the activity.

The result of this effort will take the form of test-specific design requirements that describe the activity to be performed in sufficient detail for implementation. This effort will incorporate Program requirements, and to the degree possible, the needs of all test participants and constructors, as well as requirements associated with obtaining the various permits and environmental clearances. The definition of test-specific design requirements will be the responsibility of the SCMO and the appropriate test coordinators (SBT or ESF test coordinators). They will be the requirements used in the implementation of the test activity. The process and responsibilities of the test coordinators are described in respective management plans.

Upon completion of the work consolidation effort, TPP's and JP's will be compiled in accordance with appropriate project procedures. These packages serve to document the fact that all prerequisites to field activities have been completed. These prerequisites include test interference analyses, analyses of potential impacts to waste isolation, compliance with necessary environmental regulations and policies, compliance with various permitting requirements, and the establishment of test controls.

Work authorization documents are required for all field construction activities. These documents govern the commitment of construction resources ancillary to the conduct of field testing.

The actual conduct of field testing is monitored by the Field Test Coordinator. The Field Test Coordinator is responsible for assuring that the test is conducted in accordance with the implementation plan established and documented in the TPP. All changes required that represent potentially substantive changes to the technical goals of the test will be brought to the attention of the appropriate test coordinator and the SCMO for action simultaneously with the notice given to the field change control board. The SCMO and the appropriate test coordinator will take the action of resolving required changes in the technical conduct of the test.

8.3 Monitoring Activities

Progress is monitored primarily through the tracking of milestones identified in the LRP. The deliverables and milestones in the FY '93 Annual Plan are described in the study and activity data sheets included in Appendix A. The framework embodied in the LRP provides for Project Level (level 2) milestones, that represent achievements (1) significant to goals associated with determination of overall site suitability and (2) important to assembly of a potential license application for the site. In addition, those activities that represent significant cost elements of the site characterization program or critical schedule elements are also identified as level 2 milestones. Level 3 milestones identified in the LRP represent significant Participant level achievements and deliverables that contribute to level 2 milestones.

To facilitate the management of deliverables in support of project milestones, each deliverable has been given a unique identifier in the project plan (LRP). To track receipt and initiate the review and acceptance of deliverables, formal notification of the submittal to the project office will be required. This may take the form of a letter of submittal identifying the submittal and the unique identifier. All submittals will be compiled and tracked on the data sheets in the Annual Plan and in the appropriate tables of deliverables.

Monthly tracking of the progress and cost variances incurred in working to achieve level 2 and 3 milestones provides insight into the success in achieving the overall program goals and schedule. Reporting on this progress is accomplished monthly in project management meetings held by the YM Project Manager. Status reports including technical, cost and schedule variance information will be compiled for the RSED Division Director and appropriate Branch Chiefs by the SCMO with assistance from the appropriate test coordinators.

At the end of the fiscal year, the status of milestones and deliverables will be compiled. These data will be included in the Annual Plan for the upcoming year. The impacts of uncompleted deliverables and studies will be assessed and schedules for their completion established prior to initiation of follow-on work. The impacts and potential impacts on the LRP will be evaluated and submitted to management.

8.4 Technical Evaluation and Archiving of Results

Completion of various studies and activities is noted by the preparation and submittal of work products (deliverables) to the project office. Acceptance of work products by the project office is obtained after a technical review of the submittal is completed, and the product is judged to be in compliance with the intended purpose of the effort.

Once acceptance of deliverables is obtained from the project office, the information will be archived in the Project Data Base. In addition, the information will be incorporated into the SBT catalogs (eg the Borehole/Drilling Catalog, the Geophysics Catalog, the Trench and Test Pit Catalog) as appropriate, for use by all project Participants. Incorporation of information into these catalogs is the responsibility of the SCMO and the appropriate test coordinator.

9.0 RESOURCE REQUIREMENTS

Surface-Based Test Coordination for FY'93 requires support from PACS (Planning and Control Systems) to track SBT scheduling, budget, and deliverables. The development of the various SBT catalogs (i.e., Borehole/Drilling Catalog), and the Test Interference Data Base and the Global Test Interference Model will require close interaction with, and support from the YMP GIS group. It also requires a computer terminal for the M&O Site Characterization group, providing access on-line to the GIS data base.

Much of the SBTC will be accomplished through the interaction with existing groups in the participant organizations, such as T&MSS and USGS. The resources required to accomplish SBTC for FY'93 is addressed in the FY'93 SBTC Staffing Plan, submitted by the M&O, and in various work statements of participants included in the 1.2.3. summary accounts.

TABLE 3-1: WBS 1.2.3 Site Inve ons Activities Assigned to Priorities

WBS	SCP Number	Title	Priority 1: ESF Des. Support	Priority 2: Irret. Data	Priority 3: ESF Tstg	Priority 4: GWTT Disqual.	Priority 5: Other Unsuit. Studies	Priority 6: Seismic Hazards	Priority 7: Issue Res. Activity	Priority 8: Model Devel.	Priority 9: Other SCP Activities
1.2.3.1 Coordination and Planning			X	X	X	X	X	X	X	X	
1.2.3.2 Geology											
1.2.3.2.1.1.1	8.3.1.3.2.1	Min, Petrol. & Rock Chemistry of Trnsp. Pathways			X	X	X		X		
1.2.3.2.1.1.2	8.3.1.3.2.2	Mineralogic & Geochemical Alteration		X		X	X		X		
1.2.3.2.1.2.1	8.3.1.3.3.1	Natural Analog of Hydrothermal Sys. in Tuff									X
1.2.3.2.1.2.2	8.3.1.3.3.2	Kinetics and Thermo-dynamics of Mineral Evolution		X							
1.2.3.2.1.2.3	8.3.1.3.3.3	Conceptual Model of Mineral Evolution								X	
1.2.3.2.2.1.1	8.3.1.4.2.1	Vert. and Lat. Dist. of Strat. Units in Site Area					X	X	X	X	
1.2.3.2.2.1.2	8.3.1.4.2.2	Structural Features Within the Site Area			X			X	X		
1.2.3.2.2.1.3	8.3.1.4.2.3	3-D Geologic Model								X	
1.2.3.2.2.2.1	8.3.1.4.3.1	Systematic Acq. of Site Specific Subsurface Info.					X				
1.2.3.2.2.2.2	8.3.1.4.3.2	3-D Rock Charact. Models					X			X	
1.2.3.2.3.1	8.3.1.6.1	Present Location and Rates of Surface Erosion							X		
1.2.3.2.3.2	8.3.1.6.2	Effects of Future Climate Conditions on Erosion							X		
1.2.3.2.3.3	8.3.1.6.3	Effects of Future Tectonic Activity on Erosion							X		
1.2.3.2.3.4	8.3.1.6.4	Eff. of Eros. on the Hyd., Geo., & Rock Charc.							X		
1.2.3.2.5.1.1	8.3.1.8.1.1	Probability of Volcanic Eruption					X		X		
1.2.3.2.5.1.2	8.3.1.8.1.2	Effects of a Volc. Erupt. Penetrating the Repos.					X		X		
1.2.3.2.5.2	8.3.1.8.2	Anal. of Waste Pkg. Rupture due to Tectonic Events						X			
1.2.3.2.5.3.1	8.3.1.8.3.1	Eff. of Tec. Pro. & Evnts on Avg. Perc. Flx. Rts.					X				
1.2.3.2.5.3.2	8.3.1.8.3.2	Eff. of Tectonic Events on chngs. in Water Table						X	X		
1.2.3.2.5.3.3	8.3.1.8.3.3	Eff. of Tec. Pro. & Events on Loc. Fra. Perm.					X				

TABLE 3-1: WBS 1.2.3 Site Investigations Activities Assigned to Priorities

WBS	SCP Number	Title	Priority 1: ESF Des. Support	Priority 2: Irret. Data	Priority 3: ESF Tstg	Priority 4: GWTT Disqual.	Priority 5: Other Unsuit. Studies	Priority 6: Seismic Hazards	Priority 7: Issue Res. Activity	Priority 8: Model Devel.	Priority 9: Other SCP Activities
1.2.3.2.5.4	8.3.1.8.4	Chg in Rock Geochem. Prop. Resu. from Tect. Proc.					X				
1.2.3.2.5.5.1	8.3.1.8.5.1	Charact. of Volcanic Features					X		X		
1.2.3.2.5.5.2	8.3.1.8.5.2	Charact. of Igneous Intrusive Features		X				X	X		
1.2.3.2.5.5.3	8.3.1.8.5.3	Folds in Miocene and Younger Rocks of the Region									X
1.2.3.2.6.1	8.3.1.14.1	Topo. Char. of Potent. Loc. of Surface Fac.									X
1.2.3.2.6.2	8.3.1.14.2	Soil & Rock Prop. of Poten. Loc. of Surf. Fac.	X								
1.2.3.2.6.2.1	8.3.1.14.2.1	Surface Fac. Explor. Program									X
1.2.3.2.6.2.2	8.3.1.14.2.2	Surface Fac. Lab Tests & Material Prop. Meas.									X
1.2.3.2.6.2.3	8.3.1.14.2.3	Surface Fac. Field Tests & Char. Meas.									X
1.2.3.2.7.1.1	8.3.1.15.1.1	Lab. Thermal Properties			X						
1.2.3.2.7.1.2	8.3.1.15.1.2	Lab. Thermal Expansion Testing			X						
1.2.3.2.7.1.3	8.3.1.15.1.3	Lab. Determin. of Mech. Prop. of Intact Rock	X								
1.2.3.2.7.1.4	8.3.1.15.1.4	Lab. Determ. of the Mech. Prop. of Fractures	X								
1.2.3.2.7.2.1	8.3.1.15.2.1	Site Ambient Stress Conditions									X
1.2.3.2.7.2.2	8.3.1.15.2.2	Site Ambient Thermal Conditions		X							
1.2.3.2.8.1	8.3.1.17.1	Potential for Ash Fall at the Site									X
1.2.3.2.8.2	8.3.1.17.2	Faulting Potential at the Repository					X				
1.2.3.2.8.3.1	8.3.1.17.3.1	Relevant EQ Sources						X	X	X	
1.2.3.2.8.3.2	8.3.1.17.3.2	Underground Nuclear Explosion Sources									X
1.2.3.2.8.3.3	8.3.1.17.3.3	Grd. Mot. from Region. EQ & U/G Nuc. Exp.						X	X	X	
1.2.3.2.8.3.4	8.3.1.17.3.4	Eff. of Loc. Site Geo. on Surf. & Subsurf. Motions		X				X	X		
1.2.3.2.8.3.5	8.3.1.17.3.5	Grd. Motion at Site from Controlling Seismic Events						X	X		
1.2.3.2.8.3.6	8.3.1.17.3.6	Probabalistic Seismic Hazards Analyses						X	X		
1.2.3.2.8.4.1	8.3.1.17.4.1	Historical and Current Seismicity		X				X	X		

TABLE 3-1: WBS 1.2.3 Site Inve ons Activities Assigned to Priorities

WBS	SCP Number	Title	Priority 1: ESF Des. Support	Priority 2: Irret. Data	Priority 3: ESF Tstg	Priority 4: GWTT Disqual.	Priority 5: Other Unsuit. Studies	Priority 6: Seismic Hazards	Priority 7: Issue Res. Activity	Priority 8: Model Devel.	Priority 9: Other SCP Activities
1.2.3.2.8.4.2	8.3.1.17.4.2	Loc. & Rec. of Falt. Near Prosp. Surf. Facil.	X					X	X		
1.2.3.2.8.4.3	8.3.1.17.4.3	Quat. Faulting w/in 100 km of Yucca Mtn.					X	X	X		
1.2.3.2.8.4.4	8.3.1.17.4.4	Quat. Faulting in NE- Trending Fault Zones						X	X		
1.2.3.2.8.4.5	8.3.1.17.4.5	Detachment Faults						X	X		
1.2.3.2.8.4.6	8.3.1.17.4.6	Quat. Faulting W/in the Site Area					X	X	X		
1.2.3.2.8.4.7	8.3.1.17.4.7	Subsurf. Geom & Concealed Ext. of Quat. Faults						X	X		
1.2.3.2.8.4.8	8.3.1.17.4.8	Stress Field W/in and Proximal to the Site Area						X	X		
1.2.3.2.8.4.9	8.3.1.17.4.9	Tect. Geomorph. of the Yucca Mtn Region						X	X		
1.2.3.2.8.4.10	8.3.1.17.4.10	Geodetic Leveling		X				X	X		
1.2.3.2.8.4.11	8.3.1.17.4.11	Regional Lateral Crustal Movement		X				X	X		
1.2.3.2.8.4.12	8.3.1.17.4.12	Tectonic Models & Synthesis						X	X	X	
1.2.3.3 Hydrology											
1.2.3.3.1.1.1	8.3.1.2.1.1	Precip. & Meteor. Monitor. for Region. Hydrology		X			X				
1.2.3.3.1.1.2	8.3.1.2.1.2	Runoff & Streamflow		X			X				
1.2.3.3.1.1.3	8.3.1.2.1.3	Regional Ground-water Flow System				X					
1.2.3.3.1.1.4	8.3.1.2.1.4	Regional Hydro. Ssy. Synth. & Modeling								X	
1.2.3.3.1.2.1	8.3.1.2.2.1	UZ Infiltration		X		X	X				
1.2.3.3.1.2.2	8.3.1.2.2.2	Water Movement Tracer Tests			X	X	X			X	
1.2.3.3.1.2.3	8.3.1.2.2.3	Perc. in the UZ - Surf. Based Study				X					
1.2.3.3.1.2.4	8.3.1.2.2.4	Perc. in the UZ - ESF Study			X	X					
1.2.3.3.1.2.5	8.3.1.2.2.5	Diffusion Tests in the ESF				X					
1.2.3.3.1.2.6	8.3.1.2.2.6	Gaseous-Phase Movement in UZ					X				
1.2.3.3.1.2.7	8.3.1.2.2.7	UZ Hydrochemistry				X	X				
1.2.3.3.1.2.8	8.3.1.2.2.8	Fluid Flow in UZ Fractured Rock				X				X	
1.2.3.3.1.2.9	8.3.1.2.2.9	Site UZ Modeling & Synthesis				X				X	
1.2.3.3.1.2.10	No SCP ref.	Prot. Hyd. Tsts that Supp. Mult. Site Char. Acts.					X				
1.2.3.3.1.3.1	8.3.1.2.3.1	Site SZ Ground-water flow system		X		X	X			X	
1.2.3.3.1.3.2	8.3.1.2.3.2	SZ Hydrochemistry				X				X	

TABLE 3-1: WBS 1.2.3 Site Investigations Activities Assigned to Priorities

WBS	SCP Number	Title	Priority 1: ESF Des. Support	Priority 2: Irret. Data	Priority 3: ESF Tstg	Priority 4: GWTT Disqual.	Priority 5: Other Unsuit. Studies	Priority 6: Seismic Hazards	Priority 7: Issue Res. Activity	Priority 8: Model Devel.	Priority 9: Other SCP Activities
1.2.3.3.1.3.3	8.3.1.2.3.3	SZ Hydro. Sys. Synthesis & Modeling				X				X	
1.2.3.3.2.1	8.3.1.16.1	Fld. Recur. Int. & Lvls at Pot. Loc. of Surf. Fac.									X
1.2.3.3.2.2	8.3.1.16.2	Location of Adequate Water Supplies								X	X
1.2.3.3.2.3	8.3.1.16.3	Grndwtr Cond. w/in & Above the Pot. Host Rock									
1.2.3.4 Geochemistry											
1.2.3.4.1.1	8.3.1.3.1	Groundwater Chemistry Model					X			X	
1.2.3.4.1.2.1	8.3.1.3.4.1	Batch Sorption Studies		X			X			X	
1.2.3.4.1.2.2	8.3.1.3.4.2	Biological Sorption and Transport		X			X			X	
1.2.3.4.1.2.3	8.3.1.3.4.3	Sorption Models					X			X	
1.2.3.4.1.3.1	8.3.1.3.5.1	Dissolved Species Concentation Limits		X			X			X	
1.2.3.4.1.3.2	8.3.1.3.5.2	Colloid Behavior				X	X			X	
1.2.3.4.1.4.1	8.3.1.3.6.1	Dynamic Transport Column Exp.		X		X	X				
1.2.3.4.1.4.2	8.3.1.3.6.2	Diffusion		X			X				
1.2.3.4.1.5.1	8.3.1.3.7.1	Retardation Sensitivity Analysis				X	X			X	
1.2.3.4.1.5.2	8.3.1.3.7.2	Demo. of Application Laboratory Data									X
1.2.3.4.1.6	8.3.1.3.8	Retardation of Gaseous Radionuclides					X				
1.2.3.4.2		Geochemical Modelling								X	
1.2.3.5		Drilling									
1.2.3.5.1		Sample Management Facility	X			X					
1.2.3.5.2.1	8.3.1	Common-to-Drilling Support	X			X					
1.2.3.5.2.2	8.3.1	Engineering, Design and Drilling Support	X			X					
1.2.3.5.2.3	8.3.1.2.2.3.2	Integrated Data Acquisition System (IDAS)			X						
1.2.3.5.2.4		Title III Engineering For SBT									
1.2.3.5.3.1	8.3.1.2.3.1	Water Table Drillholes				X	X				
1.2.3.5.3.2	8.3.1.2.1.3.3	Fortymile Wash Drillholes and Pond Construction									X
1.2.3.5.3.3	8.3.1.2.2.1.2	Natural Infiltration Drillholes and Construction				X					

TABLE 3-1: WBS 1.2.3 Site Inves ns Activities Assigned to Priorities

WBS	SCP Number	Title	Priority 1: ESF Des. Support	Priority 2: Irret. Data	Priority 3: ESF Tstg	Priority 4: GWTT Disqual.	Priority 5: Other Unsuit. Studies	Priority 6: Seismic Hazards	Priority 7: Issue Res. Activity	Priority 8: Model Devel.	Priority 9: Other SCP Activities
1.2.3.5.3.4	8.3.1.2.2.1.3	Rain. Sim./Art. Infil. Drlhls. and Plot Const.					X				
1.2.3.5.3.5	8.3.1.2.2.3.2	UZ, Vert. and Seis. Prof., & Prot. Drlhls. & Tsts.				X					
1.2.3.5.3.6	8.3.1.2.2.3.3	Solit. Canyon Horiz. Drillhole & Tsts. in the UZ					X				
1.2.3.5.3.7	8.3.1.2.2.4	Multipurpose Boreholes					X				
1.2.3.5.3.8	8.3.1.2.2.7.1	Gas-Phase Circulation Tests in UZ Drillholes					X				
1.2.3.5.3.9	8.3.1.2.2.8.1	Gas-Phase Chemical tests in the UZ Drillholes					X				
1.2.3.5.3.10	8.3.1.2.3.1.1	Solit. Canyon Fault Drillholes & Tests in the SZ					X				
1.2.3.5.3.11	8.3.1.2.3.1.2	Multiple Well Interference Tests at C-Hole Complex				X					
1.2.3.5.3.12	8.3.1.2.3.1	Conservative Tracer Tests				X	X				
1.2.3.5.3.13	8.3.1.2.3.1	Reactive Tracer Tests				X					
1.2.3.5.3.14	8.3.1.2.3.2	Saturated Zone Hydrochemistry Tests				X	X				
1.2.3.5.3.15	8.3.1.4.2.1	Geologic Drillholes					X				
1.2.3.5.3.16	8.3.1.4.2.2	Geologic Pavements					X				
1.2.3.5.3.17	8.3.1.4.3.1	Geostatistical Drillholes					X				
1.2.3.5.3.18	8.3.1.5.2.1	Calcite Silica Drillholes and Trenches					X				
1.2.3.5.3.19	8.3.1.8.5.1.1	Volcanic Drillholes					X				
1.2.3.5.3.20	8.3.1.14.2.1	Surface Facilities Drillholes	X								
1.2.3.5.3.21	8.3.1.16.2.1	Water Supply Drillholes and Tests									X
1.2.3.5.3.22	8.3.1.17.4.8	In Situ Strs. Drlhle. & Tsts., & Qua. Flt. Trnchs.						X			
1.2.3.5.4		Prototype Air Coring									X
1.2.3.6		**Climatology and Meteorology**									
1.2.3.6.1.1.1		Char. of Regional Meteor. Conditions					X				
1.2.3.6.1.1.2		Plan for Synthesis of Meteorological Monitoring					X				

TABLE 3-1: WBS 1.2.3 Site Investigations Activities Assigned to Priorities

WBS	SCP Number	Title	Priority 1: ESF Des. Support	Priority 2: Irret. Data	Priority 3: ESF Tstg	Priority 4: GWTT Disqual.	Priority 5: Other Unsuit. Studies	Priority 6: Seismic Hazards	Priority 7: Issue Res. Activity	Priority 8: Model Devel.	Priority 9: Other SCP Activities
1.2.3.6.1.2		Loc. of Pop. Cntrs. Relative to Wind Patterns					X				
1.2.3.6.1.3		Potent. Extrme. Weather Phenom. & Recur. Intvls.					X				
1.2.3.6.2.1	8.3.1.5	Change in Climatic Conditions					X				
1.2.3.6.2.1.1	8.3.1.5.1.1	Modern Regional Climate					X				
1.2.3.6.2.1.2	8.3.1.5.1.2	Paleoclim. Study of Lake, Playa, & Marsh Deposits					X				
1.2.3.6.2.1.3	8.3.1.5.1.3	Climatic Implications of Terrestrial Paleoecology					X				
1.2.3.6.2.1.4	8.3.1.5.1.4	Paleoenviron-mental History of Yucca Mountain					X	X	X		
1.2.3.6.2.1.5	8.3.1.5.1.5	Paleoclimate - Paleo environmental Analysis					X				
1.2.3.6.2.1.6	8.3.1.5.1.6	Future Regional Climate and Environments					X				
1.2.3.6.2.2.1	8.3.1.5.2.1	Quaternary Regional Hydrology					X				
1.2.3.6.2.2.2	8.3.1.5.2.2	Future Regional Hyrology due to Climate Changes					X				
1.2.3.7		**Resource Potential**									
1.2.3.7.1	8.3.1.9.1	Nat. Phen. & Human Act. Degrade Surf. Mkrs. & Mon.									X
1.2.3.7.2.1	8.3.1.9.2.1	Natural Resource Assessment					X				X
1.2.3.7.2.2	8.3.1.9.2.2	Water Resource Assessment									X
1.2.3.7.3.1	8.3.1.9.3.1	Future Inadvertent Human Intrusion Strategies					X				
1.2.3.7.3.2	8.3.1.9.3.2	Potent. Effects of Exploration or Extraction of Natural Resources									
1.2.3.9		Geophysical Logging					X				
1.2.3.9		Special Studies									

TABLE 3-1: WBS 1.2.3 Site Inves ons Activities Assigned to Priorities

WBS	SCP Number	Title	Priority 1: ESF Des. Support	Priority 2: Irret. Data	Priority 3: ESF Tstg	Priority 4: GWTT Disqual.	Priority 5: Other Unsuit. Studies	Priority 6: Seismic Hazards	Priority 7: Issue Res. Activity	Priority 8: Model Devel.	Priority 9: Other SCP Activities
1.2.3.10		Altered Zone					X				

Table 3-2 FY '93 Baseline Budget WBS 1.2.3

WBS	SCP Number	Title	Participant	Baseline FY '93 Budget	First Priority
1.2.3.1 Coordination and Planning					
1.2.3.1		Coordination and Plannning	EG&G	50	1
1.2.3.1		Coordination and Plannning	GSW	110	1
1.2.3.1		Coordination and Plannning	LANL	1300	1
1.2.3.1		Coordination and Plannning	M&O	1983	1
1.2.3.1		Coordination and Plannning	SNL	129	1
1.2.3.1		Coordination and Plannning	T&MSS	1089	1
1.2.3.1		Coordination and Plannning	USBR	300	1
1.2.3.1		Coordination and Plannning	USGS	3378	1
1.2.3.1		Coordination and Plannning	UT	190	1
1.2.3.2 Geology					
1.2.3.2.1.1.1	8.3.1.3.2.1	Min, Petrol. & Rock Chem.of Transport Pathways	LANL	800	1
1.2.3.2.1.1.2	8.3.1.3.2.2	Mineralogic & Geochemical Alteration	LANL	743	2
1.2.3.3.1.2.2	8.3.1.3.3.2	Kinetics and Thermodynamics of Mineral Evolution	LANL	40	2
1.2.3.2.2.1.1	8.3.1.4.2.1	Vert. and Lat. Dist. of Strat. Units in Site Area	USGS	2025	5
1.2.3.2.2.1.2	8.3.1.4.2.2	Structural Features Within the Site	USGS	1451	3
1.2.3.2.2.1.2	8.3.1.4.2.2	Structural Features Within the Site	REECo	16	3
1.2.3.2.2.1.2	8.3.1.4.2.2	Structural Features Within the Site	LBL	200	3
1.2.3.2.2.2.1	8.3.1.4.3.1	Systematic Acq. of Site Specific Subsurface Info.	SNL	130	5
1.2.3.2.2.2.2	8.3.1.4.3.2	3-D Rock Charact. Models	SNL	223	5
1.2.3.2.5.1.1	8.3.1.8.1.1	Probability of Volcanic Eruption	LANL	310	5
1.2.3.2.5.1.2	8.3.1.8.1.2	Effects of a Volc. Erupt. Penetrating the Repos.	LANL	310	5
1.2.3.2.5.3.2	8.3.1.8.3.2	Eff. of Tectonic Events on Chngs in Water Tbl	USGS	46	6
1.2.3.2.5.5.1	8.3.1.8.5.1	Charact. of Volcanic Features	LANL	750	5
1.2.3.2.5.5.2	8.3.1.8.5.2	Charact. of Igneous Intrusive Features	USGS	100	2
1.2.3.2.6.2	8.3.1.14.2	Soil & Rock Prop. of Poten. Loc. of Surf. Fac.	USGS	398	1
1.2.3.2.7.1.1	8.3.1.15.1.1	Lab. Thermal Properties	SNL	200	3
1.2.3.2.7.1.2	8.3.1.15.1.2	Lab. Thermal Expansion Testing	SNL	164	3
1.2.3.2.7.1.3	8.3.1.15.1.3	Lab. Determin. of Mech. Prop. of Intact Rock	SNL	369	1
1.2.3.2.7.1.4	8.3.1.15.1.4	Lab. Determ. of the Mech. Prop. of Fractures	SNL	240	1
1.2.3.2.8.1	8.3.1.17.1	Potential for Ash Fall at the Site	LANL	79	5
1.2.3.2.8.3.1	8.3.1.17.3.1	Relevant EQ Sources	USGS	160	6
1.2.3.2.8.3.3	8.3.1.17.3.3	Grnd Motion from Region EQ & UNEs	USGS	80	6
1.2.3.2.8.3.4	8.3.1.17.3.4	Eff. of Loc. Site Geo. on Surf. & Subsurf. Motions	USGS	60	2
1.2.3.2.8.4.1	8.3.1.17.4.1	Historical and Current Seismicity	USGS	1190	2
1.2.3.2.8.4.2	8.3.1.17.4.2	Loc. & Rec. of Falt. Near Prosp. Surf. Facil.	USGS	350	1
1.2.3.2.8.4.3	8.3.1.17.4.3	Quat. Faulting w/in 100 km of Yucca Mtn.	USGS	300	6
1.2.3.2.8.4.4	8.3.1.17.4.4	Quat. Faulting in NE- Trending Fault Zones	USGS	120	6
1.2.3.2.8.4.5	8.3.1.17.4.5	Detachment Faults	USGS	120	6
1.2.3.2.8.4.6	8.3.1.17.4.6	Quat. Faulting W/in the Site Area	USGS	334	5
1.2.3.2.8.4.10	8.3.1.17.4.10	Geodetic Leveling	USGS	190	2
1.2.3.2.8.4.12	8.3.1.17.4.12	Tectonic Models & Synthesis	USGS	146	6
1.2.3.3 Hydrology					
1.2.3.3.1.1.1	8.3.1.2.1.1	Precip. & Meteor. Monitor. for Region. Hydrology	USGS	135	2
1.2.3.3.1.1.2	8.3.1.2.1.2	Runoff & Streamflow	USGS	396	2
1.2.3.3.1.1.3	8.3.1.2.1.3	Regional Ground-water Flow System	USGS	275	4
1.2.3.3.1.1.4	8.3.1.2.1.4	Regional Hydro. Sys. Synthesis & Modeling	USGS	265	8
1.2.3.3.1.2.1	8.3.1.2.2.1	UZ Infiltration	USGS	835	2
1.2.3.3.1.2.10	No SCP ref.	Prot. Hyd. Tsts that Supp. Mult. Site Char. Acts.	USGS	70	5
1.2.3.3.1.2.2	8.3.1.2.2.2	Water Movement Tracer Tests	LANL	445	3
1.2.3.3.1.2.3	8.3.1.2.2.3	Perc. in the UZ - Surf. Based Study	USGS	2319	4
1.2.3.3.1.2.4	8.3.1.2.2.4	Perc. in the UZ - ESF Study	USGS	669	3
1.2.3.3.1.2.6	8.3.1.2.2.6	Gaseous-Phase Movement in UZ	USGS	50	5
1.2.3.3.1.2.7	8.3.1.2.2.7	UZ Hydrochemistry	USGS	600	4
1.2.3.3.1.2.8	8.3.1.2.2.8	Fluid Flow in UZ Fractured Rock	LBL	90	4

Table 3-2 FY '93 Baseline Budget WBS 1.2.3

WBS	SCP Number	Title	Participant	Baseline FY '93 Budget	First Priority
1.2.3.3.1.2.8	8.3.1.2.2.8	Fluid Flow in UZ Fractured Rock	USGS	193	4
1.2.3.3.1.2.9	8.3.1.2.2.9	Site UZ Modeling & Synthesis	LBL	266	4
1.2.3.3.1.2.9	8.3.1.2.2.9	Site UZ Modeling & Synthesis	USGS	70	4
1.2.3.3.1.3.1	8.3.1.2.3.1	Site SZ Ground-water flow system	LANL	475	2
1.2.3.3.1.3.1	8.3.1.2.3.1	Site SZ Ground-water flow system	USGS	1130	2
1.2.3.3.1.3.2	8.3.1.2.3.2	SZ Hydrochemistry	USGS	125	4
1.2.3.3.1.3.3	8.3.1.2.3.3	SZ Hydro. Sys. Synthesis & Modeling	LBL	150	4
1.2.3.3.1.3.3	8.3.1.2.3.3	SZ Hydro. Sys. Synthesis & Modeling	USGS	115	4
1.2.3.4 Geochemistry					
1.2.3.4.1.1	8.3.1.3.1	Groundwater Chemistry Model	LANL	186	5
1.2.3.4.1.2.1	8.3.1.3.4.1	Batch Sorption Studies	LANL	770	2
1.2.3.4.1.2.2	8.3.1.3.4.2	Biological Sorption and Transport	LANL	275	2
1.2.3.4.1.2.3	8.3.1.3.4.3	Sorption Models	LANL	162	5
1.2.3.4.1.3.1	8.3.1.3.5.1	Dissolved Species Concentation Limits	LANL	986	2
1.2.3.4.1.3.2	8.3.1.3.5.2	Colloid Behavior	LANL	14	4
1.2.3.4.1.4.1	8.3.1.3.6.1	Dynamic Transport Column Exp.	LANL	752	2
1.2.3.4.1.4.2	8.3.1.3.6.2	Diffusion	LANL	112	2
1.2.3.4.1.5.1	8.3.1.3.7.1	Retardation Sensitivity Analysis	LANL	425	4
1.2.3.4.2		Geochemical Modelling	LLNL	380	8
1.2.3.5 Drilling					
1.2.3.5.1		Sample Management Facility	REECo	487	1
1.2.3.5.1		Sample Management Facility	T&MSS	3465	1
1.2.3.5.2.1	8.3.1	Common-to-Drilling Support	REECo	5271	1
1.2.3.5.2.2	8.3.1	Engineering, Design and Drilling Support	JC	200	1
1.2.3.5.2.2	8.3.1	Engineering, Design and Drilling Support	RSN	1800	1
1.2.3.5.2.2	8.3.1	Engineering, Design and Drilling Support	T&MSS	1000	1
1.2.3.5.2.3	8.3.1.2.2.3.2	Integrated Data Acquisition System (IDAS)	REECo	100	3
1.2.3.5.3.3	8.3.1.2.2.1.2	Natural Infiltration Drillholes and Construction	REECo	300	4
1.2.3.5.3.5	8.3.1.2.2.3.2	UZ, Vert. and Seis. Prof., & Prot. Drlhls. & Tsts.	REECo	2000	4
1.2.3.5.3.19	8.3.1.8.5.1.1	Volcanic Drillholes	REECo	16	5
1.2.3.5.3.20	8.3.1.14.2.1	Surface Facilities Drillholes	REECo	1538	1
1.2.3.5.3.22	8.3.1.17.4.8	In Situ Stress Drlhle & Tests & Quat. Flt Trnchs	REECo	100	6
1.2.3.6 Climatology					
1.2.3.6.2.1.1	8.3.1.5.1.1	Modern Regional Climate	USGS	22	5
1.2.3.6.2.1.2	8.3.1.5.1.2	Paleoclim. Study of Lake, Playa, & Marsh Deposits	USGS	264	5
1.2.3.6.2.1.3	8.3.1.5.1.3	Climatic Implications of Terrestrial Paleoecology	USGS	58	5
1.2.3.6.2.1.4	8.3.1.5.1.4	Paleoenvironmental History of Yucca Mountain	USGS	114	5
1.2.3.6.2.1.6	8.3.1.5.1.6	Future Regional Climate and Environments	PNL	300	5
1.2.3.6.2.1.6	8.3.1.5.1.6	Future Regional Climate and Environments	SNL	175	5
1.2.3.6.2.2.1	8.3.1.5.2.1	Quaternary Regional Hydrology	USGS	1277	5
1.2.3.7 Resource Potential					
1.2.3.7.2.1	8.3.1.9.2.1	Natural Resource Assessment	USGS	80	5
1.2.3.9 Special Studies					
1.2.3.9		Geophysical Logging	T&MSS	25	5
1.2.3.10 Altered Zone Characterization					
1.2.3.10		Altered Zone Characterization	LLNL	250	5

WBS	SCP	Title	Drilling	Trenching	Test Pit Evaluation	Pavement Cleaning	Geologic Mapping	Geophysical Studies/Logging	ESF Testing	Field Hydrologic Tests	Unsaturated Zone	Saturated Zone	Field Geotechnical Studies	Field Monitoring Activities	Laboratory Tests/Analyses	Hydrology	Geochemistry	Geotechnical	Thermal Properties	Mechanical Properties	Model Development	Study Plan Development	Annotated Outline	Issue Resolution Studies	Erosion	Calcite-Silica	Volcanic Hazards	Seismic Hazards	Natural Resources	Future Climate
1.2.3.2 Geology																														
1.2.3.2.1.1.1	8.3.1.3.2.1	Min, Petrol. & Rock Chem.of Transport Pathways													X		X													
1.2.3.2.1.1.2	8.3.1.3.2.2	Mineralogic & Geochemical Alteration							X						X		X													
1.2.3.2.1.2.2	8.3.1.3.3.2	Kinetics and Thermodynamics of Mineral Evolution															X					X								
1.2.3.2.2.1.1	8.3.1.4.2.1	Vert. and Lat. Dist. of Strat. Units in Site Area					X	X							X						X									
1.2.3.2.2.1.2	8.3.1.4.2.2	Structural Features Within the Site					X		X						X							X								
1.2.3.2.2.2.1	8.3.1.4.3.1	Systematic Acq. of Site Specific Subsurface Info.					X																							
1.2.3.2.2.2.2	8.3.1.4.3.2	3-D Rock Charact. Models																			X	X								
1.2.3.2.5.1.1	8.3.1.8.1.1	Probability of Volcanic Eruption																									X			
1.2.3.2.5.1.2	8.3.1.8.1.2	Effects of a Volc. Erupt. Penetrating the Repos.																				X					X			
1.2.3.2.5.3.2	8.3.1.8.3.2	Eff. of Tectonic Events on Chngs in Water Tbl																				X								
1.2.3.2.5.5.1	8.3.1.8.5.1	Charact. of Volcanic Features			X		X								X												X			
1.2.3.2.5.5.2	8.3.1.8.5.2	Charact. of Igneous Intrusive Features						X							X							X					X			
1.2.3.2.6.2	8.3.1.14.2	Soil & Rock Prop. of Poten. Loc. of Surf. Fac.	X		X		X								X			X												
1.2.3.2.7.1.1	8.3.1.15.1.1	Lab. Thermal Properties													X				X			@								
1.2.3.2.7.1.2	8.3.1.15.1.2	Lab. Thermal Expansion Testing													X				X			@								
1.2.3.2.7.1.3	8.3.1.15.1.3	Lab. Determin. of Mech. Prop. of Intact Rock													X					X										
1.2.3.2.7.1.4	8.3.1.15.1.4	Lab. Determ. of the Mech. Prop. of Fractures													X					X										
1.2.3.2.8.1	8.3.1.17.1	Potential for Ash Fall at the Site													X												X	X		
1.2.3.2.8.3.1	8.3.1.17.3.1	Relevant EQ Sources																										X		
1.2.3.2.8.3.3	8.3.1.17.3.3	Grnd Motion from Region EQ & UNEs																										X		
1.2.3.2.8.3.4	8.3.1.17.3.4	Eff. of Loc. Site Geo. on Surf. & Subsurf. Motions																										X		
1.2.3.2.8.4.1	8.3.1.17.4.1	Historical and Current Seismicity												X														X		
1.2.3.2.8.4.2	8.3.1.17.4.2	Loc. & Rec. of Falt. Near Prosp. Surf. Facil.		X			X																					X		
1.2.3.2.8.4.3	8.3.1.17.4.3	Quat. Faulting w/in 100 km of Yucca Mtn.		X			X															@						X		
1.2.3.2.8.4.4	8.3.1.17.4.4	Quat. Faulting in NE- Trending Fault Zones		X			X																					X		
1.2.3.2.8.4.5	8.3.1.17.4.5	Detachment Faults					X								X													X		
1.2.3.2.8.4.6	8.3.1.17.4.6	Quat. Faulting W/in the Site Area		X			X	X																				X		
1.2.3.2.8.4.10	8.3.1.17.4.10	Geodetic Leveling						X																				X		
1.2.3.2.8.4.12	8.3.1.17.4.12	Tectonic Models & Synthesis																			X	X						X		
1.2.3.3 Hydrology																														
1.2.3.3.1.1.1	8.3.1.2.1.1	Precip. & Meteor. Monitor. for Region. Hydrology												X																
1.2.3.3.1.1.2	8.3.1.2.1.2	Runoff & Streamflow												X																

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WBS	SCP	Title	Drilling	Trenching	Test Pit Evaluation	Pavement Cleaning	Geologic Mapping	Geophysical Studies/Logging	ESF Testing	Field Hydrologic Tests	Unsaturated Zone	Saturated Zone	Field Geotechnical Studies	Field Monitoring Activities	Laboratory Tests/Analyses	Hydrology	Geochemistry	Geotechnical	Thermal Properties	Mechanical Properties	Model Development	Study Plan Development	Annotated Outline	Issue Resolution Studies	Erosion	Calcite-Silica	Volcanic Hazards	Seismic Hazards	Natural Resources	Future Climate
1.2.3.5 Drilling																														
1.2.3.5.3.5	8.3.1.2.2.3.2	UZ, Vert. and Seis. Prof., & Prot. Drlhls. & Tsts.	X																											
1.2.3.5.3.19	8.3.1.8.5.1.1	Volcanic Drillholes	X																											
1.2.3.5.3.20	8.3.1.14.2.1	Surface Facilities Drillholes	X																											
1.2.3.5.3.22	8.3.1.17.4.8	In Situ Stress Drlhls & Tests & Quat. Flt Trnchs		X																										
1.2.3.6 Climatology																														
1.2.3.6.2.1.1	8.3.1.5.1.1	Modern Regional Climate												X																X
1.2.3.6.2.1.2	8.3.1.5.1.2	Paleoclim. Study of Lake, Playa, & Marsh Deposits													X															X
1.2.3.6.2.1.3	8.3.1.5.1.3	Climatic Implications of Terrestrial Paleoecology													X															X
1.2.3.6.2.1.4	8.3.1.5.1.4	Paleoenvironmental History of Yucca Mountain					X								X															X
1.2.3.6.2.1.6	8.3.1.5.1.6	Future Regional Climate and Environments																			X									X
1.2.3.6.2.2.1	8.3.1.5.2.1	Quaternary Regional Hydrology					X								X											X				
1.2.3.7 Resource Potential																														
1.2.3.7.2.1	8.3.1.9.2.1	Natural Resource Assessment																											X	
1.2.3.9 Special Studies																														
1.2.3.9		Geophysical Logging	X					X																						
1.2.3.10 Altered Zone Characterization																														
1.2.3.10		Altered Zone Characterization															X													

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WBS	SCP	Title	Drilling	Trenching	Test Pit Evaluation	Pavement Cleaning	Geologic Mapping	Geophysical Studies/Logging	ESF Testing	Field Hydrologic Tests	Unsaturated Zone	Saturated Zone	Field Geotechnical Studies	Field Monitoring Activities	Laboratory Tests/Analyses	Hydrology	Geochemistry	Geotechnical	Thermal Properties	Mechanical Properties	Model Development	Study Plan Development	Annotated Outline	Issue Resolution Studies	Erosion	Calcite-Silica	Volcanic Hazards	Seismic Hazards	Natural Resources	Future Climate
1.2.3.3 Hydrology																														
1.2.3.3.1.1.3	8.3.1.2.1.3	Regional Ground-water Flow System	X								X	X		X																
1.2.3.3.1.1.4	8.3.1.2.1.4	Regional Hydro. Sys. Synthesis & Modeling																			X									
1.2.3.3.1.2.1	8.3.1.2.2.1	UZ Infiltration					X	X			X			X																
1.2.3.3.1.2.10	No SCP ref.	Prot. Hyd. Tsts that Supp. Mult. Site Char. Acts.									X	X				X						*								
1.2.3.3.1.2.2	8.3.1.2.2.2	Water Movement Tracer Tests							X		X				X		X					@								
1.2.3.3.1.2.3	8.3.1.2.2.3	Perc. in the UZ - Surf. Based Study							X		X																			
1.2.3.3.1.2.4	8.3.1.2.2.4	Perc. in the UZ - ESF Study							X		X																			
1.2.3.3.1.2.6	8.3.1.2.2.6	Gaseous-Phase Movement in UZ									X																			
1.2.3.3.1.2.7	8.3.1.2.2.7	UZ Hydrochemistry									X					X														
1.2.3.3.1.2.8	8.3.1.2.2.8	Fluid Flow in UZ Fractured Rock																			X									
1.2.3.3.1.2.9	8.3.1.2.2.9	Site UZ Modeling & Synthesis																			X	X								
1.2.3.3.1.3.1	8.3.1.2.3.1	Site SZ Ground-water flow system										X		X																
1.2.3.3.1.3.2	8.3.1.2.3.2	SZ Hydrochemistry										X				X														
1.2.3.3.1.3.3	8.3.1.2.3.3	SZ Hydro. Sys. Synthesis & Modeling																			X									
1.2.3.4 Geochemistry																														
1.2.3.4.1.1	8.3.1.3.1	Groundwater Chemistry Model																			X									
1.2.3.4.1.2.1	8.3.1.3.4.1	Batch Sorption Studies															X					@								
1.2.3.4.1.2.2	8.3.1.3.4.2	Biological Sorption and Transport															X													
1.2.3.4.1.2.3	8.3.1.3.4.3	Sorption Models															X				X	@								
1.2.3.4.1.3.1	8.3.1.3.5.1	Dissolved Species Concentation Limits															X					@								
1.2.3.4.1.3.2	8.3.1.3.5.2	Colloid Behavior															X					@								
1.2.3.4.1.4.1	8.3.1.3.6.1	Dynamic Transport Column Exp.															X					@								
1.2.3.4.1.4.2	8.3.1.3.6.2	Diffusion															X					@								
1.2.3.4.1.5.1	8.3.1.3.7.1	Retardation Sensitivity Analysis															X				X									
1.2.3.4.2		Geochemical Modelling																			X	*								
1.2.3.5 Drilling																														
1.2.3.5.1		Sample Management Facility	X																											
1.2.3.5.2.1	8.3.1	Common-to-Drilling Support	X																											
1.2.3.5.2.2	8.3.1	Engineering, Design and Drilling Support	X																											
1.2.3.5.2.3	8.3.1.2.2.3.2	Integrated Data Acquisition System (IDAS)									X	X																		
1.2.3.5.3.3	8.3.1.2.2.1.2	Natural Infiltration Drillholes and Construction	X																											

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TABLE 5-2a: DRILLING PLANNED FOR FY'93 SITE CHARACTERIZATION ACTIVITIES

ACTIVITY	WBS 123...	ENVIRON Finish*	STUDY PLAN	TPP	JP	START FIELD	COMMENTS
1. **Unsaturated Zone**	535		8.3.1.2.2.3 NRC Phase I review complete				
UZ-16	"	completed	"	92-2	92-3, drilling 92-4, pad 92-9, VSP testing	on-going	JP 92-9 is in progress, anticipated completion 3/30/93
UZ-14	"	**10/5/ 93 - f***	"	T-92-16	92-17, drilling	6/93	TPP/JPs are in progress; anticipated completion in Feb-Mar '93
UZ-9	"		"			FY'94	
2. **Neutron**	3121 533		8.3.1.2.2.1 complete through NRC Phase I review; no Phase II review	91-34, Phase 2	91-9, Phases 1, 2		Final two neutron holes (N-62, N-39) deferred indefinitely until higher priority drilling is completed

* bold dates indicate that environmental studies will not be completed by anticipated field start date

ACTIVITY	WBS 123...	ENVIRON Finish*	STUDY PLAN	TPP	JP	START FIELD	COMMENTS
N-32	"	completed	"	"	"	N/A	Completed 10/9/92 @ 207.4'
N-35	"	"	"	"	"	N/A	Completed 10/26/92 @ 175.8'
N-57	"	"	"	"	"	N/A	Completed 11/4/92 @ 118.9'
N-58	"	completed	"	"	"	N/A	Completed 11/13/92 @118.9'
N-59	"	completed	"	"	"	N/A	Completed 12/8/92 @ 118.2'
N-61	"	completed	"	"	"	N/A	Completed 12/17/92 @ 118.9'
N-62	"	completed	"	"	"		
N-39	"		"	"	"		Awaiting environmental approval
3. **ESF Ramp Holes**	262 51 521 522 5320	see below	8.3.1.14.2 NRC Phase I review complete	92-1, for all NRG, SRG bore-holes	see below		
NRG-6	"	completed	"	92-15, drilling & testing	92-10, pad 92-11, drilling & testing	11/18/92	Anticipated completion date: 3/10/93
NRG-2	"	completed	"	see above	92-19, pad, rd, drilling	1/8/93	Completed 1/28/93 @ 215'

* bold dates indicate that environmental studies will not be completed by anticipated field start date

ACTIVITY	WBS 123...	ENVIRON Finish*	STUDY PLAN	TPP	JP	START FIELD	COMMENTS
NRG-3	"	1/25/93	"	see above	93-1, drilling	3/22/93	JP in progress; anticipated completion date: 1/30/93
NRG-4	"	**4/7/93 - f**	"	see above	92-2, rd 93-2A, drilling	5/4/93	JPs in progress; anticipated completion date: TBD
NRG-5	"	**3/9/93 - f**	"	see above	93-3, rd & pad 93-3A-drilling	3/11/93	JPs in progress; anticipated completion date: TBD
SRG-1	"	8/2/93	"	see above	92-16, pad, rd, & drilling		JP in progress; activity on hold
SRG-2	"		"	see above		FY'94	
SRG-3	"		"	see above		FY'94	
SRG-4	"	**10/14/93 - f**	"	see above		10/1/93	No environmental request received (1/18/93)
SRG-5 (SD-10)	"	**9/16/93**	"	see above		7/1/93	No environmental request received (1/18/93) Need to coordinate engineering and scientific sampling needs
4. Volcanic Holes None planned for FY'93							

* bold dates indicate that environmental studies will not be completed by anticipated field start date

ACTIVITY	WBS 123...	ENVIRON Finish*	STUDY PLAN	TPP	JP	START FIELD	COMMENTS
5. SD Holes	2221		8.3.1.4.3.1 submitted to NRC 1/4/93				
SD-10: see SRG-5, above	"		"				

* bold dates indicate that environmental studies will not be completed by anticipated field start date

TABLE 5-1b: TRENCHING AND TEST PITS PLANNED FOR FY'93 SITE CHARACTERIZATION ACTIVITIES

ACTIVITY	WBS 123...	ENVIRON Finish	STUDY PLAN	TPP	JP	START FIELD	COMMENTS
1. Midway Valley -	2842		8.3.1.17.4.2 complete through NRC Phase II review	90-1; 92-3, Phase I & II	91-1; 92-5, Phases I & II 92-14, Phase III		JP 92-14 not started
a. Trench MWV-T3; north of Exile Hill	"	10/5/93	"	"	"	3/93	
b. Trench MWV-T8; across a geophysical anomaly in central Midway Valley	"	4/20/93	"	"	"	TBD	
c. Test Pits MWV- P11, P18, P27-28, P34-36	"	"	"	"	"	TBD	
2. Site Area (3 to 5 trenches)	2846	TBD	8.3.1.17.4.6 NRC Phase I review complete; no Phase II review	92-5	92-12		JP 92-12, completed; may need additional phase
a. Solitario Canyon Fault: Trenches SCF-T2, T3, T4-6	"	"	"	"	"		
b. Bow Ridge Fault: Trench BRF-T1	"	"	"	"	"		

ACTIVITY	WBS 123...	ENVIRON Finish	STUDY PLAN	TPP	JP	START FIELD	COMMENTS
c. Windy Wash Fault; Trench WWF-T1	"	"	"	"	"		
d. Fatigue Wash Fault; Trench FWF-T1	"	"	"	"	"		
e. Additional cleanup work of existing trenches and exposures	"	"	"	"	"		
3. 100-km faults	2843	1/29/93	8.3.1.17.4.3 awaiting project office approval	T-92-17	93-13 - not required - off-site		Awaiting approval of study plan
a. Bare Mtn BMT-1	"	4/15/93	"	"	"	4/93	Awaiting completion of archeological survey
b. Bare Mtn BMT-2	"	2/93	"	"	"	TBD	
4. NE-trending faults	2844	TBD	8.3.1.17.4.4 awaiting verification of comment resolution			TBD	Awaiting approval of study plan
a. Rock Valley Fault Zone; Trench RVF-T1							
5. Volcanic Features	2551	in process	8.3.1.8.5.1; complete through NRC Phase II review	91-32; under revision for Sleeping Butte and Crater Flat	N/A	TBD	Awaiting land access, and revision of TPP

ACTIVITY	WBS 123...	ENVIRON Finish	STUDY PLAN	TPP	JP	START FIELD	COMMENTS
a. Sleeping Butte; Test Pits - 1 to -10	"	"	"	"	"	"	"
b. Crater Flat; Test Pits- 1 to -40	"	"	"	"	"	"	"
6. North Ramp Geotechnical Investigations	262	TBD	8.3.1.14.2; complete through NRC Phase I review	92-1	JP 92-1	TBD	Revisions of TPP and JP may be needed
a. ESF Leach Field ; Test Pits PSF-TP1 to TP6	"	"	"	"	"	"	"
b. ESF Booster Station; Test Pits BSF-TP1, TP2	"	"	"	"	"	"	"

TABLE 5-2c: GEOPHYSICAL SURVEYS PLANNED FOR FY'93 SITE CHARACTERIZATION ACTIVITIES

ACTIVITY	WBS 1.2.3..	ENVIRON Finish	STUDY PLAN	TPP	JP	START FIELD	COMMENTS
1. Seismic Reflection Survey	2211	Bio, arch, rad surveys underway* **4/20/93**	8.3.1.4.2.1 NRC Phase I review complete	92-08**	92-15 - on hold, assumed not necessary	3/93	Contract with seismic reflection contractor not yet signed. TPP will be completed after contract is signed. Environmental surveys for shallow shot holes will be conducted in real time. Road may need widening, requiring JP and work order.
1a: Gravity Survey	"	"	"	"	"	"	"
1b: Magnetic Survey	"	"	"	"	"	"	"
2. UZ - 16, VSP	3123	**6/28/94**	8.3.1.2.2.3 complete through NRC Phase I review	92-02	92-09	11/93 (FY'94)	Will probably be delayed until FY'94. JP is in progress; field preactivity clearances scheduled to begin 10/1/93.
3. Operate seismic network and portable seismographs	2841		8.3.1.17.4.1 complete through NRC Phase I review; no Phase II review	none	none	on-going	

ACTIVITY	WBS 1.2.3..	ENVIRON Finish	STUDY PLAN	TPP	JP	START FIELD	COMMENTS
3a: install additional stations	"	9/3/93	"	none	none	TBD	
3b: install seismic telemetry sites	"	9/20/93	"	none	none	TBD	
3c: obtain ground motion recordings	2834	N/A	8.3.1.17.3.4 complete through NRC Phase I review; no Phase II review	N/A	N/A	3/93 ??	Install about 12 seismometers in boreholes and on ground surface to record ground motions.
4. Conduct geophysical logging in boreholes	various, (123)9	N/A	various	N/A	N/A	as needed	
5. **"geophysical studies"** to support volcanic characterization activities	2551	N/A	8.3.1.8.5.1 complete through NRC Phase II review	N/A	N/A	"late FY'93"	Work scope states that geophysical studies will be conducted in late FY'93 to locate potential drilling sites in the central part of the Amargosa Valley, but activity is not funded.

ACTIVITY	WBS 1.2.3..	ENVIRON Finish	STUDY PLAN	TPP	JP	START FIELD	COMMENTS
6. **Conduct shallow geophsical survey** (Seismic refraction or transient electeomagnetic survey [TEM]), S. end, Windy Wash fault	2846	not started	8.3.1.17.4.6.2	not started	not started	?	Report due 8/93
7. **Geodetic Leveling**	28410		8.3.1.17.4.10 complete through NRC Phase I review; no Phase II review				
7a: Resurvey level lines crossing Quaternary faults	"	needed?		not needed?	not needed?	TBD	
7b: Resurvey southern Nevada Great Basin Network, using GSP	"	not needed?		"	"	TBD	

TABLE 5-2d: ESF TESTING PLANNED FOR FY'93
SITE CHARACTERIZATION ACTIVITIES

ACTIVITY	WBS 123...	ENVIRON Finish	STUDY PLAN	TPP	JP	START FIELD	COMMENTS
1. Geologic Mapping- Starter Tunnel	2212	N/A	8.3.1.4.2.2 Submitted to NRC 2/8/89, Revised SP submitted to NRC 1/6/93	TPP 92-10	JP 92-20A in progress	ongoing	
2. Perched Water Testing - Starter Tunnel	3124	N/A	8.3.1.2.2.4 Submitted to NRC 2/9/91, Revised SP submitted to NRC 1/21/93	TPP 92-11	JP 92-20B in progress		Contingency Activity
3. Consolidated Sampling - Starter Tunnel				TPP 92-14	in progress		
3a. Matrix Hydrologic Properties Testing	3123	N/A	8.3.1.2.2.3 NRC Phase I Review Completed				
3b. History of Mineralogic and Geochemical Alteration of Yucca Mountain	2112	N/A	8.3.1.3.2.2 NRC Phase I Review Completed, Phase II Deferred	N/A	N/A		
3c. Chloride and Chlorine 36 Measurements of Percolation at Yucca Mountain	3122	N/A	8.3.1.2.2.2 Submitted to NRC 2/9/89, Revised SP completed Comment Resolution	N/A	N/A		

TABLE 5-2e: HYDROLOGIC STUDIES PLANNED FOR FY'93
SITE CHARACTERIZATION ACTIVITIES

ACTIVITY	WBS 123...	ENVIRON Finish	STUDY PLAN	TPP	JP	START FIELD	COMMENTS
1. **Precipitation Monitoring:** expansion of data collection network	3111		8.3.1.2.1.1 NRC Phase I review completed; no Phase II review.				Installation of about 20 additional tipping bucket gauges planned.
2. **Runoff and Streamflow Monitoring:** expand data collection network	3112		8.3.1.2.1.2 Complete through NRC Phase II reveiw.				Installation of 3 additinal stream gauges on upper Fory Mile wash. Biological and cultural surveys needed.
3. **Amargosa Desert,** Conduct Pump Tests, Collect Water Samples,	3113	5/18/93	8.3.1.2.1.3 NRC Phase I review completed; no Phase II review.				Pumping and testing of existing wells.
4. **Conduct Ponding and Infiltration Tests;** Fortymile Wash	3113		"				Infilitration tests conducted at selected sites.

ACTIVITY	WBS 123...	ENVIRON Finish	STUDY PLAN	TPP	JP	START FIELD	COMMENTS
5. **Conduct Prototype Ponding/Infiltration Study;** at N-85	3121	2/1/93	8.3.1.2.2.1 NRC Phase I review completed; no Phase II review.	T-93-1 98% complete		2/22/93	Using LiBr tracer **Work STatement discusses only development of methodology.**
6. **UZ-16**							See Table 5-2a for construction of boreholes and facilities;.
a. VSP	3123						see Table 2-5c.
b. Air Permeability Testing	3123	N/A	8.3.1.2.2.3 NRC Phase I review completed; no Phase II review.				Conducted after drilling is completed.
c. Gas Sampling	3127		8.3.1.2.2.7.1 NRC Phase I review completed; Phase II deferred.			5/93	Pump UZ-16 after drilling is complete; collect gas samples from several depths.
7. **Conduct Sea Mist Tests**	3124		8.3.1.2.2.4 Rev 1 in comment resolution				Proposed to be used in ESF radial borehole testing.
8. **ESF Testing**							See Table 5-2 ESF tracers need to be selected/approved.

ACTIVITY	WBS 123...	ENVIRON Finish	STUDY PLAN	TPP	JP	START FIELD	COMMENTS
a. Perched water testing			8.3.1.2.2.4 in comment resolution	92-11	92-20B in process	as needed during/after tunnel construction	Contingency activity
b. Gas Sampling			"	92-13		during/after tunnel construction	Drill 5 to 8 short boreholes in starter tunnel; collect gas samples.
9. UZ-6, UZ-6s, gas sampling			8.3.1.2.2.6 NRC Phase I review completed; no Phase II review.			on-going	Collect gas samples and make gas flow measurements when boreholes exhaust air.
10. C-Well Cross-Hole Hydraulic Tests	3131	5/28/93	N/A			7/1/93	Concerns: - USGS needs to submit criterial letter for tracers - NDEP and DWR permits needed for tracers, water usage and pumping
a. Discharge pipe for pump tests	"	"	N/A			2/22/93	Concerns: - possible use of water at north portal - adding tracer to water at discharge point
b. Electrical power supply	"		N/A				Concerns: - Clean and continuous power essential for daata collection and pump opeation.

ACTIVITY	WBS 123...	ENVIRON Finish	STUDY PLAN	TPP	JP	START FIELD	COMMENTS
11. **Saturated Zone** Hydrochemistry Sample Collection	3132	3127		N/A	N/A		Samples collected from identified springs, seeps, and wells.
12. **Collect Outcrop Samples for Hydrologic Properties**	3133		8.3.1.2.3.3 Approved by YMPO 1/14/93; will be submitted to NRC in Feb. '93				Collect small-diameter, drilled outcrop samples

TABLE 5-3: BOREHOLES PLANNED IN FY'93

Hole Name	Rig	Location	Drilling Type	Proposed Finished Hole Diameter	Starting Core Diameter	Proposed Depth
1. Unsaturated Zone						
UZ-16	300	N760,535/E564,856.90	Dual Wall Reverse Circulation	12 1/4"	HQ	1663 feet
UZ-14	300	~N771,275/E560,220 (near USW UZ-1)	Dual Wall Reverse Circulation	12 1/4"	HQ	~1700 feet
2. Neutron						
N-32		N764050/E562850	ODEX-115	6"	HQ	210 feet
N-35		N762200/E562350	ODEX-115	6"	HQ	175 feet
N-57		N755075/E561100	ODEX-115	6"	HQ	120 feet
N-58	850	N755200/E561250	ODEX-115	6"	HQ	120 feet
N-59	850	N755300/E561400	ODEX-115	6"	HQ	120 feet
N-61	850	N755450/E561500	ODEX-115	6"	HQ	120 feet
N-62	850	N755200/E558800	ODEX-115	6"	HQ	60 feet
N-39	850	N756500/E614500	ODEX-115	6"	HQ	125 feet
3. ESF Ramp Holes						
NRG-2	850	N765,800/E569,000	ODEX	6"	HQ	210
NRG-3	850	N766,380/E568,195	ODEX	6"	HQ	475
NRG-4	Joy-2	N766,830/E566,900	ODEX	6"	HQ	735

Hole Name	Rig	Location	Drilling Type	Proposed Finished Hole Diameter	Starting Core Diameter	Proposed Depth
NRG-5	Joy-2	N767,850/E564,700	ODEX	6"	HQ	1000
NRG-6	Joy-1	N776,726/E564,187	ODEX	6"	HQ	1100
SRG-5	Joy-2	N758,175/E558,315	ODEX	6"	HQ	1150

TABLE 5-4: PLANNED BOREHOLE GEOPHYSICAL LOGGING TO BE CONDUCTED DURING FY'93

GEOPHYSICAL LOGS	BOREHOLES						
	NRG BOREHOLES			SRG-5	N-HOLES	UZ-16	UZ-4, -5, -7, -13
	2, 3	4, 5	6				
Neutron Moisture Meter					X*		
Caliper	X	X	X	X		X	X*
Density Log	D	D	X	D		X	X*
Induction Log		D	X	D		X	
Video TV Camera (oriented)	X	X	X	X		X	
Check-shot Velocity	O	O	O	O			
Epithermal Neutron	D	D	X	D		X	X*
Gyroscopic Survey	X	X	X	X		X	
Total Gamma Ray	D	X	X	X			
Spectral Gamma Ray		D	X	D		X	
Magnetic Susceptibility and Magnetic Field	O	O	O	O		X	
Dielectric Log						X	
Borehole Gravity Meter						X	
Continuous Temperature						X	
VSP						X	

*= Logging is conducted by USGS
X= Planned
D= Will be conducted if log data derived from NRG-6 is judged to be useful
O= Optional; will be run if funding is available and schedule for engineering studies permit

Table 5-5: Estimated Schedule for Submission of Study Plans to the NRC for the Remainder of FY '93

December 1992
Biological Sorption & Transport
Characterization of Quaternary Regional Hydrology
Characterization of Future Regional Hydrology due to Climate Changes
Analysis of Waste Package Rupture due to Tectonic Processes & Events
Geomechanical Attributes of the Waste Package Environment
Natural Resource Assessment of Yucca Mountain, Nye Co., NV

January 1993
Systematic Acquisition of Site-Specific Subsurface Information
Characterization of Yucca Mountain Unsaturated Zone (UZ) in the ESF*
Characterization of Structural Features in Site Area*

February 1993
Saturated Zone (SZ) Hydrologic System Synthesis and Modeling
Meteorological Data Collection at the Yucca Mtn (YM) Site
Laboratory Thermal Properties
Quaternary Faulting Proximal to the Site within NE-Trending Fault Zones
In-Situ Design Verification*
Water Movement Test*

March 1993
Hydrochemical Characterization of the UZ
Fluid Flow in Unsaturated, Fractured Rock
Dissolved Species Concentration Limits and Colloid Behavior
Diffusion
Laboratory Thermal Expansion Testing
Ground Motion at the Site from Controlled Seismic Events

April 1993
Excavation Investigations*

May 1993
Site UZ Modeling & Synthesis

June 1993
Characterization of Igneous Intrusive Features
Characterization of Site Ambient Thermal Conditions

July 1993
Laboratory Determination of the Mechanical Properties of Fractures
Batch Sorption Studies and Development of Sorption Models
Dynamic Transport Column Experiments
Physical Processes of Magmatism & Effects on the Potential Repository

August 1993
Ground-water Chemistry Model
Ground Motion from Regional Earthquakes and UNEs

September 1993
Characterization of Future Regional Climates & Environments

* Study Plans Supporting Activities in the ESF

TABLE 6-1A
Milestones and Deliverables for FY'93 by WBS No.

WBS NO.	DUE DATE	DELIVERABLE	PARTI-CIPANT	STUDY PLAN	REPORT	MAP	PDA DATA	TDIF DATA	MODEL	CONF PRESEN-TATION	JOUR PAPER	NO.
32111	Apr-93	Status of Work on Calcite Precipitation Model	LANL							X		
32112	Mar-93	Independent Methods for Dating Zeolites	LANL		X							MS 3343
32122	Sep-93	Revised Study Plan	LANL	X								
32211	Apr-93	Report/TDIF: Preliminary Data for Yucca Wash	USGS		X			X				3GGU253M
32211	Apr-93	Preliminary Report/TDIF: Lithologies of Completed Boreholes	USGS		X			X				3GGU11AM
32211	Apr-93	Preliminary Report/TDIF: Isotopic Data	USGS		X							3GGU21M
32211	Apr-93	Preliminary Report/TDIF: Log and Core Data from Borehole Geophysical Surveys	USGS		X			X				3GGU394M
32211	Apr-93	Report/TDIF: Evaluation of Stratigraphic Model of Central Block	USGS		X				X			3GGU400M
32211	Jun-93	Report/TDIF: Map of Yucca Wash	USGS		X			X				3GGU51AM
32211	Jun-93	Report/TDIF: Preliminary Data from Seismic Line	USGS		X			X				3GGU256M
32211	Sep-93	Report/TDIF: Results from Gravity and Magnetic Surveys	USGS		X			X				3GGU02AM
32211	Sep-93	Progress Report/TDIF: Analytical Database	USGS		X			X				3GGU021M
32211	Sep-93	Report/TDIF: Yucca Wash	USGS		X			X				3GGU25AM
32211	Sep-93	TDIF: Borehole Data to Technical Database	USGS					X				3GGU395M
32211	Sep-93	Preliminary Report/TDIF: Lithologic Logs	USGS		X			X				3GGU30AB
32211	Sep-93	TDIF: Magnetometer Results- UZ-16	USGS					X				3GGU371M
32211	Sep-93	Report/TDIF: Seismic Surveys	USGS		X			X				3GGU267M
32211	Sep-93	Progress Report/TDIF: Borehole Computations	USGS		X			X				3GGU396M
32212	Sep-92	Progress Report: VSP	LBL		X							3GGF035M
32212	Dec-92	Revised Study Plan	USGS	X								3GGF005M
32212	Jan-93	Map: Tiva Canyon	USGS			X		X				3GGF100M

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Milestones and Deliverables for FY'93 by WBS No.

WBS NO.	DUE DATE	DELIVERABLE	PARTI-CIPANT	STUDY PLAN	REPORT	MAP	PDA DATA	TDIF DATA	MODEL	CONF PRESEN-TATION	JOUR PAPER	NO.
32212	Mar-93	Progress Report: VSP/Rock Characterization Integration	LBL		X							3GGF051
32212	Mar-93	Interim Report: Northern Crater Flat Mapping	USGS		X	X						3GGF200M
32212	Mar-93	Data Submittal PDA: Portal Map/Interpretation	USGS			X	X					3GGF006M
32212	Apr-93	Progress Report: VSP Computer Code Validation	LBL		X							3GGF052
32212	Apr-93	Preliminary Report: Development of Database	USGS		X							3GGF201M
32212	Apr-93	Interim Report/TDIF: Map NE Corner of the Site Area	USGS		X	X		X				3GGF186N
32212	May-93	Preliminary Report: Field VSP	LBL		X							3GGF050
32212	Sep-93	Interim Report: VSP Computer Code Validation	LBL		X			X				3GGF045M
32212	Sep-93	Report/TDIF: Progress on VSP Field Studies	LBL		X			X				3GGF042M
32212	Sep-93	Preliminary Map/TDIF: Western Yucca Mountain	USGS			X		X				3GGF20AM
32212	Sep-93	Report: Ghost Dance Fault	USGS		X							3GGF183M
32212	Sep-93	Preliminary Map/TDIF: NE Corner of the Site	USGS			X		X				3GGF186M
32212	Sep-93	Data Submittal PDA: Geologic Mapping	USGS			X	X					3GGF50M
32221	Sep-93	Data Report: Scoping Activities/Surface Transect Work	SNL		X							NA
32222	Sep-93	Report: Development of Simulation Software	SNL		X							NA
32511	Sep-93	Report: Revised Probability Calculations	LANL		X							MS 3252
32511	Sep-93	Report: Frequency and Occurrence of Quaternary Basaltic Centers in the Great Basin by Structure and Setting	LANL		X							MS 3238
32512	Sep-93	Progress Report: Effects of Volcanism	LANL		X							MS 3358
32512	Sep-93	Report: Consequences of Hydrovolcanic Activity for Performance Assessment	LANL		X							R481

TABLE 6-1A
Milestones and Deliverables for FY'93 by WBS No.

WBS NO.	DUE DATE	DELIVERABLE	PARTI-CIPANT	STUDY PLAN	REPORT	MAP	PDA DATA	TDIF DATA	MODEL	CONF PRESEN-TATION	JOUR PAPER	NO.
32532	Jun-93	Interim Status Report	USGS		X							3GTW010M
32532	Sep-93	Study Plan	USGS	X								3GTW009M
32551	Sep-93	Interim Report: Rock-Varnish Dating	LANL		X							NA
32551	Sep-93	Report: Geochemistry of Lathrop Wells Eruptive Sequence	LANL		X							MS 3129
32551	Sep-93	Preliminary Map: Basaltic Volcanic Centers	LANL			X						MS 3075
32552	Apr-93	Interim Report: Lab/Calibration	USGS		X							3GAT018M
32552	Jul-93	Data Submission PDA: Thermal Conductivity	USGS				X					3GAT015M
32552	Sep-93	Progress Report/TDIF: Field Measurements	USGS		X			X				3GAT013M
32621	May-93	Preliminary Data Report: North Ramp Design	USGS		X							3GSR006M
32621	Jul-93	Preliminary Data Report: NRG-4	USGS		X							3GSR007M
32621	Sep-93	Report/TDIF: North Ramp Geotechnical Investigations	USGS		X			X				3GSR005M
32622	Apr-93	Preliminary Report: NRG-6/NRG-2	USGS		X							3GSR002M
32622	Jun-93	Preliminary Report: NRG-5/NRG-3	USGS		X							3GSR001M
32622	Sep-93	Final Report/TDIF: Soil and Rock Testing - North Ramp	USGS		X			X				3GSR009M
32623	Mar-93	Preliminary Report: North Ramp Studies	USGS		X							3GSR028M
32623	Sep-93	Final Report: North Ramp Studies	USGS		X							3GSR031M
32831	Jun-93	Progress Report: Recommendations on Methods to Assess Earthquake Size for Seismic Sources	USGS		X							3GSS119M
32831	Sep-93	Progress Report: Identification of Relevant Earthquake Sources	USGS		X							3GSS101M
32833	Jul-93		aft Study Plan			USGS	X					
32834	May-93	Preliminary Ground-Motion Model	USGS						X			3GSG103M
32834	Sep-93	Preliminary Report: Local Site Effects Modeling	USGS		X				X			3GSG1A2M
32841	Dec-92	Report/TDIF: Initial Assessment of the Little Skull Mtn. Earthquake	USGS		X			X				3GSM146M
32841	May-93	Report: FY 92 Earthquake Catalog	USGS		X			X				3GSM140M

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WBS NO.	DUE DATE	DELIVERABLE	PARTI-CIPANT	STUDY PLAN	REPORT	MAP	PDA DATA	TDIF DATA	MODEL	CONF PRESEN-TATION	JOUR PAPER	NO.
32841	Jun-93	Progress Report: Historical Earthquake Records	USGS		X							3GSM105M
32841	Sep-93	Report/TDIF: Precarious Rock Methodology	USGS		X			X				3GSM100M
32841	Sep-93	Report/TDIF: Assessment of the Little Skull Mtn. Earthquake	USGS		X			X				3GSM149M
32842	Apr-93	Report/TDIF: Results of Logging from Trench 17	USGS		X			X				3GFP021M
32842	Jun-93	Report: Final Geologic Map of Midway Valley	USGS		X	X						3GFP004M
32842	Aug-93	Report/TDIF: Trench Log on A-3	USGS		X			X				3GFP011M
32842	Aug-93	Report/TDIF: Results of Trench Logging from the ESF Trench	USGS		X			X				3GFP008M
32842	Sep-93	Summary Report/TDIF: Geology and Faulting in Midway Valley	USGS		X			X				3GFP024M
32843	May-93	Report/TDIF: Evaluation of Beatty Scarp	USGS		X			X				3GTQ034M
32843	May-93	Report/TDIF: Preliminary Quaternary Fault Map	USGS		X			X				3GTQ035M
32843	Sep-93	Preliminary Report: Bare Mtn Fault and Trench Logs	USGS		X							3GTQ060M
32843	Sep-93	Report/TDIF: Evaluation of Faults SW of Yucca Mtn	USGS		X			X				3GTQ009M
32844	Apr-93	Interim Report: Rock Valley Fault System	USGS		X							3GTN014M
32844	Sep-93	Report/TDIF: Fault-Slip Analysis of the Rock Valley Fault System	USGS		X							3GTN013M
32845	Jun-93	Interim Report: Miocene / Paleozoic Contact in the Calico Hills	USGS		X			X				3GTD009M
32845	Jun-93	Interim Report: Extension in Miocene Rocks	USGS		X							3GTD005M
32845	Sep-93	Final Report/TDIF: Map of the Calico Hills	USGS		X			X				3GTD018M
32845	Sep-93	Map: Northern Bare Mountain	USGS			X						3GTD012M
32845	Sep-93	Progress Report: Age of Detachment Faults	USGS		X							3GTD006M

TABLE 6-1A
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WBS NO.	DUE DATE	DELIVERABLE	PARTI-CIPANT	STUDY PLAN	REPORT	MAP	PDA DATA	TDIF DATA	MODEL	CONF PRESEN-TATION	JOUR PAPER	NO.
32846	Jan-93	Interim Report: Quaternary Fault Studies in the Midway Valley Area	USGS		X							3GPF24M
32846	Jan-93	Report/TDIF: Excavated Trenches on the Solitario Canyon Fault	USGS		X			X				3GPF20M
32846	Mar-93	Report: Quaternary Fault Map	USGS		X							3GPF026M
32846	Apr-93	Report/TDIF: 14C/D Trench Studies on the Bow Ridge Fault	USGS		X			X				3GPF036M
32846	May-93	Report/TDIF: Trench Across Fault Splay of the Southern Windy Wash	USGS		X			X				3GPF035M
32846	Jul-93	Report/TDIF: Trenches on the Stagecoach Road Fault	USGS		X			X				3GPF21M
32846	Aug-93	Report/TDIF: Results of Geophysical Study across Windy Wash Fault	USGS		X			X				3GPF039M
32846	Sep-93	Report/TDIF: Scarp Degradation & Evolution - North Windy Wash Fault	USGS		X			X				3GPF034M
32846	Sep-93	Report/TDIF: Quaternary Activity on Paintbrush Canyon Faults at Busted Butte	USGS		X			X				3GPF19M
328410	Aug-93	Report/TDIF: GPS Summary- Changes in the Last 10 Years	USGS		X			X				3GTM025M
328410	Sep-93	Report/TDIF: Progress on Geodetic Leveling at Yucca Mountain	USGS		X			X				3GTM08JM
328410	Sep-93	Report/TDIF: Assessment of Surface Changes due to the Little Skull Earthquake	USGS		X			X				3GTM07JM
328412	Feb-93	Study Plan	USGS	X								3GTE074M
328412	Sep-93	Preliminary Report/TDIF: Tectonic Models	USGS		X			X	X			3GTE045M
328412	Sep-93	Map: Geology of the Death Valley Region	USGS			X						3GTE072M
3311[illegible]	Dec-92	Report Synoptic/Regional/Site Meteorological data for FY92 to PDA	USGS				X					3G[illegible]037M

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WBS NO.	DUE DATE	DELIVERABLE	PARTI-CIPANT	STUDY PLAN	REPORT	MAP	PDA DATA	TDIF DATA	MODEL	CONF PRESEN-TATION	JOUR PAPER	NO.
33111	Jun-93	Report Synoptic/Regional/Site Meteorological Data for FY92 to TDIF	USGS					X				3GMM038M
33111	Sep-93	Technical Report: Interpretative report of Synoptic/Regional/Site meteorological Data for FY92	USGS		X							
33112	Nov-92	Submit FY 92 Runoff Data to PDA	USGS				X					3GRS024M
33112	Jan-93	Report/TDIF: Streamflow and precipitation FY 83-85	USGS		X			X				3GRS030M
33112	Jun-93	Report/TDIF: Streamflow and Precipitation FY 86-91	USGS		X			X				3GRS031M
33112	Sep-93	Report/TDIF: Streamflow and Precipitation FY 92	USGS		X			X				3GRS025M
33113	Dec-92	Poster: Groundwater Recharge	USGS							X		3GRGO24M
33113	Apr-93	Report/TDIF: Existing Regional Water Level Data	USGS		X			X				3GRGO54M
33113	May-93	Interim Status Report	USGS		X							3GRG010M
33113	May-93	Interim Status Report	USGS		X							3GRG020M
33113	Sep-93	Submit FY93 Water level Data (Amargosa) to PDA	USGS				X					3GRGO68M
33113	Sep-93	Submit small diameter well data to PDA	USGS				X					3GRGO11M
33113	Sep-93	Streamflow Chaos Journal Article	USGS								X	3GRGO23M
33113	Sep-93	Report/TDIF: Areal Hydrochemistry of Franklin Lake Playa	USGS		X			X				3GRGO32M
33113	Sep-93	Submit Fortymile Wash Infiltration Test Data to PDA	USGS				X					3GRGO26M
33113	Sep-93	Report/TDIF: Fortymile Wash Recharge Data FY93	USGS		X			X				3GRGO21M
33114	May-93	Paper on Structural Flow-Path with Transport and Chemical	USGS							X		3GFH009M
33114	Sep-93	Application of GSIS to 3-D Ground Water Modeling	USGS						X			3GFH014M
33114	Sep-93	Paper on Model Units	USGS							X		3GFH022M
33121	Dec-92	Historical neutron Hole Data to PDA	USGS				X					3GUI400M
33121	May-93	Interim Status Report	USGS		X							3GUI630M
33121	May-93	Interim Status Report	USGS		X							3GUI300M

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Milestones and Deliverables for FY'93 by WBS No.

WBS NO.	DUE DATE	DELIVERABLE	PARTI-CIPANT	STUDY PLAN	REPORT	MAP	PDA DATA	TDIF DATA	MODEL	CONF PRESEN-TATION	JOUR PAPER	NO.
33121	May-93	Interim Status Report	USGS		X							3GUI010M
33121	Sep-93	Prototype Ponding/ SPRs/LPRs Study Data to PDA	USGS				X					3GUI640M
33121	Sep-93	Report, Historical Neutron Hole Data	USGS		X							3GUI050M
33121	Sep-93	OFR/TDIF, Infiltrometer Study: Development/Testing	USGS		X			X				3GUI636M
33121	Sep-93	Data, Preliminary Infiltration Runoff and Geohydrology/Surficial Map	USGS			X		X				
33122	Sep-93	Progress report on FY93 progress and available results (level 3 milestone 3356)	LANL		X							
33123	Dec-92	Report: Prototype Testing, Bergen Park	USGS		X							3GUP081M
33123	Dec-92	Report: 3-D Model	USGS		X				X			3GUP080M
33123	Feb-93	Submit Velocity Data to PDA	USGS									3GUP084M
33123	May-93	Interim status report	USGS		X							3GUP070M
33123	May-93	Interim status report	USGS		X							3GUP050M
33123	May-93	Interim status report	USGS									3GUP000M
33123	Jul-93	UZ-16 Air-K data	USGS					X				
33124	Apr-93	Journal Paper/TDIF: Detailed Moire	USGS					X			X	3GUSO15:M
33124	May-93	Interim status report	USGS		X							3GUS018M
33124	Jul-93	Analytical Report: Imbibition Experiments	USGS		X							3GUSO34M
33124	Sep-93	Status Report on Perched Water Test	USGS		X							3GUS012M
33124	Sep-93	Status Report on Excavation Effects Test	USGS		X							3GUS003M
33124	Sep-93	Status Report on Gas Sampling	USGS		X							3GUS403M
33124	Sep-93	Report on Borehole Packer System (SEAMIST)	USGS		X							3GUS411M
33124	Sep-93	OFR on Projection Moire	USGS		X							3GRGO24M
33124	Sep-93	Preliminary Report/TDIF: Borehole Instrumentation	USGS					X				3GUSO10M
33124	Sep-93	Submit Study Plan to the DOE-Percolation in the ESF	USGS	X	X					3GUS418M, 3GUS005M, 3GUS01		

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Milestones and Deliverables for FY'93 by WBS No.

WBS NO.	DUE DATE	DELIVERABLE	PARTI-CIPANT	STUDY PLAN	REPORT	MAP	PDA DATA	TDIF DATA	MODEL	CONF PRESEN-TATION	JOUR PAPER	NO.
33124	Sep-93	Write Technical procedures, Moire Fracture profiles, TDR, Resistivity,Data Acquisition System, Infiltrometer Design, Tracer Detection, Fracture, Air, permeability, rock stress and fracture deformation measurement, recognition of perched water in ESF, Samp	USGS						X			
33124	Sep-93	Develop hydrologic procedures for pertinent activities	USGS		X							
33126	May-93	Interim Status Report	USGS		X							3GGP01M
33126	Sep-93	Submit FY93 UZ Borehole Data to PDA	USGS				X					3GGP02M
33126	Sep-93	Submit Gas Sample Data to PDA	USGS				X					3GGP04M
33127	Nov-92	Submit UZ-1 Data to PDA	USGS				X					3GUH018M
33127	Mar-93	Interpretive Report/OFR: UZ-1 Gas and Water Vapor Data	USGS		X							3GUH015M
33127	Mar-93	Report/TDIF: 3H and 14C method development	USGS		X			X				3GUH036M
33127	Apr-93	Report: Effects of core sealing	USGS		X							3GUH035M
33127	May-93	Interim Status Report	USGS		X							3GUH009M
33127	May-93	Interim Status Report	USGS		X							3GUH029M
33127	Sep-93	WRIR/TDIF: Monitoring Gas Tracer	USGS		X			X				3GUH016M
33127	Sep-93	Submit UZ-1 Gas and Water Vapor Data to PDA	USGS				X					3GUH013M
33128	Dec-92	Report - Fracture roughness	LBL		X							
33128	Mar-93	Report - Semi-Analytical methods	LBL		X							
33128	Mar-93	Section of Percolation Test Report (for 8312242)	USGS		X							3GUF022M
33128	May-93	Interim Status Report	USGS		X							3GUF029M
33128	Sep-93	Status Report on Preliminary Modeling	USGS		X							3GUF021M
33129	Nov-92	Report: Moisture Flow	LBL		X							3GUM32M
33129	Dec-92	RWMNFC paper	LBL								X	3GUM25M
33129	Dec-92	Submit Revised Study Plan to DOE	USGS		X							3GUM015M
33129	Jan-93	Report: Grid Effect	LBL		X							3GUM20M
33129	Apr-93	Report: HLRWM paper	LBL		X					X		3GUM26M
33129	May-93	Interim Status Report	USGS		X							3GUM000M

TABLE 6-1A
Milestones and Deliverables for FY'93 by WBS No.

WBS NO.	DUE DATE	DELIVERABLE	PARTI-CIPANT	STUDY PLAN	REPORT	MAP	PDA DATA	TDIF DATA	MODEL	CONF PRESEN-TATION	JOUR. PAPER	NO.
33129	Sep-93	LBL Report: Tough Testing	LBL		X							3GUM12M
33129	Sep-93	Status Report on conceptual Models	USGS		X							3GUM002M
331210	Mar-93	OFR: Pore-Water Chemistry v. Pressure Data	USGS		X							3GUT052M
331210	Mar-93	Final Report for Prototype Testing	USGS		X							3GUTOO4M
331210	Jul-93	WRI Report/TDIF: Gaseous Tracers	USGS		X			X				3GUT016M
331210	Aug-93	Journal Paper; One-Dimensional Compression	USGS								X	3GUT053M
33131	Dec-92	Design memoranda for Five-Zone Packer String	USGS		X							3GWF007M
33131	Feb-93	Submit 1992 - Water-Level Data to PDA	USGS				X					3GWF002M
33131	Apr-93	Report/TDIF - Water-Level Data at Yucca Mt, 1990-91	USGS		X			X				3GWF064M
33131	Apr-93	Intraborehole Flow and Stress Test Report	USGS		X							3GWH010M
33131	May-93	Interim Status Report	USGS		X							3GWF168M
33131	May-93	Interim Status Report	USGS		X							3GWF001M
33131	May-93	Completion of Five-Zone Packer System	USGS		X							3GWF030M
33131	May-93	Interim Status Report	USGS		X							3GWF006M
33131	Sep-93	Report/TDIF: Well Test Fracture Network and Dual Porosity Analysis	USGS		X			X				3GWF004M
33131	Sep-93	Submit Strain-related C-Hole Data to PDA	USGS				X					3GWF008M
33131	Sep-93	Completion of Tracer Injection System	USGS		X							3GWF170M
33131	Sep-93	Report - Past Hydraulic Tests at C-Well Complex	USGS		X							
33131	Sep-93	Data - New Hydraulic Tests at C-Well Complex			USGS					X		
33132	May-93	Interim Status Report	USGS		X							3GWH002M
33132	May-93	Interim Status Report	USGS		X							3GWH000A
33132	May-93	Interim Status Report	USGS		X							3GWH900M
33132	Sep-93	Rpt/TDIF: Assessment of Site SZ Hydrochemical Data	USGS		X			X				3GW[illegible]O1M

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Milestones and Deliverables for FY'93 by WBS No.

WBS NO.	DUE DATE	DELIVERABLE	PARTI-CIPANT	STUDY PLAN	REPORT	MAP	PDA DATA	TDIF DATA	MODEL	CONF PRESEN-TATION	JOUR PAPER	NO.
33132	Sep-93	Submit Regional data, FY-93 to PDA	USGS				X					3GWH910M
33132	Sep-93	Submit hydrochemical data to PDA	USGS				X					3GWHOO4M
33133	Dec-92	Report - Revised potentiometric-surface map of Yucca Mt (USGS)	USGS		X	X						3GWM06M
33133	May-93	Interim Status Report	USGS		X							3GWM004M
33133	May-93	Interim Status Report	USGS		X							3GWM000M
33133	Jun-93	Report/TDIF: Crater Flat Tuff Fracture Mapping	USGS		X	X		X				3GWM013M
33133	Jun-93	Report/TDIF: Crater Flat tuff fracture mapping	USGS		X	X		X				3GWM013M
33133	Sep-93	Trinet fracture network model users manual	LBL		X				X			3GWM21CM
33133	Sep-93	Report on outcrop fracture data bias	LBL		X							3GWM18CM
33133	Sep-93	Input to multiwell test design	LBL					X				3GWM23CM
33133	Sep-93	Status Report: conceptual Model Fracture Network	USGS		X				X			3GWM005M
33133	Sep-93	Submit outcrop properties data to PDA	USGS				X					3GWM10M
3411	Sep-93	Report: Water Chemistry	LANL		X							MS2:M374
3411	Sep-93	Report: Sensitivity Analyses for Ground water Chemistry Model	LANL		X				X			MS3:R704
3411	Sep-93	Report: Modeling and Experimental Results of Saturated and Unsaturated Zone Water Chemistry	LANL		X				X			MS2:T534
34121	Jun-93	Report: Neptunium Sorption onto Feldspars	LANL		X							MS 3345
34121	Sep-93	Report: Summary of results of sorption experiments at higher temperatures	LANL		X							MS 3346
34121	Sep-93	Report : Effects of Water/ Rock Ratios on Sorption Coefficients	LANL		X							MS 3218
34122	Sep-93	Report: Microbial and Colloid transport Models	LANL		X							MS2:T537
34123	Sep-93	AFM Analysis of Hematite and Geothite	LANL		X							

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Milestones and Deliverables for FY'93 by WBS No.

WBS NO.	DUE DATE	DELIVERABLE	PARTI-CIPANT	STUDY PLAN	REPORT	MAP	PDA DATA	TDIF DATA	MODEL	CONF PRESEN-TATION	JOUR PAPER	NO.
34123		Final Report on Sorption	LANL		X							MS 376
34131	Jan-93	Report:Development of PTS	LANL		X							MS 3330
34131	Sep-93	NMR analyses of Np(v) and Pu(v) Carbonate Systems	LANL		X							MS 3351
34131	Sep-93	Speciation Measurements	LANL		X							
34131	Sep-93	Report on comparison of solubilities of NP, Am, Pu in J-13 and P-1 waters	LANL		X							MS 3344
34131	Sep-93	PAS analyses of Pu (IV) Carbonate Speciation	LANL		X							MS 3350
34132	Jan-93	Development of PTS	LANL		X							MS 3330
34132	Apr-93	Presentation of paper at HLW conference	LANL							X		
34132	Sep-93	Report on comparison of solubilities of NP, Am, Pu in J-13 and P-1 waters	LANL		X							MS 3344
34132	Sep-93	NMR analyses of Np(v) and Pu(v) Carbonate Systems	LANL		X							MS 3351
34132	Sep-93	PAS analyses of Pu (IV) Carbonate Speciation	LANL		X							MS 3350
34141	Sep-93	Summary Report: Np Transport in Tuffs	LANL		X							MS 3349
34141	Sep-93	Colloid Workshop Report	LANL		X							MS 3348
34142	Apr-93	Presentation at HLW Conference	LANL							X		
34142	Sep-93	Report: Techniques to study diffusion in saturated tuff	LANL		X							
34151	Nov-92	Baseline documentation for TRACRN	LANL		X							MS 3052
34151	Sep-93	Interim report , Update of Geophysical/Geochemical Model	LANL		X							
36211	Jan-93	Study Plan Submitted	USGS	X								3GCR005M
36211	Jan-93	Study Plan Submitted	USGS	X								3GCR005M
36211	Sep-93	Interim Report/TDIF	USGS		X							3GCR0014M
36211	Sep-93	Interim Report/TDIF	USGS		X			X				3GCR0014M
36212	Dec-92	TDIF: Cores and Samples, Lakes/Playas/Marshes	USGS					X				3GCL012M
36212	Dec-92	TDIF: Cores and Samples, Lakes/Playas/Marshes	USGS					X				3GCL012M

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Milestones and Deliverables for FY'93 by WBS No.

WBS NO.	DUE DATE	DELIVERABLE	PARTI-CIPANT	STUDY PLAN	REPORT	MAP	PDA DATA	TDIF DATA	MODEL	CONF PRESEN-TATION	JOUR PAPER	NO.
36212	Apr-93	Interim Assessment: Stratigraphic analysis	USGS		X							3GCL016M
36212	Apr-93	Interim Assessment: Stratigraphiuc analysis	USGS		X							3GCL016M
36212	Sep-93	Interim Rept/TDIF: Isotopic Analysis	USGS		X							3GCL019M
36212	Sep-93	Status Rept: Past Climate and Hydrological Reconstruction)	USGS		X							3GCL018M
36212	Sep-93	Interim Rept/TDIF: Isotopic Analysis	USGS		X			X				3GCL019M
36212	Sep-93	Interim Assessment: Paleontological Prep/Assessment	USGS		X							3GCL014M
36212	Sep-93	Interim Assessment: Paleotological Prep/Assessment	USGS		X							3GCL014M
36212	Sep-93	Status Rept: Past Cklimate and Hydrological Reconstsruction	USGS		X							3GCL018M
36212	Sep-93	Interim PRept/TDIF: Usotopic Analysis	USGS		X			X				3GCL019M
36212	Sep-93	Interim REpt/TDIF: Isotopic Analysis	USGS		X			X				3GCL019M
36213	Feb-92	Rept/TDIF: QA Evaluation	USGS		X			X				3GCL104M
36213	Apr-93	Status Rept/TDIF: DRI Status	USGS		X			X				3GCL110M
36213	Apr-93	Status Rept/TDIF: DRI Status	USGS		X			X				3GCL110M
36213	Jul-93	Status Rept/TDIF: DRI Status	USGS		X			X				3GCL111M
36213	Jul-93	Status Rept/TDIF: DRI Status	USGS		X			X				3GCL111M
36213	Sep-93	Status Rept/TDIF: C-14 Analysis	USGS		X			X				3GCL109M
36213	Sep-93	Status Rept/TDIF: C-14 Analysis	USGS		X			X				3GCL109M
36214	Jan-93	Rept./TDIF: FY'93 Study	USGS		X			X				3GCH039M
36214	Apr-93	Draft Rept./TDIF: Northern 1/3 of YM	USGS		X			X				3GCH035M
36214	Jul-93	Draft Rept./TDIF: Central 1/3 of YM		USGS		X			X			
36214	Sep-93	Final Rept./TDIF: Digitized Map, Northern 1/3 of YM	USGS		X			X				3GCH036M
36216	Apr-93	Transition Plan submitted to and approaved by YMPO	SNL		X							
36216	Jun-93	Syudy Plan submitted to and approved by YMPO	SNL	X								

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Milestones and Deliverables for FY'93 by WBS No.

WBS NO.	DUE DATE	DELIVERABLE	PARTI-CIPANT	STUDY PLAN	REPORT	MAP	PDA DATA	TDIF DATA	MODEL	CONF PRESEN-TATION	JOUR PAPER	NO.
36216	Sep-93	Revision of global climate modeling activity	PNL		X				X			
36216	Sep-93	Transfer of all study products,as specified in transition plan	PNL		X							
36221	Dec-92	Report/TDIF: Isotopic Studies/ Paleohydrology	USGS		X			X				3GQH22M
36221	Dec-92	Report/TDIF: Evidence for complex groundwater	USGS		X			X				3GQH10M
36221	Dec-92	Report/TDIF: Rediogenic Tracer Isotopes	USGS		X			X				3GQH10M
36221	Dec-92	Report/TDIF: Uranium Ratios	USGS		X			X				3GQH08M
36221	Dec-92	Report/TDIF: Evidence for Higher Water table	USGS		X			X				3GQH09M
36221	Jan-93	TDIF: Cores and Samples	USGS					X				3GQH01M
36221	Feb-93	RPT/TDIF: Meteorolgical Data FY91-92	USGS		X			X				3GQH001M
36221	Mar-93	Report/EDIF: methods of Channel Geometry	USGS		X			X				3GQH11M
36221	Apr-93	TDIF: Specimen Descriptions	USGS					X				3GQH04M
36221	Apr-93	Status Report/TDIF: Isotopic Composition/ Fluid Inclusion	USGS		X			X				3GQH06M
36221	Apr-93	TDIF: Cores and Samples	USGS					X				3GQH02M
36221	Apr-93	Report/TDIF: Hydrologic Data remote site FY92	USGS		X							3GQH12CM
36221	May-93	Interim Status Report	USGS		X							3GQH000M
36221	May-93	Interim Status Report	USGS		X							3GQH002M
36221	May-93	Interim Status report	USGS		X							3GQH015M
36221	May-93	Interim Status Report	USGS		X							3GOH10CM
36221	Jul-93	TDIF: Cores and Samples	USGS					X				3GQH03M
36221	Jul-93	TDIF: Specimen Descriptions	USGS					X				3GQH05M
36221	Sep-93	Report: Preliminary Summary of Paleoflood Studies	USGS		X							3GQH010M
36221	Sep-93	Submit Data to PDA	USGS				X					3GQH005M
36221	Sep-93	Report/TDIF: Origin or Surface Depostis	USGS		X			X				3GQH019M
36221	Sep-93	Submit Watershed/meteorolgical Data to PDA	USGS				X					3GQH003M
36221	Sep-93	RPT/TDIF: 36Cl Ages of Soil 1993	USGS		X			X				3GQH007M

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Milestones and Deliverables for FY'93 by WBS No.

WBS NO.	DUE DATE	DELIVERABLE	PARTI-CIPANT	STUDY PLAN	REPORT	MAP	PDA DATA	TDIF DATA	MODEL	CONF PRESEN-TATION	JOUR PAPER	NO.
36221	Sep-93	Submit Water Chemistry/Lithologic Data to PDA	USGS				X					3GOH025M
36221	Sep-93	Submit Faunal, Water, soil and outcrop Data to PDA	USGS				X					3GQH021M

TABLE 6-1B
Milestones and Deliverables for FY'93 by Date

WBS NO.	DUE DATE	DELIVERABLE	CIPANT	PLAN	REPORT	MAP	PDA DATA	DATA	MODEL	TATION	PAPER	NO.
32212	Sep-92	Progress Report: VSP	LBL		X							3GGF035M
33112	Nov-92	Submit FY 92 Runoff Data to PDA	USGS				X					3GRS024M
33127	Nov-92	Submit UZ-1 Data to PDA	USGS				X					3GUH018M
33129	Nov-92	Report: Moisture Flow	LBL		X							3GUM32M
34151	Nov-92	Baseline documentation for TRACRN	LANL		X							MS 3052
32212	Dec-92	Revised Study Plan	USGS	X								3GGF005M
32841	Dec-92	Report/TDIF: Initial Assessment of the Little Skull Mtn. Earthquake	USGS		X			X				3GSM146M
33111	Dec-92	Report Synoptic/Regional/Site Meteorological data for FY92 to PDA	USGS				X					3GMM037M
33113	Dec-92	Poster: Groundwater Recharge	USGS							X		3GRGO24M
33121	Dec-92	Historical neutron Hole Data to PDA	USGS				X					3GUI400M
33123	Dec-92	Report: Prototype Testing, Bergen Park	USGS		X							3GUP081M
33123	Dec-92	Report: 3-D Model	USGS		X				X			3GUP080M
33128	Dec-92	Report - Fracture roughness	LBL		X							
33129	Dec-92	RWMNFC paper	LBL								X	3GUM25M
33129	Dec-92	Submit Revised Study Plan to DOE	USGS		X							3GUM015M
33131	Dec-92	Design memoranda for Five-Zone Packer String	USGS		X							3GWF007M
33133	Dec-92	Report - Revised potentiometric-surface map of Yucca Mt (USGS)	USGS		X	X						3GWM06M
36212	Dec-92	TDIF: Cores and Samples, Lakes/Playas/Marshes	USGS					X				3GCL012M
36212	Dec-92	TDIF: Cores and Samples, Lakes/Playas/Marshes	USGS					X				3GCL012M
36221	Dec-92	Report/TDIF: Isotopic Studies/ Paleohydrology	USGS		X			X				3GQH22M
36221	Dec-92	Report/TDIF: Evidence for complex groundwater	USGS		X			X				3GQH10M
36221	Dec-92	Report/TDIF: Rediogenic Tracer Isotopes	USGS		X			X				3GQH10M
36221	Dec-92	Report/TDIF: Uranium Ratios	USGS		X			X				3GQH08M
36221	Dec-92	Report/TDIF: Evidence for Higher Water table	USGS		X			X				3GQH09M
32212	Jan-93	Map: Tiva Canyon	USGS			X		X				3GGF100M

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Milestones and Deliverables for FY'93 by Date

WBS NO.	DUE DATE	DELIVERABLE	CIPANT	PLAN	REPORT	MAP	PDA DATA	DATA	MODEL	TATION	PAPER	NO.
32846	Jan-93	Interim Report: Quaternary Fault Studies in the Midway Valley Area	USGS		X							3GPF24M
32846	Jan-93	Report/TDIF: Excavated Trenches on the Solitario Canyon Fault	USGS		X			X				3GPF20M
33112	Jan-93	Report/TDIF: Streamflow and precipitation FY 83-85	USGS		X			X				3GRS030M
33129	Jan-93	Report: Grid Effect	LBL		X							3GUM20M
36211	Jan-93	Study Plan Submitted	USGS	X								3GCR005M
36211	Jan-93	Study Plan Submitted	USGS	X								3GCR005M
36214	Jan-93	Rept./TDIF: FY'93 Study	USGS		X			X				3GCH039M
36221	Jan-93	TDIF: Cores and Samples	USGS					X				3GQH01M
34131	Jan-93	Report:Development of PTS	LANL		X							MS 3330
34132	Jan-93	Development of PTS	LANL		X							MS 3330
33123	Feb-93	Submit Velocity Data to PDA	USGS									3GUP084M
33131	Feb-93	Submit 1992 - Water-Level Data to PDA	USGS				X					3GWF002M
36213	Feb-93	Rept/TDIF: QA Evaluation	USGS		X			X				3GCL104M
36221	Feb-93	RPT/TDIF: Meteorolgical Data FY91-92	USGS		X			X				3GQH001M
328412	Feb-93	Study Plan	USGS	X								3GTE074M
32112	Mar-93	Independent Methods for Dating Zeolites	LANL		X							MS 3343
32212	Mar-93	Progress Report: VSP/Rock Characterization Integration	LBL		X							3GGF051
32212	Mar-93	Interim Report: Northern Crater Flat Mapping	USGS		X	X						3GGF200M
32212	Mar-93	Data Submittal PDA: Portal Map/Interpretation	USGS			X	X					3GGF006M
32623	Mar-93	Preliminary Report: North Ramp Studies	USGS		X							3GSR028M
32846	Mar-93	Report: Quaternary Fault Map	USGS		X							3GPF026M
33127	Mar-93	Interpretive Report/OFR: UZ-1 Gas and Water Vapor Data	USGS		X							3GUH015M
33127	Mar-93	Report/TDIF: 3H and 14C method development	USGS		X			X				3GUH036M
33128	Mar-93	Report - Semi-Analytical methods	LBL		X							
33128	Mar-93	Section of Percolation Test Report (for 8312242)	USGS		X							3GUF022M

TABLE 6-1B
Milestones and Deliverables for FY'93 by Date

WBS NO.	DUE DATE	DELIVERABLE	CIPANT	PLAN	REPORT	MAP	PDA DATA	DATA	MODEL	TATION	PAPER	NO.
36221	Mar-93	Report/EDIF: methods of Channel Geometry	USGS		X			X				3GQH11M
331210	Mar-93	OFR: Pore-Water Chemistry v. Pressure Data	USGS		X							3GUT052M
331210	Mar-93	Final Report for Prototype Testing	USGS		X							3GUTOO4M
32111	Apr-93	Status of Work on Calcite Precipitation Model	LANL							X		
32211	Apr-93	Report/TDIF: Preliminary Data for Yucca Wash	USGS		X			X				3GGU253M
32211	Apr-93	Preliminary Report/TDIF: Lithologies of Completed Boreholes	USGS		X			X				3GGU11AM
32211	Apr-93	Preliminary Report/TDIF: Isotopic Data	USGS		X							3GGU21M
32211	Apr-93	Preliminary Report/TDIF: Log and Core Data from Borehole Geophysical Surveys	USGS		X			X				3GGU394M
32211	Apr-93	Report/TDIF: Evaluation of Stratigraphic Model of Central Block	USGS		X				X			3GGU400M
32212	Apr-93	Progress Report: VSP Computer Code Validation	LBL		X							3GGF052
32212	Apr-93	Preliminary Report: Development of Database	USGS		X							3GGF201M
32212	Apr-93	Interim Report/TDIF: Map NE Corner of the Site Area	USGS		X	X		X				3GGF186N
32552	Apr-93	Interim Report: Lab/Calibration	USGS		X							3GAT018M
32622	Apr-93	Preliminary Report: NRG-6/NRG-2	USGS		X							3GSR002M
32842	Apr-93	Report/TDIF: Results of Logging from Trench 17	USGS		X			X				3GFP021M
32844	Apr-93	Interim Report: Rock Valley Fault System	USGS		X							3GTN014M
32846	Apr-93	Report/TDIF: 14C/D Trench Studies on the Bow Ridge Fault	USGS		X			X				3GPF036M
33113	Apr-93	Report/TDIF: Existing Regional Water Level Data	USGS		X			X				3GRGO54M
33124	Apr-93	Journal Paper/TDIF: Detailed Moire	USGS					X			X	3GUSO15:M
33127	Apr-93	Report: Effects of core sealing	USGS		X							3GUH035M
33129	Apr-93	Report: HLRWM paper	LBL		X					X		3GUM26M
33131	Apr-93	Report/TDIF - Water-Level Data at Yucca Mt, 1990-91	USGS		X			X				3GWF064M

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Milestones and Deliverables for FY'93 by Date

WBS NO.	DUE DATE	DELIVERABLE	CIPANT	PLAN	REPORT	MAP	PDA DATA	DATA	MODEL	TATION	PAPER	NO.
33131	Apr-93	Intraborehole Flow and Stress Test Report	USGS		X							3GWH010M
34132	Apr-93	Presentation of paper at HLW conference	LANL							X		
34142	Apr-93	Presentation at HLW Conference	LANL							X		
36212	Apr-93	Interim Assessment: Stratigraphic analysis	USGS		X							3GCL016M
36212	Apr-93	Interim Assessment: Stratigraphiuc analysis	USGS		X							3GCL016M
36213	Apr-93	Status Rept/TDIF: DRI Status	USGS		X			X				3GCL110M
36213	Apr-93	Status Rept/TDIF: DRI Status	USGS		X			X				3GCL110M
36214	Apr-93	Draft Rept./TDIF: Northern 1/3 of YM	USGS		X			X				3GCH035M
36216	Apr-93	Transition Plan submitted to and approaved by YMPO	SNL		X							
36221	Apr-93	TDIF: Specimen Descriptions	USGS					X				3GQH04M
36221	Apr-93	Status Report/TDIF: Isotopic Composition/ Fluid Inclusion	USGS		X			X				3GQH06M
36221	Apr-93	TDIF: Cores and Samples	USGS					X				3GQH02M
36221	Apr-93	Report/TDIF: Hydrologic Data remote site FY92	USGS		X							3GQH12CM
32212	May-93	Preliminary Report: Field VSP	LBL		X							3GGF050
32621	May-93	Preliminary Data Report: North Ramp Design	USGS		X							3GSR006M
32834	May-93	Preliminary Ground-Motion Model	USGS						X			3GSG103M
32841	May-93	Report: FY 92 Earthquake Catalog	USGS		X			X				3GSM140M
32843	May-93	Report/TDIF: Evaluation of Beatty Scarp	USGS		X			X				3GTQ034M
32843	May-93	Report/TDIF: Preliminary Quaternary Fault Map	USGS		X			X				3GTQ035M
32846	May-93	Report/TDIF: Trench Across Fault Splay of the Southern Windy Wash	USGS		X			X				3GPF035M
33113	May-93	Interim Status Report	USGS		X							3GRG010M
33113	May-93	Interim Status Report	USGS		X							3GRG020M
33114	May-93	Paper on Structural Flow-Path with Transport and Chemical	USGS							X		3GFH009M
33121	May-93	Interim Status Report	USGS		X							3GUI630M
33121	May-93	Interim Status Report	USGS		X							3GUI300M
33121	May-93	Interim Status Report	USGS		X							3GUI010M
33123	May-93	Interim status report	USGS		X							3GUP070M

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Milestones and Deliverables for FY'93 by Date

WBS NO.	DUE DATE	DELIVERABLE	CIPANT	PLAN	REPORT	MAP	PDA DATA	DATA	MODEL	TATION	PAPER	NO.
33123	May-93	Interim status report	USGS		X							3GUP050M
33123	May-93	Interim status report	USGS									3GUP000M
33124	May-93	Interim status report	USGS		X							3GUS018M
33126	May-93	Interim Status Report	USGS		X							3GGP01M
33127	May-93	Interim Status Report	USGS		X							3GUH009M
33127	May-93	Interim Status Report	USGS		X							3GUH029M
33128	May-93	Interim Status Report	USGS		X							3GUF029M
33129	May-93	Interim Status Report	USGS		X							3GUM000M
33131	May-93	Interim Status Report	USGS		X							3GWF168M
33131	May-93	Interim Status Report	USGS		X							3GWF001M
33131	May-93	Completion of Five-Zone Packer System	USGS		X							3GWF030M
33131	May-93	Interim Status Report	USGS		X							3GWF006M
33132	May-93	Interim Status Report	USGS		X							3GWH002M
33132	May-93	Interim Status Report	USGS		X							3GWH000A
33132	May-93	Interim Status Report	USGS		X							3GWH900M
33133	May-93	Interim Status Report	USGS		X							3GWM004M
33133	May-93	Interim Status Report	USGS		X							3GWM000M
36221	May-93	Interim Status Report	USGS		X							3GQH000M
36221	May-93	Interim Status Report	USGS		X							3GQH002M
36221	May-93	Interim Status report	USGS		X							3GQH015M
36221	May-93	Interim Status Report	USGS		X							3GOH10CM
32211	Jun-93	Report/TDIF: Map of Yucca Wash	USGS		X			X				3GGU51AM
32211	Jun-93	Report/TDIF: Preliminary Data from Seismic Line	USGS		X			X				3GGU256M
32532	Jun-93	Interim Status Report	USGS		X							3GTW010M
32622	Jun-93	Preliminary Report: NRG-5/NRG-3	USGS		X							3GSR001M
32831	Jun-93	Progress Report: Recommendations on Methods to Assess Earthquake Size for Seismic Sources	USGS		X							3GSS119M
32841	Jun-93	Progress Report: Historical Earthquake Records	USGS		X							3GSM105M
32842	Jun-93	Report: Final Geologic Map of Midway Valley	USGS		X	X						3GFP004M
32845	Jun-93	Interim Report: Miocene / Paleozoic Contact in the Calico Hills	USGS		X			X				3GTD009M
32845	Jun-93	Interim Report: Extension in Miocene Rocks	USGS		X							3GTD005M

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Milestones and Deliverables for FY'93 by Date

WBS NO.	DUE DATE	DELIVERABLE	CIPANT	PLAN	REPORT	MAP	PDA DATA	DATA	MODEL	TATION	PAPER	NO.
33111	Jun-93	Report Synoptic/Regional/Site Meteorological Data for FY92 to TDIF	USGS					X				3GMM038M
33112	Jun-93	Report/TDIF: Streamflow and Precipitation FY 86-91	USGS		X			X				3GRS031M
33133	Jun-93	Report/TDIF: Crater Flat Tuff Fracture Mapping	USGS		X	X		X				3GWM013M
33133	Jun-93	Report/TDIF: Crater Flat tuff fracture mapping	USGS		X	X		X				3GWM013M
34121	Jun-93	Report: Neptunium Sorption onto Feldspars	LANL		X							MS 3345
36216	Jun-93	Syudy Plan submitted to and approved by YMPO	SNL	X								
32552	Jul-93	Data Submission PDA: Thermal Conductivity	USGS				X					3GAT015M
32621	Jul-93	Preliminary Data Report: NRG-4	USGS		X							3GSR007M
32833	Jul-93		aft Study Plan			USGS	X					
32846	Jul-93	Report/TDIF: Trenches on the Stagecoach Road Fault	USGS		X			X				3GPF21M
33123	Jul-93	UZ-16 Air-K data	USGS					X				
33124	Jul-93	Analytical Report: Imbibition Experiments	USGS		X							3GUSO34M
36213	Jul-93	Status Rept/TDIF: DRI Status	USGS		X			X				3GCL111M
36213	Jul-93	Status Rept/TDIF: DRI Status	USGS		X			X				3GCL111M
36214	Jul-93	Draft Rept./TDIF: Central 1/3 of YM		USGS		X			X			
36221	Jul-93	TDIF: Cores and Samples	USGS					X				3GQH03M
36221	Jul-93	TDIF: Specimen Descriptions	USGS					X				3GQH05M
331210	Jul-93	WRI Report/TDIF: Gaseous Tracers	USGS		X			X				3GUT016M
32842	Aug-93	Report/TDIF: Trench Log on A-3	USGS		X			X				3GFP011M
32842	Aug-93	Report/TDIF: Results of Trench Logging from the ESF Trench	USGS		X			X				3GFP008M
32846	Aug-93	Report/TDIF: Results of Geophysical Study across Windy Wash Fault	USGS		X			X				3GPF039M
328410	Aug-93	Report/TDIF: GPS Summary- Changes in the Last 10 Years	USGS		X			X				3GTM025M
331210	Aug-93	Journal Paper; One-Dimensional Compression	USGS								X	3GUT053M
3411	Sep-93	Report: Water Chemistry	LANL		X							MS2:M374

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Milestones and Deliverables for FY'93 by Date

WBS NO.	DUE DATE	DELIVERABLE	CIPANT	PLAN	REPORT	MAP	PDA DATA	DATA	MODEL	TATION	PAPER	NO.
3411	Sep-93	Report: Sensitivity Analyses for Ground water Chemistry Model	LANL		X				X			MS3:R704
3411	Sep-93	Report: Modeling and Experimental Results of Saturated and Unsaturated Zone Water Chemistry	LANL		X				X			MS2:T534
32122	Sep-93	Revised Study Plan	LANL	X								
32211	Sep-93	Report/TDIF: Results from Gravity and Magnetic Surveys	USGS		X			X				3GGU02AM
32211	Sep-93	Progress Report/TDIF: Analytical Database	USGS		X			X				3GGU021M
32211	Sep-93	Report/TDIF: Yucca Wash	USGS		X			X				3GGU25AM
32211	Sep-93	TDIF: Borehole Data to Technical Database	USGS					X				3GGU395M
32211	Sep-93	Preliminary Report/TDIF: Lithologic Logs	USGS		X			X				3GGU30AB
32211	Sep-93	TDIF: Magnetometer Results- UZ-16	USGS					X				3GGU371M
32211	Sep-93	Report/TDIF: Seismic Surveys	USGS		X			X				3GGU267M
32211	Sep-93	Progress Report/TDIF: Borehole Computations	USGS		X			X				3GGU396M
32212	Sep-93	Interim Report: VSP Computer Code Validation	LBL		X			X				3GGF045M
32212	Sep-93	Report/TDIF: Progress on VSP Field Studies	LBL		X			X				3GGF042M
32212	Sep-93	Preliminary Map/TDIF: Western Yucca Mountain	USGS			X		X				3GGF20AM
32212	Sep-93	Report: Ghost Dance Fault	USGS		X							3GGF183M
32212	Sep-93	Preliminary Map/TDIF: NE Corner of the Site	USGS			X		X				3GGF186M
32212	Sep-93	Data Submittal PDA: Geologic Mapping	USGS			X	X					3GGF50M
32221	Sep-93	Data Report: Scoping Activities/Surface Transect Work	SNL		X							NA
32222	Sep-93	Report: Development of Simulation Software	SNL		X							NA
32511	Sep-93	Report: Revised Probability Calculations	LANL		X							MS 3252

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Milestones and Deliverables for FY'93 by Date

WBS NO.	DUE DATE	DELIVERABLE	CIPANT	PLAN	REPORT	MAP	PDA DATA	DATA	MODEL	TATION	PAPER	NO.
32511	Sep-93	Report: Frequency and Occurrence of Quaternary Basaltic Centers in the Great Basin by Structure and Setting	LANL		X							MS 3238
32512	Sep-93	Progress Report: Effects of Volcanism	LANL		X							MS 3358
32512	Sep-93	Report: Consequences of Hydrovolcanic Activity for Performance Assessment	LANL		X							R481
32532	Sep-93	Study Plan	USGS	X								3GTW009M
32551	Sep-93	Interim Report: Rock-Varnish Dating	LANL		X							NA
32551	Sep-93	Report: Geochemistry of Lathrop Wells Eruptive Sequence	LANL		X							MS 3129
32551	Sep-93	Preliminary Map: Basaltic Volcanic Centers	LANL			X						MS 3075
32552	Sep-93	Progress Report/TDIF: Field Measurements	USGS		X			X				3GAT013M
32621	Sep-93	Report/TDIF: North Ramp Geotechnical Investigations	USGS		X			X				3GSR005M
32622	Sep-93	Final Report/TDIF: Soil and Rock Testing - North Ramp	USGS		X			X				3GSR009M
32623	Sep-93	Final Report: North Ramp Studies	USGS		X							3GSR031M
32831	Sep-93	Progress Report: Identification of Relevant Earthquake Sources	USGS		X							3GSS101M
32834	Sep-93	Preliminary Report: Local Site Effects Modeling	USGS		X				X			3GSG1A2M
32841	Sep-93	Report/TDIF: Precarious Rock Methodology	USGS		X			X				3GSM100M
32841	Sep-93	Report/TDIF: Assessment of the Little Skull Mtn. Earthquake	USGS		X			X				3GSM149M
32842	Sep-93	Summary Report/TDIF: Geology and Faulting in Midway Valley	USGS		X			X				3GFP024M
32843	Sep-93	Preliminary Report: Bare Mtn Fault and Trench Logs	USGS		X							3GTQ060M
32843	Sep-93	Report/TDIF: Evaluation of Faults SW of Yucca Mtn	USGS		X			X				3GTQ009M
32844	Sep-93	Report/TDIF: Fault-Slip Analysis of the Rock Valley Fault System	USGS		X							3GTN013M
32845	Sep-93	Final Report/TDIF: Map of the Calico Hills	USGS		X			X				3GTD018M

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Milestones and Deliverables for FY'93 by Date

WBS NO.	DUE DATE	DELIVERABLE	CIPANT	PLAN	REPORT	MAP	PDA DATA	DATA	MODEL	TATION	PAPER	NO.
32845	Sep-93	Map: Northern Bare Mountain	USGS			X						3GTD012M
32845	Sep-93	Progress Report: Age of Detachment Faults	USGS		X							3GTD006M
32846	Sep-93	Report/TDIF: Scarp Degradation & Evolution - North Windy Wash Fault	USGS		X			X				3GPF034M
32846	Sep-93	Report/TDIF: Quaternary Activity on Paintbrush Canyon Faults at Busted Butte	USGS		X			X				3GPF19M
33111	Sep-93	Technical Report: Interpretative report of Synoptic/Regional/Site meteorological Data for FY92	USGS		X							
33112	Sep-93	Report/TDIF: Streamflow and Precipitation FY 92	USGS		X			X				3GRS025M
33113	Sep-93	Submit FY93 Water level Data (Amargosa) to PDA	USGS				X					3GRGO68M
33113	Sep-93	Submit small diameter well data to PDA	USGS				X					3GRGO11M
33113	Sep-93	Streamflow Chaos Journal Article	USGS								X	3GRGO23M
33113	Sep-93	Report/TDIF: Areal Hydrochemistry of Franklin Lake Playa	USGS		X			X				3GRGO32M
33113	Sep-93	Submit Fortymile Wash Infiltration Test Data to PDA	USGS				X					3GRGO26M
33113	Sep-93	Report/TDIF: Fortymile Wash Recharge Data FY93	USGS		X			X				3GRGO21M
33114	Sep-93	Application of GSIS to 3-D Ground Water Modeling	USGS						X			3GFH014M
33114	Sep-93	Paper on Model Units	USGS							X		3GFH022M
33121	Sep-93	Prototype Ponding/ SPRs/LPRs Study Data to PDA	USGS				X					3GUI640M
33121	Sep-93	Report, Historical Neutron Hole Data	USGS		X							3GUI050M
33121	Sep-93	OFR/TDIF, Infiltrometer Study: Development/Testing	USGS		X			X				3GUI636M
33121	Sep-93	Data, Preliminary Infiltration Runoff and Geohydrology/Surficial Map	USGS			X		X				
331[illegible]	Sep-93	Progress report on FY93 progress and available results (level 3 milestone 3356)	LANL									

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Milestones and Deliverables for FY'93 by Date

WBS NO.	DUE DATE	DELIVERABLE	CIPANT	PLAN	REPORT	MAP	PDA DATA	DATA	MODEL	TATION	PAPER	NO.
33124	Sep-93	Status Report on Perched Water Test	USGS		X							3GUS012M
33124	Sep-93	Status Report on Excavation Effects Test	USGS		X							3GUS003M
33124	Sep-93	Status Report on Gas Sampling	USGS		X							3GUS403M
33124	Sep-93	Report on Borehole Packer System (SEAMIST)	USGS		X							3GUS411M
33124	Sep-93	OFR on Projection Moire	USGS		X							3GRGO24M
33124	Sep-93	Preliminary Report/TDIF: Borehole Instrumentation	USGS					X				3GUSO10M
33124	Sep-93	Submit Study Plan to the DOE-Percolation in the ESF	USGS	X	X					3GUS418M, 3GUS005M, 3GUS01		
33124	Sep-93	Write Technical procedures, Moire Fracture profiles, TDR, Resistivity,Data Acquisition System, Infiltrometer Design, Tracer Detection, Fracture, Air, permeability, rock stress and fracture deformation measurement, recognition of perched water in ESF, Samp	USGS						X			
33124	Sep-93	Develop hydrologic procedures for pertinent activities	USGS		X							
33126	Sep-93	Submit FY93 UZ Borehole Data to PDA	USGS				X					3GGP02M
33126	Sep-93	Submit Gas Sample Data to PDA	USGS				X					3GGP04M
33127	Sep-93	WRIR/TDIF: Monitoring Gas Tracer	USGS		X			X				3GUH016M
33127	Sep-93	Submit UZ-1 Gas and Water Vapor Data to PDA	USGS				X					3GUH013M
33128	Sep-93	Status Report on Preliminary Modeling	USGS		X							3GUF021M
33129	Sep-93	LBL Report: Tough Testing	LBL		X							3GUM12M
33129	Sep-93	Status Report on conceptual Models	USGS		X							3GUM002M
33131	Sep-93	Report/TDIF: Well Test Fracture Network and Dual Porosity Analysis	USGS		X			X				3GWF004M
33131	Sep-93	Submit Strain-related C-Hole Data to PDA	USGS				X					3GWF008M
33131	Sep-93	Completion of Tracer Injection System	USGS		X							3GWF170M

TABLE 6-1B
Milestones and Deliverables for FY'93 by Date

WBS NO.	DUE DATE	DELIVERABLE	CIPANT	PLAN	REPORT	MAP	PDA DATA	DATA	MODEL	TATION	PAPER	NO.
33131	Sep-93	Report - Past Hydraulic Tests at C-Well Complex	USGS		X							
33131	Sep-93	Data - New Hydraulic Tests at C-Well Complex			USGS					X		
33132	Sep-93	Rpt/TDIF: Assessment of Site SZ Hydrochemical Data	USGS		X			X				3GWFOO1M
33132	Sep-93	Submit Regional data, FY-93 to PDA	USGS				X					3GWH910M
33132	Sep-93	Submit hydrochemical data to PDA	USGS				X					3GWHOO4M
33133	Sep-93	Trinet fracture network model users manual	LBL		X				X			3GWM21CM
33133	Sep-93	Report on outcrop fracture data bias	LBL		X							3GWM18CM
33133	Sep-93	Input to multiwell test design	LBL					X				3GWM23CM
33133	Sep-93	Status Report: conceptual Model Fracture Network	USGS		X				X			3GWM005M
33133	Sep-93	Submit outcrop properties data to PDA	USGS				X					3GWM10M
34121	Sep-93	Report: Summary of results of sorption experiments at higher temperatures	LANL		X							MS 3346
34121	Sep-93	Report : Effects of Water/ Rock Ratios on Sorption Coefficients	LANL		X							MS 3218
34122	Sep-93	Report: Microbial and Colloid transport Models	LANL		X							MS2:T537
34142	Sep-93	Report: Techniques to study diffusion in saturated tuff	LANL		X							
34151	Sep-93	Interim report , Update of Geophysical/Geochemical Model	LANL		X							
36211	Sep-93	Interim Report/TDIF	USGS		X							3GCR0014M
36211	Sep-93	Interim Report/TDIF	USGS		X			X				3GCR0014M
36212	Sep-93	Interim Rept/TDIF: Isotopic Analysis	USGS		X							3GCL019M
36212	Sep-93	Status Rept: Past Climate and Hydrological Reconstruction)	USGS		X							3GCL018M
36212	Sep-93	Interim Rept/TDIF: Isotopic Analysis	USGS		X			X				3GCL019M
36212	Sep-93	Interim Assessment: Paleontological Prep/Assessment	USGS		X							3GCL014M

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Milestones and Deliverables for FY'93 by Date

WBS NO.	DUE DATE	DELIVERABLE	CIPANT	PLAN	REPORT	MAP	PDA DATA	DATA	MODEL	TATION	PAPER	NO.
36212	Sep-93	Interim Assessment: Paleotological Prep/Assessment	USGS		X							3GCL014M
36212	Sep-93	Status Rept: Past Cklimate and Hydrological Reconstsruction	USGS		X							3GCL018M
36212	Sep-93	Interim PRept/TDIF: Usotopic Analysis	USGS		X			X				3GCL019M
36212	Sep-93	Interim REpt/TDIF: Isotopic Analysis	USGS		X			X				3GCL019M
36213	Sep-93	Status Rept/TDIF: C-14 Analysis	USGS		X			X				3GCL109M
36213	Sep-93	Status Rept/TDIF: C-14 Analysis	USGS		X			X				3GCL109M
36214	Sep-93	Final Rept./TDIF: Digitized Map, Northern 1/3 of YM	USGS		X			X				3GCH036M
36216	Sep-93	Revision of global climate modeling activity	PNL		X				X			
36216	Sep-93	Transfer of all study products,as specified in transition plan	PNL		X							
36221	Sep-93	Report: Preliminary Summary of Paleoflood Studies	USGS		X							3GQH010M
36221	Sep-93	Submit Data to PDA	USGS				X					3GQH005M
36221	Sep-93	Report/TDIF: Origin or Surface Depostis	USGS		X			X				3GQH019M
36221	Sep-93	Submit Watershed/meteorolgical Data to PDA	USGS				X					3GQH003M
36221	Sep-93	RPT/TDIF: 36Cl Ages of Soil 1993	USGS		X			X				3GQH007M
36221	Sep-93	Submit Water Chemistry/Lithologic Data to PDA	USGS				X					3GOH025M
36221	Sep-93	Submit Faunal, Water, soil and outcrop Data to PDA	USGS				X					3GQH021M
328410	Sep-93	Report/TDIF: Progress on Geodetic Leveling at Yucca Mountain	USGS		X			X				3GTM08JM
328410	Sep-93	Report/TDIF: Assessment of Surface Changes due to the Little Skull Earthquake	USGS		X			X				3GTM07JM
328412	Sep-93	Preliminary Report/TDIF: Tectonic Models	USGS		X			X	X			3GTE045M
328412	Sep-93	Map: Geology of the Death Valley Region	USGS			X						3GTE072M
34123	Sep-93	AFM Analysis of Hematite and Geothite	LANL		X							

TABLE 6-1B
Milestones and Deliverables for FY'93 by Date

WBS NO.	DUE DATE	DELIVERABLE	CIPANT	PLAN	REPORT	MAP	PDA DATA	DATA	MODEL	TATION	PAPER	NO.
34131	Sep-93	NMR analyses of Np(v) and Pu(v) Carbonate Systems	LANL		X							MS 3351
34131	Sep-93	Speciation Measurements	LANL		X							
34131	Sep-93	Report on comparison of solubilities of NP, Am, Pu in J-13 and P-1 waters	LANL		X							MS 3344
34131	Sep-93	PAS analyses of Pu (IV) Carbonate Speciation	LANL		X							MS 3350
34132	Sep-93	Report on comparison of solubilities of NP, Am, Pu in J-13 and P-1 waters	LANL		X							MS 3344
34132	Sep-93	NMR analyses of Np(v) and Pu(v) Carbonate Systems	LANL		X							MS 3351
34132	Sep-93	PAS analyses of Pu (IV) Carbonate Speciation	LANL		X							MS 3350
34141	Sep-93	Summary Report: Np Transport in Tuffs	LANL		X							MS 3349
34141	Sep-93	Colloid Workshop Report	LANL		X							MS 3348
34123	Sep-93	Final Report on Sorption	LANL		X							MS 376

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Milestones and Deliverables for FY 92 - Accomplished

WBS NO.	DUE DATE	DELIVERABLE	PART ICIPANT	DELIVERY STATUS	COMMENT	DELIVERABLE NO.
1232111	Jun-92	Report: Calcite in the upper Paintbrush Tuff	LANL	Y	Completed and submitted to TPO	MS 3120
1232111	Aug-92	Report: Fracture mineralogy of the Paintbrush Tuff	LANL	Y	Submitted to Chemical Geology	MS 3130
1232112	Apr-92	Experimental Dehydration of Volcanic Glasses,	LANL	Y	Yes, 6/92	MS 3143
1232211	Dec-91	Study Plan Submitted	USGS	Y	12/30/91 per USGS	3GGF200M
1232211	Feb-92	Study Plan to NRC	USGS	Y	6/22/92 per R. Rogers	3GGU001A
1232211	Jun-92	Report: Existing Water Table Holes	USGS	Y	9/1/92 per USGS	3GGU031M
1232221	Sep-92	Rautman, C.A., and A.L. Flint, "Deterministic Geologic Processes and Stochastic Modeling", in Proc. Third International High Level Radioactive Waste Management Conference, Vol 2, pp. 1617-1624.	SNL	Y	Apr-92	
1232221	Sep-92	Rautman, C.A., "Advanced Geostatistical Methods Applied to the Yucca Mountain High-Level Nuclear Waste Program," in Abstracts, 29th International Geological Congress, Vol. 3, p. 868.	SNL	Y	Apr-92	
1232511	Sep-92	Crowe, et al., "Recurrence Models of Volcanic Events: Application to Volcanic Risk Assessment", Proc. Third International High-Level Radioactive Waste Management Conference, Vol. 2,pp. 2344-2355.	LANL	Y	Apr-92	
1232512	Sep-92	Valentine, G., B.M. Crowe, and F.V. Perry, "Physical Processes and the Effects of Magmatism in the Yucca Mountain Region," in Proc. Third International High-Level Radioactive Waste Management Conference, Vol 2, pp. 2014-2024.	LANL	Y	Apr-92	

TABLE 6-2A
Milestones and Deliverables for FY 92 - Accomplished

WBS NO.	DUE DATE	DELIVERABLE	PART ICIPANT	DELIVERY STATUS	COMMENT	DELIVERABLE NO.
1232532	Mar-92	Report: Large Hydraulic Gradient	USGS	Y	3/18/92 per USGS	3GTW021M
1232551	Sep-92	Crowe, et al., "The Lathrop Wells Volcanic Center: Status of Field and Geochronology Studies", Proc. Third International High-Level Radioactive Waste Management Conference, Vol 2, pp 1997-2013.	LANL	Y	Apr-92	
1232551	Sep-92	Perry and Crowe, "Geochemical Evidence for Waning Magmatism and Polycyclic Volcanism at Crater Flat, Nevada", Proc. Third International High-Level Radioactive Waste Management Conference, Vol 2, pp 2356-2365.	LANL	Y	Apr-92	
1232552	Apr-92	Technical Procedure GPP-20 Approval	USGS	Y	4/30/92 per USGS	3GAT008M
1232552	Apr-92	Approval: Technical Procedure Calibration	USGS	Y	4/30/92 per USGS	3GAT009M
1232552	Apr-92	Approval: Measurement of Thermal Conductivity	USGS	Y	4/30/92 per USGS	3GAT014M
1232552	Jul-92	Study Plan to YMPO	USGS	Y	10/13/92	3GAT006M
1232712	Sep-92	SAND 88-1581, "Linear Thermal Expansion Data for Tuffs from the Unsaturated Zone at Yucca Mountain"	SNL	Y	Yes	
1232713	Sep-92	Connolly, J.R., "Mineralogy, Petrology, and Whole-Rock Chemistry Data Compilation for Selected Samples of Yucca Mountain Tuffs," SAND90-7058	SNL	Y	Yes	
1232713	Sep-92	Connolly, J.R., "Mineralogy, Petrology, and Whole-Rock Chemistry of Selected Mechanical Test Samples of Yucca Mountain Tuffs, SAND90-4025.	SNL	Y	Yes	

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Milestones and Deliverables for FY 92 - Accomplished

WBS NO.	DUE DATE	DELIVERABLE	PART ICIPANT	DELIVERY STATUS	COMMENT	DELIVERABLE NO.
1232714	Sep-92	Wibowo, J.T., B. amadei, S. Sture, A.B. Robertson, and R.H. Price, "Shear Response of a Rock Joint Under Different Boundary Conditions: An Experimental Study," SAND-0386C, in Proc. Fractured and Jointed Rock Masses Conference.	SNL	Y	Yes	
1232834	Sep-92	Revision 1 of Study Plan	USGS	Y	9/16/92	
1232841	Mar-92	FY'91 EQ Catalog	USGS	Y	7/21/92 per USGS	3GSM022M
1232842	Sep-92	Wesling, J.R., et al., "Preliminary Mapping of Surficial Geology of Midway Valley, Yucca Mountain Project, Nye County, Nevada," SAND91-0607.	SNL	Y	1992	
1232844	Jan-92	Study plan for 8.3.1.17.4.4.1 for USGS review	USGS	Y	6/11/92 per USGS	3GTN006M
1232844	Apr-92	Study plan for 8.3.1.17.4.4.1 to DOE	USGS	Y	8/3/92	3GTN007M
1232844	Sep-92	Report: Rock Valley, Mine Mountain and Cane Spring faults	USGS	Y	9/28/92 per USGS	3GTN009M
1232845	Mar-92	Revised Study Plan for YMPO approval	USGS	Y	Mar-92	3GTD001M
1233111	Oct-91	NRC Approval of Study Plan	USGS	Y	10/21/91	RP01M
1233112	Jul-92	Submit FY'92 Runoff Data to PDA	USGS	Y	YES (7/31/92)	3GRS002M
1233113	May-92	Regional water-level data to PDA	USGS	Y	YES (5/20/92)	3GRG003M
1233113	Sep-92	Criteria letter for FM and FMN holes	USGS	Y	YES (9/30/92)	3GRG006M
1233113	Sep-92	Submit FY92 Moisture Data to PDA	USGS	Y	YES (9/30/92)	3GRG028M
1233113	Dec-92	Vertical Multilevel Sampler, Franklin Lake Playa	USGS	Y	YES (12/24/91)	G2A4
1233123	May-92	Report: 2D Fault Method	USGS	Y	YES (5/15/92)	P17M
1233123	Jul-92	Scientific Notebook Procedure for Air-K Testing	USGS	Y	YES (7/29/92)	3G012M
1233123	Aug-92	3D Model Report	USGS	Y	YES (8/31/92)	P20M
1233123	Sep-92	Technical procedure for thermistors	USGS	Y	YES (7/29/92)	3GP16M
1233124	Aug-92	HP Fracture air permeability technical procedure	USGS	Y	YES (8/26/92	S003M
1233126	Jun-92	NRC APPROVAL OF STUDY PLAN	USGS	Y	Yes -10/91	3GG01M

TABLE 6-2A
Milestones and Deliverables for FY 92 - Accomplished

WBS NO.	DUE DATE	DELIVERABLE	PART ICIPANT	DELIVERY STATUS	COMMENT	DELIVERABLE NO.
1233127	Jun-91	TDIF for UZ1 Raw Data to LRC 1984-1991	USGS	Y	YES (11/6/91)	H27MA
1233127	May-92	HP Portable GC, SF6 Meter	USGS	Y	YES (5/29/92)	H19M
1233127	Jun-92	TDIF	USGS	Y	YES (6/2/92)	HA0M
1233127	Jul-92	TDIF	USGS	Y	YES (2/1/92)	HO2M
1233128	Apr-92	Rept: 1992 IHLRMN Conference	USGS	Y	YES (4/15/92)	F06L
1233128	Apr-92	Rept: RWMNFC Journal	USGS	Y	YES (4/28/92)	F05L
1233129	Apr-92	LBL Report: ANS Paper	LBL/USGS ?	Y	YES (4/30/92)	B11M
1233129	May-92	LBL Report: WMNFC Paper	LBL/USGS ?	Y	YES (5/31/92)	B12M
1233129	Jun-92	Report: Preliminary Moisture-flow model *	LBL	Y	yes	
1233129	Sep-92	Report: Grid Effects *	LBL	Y	yes	
12331210	Jan-92	Second Data Acquisiiton System Procured	USGS	Y	YES (1/17/92)	T21M
12331210	Feb-92	HP-1D Compression	USGS	Y	YES (2/28/92)	T19M
12331210	Jul-92	Prototype Air-K Data set to PKA	USGS	Y	YES (7/29/92)	T02M
12331210	Aug-92	Complete WRI Report on G-Tunnel	USGS	Y	YES (8/3/92)	T03M
12331210	Sep-92	Technical Procedure on Core Sealing	USGS	Y	YES (9/22/92)	T04MA
1233131	Dec-91	1991 Water level data submitted to PDA	USGS	Y	YES (12/30/91)	3G01M
1233131	Apr-92	Revision of HP-93 for Conversion of Transducer	USGS	Y	YES (4/29/92)	3G04M
1233131	Jun-92	Six Sites going into NWIS Data Files	USGS	Y	YES (6/05/92)	3G03M
1233131	Sep-92	Cross hole seismic data to PDA	USGS	Y	YES (9/25/92)	3GWF03CM
1233131	Sep-92	Accuracy-Precision of water-level data	USGS	Y	YES (9/30/92)	G009
1233131	Sep-92	Z412: Analysis of Water Fluctuation at Yucca Mountain	USGS	Y	YES (9/28/92)	Z412
1233131	Sep-92	Water-level data at Yucca Mtn (1989)	USGS	Y	YES (10/92)	G007
1233131	Nov-92	C-Hole Temp Data to PDA	USGS	Y	YES (11/29/91)	3GWF029M
1233133	Dec-91	Prepare and present fracture mapping results	USGS	Y	YES (12/13/91)	3GWM014M
1233133	Mar-92	Submit fracture data to PDA	USGS	Y	YES(3/31/92)	3GW011M
1233133	Sep-92	Submit fracture data to PDA	USGS	Y	Yes (9/30/92)	3GW012M
1233135	Mar-92	Incorp. outcrop data in frac. network modle	LBL	Y	Yes	
1233135	Mar-92	Crosshole sismic data to PDA	LBL	Y	Yes	

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Milestones and Deliverables for FY 92 - Accomplished

WBS NO.	DUE DATE	DELIVERABLE	PART ICIPANT	DELIVERY STATUS	COMMENT	DELIVERABLE NO.
1233135	Jun-92	Report borehole frac. data bias	LBL	Y	Yes	
1233135	Sep-92	trinet fracnet model draft users manual	LBL	Y	Yes	
1233135	Sep-92	Report: hydrolgic and seismic data correlation	LBL	Y	Yes	
1233135	Sep-92	Report on results of cross hole seismic profiles	LBL	Y	Yes	
1234131	Sep-92	Plutonium (iv) and Plutonium (vi) Carbonate Speciation studies by NMR and PAS Spectroscopies		Y	On schedule 8/92	MS 3031
1234131	Sep-92	Report on Neptunium, Plutonium, and Americium solubility experiments in UE-25p#1 water from oversaturation		Y	On schedule 8/92	MS 3329
1234151	Sep-92	Report - Three-dimensional simulations of radionuclide transport at Yucca Mountain	LANL	Y	Yes	
1234151	Sep-92	Report - Sensitivity analysis of integrated radionuclide transport	LANL	Y	Yes	
1236212	May-92	(6212) Submit Study Plan to NRC	USGS	Y	Yes	
1236213	May-92	(6213) Submit Study Plan to NRC	USGS	Y	Yes	

TABLE 6-2B
Milestones and Deliverables for FY 92 - Not Accomplished or Status Unknown

WBS NO.	DUE DATE	DELIVERABLE	PARTICIPANT	DELIVERY STATUS	COMMENT	DELIVERABLE NO.
1232111	Sep-92	Report: Geologic evaluation of Six Nonwelded Tuff Sites for a Surface-Based Test Facility for the Yucca Mountain Site Characterization Project	LANL	N	In technical review	MS 3137
1232112	Mar-92	Laminated Zone in Trench 14,	LANL	N	65% complete, 8/92	MS 3141
1232112	Jul-92	K/Ar Dating of Clays and Zeolites,	LANL	N	In Technical review 8/92	MS 3142
1232212	Nov-91	Surveillance report(surface fracture network studies)	USGS	N	???	3GGF159M
1232212	Feb-92	Submit technical procedure for review TMS	USGS	N	???	3GGF160M
1232212	Apr-92	Surveillance report(borehole evaluation of faults & fractures)	USGS	N	???	3GGU03AM
1232212	Apr-92	Specification for data acquisition	USGS	N	???	3GGU07AM
1232212	Jun-92	Map of Tiva Canyon fractures for review	USGS	N	???	
1232212	Jul-92	G-5 data acquisition and analysis	USGS	N	G-5 not drilled	
1232212	Aug-92	Maps of southwest Yucca Mountain	USGS	N	???	3GGF188M
1232212	Aug-92	Transmit data from Fran Ridge Pavement	USGS	N	???	
1232212	Aug-92	Prow Pass and Solitario Data Transmit	USGS	N	???	
1232212	Aug-92	Summary and catalog of existing fracture data	USGS	N	???	3GGF152M
1232212	Aug-92	Submit receipt of documentation for G-5 drilling plan	USGS	N	G-5 not drilled	
1232212	Sep-92	Summary report northeast corner of site area	USGS	N	???	
1232212	Sep-92	Report data on exposed fault zones	USGS	N	???	
1232212	Sep-92	Data of samples TPT, THT, T	USGS	N	???	
1232212	Sep-92	Summary report and catalog of existing data	USGS	N	???	
123262	Jul-92	Final Rept: Engineering Geophysics	USGS /USBR	N		
123262	Aug-92	Final Rept: Field Testing, Physical Properties	USGS /USBR	N		

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Milestones and Deliverables for FY 92 - Not Accomplished or Status Unknown

WBS NO.	DUE DATE	DELIVERABLE	PARTICIPANT	DELIVERY STATUS	COMMENT	DELIVERABLE NO.
123262	Aug-92	Final Rept: Field Testing, Mechanical Properties	USGS /USBR	N		
123262	Sep-92	Final Rept: Lab Testing, Physical Properties	USGS /USBR	N		
123262	Sep-92	Final Rept: Lab Testing, Mechanical Properties	USGS /USBR	N		
1232842	Feb-92	Report: Swan, F.B., et al., "Geologic Interpretation of Trench A/BR-3 for Site Characterization Study 8.3.1.17.4.2, Midway Valley Area, Yucca Mountain Site, Nevada"	USGS	N	Completed 4/92, but not yet published by SNL.	
1232843	Apr-92	Submit study plan to NRC	USGS	N	Not yet	
1232843	Sep-92	Report: Preliminary assessment on the Quaternary tectonics and faulting	USGS	N	Open-file report completed 9/92, but not yet published .	
1233111	Sep-92	Open File Report: YM Precipitation Data -FY 91	USGS	N	Not on Current Schedule	M043M
1233111	Sep-92	Report: Regional Met-FY91	USGS	N	Not on Current Schedule	M35M
1233112	Aug-92	Reduced FY 83-85 Data to PDA	USGS	N	NO Reschedul ed 1/31/93 (3GRS030M)	3GRS022M
1233113	Aug-92	Regional water-level data to PDA	USGS	N	Reschedul ed for 9/30/93 (3GRG068M)	3GRG004M
1233113	Aug-92	Regional water-level data to PDA	USGS	N		3GRG04AM
1233113	Aug-92	Regional water-level data to PDA	USGS	N		3GRG05AM
1233113	Sep-92	Criteria for ponding sites	USGS	N	LOE Activity	3GRG001M
1233113	Sep-92	Preliminary Channel width and recharge Forty Mile Wash	USGS	N	Deleted	G1A5
1233113	Sep-92	Submit Piezometer Nest Data to PDA	USGS	N	Canceled	3GRG031M
1233122	Sep-92	Procedure for Chlorine-36 Analysis of unsaturated Zone samples	LANL	N	(a)	MS 3191
1233123	Sep-92	Technical Procedure for Pressure Transducer Calibration	USGS	N	LOE Activity	3GP15M

TABLE 6-2B
Milestones and Deliverables for FY 92 - Not Accomplished or Status Unknown

WBS NO.	DUE DATE	DELIVERABLE	PARTICIPANT	DELIVERY STATUS	COMMENT	DELIVERABLE NO.
1233123	Sep-92	Technical Procedure for mass-flow controller calibration	USGS	N	LOE Activity	3GP015M
1233123	Sep-92	Technical Procedure: VSP data acquisition	USGS	N	LOE Activity	P30M
1233123	Sep-92	Report: Prototype field test, Bergen Park	USGS	N	Reschedul ed 4/15/93(3GUP081M)	P25M
1233123	Sep-92	QA drawings, 8-12" Packers/trailers	USGS	N	LOE Activity)	3GP004M
1233123	Sep-92	Engineering drawings/manuals for 8-12" Packers/Trailers	USGS	N		3GP010M
1233123	Sep-92	Technical Procedure: Instrumentation of VSP Boreholes	USGS	N	LOE Activity	P33M
1233123	Sep-92	HP, Thermistor/Press/Psych ro/Tech Procedure Cal	USGS	N	LOE Activity	3GUP059M
1233124	Sep-92	Journal paper FFT Moire	USGS	N	Reschedul ed 9/30/92; Combined three into one open file report - 3GUS024M	
1233124	Sep-92	Journal paper Moire automation	USGS	N		3GU12M
1233124	Sep-92	Journal paper stereo viewing Moire	USGS	N		3GU14M
1233124	Sep-92	Journal paper detailed Moire	USGS	N	Reschedul ed 4/30/93 - 3GUS015M	3GU15M
1233124	Sep-92	Bench mark; Moire equipment	USGS	N	Cancelled	S23M
1233124	Sep-92	Report: Large block ponding test	USGS	N	Reschedul ed9/30/93 - 3GUS033M	S26M
1233124	Sep-92	Data report -imbibition experiments	USGS	N	Reschedul ed 3GUS034M	S29M
1233124	Sep-92	Analytical report -imbibition experiments	USGS	N		S32M
1233124	Sep-92	Hydrologic properties	USGS	N	Not on current schedule	S35M
1233124	Sep-92	HP tensiometry technical procedure	USGS	N	LOE Activity	S013M
1233124	Sep-92	HP psychrometry technical procedure	USGS	N	LOE Activity	S07M
1233126	Sep-92	OPEN FILE REPORT	USGS	N	Not on current schedule	P17A

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Milestones and Deliverables for FY 92 - Not Accomplished or Status Unknown

WBS NO.	DUE DATE	DELIVERABLE	PARTICIPANT	DELIVERY STATUS	COMMENT	DELIVERABLE NO.
1233127	Sep-92	HP Fracture Water	USGS	N	LOE Activity	H013M
1233127	Sep-92	Straddle-Packer Evaluation	USGS	N	Reschedul ed 3/31/923GUH014M	H21M
1233128	Sep-92	Rept: SCoping Calculations of Perc. Test	USGS	N		FA03
1233128	Sep-92	NRC Approval of Study Plan	USGS	N		F00MA
1233129	Sep-92	Draft alternate conceptual models report WRIR *	USGS	N	?	
12331210	Sep-92	Alts Data Report: Prototype Air-K Testing	USGS	N	Reschedul ed 5/31/93 (3GUT004M)	T05M
12331210	Sep-92	WRI Report - Aqueous Tracers	USGS	N	Reschedul ed 7/31/92 3GUT004M	TD03M
12331210	Sep-92	WRI Report - Gas Tracers	USGS	N		T14MA
12331210	Sep-92	Report: Monitoring Gas Tracer	USGS	N	Reschedul ed 9/93 (3GUH016M)	TD08
12331210	Sep-92	Technical Procedure on Rubble Coring	USGS	N	LOE Activity	T07MA
12331210	Sep-92	Report: Effects of Core Sealing	USGS	N		T02MA
12331210	Sep-92	Triaxial and 1D methods Report	USGS	N	Deleted	T12M
12331210	Sep-92	Additional High Pressure 1-D Cell	USGS	N	LOE Activity	T22M
12331210	Sep-92	HP- High Pressure Cell	USGS	N	LOE Activity	T17M
12331210	Sep-92	QA Submittal of Software Requirements	USGS	N	LOE Activity	T23M
1233131	Sep-92	SCI NTBK Cross hole tests	USGS	N	LOE Activity	3GWF025M
1233132	Aug-92	Submit weapons-holes data to PDA	USGS	N	Data not generated ; activity dropped	
1233133	Mar-92	Incorp. outcrop data in frac. network model	LBL	N		
1233133	Mar-92	Report: hydrologic and seismic data correlation	LBL	N		
1233133	May-92	Potentiometric Map Reports	USGS	N		
1233133	Jun-92	Report borehole frac. data bias	LBL	N		
1233133	Sep-92	Trinet fracnet model draft users manual	LBL	N		
1233133	Sep-92	Report on results of cross hole seismic profiles	LBL	N		

TABLE 6-2B
Milestones and Deliverables for FY 92 - Not Accomplished or Status Unknown

WBS NO.	DUE DATE	DELIVERABLE	PARTICIPANT	DELIVERY STATUS	COMMENT	DELIVERABLE NO.
1234121	Sep-92	Variation of Water-Rock Ratio Sorption Coefficients on Zeolitic Tuff	LANL	N	?	MS 3009
1234121	Sep-92	Progress Report on Single Mineral Experiments	LANL	N	?	MS 3212
1234122	Sep-92	Report on Chelation	LANL	N	In prep 8/92	MS 3080
1234122	Sep-92	Report on Colloidal Agglomeration	LANL	N	In prep 8/92	MS 3092
1234122	Sep-92	Procedure for Determination of Formation Constraints	LANL	N	In progress 8/92	MS 3176
1234122	Sep-92	Procedure for Determination of Effects on Colloidal Agglomeration	LANL	N	In prep 8/92	MS 3177
1234141	Mar-92	Report on sorption by batch and column techniques	LANL	N		MS 3027
1234141	Aug-92	Letter report on assessment of available techniques for unsaturated column transport experiments	LANL	N	In prep 8/92	MS 3044
1234141	Sep-92	Kinetics of sorption on columns of pure minerals	LANL	N		MS 3040
1234151	Sep-92	Baseline documentation for TRACRN	LANL	N		MS 3052
12342	Sep-92	Issue GT output option of DOOUT	LLNL	N		
12342	Sep-92	Issue DOOut users manual	LLNL	N		
12342	Sep-92	Prepare draft/rvw/rev/issue EQ3 users manual	LLNL	N		
12342	Sep-92	Prepare/issue EQ3/6 package overview manual	LLNL	N		
12342	Sep-92	Prepare draft qualifications plan	LLNL	N		
12342	Sep-92	Prepare test case library	LLNL	N		
12342	Sep-92	Prepare/issue DBERROR documentation	LLNL	N		
12342	Sep-92	Prepare draft/rvw/rev/issue EQ6 users manual	LLNL	N		
1236214	Sep-92	(6214) Make draft map (Paleoenvironmental History)	USGS	N	No - in internal review	
1236221	Jan-92	Data from Kawich -FY85-90	USGS	N		
1236221	Jan-92	Data from Stewart Creek - FY85-90	USGS	N		

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Milestones and Deliverables for FY 92 - Not Accomplished or Status Unknown

WBS NO.	DUE DATE	DELIVERABLE	PARTICIPANT	DELIVERY STATUS	COMMENT	DELIVERABLE NO.
1236221	Feb-92	Submit Vegetation Map to PDA	USGS	N		
1236221	Apr-92	Data from Kawich -FY91	USGS	N		
1236221	Apr-92	Data from Stewart Creek - FY91	USGS	N		
1236221	Jul-92	Tech. Proc. for Paleoflood Analysis	USGS	N		
1236221	Jul-92	Topographic Map of Watershed	USGS	N		
1236221	Aug-92	Reports on Wet/Dry Playas	USGS	N		
1236221	Aug-92	Report on Contents of Samples	USGS	N		
1236221	Sep-92	Submit Modern Spring Data to PDA	USGS	N		
1236221	Sep-92	Faunal Data Discharge Deposits to PDA	USGS	N		
1236221	Sep-92	Interpretive Report on Faunal Data	USGS	N		
1236221	Sep-92	Rept: Paleo Streamflow/Recharge-Channel Geometry	USGS	N		
1236221	Sep-92	Water Chemistry Data to PDA	USGS	N		
1236221	Sep-92	Faunal Data, Modern Springs to PDA	USGS	N		
1236221	Sep-92	Progress Rept: 36Cl Ages of Soil 1992	USGS	N		
1236221	Sep-92	Hydrogenic Deposits, Trench !4 for Comment	USGS	N		

TABLE 7.1 Underfunded or Unfunded WBS Elements - By WBS

WBS SCP Number	Title	Participant	Unfunded or Underfunded Amount	Comments/ Impacts of not funding or underfunding
1.2.3.1 Coordination and Planning				
1.2.3.1	C&P	ANL	-200	
1.2.3.1	C&P	LANL	-100	Reduction in ability to manage the site effort.
1.2.3.1	C&P	M&O	-1047	Limited support for technical integration efforts and technical reviews. Delays in completion of test interference evaluations. No field management support.
1.2.3.1	C&P	T&MSS	-111	Reduced staff for preparation of TPPs and JPs and reduced staff for support to the Site Investigations Branch.
1.2.3.1	C&P	UT	-110	Revised Estimate for maintenance of the Salt core.
1.2.3.2 Geology				
1.2.3.2.1.1.1	Min., Petrol. & Rock Chemistry of Transport Pathways	LANL	-42	Reduction will defer the statistical analysis and chemistry of host rock activity. This task will define the limits of precision & accuracy for mineralogic analyses that determine sampling reqmts. The impact will be to delay definition of borehole and ESF sample requirements.
	Kinetics and Thermo- dynamics of Mineral Evolution	LANL	-40	Mineral kinetics low priority, therefore can defer to later fiscal year.
1.2.3.2.2.2.1 8.3.1.4.3.1	Systematic Acquisition of Site-Specific Subsurface Info.	SNL	-134	Reduced funding eliminates all field activities, all rock-properties measurements, and all data analysis and reporting in support of drillhole SD-1. However, this drill hole was deferred to FY 94. Surface transect work will not be supported. This effort provide only hard data in support of spatial continuity models used in PA.
1.2.3.2.2.2.2 8.3.1.4.3.2	3-D Rock Charac. Models	SNL	-34	Reduction of funding does not support completion of a study plan. Reduced funding slows development of integrated geostatistics software modules (GSLIB) and slow implementation of geostatistical package (LYNX 3D) Reduced capabilities prevents SNL from getting into "production mode" for geostatistical calculations.This will reduce support to GWTT, TSPA and PA work in support of ESF & SBT drilling.
1.2.3.2.5.1.2 8.3.1.8.1.2	Effects of a Volc. Erupt. Penetrating the Repos.	LANL	-10	There will be no impact on the products for the reduction. The study plan was submitted to the Project Office on 10/14/92.
1.2.3.2.5.5.1 8.3.1.8.5.1	Charact. of Volcanic Features	LANL	-25	There will be reduced geochronology and field efforts.
1.2.3.2.7.2.2	Site Ambient Thermal Conditions	USGS	-20	Will not be able to respond to DOE reviews and begin data evaluation.
1.2.3.2.8.1	Potential for Ash Fall at the Site	LANL	-11	Rock varnish task will be reduced; this work is conducted in conjunction with the USGS and falls under the seismic study plans.

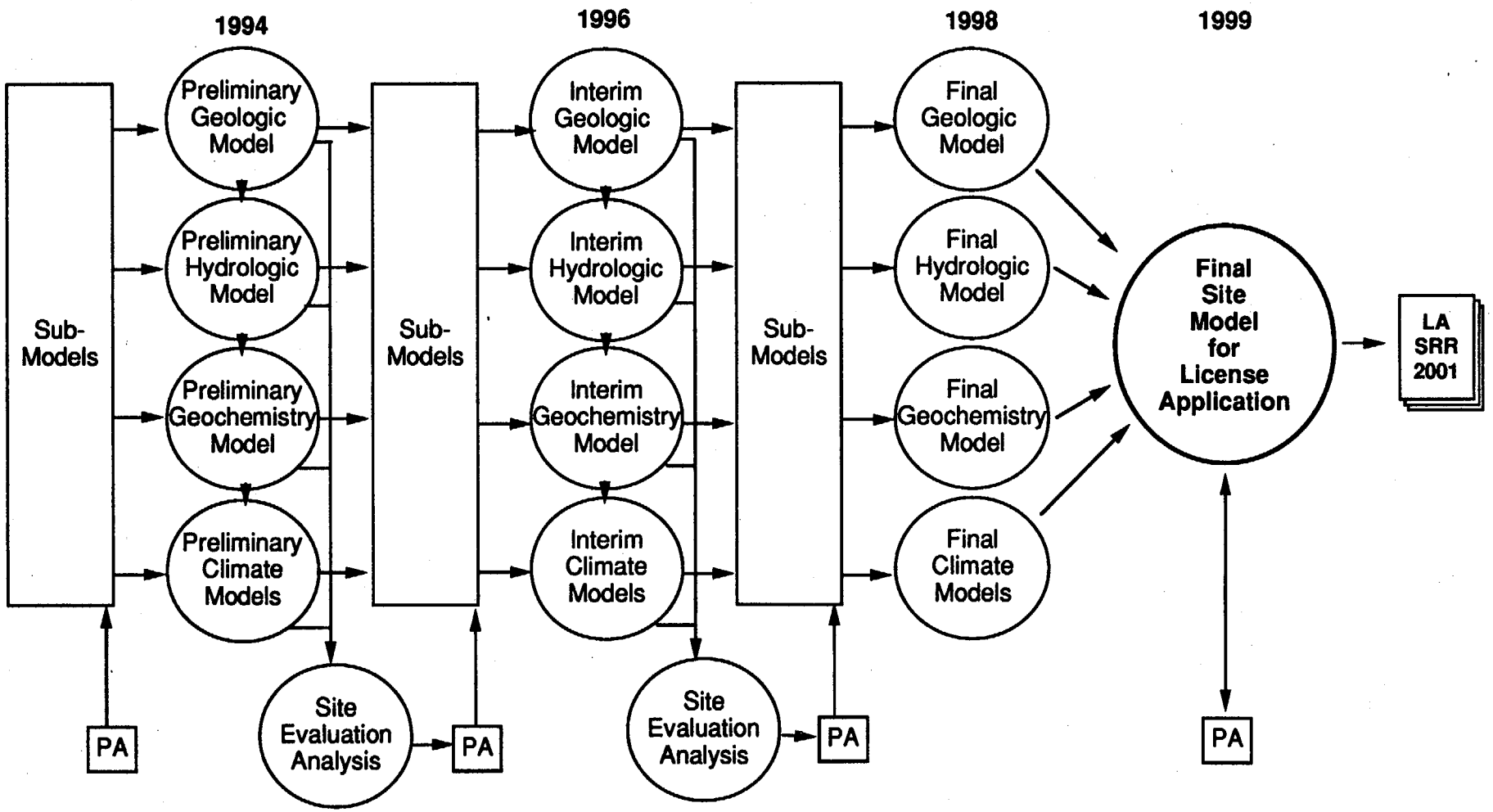
TABLE 7.1 Underfunded or Unfunded WBS Elements - By WBS

WBS SCP lumber	Title	Participant	Unfunded or Underfunded Amount	Comments/ Impacts of not funding or underfunding
1.2.3.2.8.3.3 8.3.1.17.3.3	Grd. Mot. from Region. EQ & U/G Nuc. Exp.	SNL	-104	No completed study plan, no final summary report this year. All work in this area will cease. Study plan comments will not be resolved. Recent statistical analyses of UNE data suggest that high confid. maximum UNE would have higher accel. at YM than previously anticipated. Without funding, activities to resolve this issue, which has a major impact on ESF design will be unavailable.
1.2.3.2.8.3.6 8.3.1.17.3.6	Probabalistic Seismic Hazards Analyses	USGS	-20	Delay in Study Plan until FY'94 will necessitate high priority in FY '94 to complete analysis in FY '95.
1.2.3.2.8.4.3 8.3.1.17.4.3	Quat. Faulting w/in 100 km of Yucca Mtn.	USGS	-21	The number of trenches that can be excavated off-site may be reduced. Defer work scope until FY 94.
1.2.3.2.8.4.9 8.3.1.17.4.9	Tect. Geomorph. of the Yucca Mtn Region	USGS	-30	Delay in completion of study plan will lead to delays in the seismic hazards evaluations and overall tectonic analyses supporting site suitability studies.
1.2.3.3 Hydrology				
1.2.3.3.1.2.10 No SCP Reference	Prot. Hydrologic Tests that support mult. site char. activities	USGS	-62	Underfunding will severely limit the final products or prototype tests conducted for this activity. Reports documenting equipment development, field techniques, and analytical methods for air-permeability testing, gaseous tracer testing, and pore-water extraction methods will not be completed. A reduction in expert staff resulted when this account was underfunded.
1.2.3.3.1.2.5 8.3.1.2.2.5	Diffusion Tests in the ESF	LANL	-79	
.2.3.3.1.2.8 .3.1.2.2.8	Fluid Flow in UZ Fractured Rock	LBL	-139	
1.2.3.3.1.3.3 8.3.1.2.3.3	SZ Hydro Sys. Synthesis & Modeling	LBL	-71	
1.2.3.4 Geochemistry				
1.2.3.4.1.1 8.3.1.3.1	Groundwater Chemistry Model	LANL	-74	Delay work by 1 yr. will also extend schedule by 1 yr. for sorption and solubility because this is a critical driver for those tasks.
1.2.3.4.1.5.2 8.3.1.3.7.2	Demo. of Application of Lab. Data	LANL	-120	1) Only study that measures transport. No other way to test models for transport. 2) Jeopardize getting info. for licensing '99 or Rn transport. 3) Without funding the independent review group cannot be maintained.
1.2.3.4.1.5.2 8.3.1.3.7.2	Demo. of Application of Lab. Data	LBL	-1230	Delay in development of the study plan, initial experimental work and modeling. Delay ability to begin testing in the ESF.
1.2.3.4.1.6 8.3.1.3.8	Retardation of Gaseous Radionuclides	LANL	-125	Reduction will delete scoping studies to look at retardation of C-14 at YM. The issue of gaseous C-14 has consistently risen to the top for various site suitability studies. The effort from this study will provide a basis as to whether this should be pursued in the future.
1.2.3.4.2	Geochemical Modeling (**1.2.1.4.3**)	LLNL	-220	Delay in development of additional modules for the EQ3/6 data base (e.g. kinetics and ion exchange capability).
1.2.3.5 Drilling				
1.2.3.5.1	Sample Management Facility	T&MSS	-116	Will not hire 4 support geologists for Drilling Support Division: Coverage for 3rd rig operation reduced to 2 people wiith no backup.
.2.3.5.2.1	Common-to-Drilling Support	REECo	-6244	Defer purchase of LM-300 Drill rig.

TABLE 7.1 Underfunded or Unfunded WBS Elements - By WBS

WBS SCP Number	Title	Participant	Unfunded or Underfunded Amount	Comments/ Impacts of not funding or underfunding
1.2.3.5.2.2	Engineering, Design and Drilling Support	T&MSS	381	Will not bring on new log analyst as budgeted for support for geophysical logging program.
1.2.3.5.3.17 8.3.1.4.3.1	Geostatistical Drillholes	REECo	-64	Drillholes deferred to FY '94.
1.2.3.5.3.20 8.3.1.14.2.1	Surface Facilities Drillholes	REECo	-430	Planned second shift deferred.
1.2.3.5.3.22 8.3.1.17.4.8	In Situ Stress Drlhole & Tsts. & Quat. Fault Trenching	REECo	-130	Limited trenching capability.
1.2.3.5.3.4	Rain. Sim./Art. Infil. Drlhls. and Plot Const.	REECo	-1751	Study and therefore drillholes deferred to FY '94.
1.2.3.5.3.5 8.3.1.2.2.3.2	UZ, Vert. and Seis. Prof., & Prot. Drlhls. & Tsts.	REECo	-1340	Planned second shift deferred.
1.2.3.6 Climatology				
1.2.3.6.2.1.2 8.3.1.5.1.2	Paleoclimate Study of Lake, Playa and Marsh Deposits	USGS	-175	Budget cuts necessitated cutting contractors from DRI, U of AZ, and U of Utah from the program with the loss of about 5 experienced part-time scientists. Elimination of acquisition of core data important for input into hydrol. models.
1.2.3.6.2.1.3 8.3.1.5.1.3	Climatic Implications of Terrestrial Paleoecology	USGS	-42	Funds required to write and manage contract with DRI. This would have allowed them to work the QA program including work directly funded by DOE.
1.2.3.6.2.1.6 8.3.1.5.1.6	Future Regional Climate and Environ.	PNL	-200	
1.2.3.6.2.1.6 8.3.1.5.1.6	Future Regional Climate and Environ.	SNL	-340	Reduction in funding eliminates validation efforts for regional climate model. The validation is necessary to add credibility to climate evaluations that are critical to site-suitability assessments.
1.2.3.7 Natural Resources				
1.2.3.7.2.1 8.3.1.9.2.1	Natural Resource Assessment	USGS	-190	Loss of part-time experienced people. May impact collection of data.
1.2.3.10 Altered Zone				
1.2.3.10	Altered Zone Characterization	LLNL	-500	Delay in developing the study plan, delay in experimental work.

Figure 3.1 **WBS 1.2.3. Site Investigations Iterative Summary Schedule**



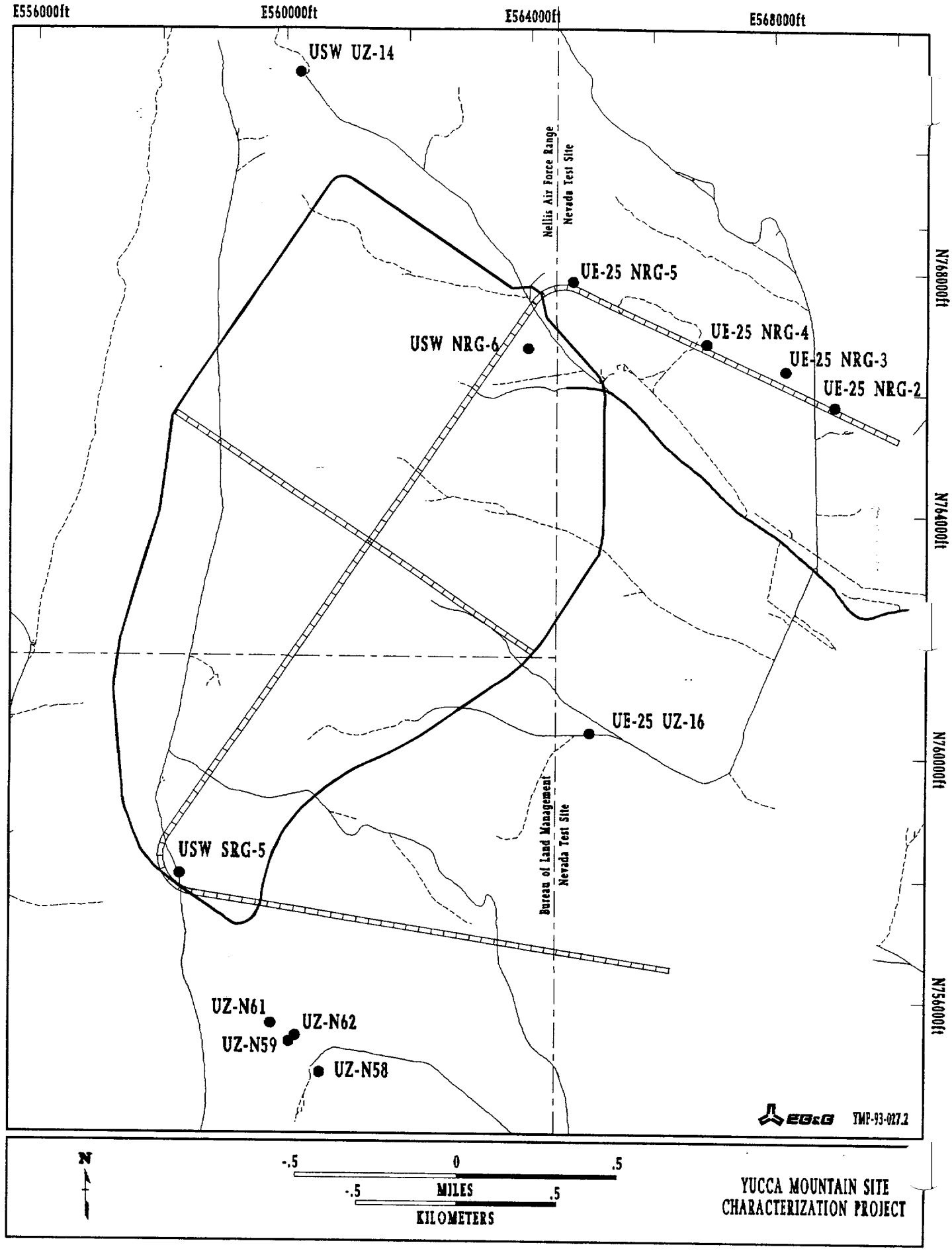
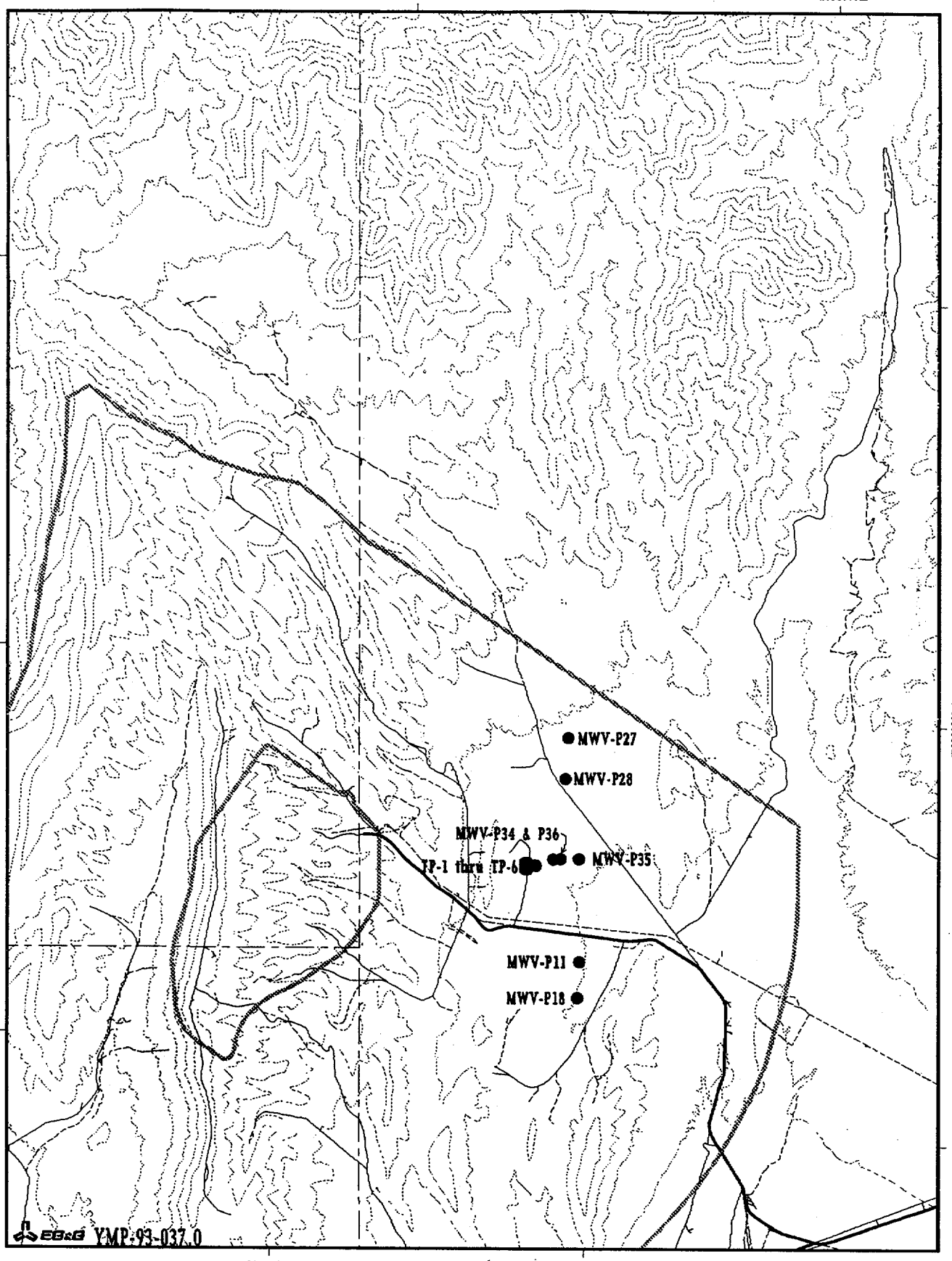


Figure 5.1 - Planned FY93 Boreholes.



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YUCCA MOUNTAIN SITE
CHARACTERIZATION PROJECT

Figure 5.2 - Planned Test Pits in Midway Valley (Proposed Locations)

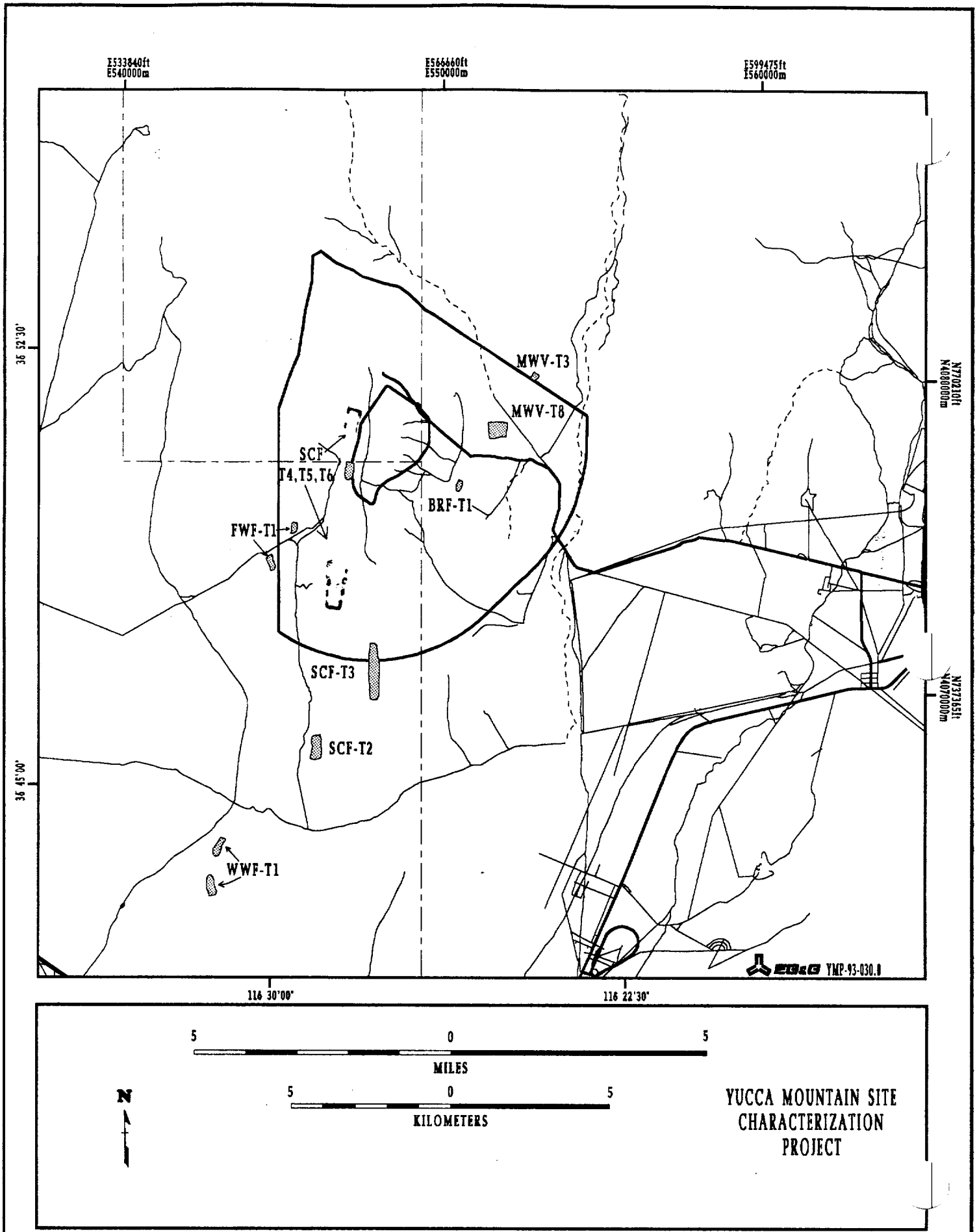


Figure 5.3 - Planned Trenches in the Site Area (Proposed Locations).

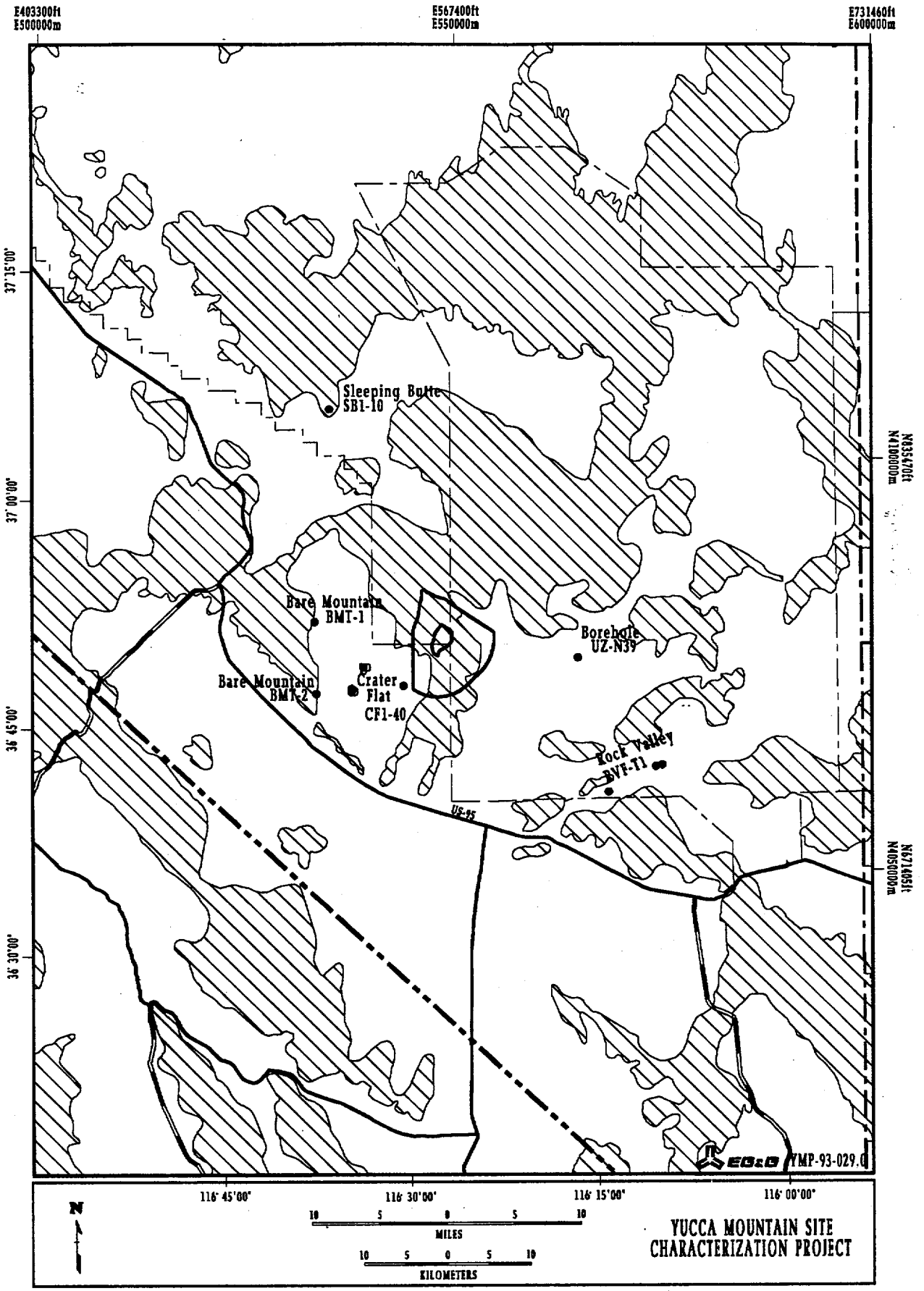


Figure 5.4 - Planned Trenches and Test Pits in Regional Investigations (Proposed locations).

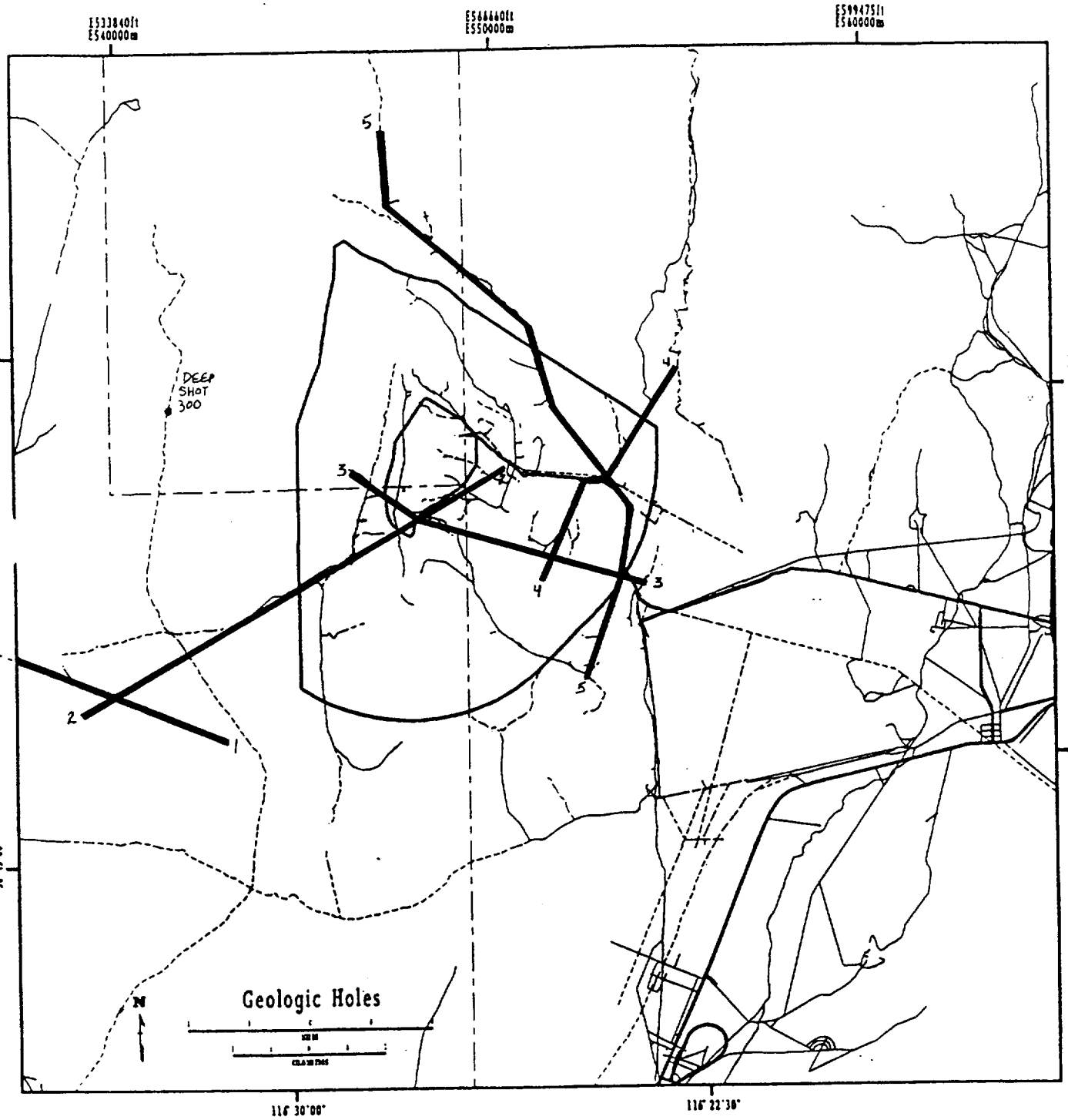
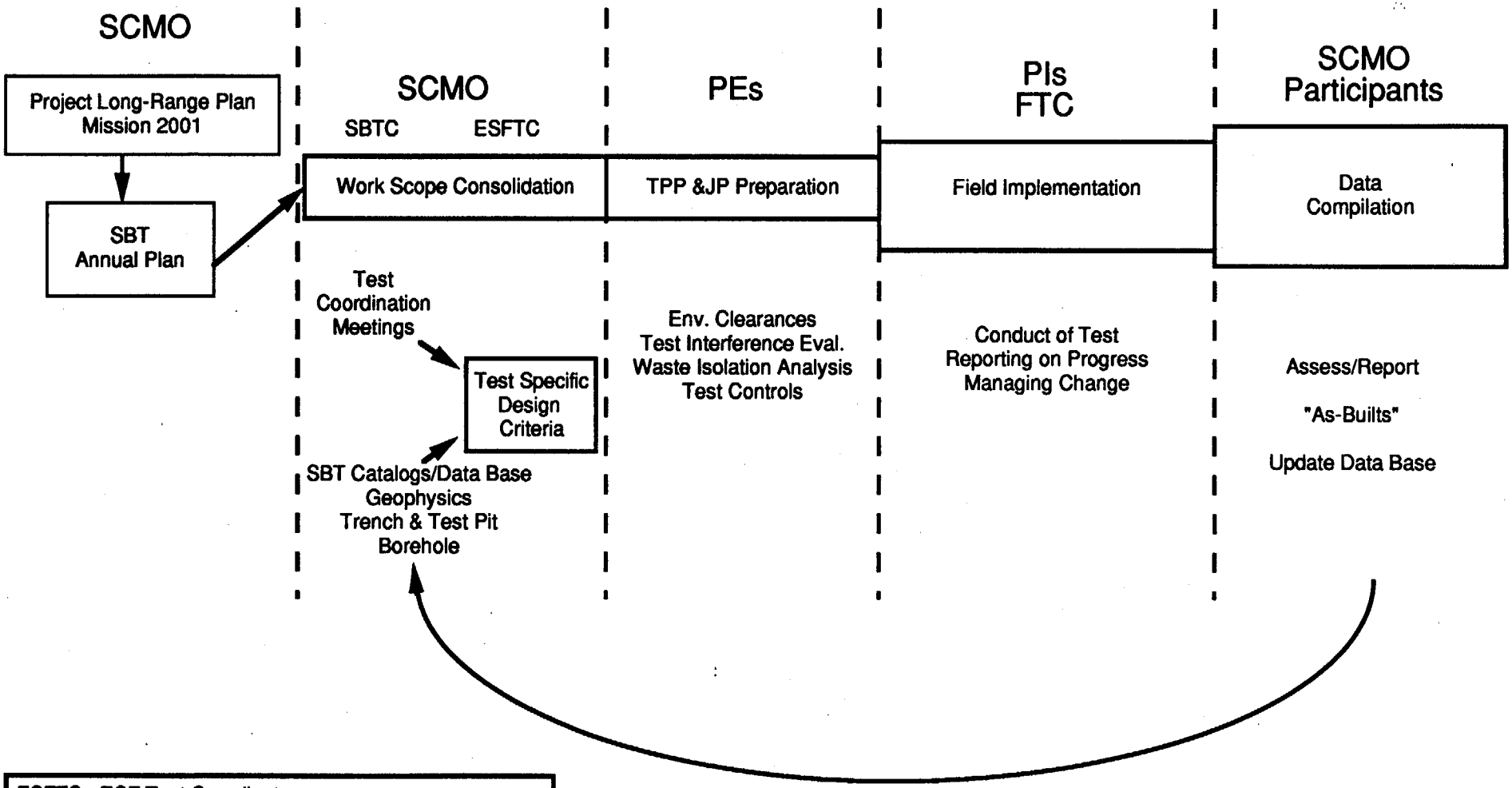


Figure 5.5 - Location of the five Seismic Reflection Profiling Lines, and associated Gravity and Magnetic Surveys. Deep Shot #300 is one of two proposed deep shotholes designed to undershoot Yucca Mountain (the other hole is TBD).

Figure 8.1: Site Investigation Management



ESFTC - ESF Test Coordinator
FTC - Field Test Coordinator
PE - Project Engineer
PI - Principal Investigator
SBT - Surface-Based Testing
SBTC - Surface-Based Test Coordinator
SCMO - Site Characterization Management Organization

FY'93 ANNUAL PLAN FOR SITE CHARACTERIZATION

YUCCA MOUNTAIN PROJECT

APPENDICES

January 31, 1993

Prepared by:
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APPENDIX A

Data Sheets for WBS 1.2.3 Activities Funded in FY'93

The following annotated outline presents either the source of information shown on the data sheets included in this appendix, or the rationale for including the category on the data sheet. This appendix represents the status of the presently gathered data; for this plan, the emphasis was to give priority to those areas that directly affect the 1993 planning porcess. Some of the other desired information has yet to be gathered or updated.

WBS NUMBER AND TITLE OF ACTIVITY

Purpose: *Statement of overall purpose for the study*

Description: *Statement of overall description of the study*

FY'93 Funding: *Baselined FY'93 budget*

Rationale for FY'93 Funding: *The ranking for the study, as the WBS 1.2.3 studies were prioritized during the allocation of the FY'93 budget. (See discussion in Sections 3 and 4 of Annual Plan).*

ITE Test Prioritization: *From the results of the Integrated Test Evaluation Task Force (discussed in "Draft Final Report, Integrated Test Evaluation Framework for Prioritizing Tests for the Yucca Mountain Site Characterization Project", prepared September 18, 1992, revised November 3, 1992).*

WBS Elements (1.2.3..) / Participant: *This information is from FY'93 PACS summary account planning sheets.*

Principal Investigator: *The Participant manager of the technical activity. If the PI is from a different orgainization, that affiliation is indicated.*

FY'93 Scope: *This information is from FY'93 PACS summary account planning sheets.*

Status at Beginning of FY'93: *Blank*

Study Plan: *Status derived from DOE/M&O's schedule of study plans.*

JP/TPP: *Identified from the "TPP/JP Consolidated Status Report", compiled by the T&MSS Planning and Support Department.*

Environmental Studies: *Number assigned upon receipt by Operations Contol Branch to initiate a pre-activity survey. The dates shown on the data sheets may be superceded by recent schedule changes or completion of preactivities.*

Prerequisite Predecessor: *This questions whether the study is dependent on the completion of another study, the purchase of particular equipment, or some other concern.*

1993 Deliverables: *Information has been derived from the FY'93 PACS summary account planning sheets.*

FY'92 Scenario: *The purpose of this section is to evaluate to progress of the study through FY'92, to assess status at the start of FY'93 and if there is a major change in the long-range plan for the study, due to the events of FY'92.*

Budget: $_____; ___% spent. *Based on the PACs cost performance reports at the end of FY'92.*

1992 Accomplishments: *Presents the major accomplishments of FY'92. The major source of this information are the 6-month progress reports published by DOE. See:*

"Progress Report on the Scientific Investigation Program for the Nevada Yucca Mountain Site":

No. 6, for October 1, 1991 - March 31, 1992 (DOE/RW-0307P-6)

No. 7, for April 1, 1992 - September 31, 1992 (DOE/R-0307P-7)

1992 Deliverables: *This reflects the current understanding of the status of FY'92 deliverables. It is possible that some of the products that have been completed have not been noted here .*

Impact of FY'92 on FY'93: *This is intended to identify any 'make-up' that may be required in FY'93 because some part of the study was not finished in FY'92, or to identify if there should by any resulting programatic change. Problems that resulted in late deliverables are also identified.*

FY'94 Scenario: *What is presented is from PACS; if there are known changes of the MISSION 2001 statement at this point in time, indicate it here..*

Budget: *The budget given is from the Mission 2001 Long-Range Plan.*

FY'94 Workscope: *This information is from the PACS summary account planning sheets for FY'94, developed during the Mission 2001 exercise.*

1.2.3.1 COORDINATION AND PLANNING

Purpose: To assist YMPO in meeting site characterization goals in a cost-effective manner.

Description: Support provided to YMPO in overall management of Site Characterization activities, including planning, scheduling, budgeting, controlling, and reporting. This includes strategic evaluation of alternatives, setting test priortities, technical peer review and reports, monitoring of performance, and initiating or modifying plans, procedures, and strategies.

FY'93 Budget: $7,099,000 (Mission 2001: $6,795,000)

Rationale for FY'93: Priority 1 study funding levels shown below based on participant estimate.

Organization	Role	Scope (see below)	Budget
EG&G	C&I	(a)	$ 50,000
GSW	C&I	(b)	110,000
LANL	Site Management and Integration		327,000
	Test Management and Planning		445,000
	Site QA	(c)	305,000
	Site Test Engineering Support	(d)	223,000
	Subtotal:		$1,300,000
SNL	M&I	(e)	129,000
TESS	M&I		
	Support YMPO and Integrate Site Characterization Activities	(f)	
	Surface-Based Testing Coordination	(g)	

	Outreach Support	(h)	
	Subtotal:		$1,983,000
T&MSS	M&I	(i)	1,089,000
USBR	M&I	(k)	300,000
USBS	M&I		
USGS	Computer Operation, Hydrology	(l)	416,000
	Branch Administrative Services		374,000
	M&I Branch Staff	(o)	776,000
	Geologic Studies Program	(m)	422,000
	QA Implementation - GSP	(n)	378,000
	Hydrology Program Management	(o)	646,000
	QA Implementation - Hydrology	(p)	266,000
	Scientific Reports/Project Documents	(q)	100,000
	Subtotal: $		3,378,000
UT	Maintain Salt Core	(r)	190,000
		TOTAL	$8,529,000

C&P Managers:

EG&G
GSW
LANL — Julie Canepa
- Site QA
- Site M&I
- Test Management and Planning
- Site Test Engineering Support

SNL — Les Shepard
TESS — Dale Foust
- Support YMPO

Surface-Based Testing Coordination
Outreach Support

T&MSS — Michael Vogele

USBR

USGS — Larry Hayes

M&I Staff Branch
QA Implementation - GSP
QA Implementation - Hydrology
Computer Operations - Hydrology
USBR Management
Hydrology Program Management
Scientific Reports/Project Documents
Geologic Studies Program

UT

FY'93 Scope:

(a) EG&G:
Generate digital elevation contour maps and any other maps as requested for the Yucca Mountain site.

(b) GSW:
Assist the Yucca Mountain Project Office in coordination between the USGS/Denver office and the USGS/HQ.

(c) LANL:

Site QA: Coordinate and host internal and external surveys and audits and assist in preparation of responses to survey and audit findings; prepare quality detailed implementing procedures; review purchase requests; identify measurements and test equipment to be placed under calibration control; and review QA records for accuracy and completeness.

Site Management and Integration: Plan, schedule and coordinate Los Alamos activities in 1.2.3.2, 1.2.3.3, and 1.2.3.4 WBS areas. Interface with other Project participants and report radionuclide transport results from Los Alamos as they affect other Project activities. Supervise principal investigators and determine technical objectives, including workscope and milestones for activities given Project priorities and available resources. Allocate resources. Assist and review Los Alamos field and lab efforts including test planning package and job package preparation and processing, and readiness review. Prepare progress reports as required. Participate in activities such as SBTC and the TIG and SOC.

(d) SNL:

Provide secretarial and managerial support for activities conducted under WBS 1.2.3. Provide for SNL participation on YMP Sample Overview Committee, Technical Integration Group, Geochemistry Integration Team and other Project-level interactions not directly related to specific work elements.

(e) TESS

Support YMPO and Integrate Site Characterization Activities:
Support YMPO in overall management of site characterization activities, including planning, scheduling, budgeting, controlling and reporting. Support YMPO in strategic evaluation of alternatives, and in setting test priorities based on the established program and new information from ongoing activities. Provide technical support to YMPO in managing site characterization activities (e.g., peer review, geologic evaluation reports, geologic/geophysical logs of core). Monitor performance and report on progress of site characterization activities. Support YMPO in ensuring that ESF testing is consistent with overall site characterization strategy. Modify and/or initiate procedures, plans, and strategies to help make site characterization achieve its goals in a cost-effective manner. Carry out management reviews as requested.

Provide integration of site characterization activities, including requirements, scope, schedule, cost, and inter-Participant interfaces, and interfaces to other WBS elements. Assist YMPO Division Directors and WBS managers in their interactions with Project Participants and DOE/HQ to transmit directions, changes, and concerns between the parties. Carry out evaluations to ensure that essential tasks are included in program planning documents and that responsibility for them is assigned. Provide integration for planning exercises of scope, schedule, cost, requirements and interfaces. Participate in the Technical Integration Group (TIG) and Sample Oversight Committee (SOC) activities. Review site characterization data submitted by Principal Investigators to the Technical Data Base (TDB). Use TDB data set in the geologic/hydrologic models of Yucca Mountain to identify any inconsistencies. Resolve apparent technical inconsistencies with investigators, in review groups, and in the TIG. Advise the TDB manager on end-use requirements, data formats, and modelling applications.

Surface-based Test Coordination:
Develop and implement a plan for coordination of surface-based testing activities. Compile and integrate information on surface-based testing activities, including for each activity, scientific motivation, tests planned, studies dependent upon results, required participation, logistical support required, and schedule/network connections. Perform test interference evaluation for near-term activities, as

requested. Implement test interference evaluations using x-terminal access to real-time Project Technical Data Base. Provide preliminary global test interference analysis for site. Update interference evaluations as interference data become available. Support update of Project Site Atlas. Review technical deliverables for adequacy. Provide support for update and maintenance of the surface-based investigation attribute database. Develop procedures as necessary.

Outreach Support:
Support outreach activities for site characterization. As requested, prepare materials for and participate in site tours, public meetings, and other activities in support of YMPO outreach support.

(f) T&MSS:
Assist the YMPO/M&O (assigned YMPO WBS managers and M&O personnel)in interfacing with the Project participants to prepare test Planning Packages and Job Packages in accoardance with surface based testing tasks included in the Annual Work Plan. Assign Project Engineers and Job Package Coordinators to prepare Test Planning Packages and Job Packages to support a maximum of eleven scheduled and two unscheduled TPP/JP efforts in FY 93.

(g) USBR:

(h) USGS:
M&I Branch Staff:
Participate in planning, coordination, and working group meetings for all USGS surface-based, ESF, and prototype testing. Staff will plan, organize, and coordinate support for field operations, including laboratory and office requirements in Nevada; participate in meetings with USGS principal investigators, the SBT and ESF test coordinators and staff, DOE/YMPO/M&O, other Project participants and support contractors for the purpose of interfacing to ensure coordination and integration of testing requirements; and review documents, e.g. ESF Subsystems Design Requirements documents, Surface Based Investigations Plan, etc., for compatibility with USGS testing requirements.

Branch Administrative Services:
Provide support and tracking for personnel actions, budgets, controlled property, travel, and performance appraisals for Branch, Hydrologic Investigations Program, and Geologic Studies Program; track expenditures and prepare fiscal reports in support of monthly budget analyses and orderly close out of fiscal issues as required by WRD and YMPO/M&O; prepare, process, and monitor requisitions for capital equipment, controlled property and consumables; provide administrative support for Nevada Operations; and track

expenditures under Memorandums of Agreement, Intergovernmental Personnel Acts, and Bureau of Reclamation.

QA Implementation - GSP:
QA implementation contractors will assist GSP Principal Investigators and staff in the preparation of planning documents or prerequisite review packages; the full implementation of QA for on-going monitoring and near-term activities; implementation of records management; integration of the Study Plan review process with QA requirements; and coordination of audits and surveillances. Technical Procedures and Scientific Notebook Plans will be processed and tracked. Software QA assistance will be given to the technical staff in the preparation of Software QA documentation, preparation and/or collection of YMP-USGS software documentation, participation in meetings, e.g. Software Configuration Control Committee.

QA Implementation - Hydrology:
QA Implementation staff will assist Principal Investigators in the preparation of planning documents or prerequisite review packages; the full implementation of QA for on-going monitoring and near-term activities; implementation of records management; integration of the Study Plan review process with QA requirements; and coordination of audits and surveillances. Technical Procedures and Scientific Notebook Plans will be processed and tracked. Software QA assistance will be given to the technical staff in the preparation of Software QA documentation, preparation and/or collection of YMP-USGS software documentation, participation in meetings, e.g. Software Configuration Control Committee.

Computer Operation - Hydrology:
Staff will maintain and enhance computer operations for the Hydrology Program, TPO Office, Geologic Studies Program, LRC, QA Office, and Administrative Management Section; configure, test, and train on Novell LAN and WAN; operate and maintain the SUN and PRIME LANs to support all users; provide contract support for PC purchases, LAN wiring, and hardware and software purchases; participate in meetings with DOE and other Project personnel regarding computer interfacing requirements and property, prepare DOE Acquisition Plans for all Hardware and Software listed in the USGS input to the DOE Short Range Plan; and maintain communications/data transmittal lines between USGS-Denver and YMP operations in Las Vegas.

USBR Management:
The USBR management staff will supervise personnel; manage USBR participation in both geologic and hydrologic studies; implement QA procedures; oversee budget schedule development; review monthly cost/schedule status input;

monitor progress of USBR activities in relation to schedules and provide variance analyses and management intervention to identify and resolve conflicts and slippages, as appropriate.

Hydrology Program - Management:
Supervise personnel; manage technical and operational activities int he Saturated Zone/Quaternary Hydrology, Unsaturated Zone, and Computer/Data Management Sections; participate on various project committees and work groups, e.g. Study Plan Coordination, Work Authorization, SBT Coordination, etc.; compile detailed schedules, work-scope descriptions, and monthly status reports for input into PACS; compile and approve PACS Summary Account input which will provide the USGS TPO with preliminary FY 1994 budgets for all activities; and develop final detailed budgets for all FY'93 activities; monitor progress of hydrology activities in relation to schedules and provide variance analyses and management intervention to identify and resolve conflicts and slippages, as appropriate; and plan, organize, and conduct annual project reviews for all activities.

Scientific Reports/Project Documents - Hydrology:
Review technical reports and abstracts from the TPO office, geologic program and hydrologic program to evaluate adequacy of colleague reviews, comment resolution, verification, and overall content and conclusions; select well qualified technical reviewers for Study Plans submitted by other participants, schedule technical reviews, evaluate comments, and transmit review documents and comments to appropriate agency personnel; implement reports-verification system to improve existing reports review and appraisal system; provide timely and high quality technical publication editing services; and coordinate technical editing, manuscript preparation, drafting, and library services for the TPO office, geologic studies program, and hydrology program. Coordinate compilation and submittal to the LRC of the published record package for all YMP-USGS published reports.

Geologic Studies Program:
Provide management and integration of site characterization of work performed by the USGS, including overall management of USGS GSP site characterization activities; interactions with OCRWM, YMPO/M&O, and other Project participants; implementation of quality assurance procedures; tracking expenditures and compiling monthly cost reports and monthly status reports for input into PACS; reviewing Geologic Studies Program input to the annual Work Authorization Submission (WAS) and finalizing budgets for all Geologic Studies Program activities; monitoring progress of GSP activities in relation to schedules and provide management

intervention to resolve conflicts and slippages, as appropriate; information exchange; and other functions as necessary to meet changing programmatic objectives, priorities and budget constraints. Staff includes representatives for integration of program management and objectives, QA, and other related matters among the permanent employees of the Water Resources Division, employees of the Geologic Division working under memoranda of agreement, private contractors and other government personnel working under interagency personnel agreements.

1993 Deliverables:

Due Date	Deliverable	Parti-cipant
1/93	FY'93 PACs inputs (workscope and schedule)	USGS
4/93, 9/93	FY'94 Preliminary PAC's inputs	USGS

1992 Scenario:

Budget: $7545; 105% spent.

Organization	Role	Scope (see below)	Budget
EG&G	M&I	(a)	$48,000*
GSW	M&I	(b)	156,000*
LANL	M&I		1,022,000*
	Site QA	(c)	
	Site Management and Integration	(d)	
	Subtotal: $		
SNL	M&I	(e)	204,000*
TESS	M&I		760,000*

	Support YMPO and Integrate Site Characterization Activities	(f)	
	Surface-Based Testing Coordination	(g)	
	Outreach Support	(h)	
	Subtotal: $1,977,000	(check)	
T&MSS	M&I	(i)	813,000*
USBR	M&I	(k)	0
USGS	M&I		3,492,000*
	Computer Operation, Hydrology	(l)	416,000
	Branch Administrative Services		245,000
	M&I Branch Staff	(o)	688,000
	M&I - USBR		280,000
	Geologic Studies Program	(m)	400,000
	QA Implementation - GSP	(n)	400,000
	Hydrology Program Management	(o)	645,000
	QA Implementation - Hydrology	(p)	244,000
	Scientific Reports/Project Documents	(q)	100,000
	Subtotal: $		
UT	Maintain Salt Core	(r)	300,000*
RSN			250,000*
		TOTAL	7,545,000

FY'92 Scope:

T&MSS:

Provide for the overall management of site characterization activities, including planning, scheduling, budgeting, controlling, and reporting. Assist the YMSCPO Division Directors and the assigned WBS Managers in interfacing, with the Project participants. Provide site investigation support, responsible for activities/tasks which are consistent with the Project requirements for this WBS

element. Support the Surface Based Investigation Tracking (SBIT) system. Update and maintain the surface based investigation attribute database and integrate Site Atlas mapping capability. Assist the Project Office interaction with DOE/HQ and Project participants. Provide technical support to the Project's prototype drilling program. Prepare geologic evaluation reports on proposed drill sites; provide expertise on drilling and logging methodology; assist with preparation of final reports. Support DOE in the ongoing review and evaluation of the international high-level radioactive waste program, with the intent of integrating ideas, concepts, and designs into the Yucca Mountain Site Characterization Project. Attend meetings related to the international program; and prepare evaluation letters, memos, and reports in support of the integration effort. Support the Project Office in the effort to QA qualify "old" data, samples, and analyses for the Project. Review drilling records and geophysical and geologic logs of core; review sample custody records; and prepare new geologic and geophysical logs of core, as necessary, for evaluations. Prepare reports summarizing evaluations and recommendations to DOE.

LANL:

Plan, schedule, and coordinate LANL activities in the 1.2.3 WBS. Provide support site testing and coordinate requirements with facilities and testing personnel to ensure that testing can be conducted. Coordinate activities between characterization testing and test facilities, and plan tests as requirements change. Integrate intra-organization efforts, define work scope and milestones. Develop and maintain Project Documentation on the location, status, and design of site characterization activities. Develop, implement, and maintain detailed technical procedures to ensure that all applicable QA requirements are met. Provide interface with other YMP participants on site activities, including drilling, construction, and testing associated with the ESF. Implement QA procedures for site activities. Respond to Project Office requests for information and prepare reports as needed. Propose funding allocations. Report monthly progress to Project Leader at Los Alamos National Laboratory and YMPO. No level 1 or 2 milestones are planned for this area.

M&O:

<u>Manage and Integrate site characterization activities.</u>

-- Assist YMPO in strategic planning, scheduling, budgeting, controlling and reporting for surface based and ESF testing.

-- Provide analysis of project cost and schedule for site characterization activities.
-- Assist YMPO in setting test priorities based on established plan and new information from current activities.
-- Provide technical support to YMPO in managing site characterization activities.
-- Assist YMPO in ensuring that ESF testing is consistent with overall site characterization strategy.
-- Develop/Modify procedures to enable site characterization to achieve its goals in a cost-effective manner.
-- Assist principal investigators in writing initial draft study plans prior to YMPO review.
-- Perform technical and peer review for site characterization activities.
-- Assist YMPO Division Directors and assigned WBS managers in interfacing with the project participants.
-- Assist YMPO in interfacing with DOE/HQ.
-- Assist YMPO in determination that all essential tasks are included in program planning and have assigned responsibilities.
-- Support planning exercises to ensure that scope, budget and schedule are integrated for each participant, and also between participants.
-- Participate in Sample Oversight Committee (SOC).
-- Participate in the Technical Integration Group (TIG).
-- Use Technical Data Base (TDB) in the geologic/hydrologic models of Yucca Mountain to identify any inconsistencies.

<u>Coordinate Surface Based Testing Program</u>
-- Develop a plan for coordination of surface-based testing.
-- Perform test interference evaluations and update them as necessary.
-- Develop a global test interference analysis for the site.
-- Provide information for update of Project Site Atlas.
-- Develop testing implementation procedures as appropriate.

<u>Provide Field Management Support.</u>

<u>Support outreach activities for site characterization.</u>

EG&G:

Preparation of multiple mylar copies of the digitally generated elevation contour maps and other maps as requested.

GSW:

Assist the Yucca Mountain Project Office in coordination between

the USGS/Denver office and the USGS/HQ.

SNL:

Provide for the overall management of SNL activities associated with site investigations, sample management, testing and development activities, including planning, scheduling, budgeting, controlling, and reporting for SNL work elements. Appropriate management of interactions between participants and SNL and its contractors that relate to site investigations are included under this task.

Management and administrative support are required to establish a budget and a schedule, provide cost control and reporting, arrange for training of staff, and establish work and study definitions and analysis needs.

The same management procedures used for planning, scheduling, budgeting, controlling, and reporting other Sandia activities will be used to manage site investigation activities.

USGS:

Provide for the overall project management of USGS site characterization activities; interaction with the OCRWM and YMPO/M&O and other project participants and USGS organizations on site activities; overall implementation of quality-assurance procedures for USGS site activities; preparation of talks and papers, and participation in meetings and conferences, related to integrating investigations in various earth-science disciplines, with emphasis on the relationships of hydrology to geology, tectonics, volcanism, and crustal heat-flow; membership on the Earth Science Quality Assurance Team (ESQAT); participation in the development of QA guidelines for application in earth-science studies; site activity prerequisite reviews, including assisting USGS technical staff with identification of project prerequisites, preparing and distributing actions plans, providing input to monthly status reports, and assisting with prerequisite's completion through work authorization; coordination of engineering, personnel, equipment, facilities, and housing support for field operations with the DOE-NVO-YMPO FOC and DOE-NVO-NTSO; coordination and integration of USGS tests with DOE-YMP, T&MSS ESF Test Manager's Office (LANL) and the other scientific participants; review of QA program implementing documents in the areas of design, procurement, scientific investigations, construction, and operation to ensure that the QA program is appropriately implemented and QA program requirements are defined; and analysis and investigation of technical problems that relate to quality-affecting activities.

Provide preparation of technical or quality assurance

documentation and assistance with the resolution of open action items in a timely manner; performance of reviews; researching and preparing responses to issues and open Action Items; assisting with the collection and processing of records and other documentation; and monitoring compliance with the controlled document requirements.

UT:

Maintain SALT Core.

RSN:

No work scope beyond FY 92.

1992 Milestones accomplished:

Impact of FY'92 on FY'93:

Status at Beginning of FY'93:

FY'94 Scenario:

Budget:

FY'94 Scope: More of the same

1.2.3.2.1.1.1 MINERALOGY, PETROLOGY, AND ROCK CHEMISTRY OF TRANSPORT PATHWAYS

Purpose:

The purpose of this activity is to define the important mineralogical and geochemical variables along fracture and rock-matrix transport pathways at Yucca Mountain, in support of performance assessment and to evaluate the impact of repository construction on natural waste-transport barriers.

This activity supports all activities using X-ray diffraction data including the Transport Pathways, Alteration History, Fracture Mineralogy, and Sorption studies at Los Alamos as well as paleoclimatology and Geohydrology studies of the USGS.

Description:

- This activity will identify and determine the abundance of trace minerals that occur in the tuffs at Yucca Mountain. Emphasis will be placed on characterizing trace minerals such as Fe-Ti oxides which have significantly greater sorption potential than the bulk rock.

- The mineralogy of units above and below the potential repository horizon will be determined, and the mineralogy and chemistry of calcite in fractures will be examined to determine the origin of calcite-depositioning fluids.

- Mineralogic, chemical and petrographic data will be examined by probabilistic modeling and statistical extrapolation to 1) determine lateral and vertical trends in mineralogy, 2) correlate mineralogic and petrographic data with internal stratigraphy of the Topopah Spring member, 3) detect outlines in these data sets, and 4) extrapolate mineralogic and petrologic contracts between drill holes.

FY'93 Funding: $800,000 (Mission 2001: $842,000)

Rationale for FY'93 Funding: This is a priority 3 study.
This study supports ESF testing. It also supports priority 4 (GWTT Disqualified), priority 5 (Other Unsuitability studies) and priority 7 (Issue Resolution).

ITE Test Prioritization:

STUDY	UNSUITABILITY	REGULATORY COMPLIANCE	SCIENTIFIC CONFIDENCE
MINERALOGY AND PETROLOGY	High (14)	Medium (6)	Medium (9)

1.2.3.2.1.1.1 MINERALOGY, PETROLOGY, AND ROCK CHEMISTRY OF TRANSPORT PATHWAYS

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ITE Test Prioritization:

STUDY	UNSUITABILITY	REGULATORY COMPLIANCE	SCIENTIFIC CONFIDENCE
MINERALOGY AND PETROLOGY	High (14)	Medium (6)	Medium (9)

WBS Elements (1.2.3.2.) / Participant:

.1.1.1	LANL	MIN., PETROL., AND ROCK CHEM. OF TRANSPORT PATHWAYS	Scope (see below)	Budget
		Statistical Analysis and Chemistry of Host rock	(a)	$45,000
		Characterization of Airborne Minerals	(b)	$ 161,000
		Separate Trace Minerals from New Core	(c)	$54,000
		Analyze Quantitative Mineralogy of Core	(d)	$164,000
		Fracture Mineralogy from Existing and New Core	(e)	$240,000
		Continue to Develop Calcite Precipitation Model	(f)	$136,000
			LANL TOTAL	**$800,000**

Principal Investigator: D.E. Broxton, LANL

FY'93 Scope:

- Continue work to define limits on precision and accuracy for X-ray diffraction analyses of tuffs at Yucca Mountain
- Determine natural levels of airborne mordenite and/or other minerals at Yucca Mountain.
- Determine the abundance of trace minerals in tuff at Yucca Mountain.
- Analyze core samples to assess mineralogy of rock units above and below the potential repository horizon.
- Analyze fracture lining minerals
- Analyze calcite in fractures at Yucca Mountain to determine its origin.

Status at Beginning of FY'93:

Study Plan: 8.3.1.3.2.1 'Mineralogy, Petrology, and Chemistry of Transport Pathways' approved 6/13/89, Phase II NRC Review complete 3/13/91

JP/TPP: May require TPP for laboratory work

Environmental Studies: Probably none needed - no field activities planned.

Prerequisite Predecessor: A number of the activities require core samples and thus depend on the progress of the drilling programs.

1993 Deliverables:

Due Date	Deliverable	Participant	Delivered ?
9/30/93	Report: Statistical analysis of Topopah Spring Compositional Variability MS 3152	LANL	
4/93	Report: Fibrous Minerals at Yucca Mountain	LANL	
9/93	Report: Characterization of Airborne Mineral Around UZ-16	LANL	

1992 Scenario:

Budget: $611,000; $585,000 (96%) spent.

1992 Accomplishments:

- Completed software QA for X-ray diffraction work
- Continued to analyze samples

1992 Deliverables:

Due Date	Deliverable	Participant	Delivered ?
6/30/92	Report: Calcite in the upper Paintbrush Tuff MS 3120	LANL	(a)
8/17/92	Report: Fracture mineralogy of the Paintbrush Tuff MS 3130	LANL	(b)
9/30/92	Report: Geologic evaluation of Six Nonwelded Tuff Sites for a Surface-Based Test Facility for the Yucca Mountain Site Characterization Project MS 3137	LANL	(c)

(a) Completed and submitted to TPO
(b) Submitted to Chemical Geology
(c) In technical review

Impact of FY'92 on FY'93: None.

FY'94 Scenario:

Budget: $1,743,000

FY'94 Scope:

- Continue studies as more samples become available through progress in the drilling program.

1.2.3.2.1.1.2 MINERALOGIC AND GEOCHEMICAL ALTERATION

Purpose:

To determine the timing, temperature and hydrologic conditions of past alteration at Yucca Mountain, and define how minerals and glasses in the rocks will respond to the elevated temperatures and modified water vapor pressures and fluid compositions produced by the repository.

To characterize past and present natural alteration processes that have affected the potential geologic repository and to predict future effects of natural and repository-induced alteration.

Activity supports colloid transport, fracture mineralogy and transport pathway (LANL) and geologic, hydrologic and isotope geochemistry (USGS), sorptive properties (LANL), kinetics and thermodynamics (LANL), thermal and rock properties (SNL), thermal modeling (SNL).

Description:

- Perform surface and subsurface studies of the host rock and surrounding units, borehole evaluation of faults and fractures, geologic mapping of the exploratory shaft and drifts, and systematic drilling.

- Perform quantitative assessment of calcite and silica mass balance from trench 14.

- Perform alteration studies (for alteration history assessment), including petrologic studies; scanning electron microscopy; electron spin resonance dating; potassium/argon isotopic studies; fluid inclusion studies; dehydration/rehydration experiments on smectites, zeolites, and volcanic glasses; and long term heating experiments in unsaturated to saturated conditions.

FY'93 Funding: $743,000 (Mission 2001: $783,000)

Rationale for FY'93 Funding: A priority 2 study.

This study involves otherwise irretrievable data. It also supports priority 4 (GWTT), priority 5 (Other Unsuitability Studies), and priority 7 (Issue Resolution).

In addition, it supports Level 2 milestone TO11, Geochemical Characterization of Yucca Mountain

ITE Test Prioritization: Middle Study Plan (3 of 3 middle 20)

ITE TEST PRIORITIZATION

STUDY	UNSUITABILITY	REGULATORY COMPLIANCE	SCIENTIFIC CONFIDENCE
Mineral Alteration	**Medium (3)**	**Medium (8)**	**Medium (18)**

WBS Elements (1.2.3):/Participant:

2.1.1.2	LANL	MINERALOGIC AND GEOCHEMICAL ALTERATION	Scope (see below)	Budget
		Analyze Alteration of cores	(a)	$174,000
		Mineralogic Alteration Transport and paleohydrology type of effort	(b)	$223,000
		Determine Feasibility Ar/Ar Rb/Sr and K/Ar Secondary Type of Effort	(c)	$266,000
		Long Term Heating Experiments	(d)	$80,000
			TOTAL	$ 743,000

Principal Investigator: Schon Levy, LANL

FY'93 Scope:

(a) Collect, textural, mineral and chemical analyses for core containing alteration features, with emphasis on faults, breccia zones, transport-related features.

(b) Examine relationship between mineral alteration: hydrologic history, using surface and subsurface samples, to identify past preferential ground-water pathways.

(c) Radiometrically date secondary minerals and determine feasibility of their use as indicators of alteration age or paleohydrology.

(d) Determine dehydration/rehydration behavior and volume changes during short-term experiments on pure minerals; determine stability of clinoptilolite, smectite, hematite, devitrified, vitric, and zeolitic tuffs, vitrophyre, and opal-CT in heated dry, steam, and saturated atmospheres over periods of months to years.

Status at Beginning of FY'93:

Study Plan: **8.3.1.3.2.2** History of Mineral and Geochemical Alteration of Yucca Mountain, Approved 12/18/91, Phase II Review Deferred

JP/TPP:

Environmental Studies:

Prerequisite Predecessor:

1993 Deliverables:

Due Date	Deliverable	Participant	Delivered ?
10/30/92	"Chemical Transport in Zeolitic Alteration", MS 3138	LANL	(a)
4/15/93	"Final Report on Bedrock", MS 3150	LANL	(b)
9/30/93	"Analyses of Core for Alteration, MS 3342	LANL	No
9/30/93	"Report on Zeolite Dating", MS 3343	LANL	No
	Present paper at "Zeolites '93"	LANL	No

(a) 60% complete, 8/92

(b) 30% complete, 8/92

1992 Scenario:

Budget: $916,000; $890,000 (97%) spent.

1992 Milestones accomplished:

- Conducted investigations supporting and initiated preparation of a report addressing calcite-silica evidence at Trench 14 in regard to the ground-water up-welling hypothesis.
- Data collection completed for study on effects of dehydration and re-hydration of lower vitrophyre of the Topopah Spring Member of Paintbrush Tuff.

1992 Deliverables:

Due Date	Deliverable	Participant	Delivered ?
3/31/92	"Laminated Zone in Trench 14", MS 3141	LANL	(a)
4/30/92	"Experimental Dehydration of Volcanic Glasses", MS 3143	LANL	Yes, 6/92
7/31/92	"K/Ar Dating of Clays and Zeolites", MS 3142	LANL	(b)

(a) 65% complete, 8/92
(b) In Technical review 8/92

Impact of FY'92 on FY'93

MS 3141, "Laminated Zone in Trench 14," was delayed due to participation in the issue resolution process.

FY'94 Scenario:

Total Budget: $689,000

FY'94 Scope:

Analyze Alteration of New Cores
Long-term Heating Experiments
Mineral Alteration Transport and Paleohydrology

1.2.3.2.1.2.2 KINETICS AND THERMODYNAMICS OF MINERAL EVOLUTION

Purpose:

Determine the stability of minerals and glasses along flow paths to the accessible environment to assess impacts of waste emplacement on mineral stability and the resultant effects on radionuclide migration.

Description:

- Collect data to establish validity of a conceptual model of mineral and glass evolution
- Generate experimental data on the kinetics of glass and silica polymorph transitions and their relationship to aqueous silica activity.
- Provide thermodynamic data and model for clinoptilolite, albite, and analcime and possibly mordenite.

FY'93 Funding: $40,000 (Mission 2001: $40,000)

Rationale for FY'93 Funding: A priority 2 study.
This study involves otherwise irretrievable data.

ITE Test Prioritization:

STUDY	UNSUITABILITY	REGULATORY COMPLIANCE	SCIENTIFIC CONFIDENCE
Mineral Evolution Kinetics	**Low (unranked)**	**Medium(16)**	**Low (3)**

WBS Elements (1.2.3):/Participant:

2.1.1.2	LANL	KINETICS AND THERMODYNAMICS OF MINERAL EVOLUTION	Scope (see below)	Budget
		Revise Study Plan	Revise Study Plan	$40,000
			LANL TOTAL	**$ 40,000**

Principal Investigator: D.E. Broxton, LANL

FY'93 Scope:

- Respond to outstanding comments on draft Study Plan, participate in comment resolution, and submit revised Study Plan for DOE acceptance.

Status at Beginning of FY'93:

Study Plan: 8.3.1.3.3.2 "Kinetics and Thermodynamics of Mineral Evolution" Study Plan submitted to DOE on 2/23/89, currently in process of being revised to address technical review comments.

JP/TPP: None required.

Environmental Studies: None required.

Prerequisite Predecessor: None

1993 Deliverables:

Due Date	Deliverable	Participant	Delivered ?
9/93	Revised Study Plan	LANL	

1992 Scenario:

Budget: Unfunded in FY 92.

1992 Milestones accomplished: Unfunded in FY 92

1992 Deliverables: Unfunded in FY 92

Impact of FY'92 on FY'93 None.

FY'94 Scenario:

Total Budget: $743,000

FY'94 Scope:

- Determine thermodynamic properties of clinoptilolite-heulandite, analcime, and albite from literature studies and experimental work ($ 68,000)
- Determine rates and mechanisms of reactions from amorphous silica to quartz via opal and cristobalite through literature search and experimental work. ($ 450,000)
- Determine aqueous silica activity at equilibrium with cristobalite, quartz, and opaline phases through literature search and studies using flexible cell and cold-seal hydrothermal vessels at variable temperatures. ($225,000)

1.2.3.2.2.1.1 VERTICAL AND LATERAL DISTRIBUTION OF STRATIGRAPHIC UNITS IN THE SITE AREA

Purpose: Obtain an understanding of the vertical and lateral distribution, variability, and emplacement history of stratigraphic rock units and lithostratigraphic subunits within the Yucca Mountain Site Area through geologic mapping, surface-based geophysical surveys, borehole geophysical studies, and analyses of drill core and surface samples. Results will form the basis for a three-dimensional geologic model of the site to support site characterization and performance assessment studies, as well as design criteria for the engineered barriers.

Description: 1. Establish the reference stratigraphic framework. Develop a database for geologic and hydrologic purposes from analyses of rock samples collected from drill holes. Incorporate additional stratigraphic data collected from field surface activities. Establish the 3-D distribution of rock characteristics.

2. Perform surface-based geophysical surveys to help define the lateral and vertical distribution of stratigraphic units and lithostratigraphic subunits of the Yucca Mountain tuffs, and to help determine favorable sites for future drill holes.

3. Obtain commercial and experimental geophysical logs in future holes drilled in the vicinity of Yucca Mountain to help determine the vertical and lateral continuity of the lithostratigraphic units. Acquire additional logs in existing water table drill holes, existing deep drill holes (where hole size permits), and all proposed drill holes that penetrate the base of the Topopah Spring Member.

- Use borehole gravimetry in available boreholes to obtain bulk density and structural information for the area in the immediate vicinity of each borehole.

- Test and evaluate large spacing electromagnetic (EM) and resistivity logging to determine applicability for studying fractures and lithophysal zones and for interpreting anomalies detected by means of other borehole and surface geophysical methods.

4. Perform laboratory petrophysical properties studies of drill core samples for correlation with in situ rock properties determined by geophysical logging of boreholes.

5. Collect data to identify mineralogical variations that produce the observed changes in magnetic susceptibility and remanent magnetization Develop empirical relationships between depositional breaks and variations in these magnetic properties to provide information for the three-dimensional geologic model. Focus studies on identification of depositional units and rock characteristics changes in the Topopah Spring Member.

FY'93 Funding: $2,025,000 (Mission 2001: $1,685,000)

Rationale for FY'93 Funding: A Priority 5 Study

ITE Test Prioritization:

STUDY	UNSUITABILITY	REGULATORY COMPLIANCE	SCIENTIFIC CONFIDENCE
Stratigraphic Units	High (9)	High (15)	High (14)
Other studies that are supported by the above:			
Surface-based UZ Percolation	High (1)	High (1)	High (1)
Site-specific Subsurface Info	Medium	High (9)	High (4)
Site-Area Faulting	Medium	Medium	High (7)
Faulting near Facilities	Low	Medium	High (8)

WBS Elements/Participant:

DOE WBS Manager - M. Tynan (.1, .2, .4)
R. Long (.3, .5)

2.2.1.1	Participant	VERTICAL AND LATERAL DISTRIBUTION OF STRATIGRAPHIC UNITS IN SITE AREA	Scope	Budget
	USGS	Stratigraphic Studies	borehole logging and sampling, evaluation and synthesis of data, reporting, construction of isopach and structural contour maps	$475,000
		Surface-Based Geophysics	conduct geophysical surveys, develop methods, reporting	1,280,000
		Borehole Geophysical Surveys	compute porosity and water saturation from borehole logs, run additional logs, evaluate and interpret logs, report writing	158,000
		LOE Activities	administrative duties performed by the principal investigator related to this P&S Account	112,000
			USGS TOTAL	**$2,025,000**

Principal Investigators:

P&S Account:	Vert. & Lat. Distr. of Strat. Units	R. Spengler (USGS)
Summary Accounts:		
	Stratigraphic Studies	C. Hunter
	Surface-Based Geophysics	C. Hunter (T. Brocher)
	Borehole Geophysical Surveys	P. Nelson

FY'93 Scope:

Stratigraphic Studies:
Conduct Logging and Synthesis of Existing and New Borehole Data
Continue Isotopic Sampling and Analyses
Evaluate and Synthesize Isotopic Data
Construct Isopach and Structural Contour Maps

Surface-Based Geophysics:
Conduct Field Seismic Survey Across Crater Flat and Yucca Mountain
Conduct Ground Magnetic and Gravity Surveys

Borehole Geophysical Surveys:
Maintain and Expand Existing Well Log Database
Run Magnetometer and Magnetic Susceptibility Logs UZ/SD

Status at Beginning of FY'93:

Study Plan:

8.3.1.4.2.1 - "Characterization of the Vertical and Lateral Distribution of Stratigraphic Units within the Site Area"

Sections .1, .2, and .4 submitted to NRC 6/22/92; NRC Phase I review completed on 12/14/92.

Sections .3 and .5 not yet submitted to YMPO (may be transferred to another WBS element)

JP/TPP:

JP 92-15: Surface Geophysical Surveys on hold (assuming that JP will not be required for Reflection Seismic work - 11/20/92)
Records Package ID: DRC-022
Division Director: J.R. Dyer (YMP)
JP Coordinator: J. Savino (TMSS)

TPP 92-08: Surface Geophysical Surveys; initiated R0, approved
Records Package ID: TM-0008
YMPO contact: M.C. Tynan
PE: J. Savino (TMSS)

Environmental Studies:

Preactivity surveys required for reflection/refraction seismic work:
Radiological, Archeological, Biological

Prerequisite Predecessors: None

1993 Deliverables:

Due Date	Deliverable	Participant	Delivered?
4/93	Preliminary Report/TDIF: Isotopic Data	USGS	
4/93	Report/TDIF: Evaluation of Stratigraphic Model of Central Block	USGS	
4/93	Preliminary Report/TDIF: Lithologies of Completed Boreholes	USGS	
4/93	Report/TDIF: Preliminary Data for Yucca Wash	USGS	
4/93	Preliminary Report/TDIF: Core Data from Borehole Geophysical Surveys	USGS	
6/93	Report/TDIF: Map of Yucca Wash	USGS	
6/93	Report/TDIF: Preliminary Data from Seismic Line	USGS	
9/93	Preliminary Report/TDIF: Lithologic Logs	USGS	
9/93	Progress Report/TDIF: Analytical Database	USGS	
9/93	Report/TDIF: Results from Gravity and Magnetic Surveys	USGS	
9/93	Report/TDIF: Yucca Wash	USGS	
9/93	Report/TDIF: Seismic Surveys	USGS	
9/93	TDIF: Magnetometer Results-UZ-16	USGS	
9/93	TDIF: Borehole Data to Technical Database	USGS	
9/93	Progress Report/TDIF: Borehole Computations	USGS	

FY'92 Scenario:

Budgeted	Spent		Variance
	Amount	Percent	
$ 1,630,000	$ 907,000	56	Underspending partially explained by delay in executing the seismic reflection/refraction line.

1992 Accomplishments:

- Study plan revised to incorporate review comments and submitted to YMPO for approval and submittal to the NRC.
- Evaluated usefulness of Sr isotope variation as an indicator of stratigraphic units.
- Synthesized existing borehole data for inclusion in the three-dimensional geologic model.
- Completed review of preexisting gravity and magnetic data from Fortymile Wash. No significant vertical offset of geologic units underlies Fortymile Wash.
- RFP for Reflection Seismic Program issued
- Carried out five gravity and magnetic profiles across Midway Valley, and six profiles in Yucca Wash. Reduced data for four of the five profiles across Midway Valley.
- Evaluated commercially available electrical logging systems. Results will be described in a report

1992 Deliverables:

Due Date	Deliverable	Participant	Delivered?
12/91	Study Plan Submitted	USGS	12/30/91 per USGS
2/92	Study Plan to NRC	USGS	6/22/92 per R. Rogers
6/92	Report: Existing Water Table Holes	USGS	9/1/92 per USGS

Other Deliverables Funded by this WBS No, but not listed as Milestones in PACS for FY 92:

Report	Participant	Date Delivered
"Gravity and magnetic data of Fortymile Wash, Nevada Test Site, Nevada," by D.A. Ponce, S.B. Kohrn, and S. Waddell	USGS	5/22/92
"Gravity and magnetic anomalies in the vicinity of Yucca Mountain, and their geologic implications," by D.A. Ponce and H.W. Oliver.	USGS	2/2/92
"Status of aeromagnetic survey coverage of a part of southwestern Nevada and southeastern California," by R.f. Sikora, D.A. Ponce and H.W. Oliver.	USGS	12/2/92
"Assessment of geophysical logs from borehole USW G-2, Yucca Mountain, Nevada," by P.H. Nelson and Ulrich Schimschial	USGS	9/25/92
"Magnetic Investigations of Buried Volcanic Centers near Yucca Mountain," by V.E. Langenheim, K.S. Kirchoff-Stein, and H.W. Oliver (Submitted as work under WBS 1.2.3.2.2.1, but it sounds like it should be included under 1.2.3.2.5.5, Characterization of Igneous Intrusive Features)_	USGS	12/3/92

Impact of FY'92 on FY'93:

The delay in implementing the seismic reflection/refraction line across Yucca Mountain results in geophysical work previously planned for FY 93 to also be delayed pending completion of the line. Further delays in the seismic reflection line could impact selection of site for borehole G-5.

FY'94 Scenario:

Budget: $2,540,000

FY'94 Scope: Vertical and Lateral Distribution of Stratigraphic Studies within the Site Area

Stratigraphic Studies - **$1,140,000:** Continue synthesis of borehole lithostratigraphic data from new and existing boreholes; collect isotopic samples from UZ-11, -9a, -3, -9b, WT-23, G-5, -6; continue evaluation and synthesis of isotopic data; lithologic logging of new boreholes; construct isopach and structural contour maps; prepare reports.

Surface-Based Geophysics - **$900,000:** Continue intermediate seismic reflection and refraction surveys; conduct ground magnetic and gravity surveys, continue development of electrical methods; write reports

Borehole Geophysical Surveys - **$300,000:** Run logs in G-5, -6; UZ-7a, -11, 9a, -3; WT-23, V-1, -2; process and interpret logs; write reports on porosity and water saturation, geophysical characteristics of USW G-5.

Magnetic Properties and Stratigraphic Correlations - **$200,000:** collect magnetic susceptibility and remanent magnetism data from core and outcrop samples.

NOTE:	Activity 6 of this study has been deleted. Its scope of work was transferred to 8.3.1.4.1.2 (Integration of Geophysical Activities)

1.2.3.2.2.1.2 STRUCTURAL FEATURES WITHIN THE SITE AREA

Purpose:

- To determine the frequency, distribution, characteristics, and relative chronology of structural features within the Yucca Mountain site area.

  - To provide input to structural model to address potential for rapid transport pathways in repository block and down gradient of repository.
  - To provide input on structural features to the geologic model
  - To provide information on the mineability across geologic structures and the stability of underground openings
  - To provide input for the development of the tectonic model and seismic rick assessment for Yucca Mountain, required for determinations on the Preclosure and Postclosure Tectonics Qualifying conditions by the end of FY'97.

Description:

- Collect geologic data to develop geologic and structural models of Site through lithostratigraphic interpretations, fault and fracture mapping, pavement studies, geophysical surveys, paleomagnetic analyses, and logging of boreholes.

- Perform detailed geologic mapping of zonal features in exposed ash-flow tuffs of YM to provide stratigraphic control for identifying small-scale faults.

- Study lateral variability of fracture networks by detailed mapping (on surface and from aerial photographs) and pavement analysis.

- Study subsurface distribution and geologic characteristics of fracture-fault zones by analysis of core samples, borehole evaluations, ESF studies, and geophysical surveys (borehole video-camera, acoustic televiewer, shear-wave VSP)

- Perform geologic mapping and fracture analysis on the ESF and drifts.

FY'93 Funding: **$1,451,000** (Mission 2001: $1,495,000)

Rationale for FY'93 Funding: A Priority 3 study

Studies related to ESF testing in the starter tunnel and studies related to tectonics program depend on the results of the subject program.

ITE Test Prioritization:

STUDY	UNSUITABILITY	REGULATORY COMPLIANCE	SCIENTIFIC CONFIDENCE
STRUCTURAL FEATURES	High (10)	High (16)	High (15)

WBS Elements (1.2.3.) / Participant:

.2.2.1.2	Participant	STRUCTURAL FEATURES WITHIN THE SITE AREA	Scope	Budget
	USGS	Geologic Mapping of Zonal Features	Detailed mapping of the internal stratigraphy within the Paintbrush Tuffs.	$811,000
		Surface Fracture Network Studies	Gather detailed information on surface fracture distribution and properties in volcanic bedrock units.	$90,000
		Borehole Evaluation of Faults & Fractures	Evaluate faults and fractures from borehole samples and geophysical logs	$0
		Geologic Mapping of the ESF & Drifts	Comprehensive geologic mapping of the ESF and drifts.	$342,000
		LOE	Planning and administrative aspects of the activity.	$208,000
			USGS TOTAL	**$1,451,000**
	LBL	Vertical Seismic Profiling	Carry out VSP survey in support of fracture characterization.	$0
			LBL TOTAL	**$0**
	REECo	Logistical Support	Deepen northernmost test pit at Fran Ridge as ESF mapping analog.	$233,000
			REECo TOTAL	**$233,000**
			STUDY TOTAL	**$1,684,000**

Principal Investigator:

P&S Account:	Structural Features at the Site	Rick Spengler, USGS
Summary Accounts:	Geologic Mapping of Zonal Features	Hunter, USGS
	Surface Fracture Network Studies	Fahy, USBR
	Geologic Mapping of ESF & Drifts	Beason, USBR
	Level of Effort	Spengler, USGS
	Vertical Seismic Profiling	Majer, LBL
	Fran Ridge Test Pits	Leonard, REECo

FY'93 Scope:

Geologic Mapping of Zonal Features

- Conduct detailed structural mapping and structural analysis of fault zones.
- Perform geologic mapping of northeast corner of site area.
- Perform geologic mapping of western Yucca Mountain and Northern Crater Flat.
- Continue sampling and isotopic/geochemical analysis of reference sections.
- Evaluate data and development of isotopic, geochemical and lithostratigraphic reference.

Surface Fracture Network Studies

- Compile map of Tiva Canyon Data area

Geologic Mapping of the ES and Drifts

- Revise and submit Study Plan
- Map portal; interpret and submit data
- Prepare conventional geologic map of launch chamber
- Prepare photogrammetric map of launch chamber
- Reduce launch chamber mapping data
- Write mapping QAGR

Status at Beginning of FY'93:

Study Plan:

Study Plan **8.3.1.4.2.2**, Characterize structural features within the site area; Rev 0 includes activities 8.3.1.4.2.2.1, .2 and .4, submitted to NRC 2/9/89

Study Plan **8.3.1.4.2.2**, Characterize structural features within the site area; Rev 1 contains activities 8.3.1.4.2.2.3, .5, submitted to NRC 6/15/92

Study plans must be rewritten for new ESF configuration

JP/TPP: 92-7, Fran Ridge Test Pit Mappings R0 approved, 100% complete

Environmental Studies:

Prerequisite Predecessor: None

1993 Deliverables:

Due Date	Deliverable	Participant	Delivered ?
12/92	Revised Study Plan	USGS	12/92
1/93	Map: Tiva Canyon	USGS	
3/93	Data Submittal PDA: Portal Map/Interpretation	USGS	
3/93	Interim Report: Northern Crater Flat Mapping	USGS	
4/93	Preliminary Report: Development of Database	USGS	
4/93	Interim Report/TDIF: Map NE Corner of the Site Area	USGS	
9/93	Preliminary Map/TDIF: Western Yucca Mountain	USGS	
9/93	Report: Ghost Dance Fault	USGS	
9/93	Data Submittal PDA: Geologic Mapping	USGS	
9/93	Preliminary Map/TDIF: NE Corner of the Site	USGS	

FY'92 Scenario:

Budget:

Budgeted	Spent		Variance
	Amount	Percent	
$ 945,000	$ 742,000	78	Budget uncertainties at the beginning of the FY resulted in delays in hiring staff to perform work.

1992 Accomplishment:

- Completed revision of Study Plan for additional activities (.3 and .5) to address review comments. Submitted Study Plan to YMPO for approval. Submitted to NRC on 6/15/92.
- Conducted detailed structural analysis of the central Ghost Dance fault.
- Continued development of reference geochemical section. Studied Sr isotopic compositions from samples that have never been saturated. These will be used for reference comparison when samples are obtained from boreholes.
- Began construction of isopach maps, and incorporation of data into a computer database for three-dimensional computer-based modeling.
- Mapped in detail a 2 km x 0.5 km area of stratigraphically complex rhyolite of CH in upper Paintbrush Canyon.
- Completed preliminary map of northern Crater Flat.
- Continued surface-fracture network studies on the west side of Fran Ridge (four bedded tuff stations and one upper-lithophysal station), Solitario Canyon (bedded tuffs), and on the east of Exile Hill. Continued reduction and analysis of previously collected data.
- Borehole data was re-formatted to facilitate evaluation of faults and fractures.
- Deepened Fran Ridge test pit to allow prototype ESF mapping to be developed.
- Continued enhancement of software to support vertical seismic profiling in the C-well complex. Using available data from Yucca Mountain, modeled some test cases to examine likely sensitivities and potential problem areas.

1992 Deliverables:

Due Date	Deliverable	Parti-cipant	Delivered ?
9/92	Summary report northeast corner of site area	USGS	???
9/92	Report data on exposed fault zones	USGS	???

1992 Deliverables:

Due Date	Deliverable	Parti-cipant	Delivered ?
9/92	Summary report northeast corner of site area	USGS	???
9/92	Report data on exposed fault zones	USGS	???
8/92	Maps of southwest Yucca Mountain	USGS	???
9/92	Data of samples TPT, THT, T	USGS	???
6/92	Map of Tiva Canyon fractures for review	USGS	???
8/92	Transmit data from Fran Ridge Pavement	USGS	???
8/92	Prow Pass and Solitario Data Transmit	USGS	???
8/92	Summary and catalog of existing fracture data	USGS	???
11/91	Surveillance report(surface fracture network studies)	USGS	???
2/92	Submit technical procedure for review TMS	USGS	???
4/92	Surveillance report(borehole evaluation of faults & fractures)	USGS	???
4/92	Specification for data acquisition	USGS	???
7/92	G-5 data acquisition and analysis	USGS	G-5 not drilled
8/92	Submit receipt of documentation for G-5 drilling plan	USGS	G-5 not drilled
9/92	Summary report and catalog of existing data	USGS	???

Impact of FY'92 on FY'93:

None.

FY'94 Scenario:

Budget: $2,245,000

FY'94 Workscope:

Structural Features within the Site Area

Geologic Mapping of Zonal Features - **$760,000:** Continue to map exposed fault zones, NE corner of Site, Northern Crater Flat; Continue sampling and isotopic/geochemical analyses; develop isotopic/geochemical/lithostratigraphic reference sections.

Surface Fracture Network Study - **$265,000:** Continue development of Tiva Fracture Model, Prepare and map 5 new pavements, develop a local 3-D model at each pavement station, integrate with borehole data, write 2 reports on pavement studies and pavement fractures of Yucca Mtn.

Borehole Evaluation - Faults/Fractures - **$394,000**: Continue to collect, reduce, and analyze borehole television data from NRG-6, UZ-16, -14, -7A; WT-23, UZ-11, V-1, -2; G-5, -6: SRG-2, -3, -4, -5; UZ-9A, -3; write New Boreholes Phase II Rept.

Geologic Mapping of ES and Drifts - **$810,000:** Continue to map ramp and drifts.

Three-Dimensional Geologic Model - **$218,000**: Develop and submit Study Plan to YMPO and NRC for 3-Dimensional Geologic Model

1.2.3.2.2.2.1 SYSTEMATIC ACQUISITION OF SITE-SPECIFIC SUBSURFACE INFORMATION

Purpose:

To collect statistically valid distribution of geologic data to characterize the three-dimensional distribution of rock characteristics, including hydrologic and geochemical variables, for the unsaturated zone of the repository site.

Description:

A suite of boreholes will be drilled through the rocks forming the repository horizon to about two hundred feet below the static water table. Drillholes will be continuously cored. The intact core will be examined carefully and logged in detail for information important to either engineering design or performance assessment activities. The drill core will also provide physical specimens for laboratory testing of hydrologic and mechanical rock properties important to design and performance assessment. Specimens will also be analyzed for mineralogic and geochemical purposes as well. The drill holes themselves will provide access to the subsurface environment of Yucca Mountain. These access locations will be used by certain other site characterization activities that are studying the in situ characterization of the mountain.

The Systematic Drilling Program will provide a major portion of the total information and physical sample material from within the proposed repository and immediate vicinity. Only the ESF will provide a similar volume of samples or information, and this material will be restricted to the location of the ESF and related underground excavations. In this respect, the Systematic Drilling program-- particularly when combined with the holes to be drilled as part of the UZ percolation study, may be viewed as providing extensive coverage whereas the ESF itself provides intensive detail. Also, the extent to which the ESF will sample rocks belonging to the tuffs of Calico Hills is uncertain. Unless the ESF penetrates into the Calico, core from the Systematic Drilling program will be the only sample material obtained by the Project from the Calico Hills.

FY'93 Funding: $130,000 (Mission 2001: $264,000)

Rationale for FY'93 Funding: A priority 5 study.

ITE Test Prioritization: Not Ranked

WBS Elements (1.2.3.)/Participant:

.2.2.2.1	Participant	SYSTEMATIC ACQUISITION OF SITE-SPECIFIC SUBSURFACE INFORMATION	SCOPE:	Budget
	SNL	Field Activities to Support Systematic Drilling		$0
		Scoping and Prep Drilling Activities	Conduct scoping studies and prepare prerequisites for SD program.	$130,000
			SNL TOTAL	**$130,000**

Principal Investigator:

P&S Account: Syst. Acquis. of Site-Specific Subsurf. Info. Rautman, SNL

Summary Account: Conduct Scoping & Prep Drilling Activities Rautman, SNL

FY'93 Scope:

- Complete prerequisites for drilling
- Conduct surface transect work to fill out existing data set
- Evaluate entire transect data set using statistical and geostatistical methods

Status at Beginning of FY'93:

Study Plan: 8.3.1.4.3.1 - "Systematic Acquisition of Site-Specific Subsurface Information", verify comment resolution 9/4/92

JP/TPP:

Begin planning for SD-1 prerequisites. SD-1 is scheduled for FY 94.

Environmental Studies:

Begin planning for SD-1 prerequisites. SD-1 is scheduled for FY 94.

Prerequisite Predecessor: None

1993 Deliverables:

Due Date	Deliverable	Participant	Delivered ?
9/93	Progress Report: Surface Transect Work	SNL	

FY'92 Scenario:

Budget:

Budgeted	Spent		Variance
	Amount	Percent	
$ 130 K	$ 118 K	91	No significant variance.

1992 Accomplishments:

- Continued evaluation of "framework" matrix properties based on outcrop samples and samples from existing boreholes. In addition to the statistical variations, there are also deterministic components to the distribution of properties. These deterministic factors result from well understood geologic processes.
- Continued to explore gas permeameter development. Prototype device was tested in the field. It operated successfully, but operation in a production mode may not be successful.
- Carried out a limited natural-analog scoping study in the Bandelier Tuff near Los Alamos.

1992 Deliverables:

Due Date	Deliverable	Participant	Delivered ?
	Rautman, C.A., and A.L. Flint, "Deterministic Geologic Processes and Stochastic Modeling", in Proc. Third International High Level Radioactive Waste Management Conference, Vol 2, pp. 1617-1624.	SNL	4/92
	Rautman, C.A., "Advanced Geostatistical Methods Applied to the Yucca Mountain High-Level Nuclear Waste Program," in Abstracts, 29th International Geological Congress, Vol. 3, p. 868.	SNL	4/92

Impact of FY'92 on FY'93:

None.

FY'94 Scenario:

Budget: $511,000 (This level anticipated supporting the drilling of 3 to 4 boreholes in FY 94. Current schedule calls for only SD-1 to be drilled in FY 94.)

FY'94 Scope:

- Scoping and Planning Activities
- Field Activities to Support borehole SD-1
- Rock Properties measurement to support SD-1
- Data analysis and report to support SD-1

1.2.3.2.2.2.2 THREE-DIMENSIONAL ROCK CHARACTERISTICS MODELS

Purpose:

Develop computer based models of rock characteristics and other geologic features for the Yucca Mountain site. Models will serve as focal points for data and information obtained from many diverse site characterization studies. The models will summarize and integrate site characterization data for performance assessment and design activities.

Description:

This study aims to incorporate three-dimensional information from site characterization activities into a computer model that can serve as a basis for performance assessment and design. Geostatistical simulations will be used to characterize the regions between data points. Visualization of the data in two and three dimensions is also a goal.

FY'93 Funding:

$102,000

Rationale for FY'93 Funding:

Three-dimensional geologic modeling falls under priorities 5 and 8.

ITE Test Prioritization:

Not rated in the ITE process.

WBS Elements (1.2.3..) / Participant:

2.2.2.2	Participant	THREE-DIMENSIONAL ROCK CHARACTERISTIC MODELS	Scope	Budget
	SNL	Prepare Study Plan	Develop and write the Study Plan for this activity.	$4,000
		Develop Simulation Software	Integrate prototype simulation computer routines into a "production" program and test it.	$98,000
			SNL TOTAL	**$102,000**

Principal Investigator:

P&S Account:	3-D Rock Characteristic Model	Rautman, SNL
Summary Accounts:	Prepare Study Plan	Rautman, SNL
	Develop Simulation Software	Rautman, SNL

FY'93 Scope:

- Initiate development of a Study Plan for this activity.
- Develop coherent software module for simulation
- Create preliminary rock properties models to test software
- Investigate methods for block-scale upscaling of simulated models
- *Lynx* system model development
- Support Stanford Center for Reservoir Forecasting

Status at Beginning of FY'93:

Study Plan:
Not yet written.

JP/TPP:
Not applicable.

Environmental Studies:
Not applicable.

Prerequisite Predecessor: None

1993 Deliverables:

Due Date	Deliverable	Parti-cipant	Delivered ?
4/93	Report: Preliminary Rock Property Models		
9/93	Progress Report: Simulation Software Development	SNL	

FY'92 Scenario:

Budgeted	Spent		Variance
	Amount	Percentage	
$ 229,000	$ 167,000	73	

1992 Milestones accomplished:

- Obtained and installed LYNX Geotechnical Modeling System (GMS) to facilitate three-dimensional modeling.
- Carried out simplified modeling to become familiar with the software.

1992 Deliverables:

Due Date	Deliverable	Participant	Delivered ?

Impact of FY'92 on FY'93: None.

FY'94 Scenario:

Budget: $360,000

FY'94 Scope:

- Complete Study Plan for activity
- Continue development and testing of geostatistical models
- Incorporate site characterization data into models

1.2.3.2.5.1.1 PROBABILITY OF A VOLCANIC ERUPTION

Purpose:

Assess the probability of future volcanic activity with respect to siting of a repository for disposal of high-level radioactive waste at Yucca Mountain.

Description:

1) synthesize data on the dating, location, and volume of late Cenozoic volcanic events in the region surrounding the site. Produce maps showing the age, location of vents, and distribution and volume of lava and pyroclastic deposits,

2) investigate time-space patterns of past volcanic activity in the Yucca Mountain region, and the possible structural controls of volcanic centers and potential future volcanic centers at and adjacent to Yucca Mountain,

3) review geophysical data collected in the vicinity of the site. Assess whether any indications of midcrustal magma bodies are present that might be the source for future volcanic events, and

4) revise the estimates of the probability of volcanic disruption of a repository at the Yucca Mountain site.

FY'93 Funding:

$310,000 (Mission 2001: same)

Rationale for FY'93 Funding:

Probability of a volcanic eruption is a priority 5 activity. It contributes to the resolution of unsuitability conditions at Yucca Mountain.

ITE Test Prioritization:

Not Ranked

WBS Elements (1.2.3.)/Participant:

.2.5.1.1	Participant	PROBABILITY OF VOLCANIC ERUPTION	Scope:	Budget
	LANL	Probability Calculations and Assessments	Develop data and methodology to assess probability of volcanic eruptions that might affect the sight.	$220,000
		Evaluation of Structural Controls of Basalitic Volcanic Centers	Evaluate the degree to which geologic structure controls the spatial distribution of volcanic centers near YM.	$90,000
			LANL TOTAL	**$310,000**

Principal Investigator:

P&S Account:	Probability of Volcanic Eruption	Crowe, LANL
Summary Accounts:	Prob. Calculations and Assessment	Crowe, LANL
	Eval. Struct. Controls of Basalt	Crowe, LANL

FY'93 Scope:

Probability Calculations and Assessments

Develop refined methods and calculations of the first two parameters of the three-part probability calculation. Use an iterative approach incorporating multiple alternative models for estabilishing the recurrence rate of volcanic events, similar to the approach for used for establishing E2. The final iteration of a data matrix of recurrence calculations has been completed using a Poisson reccurence model. The volume refinements will use digital terrain data and the computer code Surface Display System for the calculations. Volcme calculations of FY93 will be completed for the Sleeping Butte, and the 1.2 and 3.7 center of Crater Flat. Additionally, we will support efforts interacting with external organizations reviewing the Volcanism Issue Resolution Report.

Determine Structural Controls of Basalitic Volcanic Centers

This activity attempts to establish the probability that, given a future volcanic event, the event would directly intersect the potential repository or the controlled area surrounding the repository. The first matrix of calculations of E2 was completed in FY 92. Work in FY93 will focus on the development of alternative structural models for the distribution on past basalitic centers. These models will use constraint probability ranges of E3. Data will be integrated into this activity from field geologic studies, and from aspects of the tectonic programs.

Status at Beginning of FY'93:

Study Plan:

8.3.1.8.1.1 "Probability of a Magmatic Eruption Penetrating the Repository", NRC Phase II review completed 7/10/92

JPP/TPP:

Not Applicable

Environmental Studies:

Not Applicable

Prerequisite Predecessor:

1993 Deliverables:

Due Date	Deliverable	Parti-cipant	Delivered ?
9/93	Report: Revised Probability Calculations (MS 3252)	LANL	
9/93	Report: Frequency and Occurrence of Quaternary Basaltic Centers in the Great Basin by Structure and Setting (MS 3238)	LANL	
9/93	Report: Consequences of Hydrovolcanic Activity for Performance Assessment (R481)	LANL	
9/93	Progress Report: Effects of Volcanism (MS 3358)	LANL	

FY'92 Scenario:

Budgeted	Spent		Variance
	Amount	Percent	
$330,000	$259,000	78	No schedule variance

1992 Milestones accomplished:

- Revised calculations of the probability of magmatic disruption using a range of structural models.
- Assessed time distribution models for volcanic events

1992 Deliverables:

Due Date	Deliverable	Participant	Delivered ?
	Crowe, et al., "Recurrence Models of Volcanic Events: Application to Volcanic Risk Assessment", Proc. Third International High-Level Radioactive Waste Management Conference, Vol. 2,pp. 2344-2355.	LANL	4/92

Impact of FY'92 on FY'93: None.

FY'94 Scenario:

Total Budget - $1,036,000[1]

FY'94 Workscope:

Activity	Scope	Budget[2]
Probability Calculations and Assessment	Develop refined probability calculations.	$350,000
Probability of Volcanic Eruption	Examine space-time relations for volcanism near YM. Evaluate possibilities for structural control of eruptions.	$60,000
Presence of Magma Bodies in the Site Vicinity	Review geophysical data for information on possible magma bodies.	$500,000
Geochemistry of Volcanic Centers	Evaluate the geochemistry of volcanic centers near YM. Evaluate origin and geochemical evolution of basaltic volcanic centers.	$110,000
	LANL TOTAL	**$1,020,000**

Notes:

1. Budget taken from PACS run 05 JAN 93
2. Budget taken from PACS run of 16 JUL 92

1.2.3.2.5.1.2 EFFECTS OF A VOLCANIC ERUPTION PENETRATING THE REPOSITORY

Purpose:

To gather data on the effects of a potential volcanic eruption should such an eruption penetrate the site.

Description:

1) summarize the effects of a strombolian eruption on the repository, and
2) obtain geologic parameters for the disruption of a repository by magmatic activity accompanied by hydrovolcanic (magma-water) explosions; identify critical parameters controlling hydrovolcanic explosions.

FY'93 Funding: $310,000 (Mission 2001, $320,000)

Rationale for FY'93 Funding: This is a priority 5 study.
The study supports determination of whether the site is unsuitable.

ITE Test Prioritization:
Not Ranked.

WBS Elements (1.2.3.)/Participant:

.2.5.1.2	Participant	EFFECTS OF A VOLCANIC ERUPTION PENETRATING THE REPOSITORY	Scope	Budget
	LANL	Determine Presence of Magma Bodies	Use geology and geophysics to assess whether magma bodies are present beneath or near YM	$0
		Eruptive Effects	Examine how eruption effects could transport radioactive waste to the accessible environment	$135,000
		Subsurface Effects	Determine how intrusions of magma could affect waste isolation	$115,000
		Magma System Dynamics	Study how magma system dynamics can contribute to the probability that waste isolution will be disrupted.	$60,000
			LANL TOTAL	**$310,000**

Principal Investigator:

P&S and Summary Accounts: Bruce Crowe , LANL

FY'93 Scope:

Eruptive Effects

- Determine the probability of direct magmatic disruption on the repository resulting in dispersion of significant quantitites of radioactive waste to the surface to exceed the regulatory requirement for licensing of a repository.
- Examine the physical constraints on the amount of waste that can be carried to the surface.

- Continue work on the direct effects of eruptions through the controlled area.

Subsurface Effects

- Continue work on the potential subsurface effects of intrusion of magma into a repository.
- Focus the anlaysis on the effects of mechanical emplacement of the intrusion, on the thermal perturbations from the intrusions and the effects of volatile degassing on the unsaturated and saturated zone hydrology.

Magma System Dynamics

- Examine the processes of magmatic activity in support of probabilistic calculations.
- Revise Study Plan when comments are received from DOE.

Status at Beginning of FY'93:

Study Plan:

8.3.1.8.1.2 - "Physical Processes of Magmatism and Effects", Review Comments sent to PI - 1/14/93

JPP/TPP:

Not Applicable at the present time.

Environmental Studies:

Not Applicable at the present time.

Prerequisite Predecessor:

None.

1993 Deliverables:

Due Date	Deliverable	Parti-cipant	Delivered ?
9/93	Report: Consequences of Hydrovolcanic Activity for Performance Assessment (R481)	LANL	
9/93	Progress Report: Effects of Volcanism (MS 3358)	LANL	

FY'92 Scenario:

Budget:

Budgeted	Spent		Variance
	Amount	Percent	
$ 102,000	$ 102,000	100	None

1992 Milestones accomplished:

- Developed a strategy for calculating the probability of bounding the effects of magmatic disruption on a repository.
- Began modeling of basaltic magma chambers
- Carried out literature search on compaction, magma segregation, mantle ascent, magma storage, and crustal ascent.

1992 Deliverables:

Due Date	Deliverable	Participant	Delivered ?
	Valentine, G., B.M. Crowe, and F.V. Perry, "Physical Processes and the Effects of Magmatism in the Yucca Mountain Region," in Proc. Third International High-Level Radioactive Waste Management Conference, Vol 2, pp. 2014-2024.	LANL	4/92

Impact of FY'92 on FY'93: None

FY'94 Scenario:

Total Budget: $698,000[1]

FY'94 Scope:

Activity	Scope	Budget[2]
Eruptive Effects	Continue assessment of probability that eruptive effects will disrupt waste isolation.	$350,000
Subsurface Effects	Continue work on effects of intrusion into or near a repository at YM	$200,000
Magma System Dynamics	Continue work on dynamics of magma systems as they relate to intrusion.	$85,000
	LANL TOTAL	**$635,000**

Notes:

1. Value taken from PACS run of 21 DEC 92
2. Values taken from PACS run of 16 JUL 92

1.2.3.2.5.3 CHANGES IN HYDROLOGY DUE TO TECTONIC EVENTS

Purpose:

Determine how tectonic processes and events might affect the water table.

Description:

- Model the perturbations resulting from dike emplacement. Include thermal effects and barrier effects.
- Evaluate the potential for magma bodies to move in the YM vicinity, and the thermal effects of any such movement.
- Assess how faulting events might affect the water table level.

FY'93 Funding:

$46,000

Rationale for FY'93 Funding:

Need to integrate post-closure tectonics investigations into one study.

ITE Test Prioritization:

Not ranked.

WBS Elements (1.2.3..) / Participant:

2.5.3.2	Participant	CHANGES IN HYDROLOGY DUE TO TECTONIC EVENTS	Scope	Budget
	USGS	1.2.3.2.5.3.2 Effects of Tectonic Processes and Events on Changes in the Water Table	Determine how tectonic events and processes might affect the water table over the next 10,000 years	$46,000
			USGS TOTAL	**$46,000**

Principal Investigator:

P&S Account: Effects of Tectonic Processes . . . Whitney, USGS

Summary Account: Effects of Faulting on WT . . . Fridrich, USGS

FY'93 Scope:

- Integrate studies of effects of tectonic processes on hydrological parameters and develop integrated study plan
- Study effects of faulting on water table levels as documented in the literature
- Develop an interim status report

Status at Beginning of FY'93:

Study Plan:

Not yet written. An integrated study plan for studies 8.3.1.8.3.1, 8.3.1.8.3.2, and 8.3.1.8.3.3 is a deliverables for this activity in FY 93.

JP/TPP:

Not Applicable

Environmental Studies:

Not Applicable

Prerequisite Predecessor:

Will integrate results from other studies, but work can begin on the models and analogs before the predecessor studies are completed.

1993 Deliverables:

Due Date	Deliverable	Participant	Delivered ?
6/93	Interim Status Report	USGS	
9/93	Integrated Study Plan	USGS	

FY'92 Scenario:

Budget:

Budgeted	Spent		Variance
	Amount	Percent	
$ 71,000	$76,000	107	No significant variance.

1992 Milestones accomplished:

- Prepared report entitled "A Hydrogeologic Analysis of the Saturated-Zone Groundwater System Under Yucca Mountain, Nevada". Report underwent internal review at USGS.

1992 Deliverables:

Due Date	Deliverable	Participant	Delivered ?

Impact of FY'92 on FY'93: None.

FY'94 Scenario:

Budget:
$95,000

FY'94 Scope:

Activity		Scope	Budget
2.5.3.1	Effects of Tectonic Processes & Events on Average Percolation Flux Rates	Evaluate the possible effects of volcanic, seismic, uplift / subsidence, and folding events on the average percolation flux rate at Yucca Mountain.	$0
2.5.3.2	Effects of Tectonic Processes & Events on Changes in the Water Table	Evaluate the possible effects of volcanic, seismic, uplift / subsidence, and folding events on the water table at Yucca Mountain.	$70,000
2.5.3.3	Effects of Tectonic Processes & Events on Local Fracture Permeability	Evaluate the possible effects of volcanic, seismic, uplift / subsidence, and folding events on local fracture permeability at Yucca Mountain.	$25,000
		TOTAL	$95,000

1.2.3.2.5.5.1 CHARACTERISTICS OF VOLCANIC FEATURES

Purpose:

Provide refined data on the age, location, geochemical and petrologic composition, and volume of young volcanic rocks in the vicinity of the site.

Description:

1) investigate the origin of four aeromagnetic anomalies found in Crater Flat and the Amargosa Valley, which are inferred to represent shallowly buried basaltic or silicic volcanic centers or intrusive bodies; recover continuous core from drillholes at these sites.

2) establish the chronology of basaltic volcanism and the youngest silicic volcanic activity in the Yucca Mountain area; revise the rate parameter of the volcanic probability calculations and determine the age of cessation of silicic volcanic activity.

3) establish the field geologic relations and eruptive history of basaltic volcanic centers in the Yucca Mountain region.

4) determine the geochemistry of scoria sequences of different ages at the Lathrop Wells center and older centers in the Crater Flat area; use data to test and develop petrologic models of polycyclic volcanism, which will be used to test geologic assumptions made for (1) the probability calculations and (2) the time-space tectonic model for the distribution of basaltic magmatism; use scoria sequences to correlate basaltic ash interbedded in trenches with their correct eruptive source.

5) determine the time-space geochemical variations of the volcanic fields of the southern Great Basin and compare these patterns with documented geochemical patterns for the volcanics fields of the Yucca Mountain area.

FY'93 Funding:

$750,000 (Mission 2001:$775,000)

Rationale for FY'93 Funding: This is a priority 5 study.

These activities support evaluation of potential unsuitability conditions. The activities also support the Issue Resolution effort on Volcanism.

ITE Test Prioritization:

Study	Unsuitability	Regulatory Complicance	Scientific Confidence
Volcanic Features	Low (Unranked)	Low (1)	High (11)

WBS Elements (1.2.3.)/Participant:

.2.5.5.1	Participant	CHARCTERIZATION OF VOLCANIC FEATURES	Scope:	Budget
	LANL	Geochemistry of Eruptive Sequences	Establish geochemical characteristics of various eruptive events.	$90,000
		Evolution Patterns of Basaltic Volcanic Fields	Examine space-time variations of eruptive sequences and place in a regional/global context.	$110,000
		Volcanic Drillholes	Drill boreholes to examine subsurface aeromagnetic anomalies.	$0
		Geochronology Studies	Determine age of volcanic sequences.	$450,000
		Field Geologic Studies	Map volcanic features in the vicinity of YM.	$100,000
			LANL TOTAL	$750,000

Principal Investigator:

P&S Account: Crowe, LANL

Summary Accounts: Crowe, LANL

FY'93 Scope:

- Geochemistry of Eruptive Sequences - Conduct petrological and isotopic analyses of basalt at Sleeping Butte and from the 1 Ma and 3.7 Ma sequences in Crater Flat. Develop models of basalt petrogenesis for incorporation into the probability calculations.

- Evolution Patterns of Basaltic Volcanic Fields - Collect data on the time, volume, space and compositional patterns of basalt fields in the Basin and Range province and the adjacent transitional regions. Use data to study at what point YM lies in the volcanic evolutionary cycle.

- Volcanic Drillholes - No activity in FY 93.

- Geochronology Studies - Continue geochronology studies at Lathrop Wells volcanic center. Evaluate age of basalt at Sleeping Butte, in Crater Flat, at Buckboard Mesa, and of the approximately 10 Ma basalt dike intruded into the Solitario Canyon fault.

- Field Geologic Studies - Complete geologic mapping of basalt at Buckboard Mesa. Compile geologic maps of Lathrop Wells, Sleeping Butte, and the basalt units of Crater Flat for volume computations.

Status at Beginning of FY'93:

Study Plan:

8.3.1.8.5.1 - Characterization of Volcanic Features, NRC Phase II Review 3/18/91

JPP/TPP:

TPP 91-32 Test Pits, R2 Approved 6/26/91
Under revision for Sleeping Butte and Crater Flats studies.

No JP; all work is off-site.

Environmental Studies:

Prerequisite Predecessor:

None.

1993 Deliverables:

Due Date	Deliverable	Participant	Delivered ?
9/93	Report: Geochemistry of Lathrop Wells Eruptive Sequence (MS 3129)	LANL	
9/93	Preliminary Map: Basaltic Volcanic Centers (MS 3075)	LANL	
9/93	Interim Report: Rock-Varnish Dating	LANL	

FY'92 Scenario:

Budget:

Budgeted	Spent		Variance
	Amount	Percent	
$ 742,000	$ 818,000	110	

1992 Milestones accomplished:

- Obtained basalt cuttings from a borehole less than 400 feet deep at one of the aeromagnetic anomalies. Submitted samples for $^{40}Ar/^{39}Ar$ dating.
- Completed statistical analyses of K-Ar and $^{40}Ar/^{39}Ar$ dating for the Lathrop Wells center.
- Obtained initial paleomagnetic data for the Ql_6, Ql_5, and Ql_7 at the Lathrop Wells Center.
- Completed three phases of trenching at the Lathrop Wells center for a total of 35 trenches. Completed and studied nine at the Cima volcanic field.
- Revised stratigraphy of the Lathrop Wells center using data from trenches.
- Completed field studies for a sequence of mesa-forming basaltic lava flows south of Black Mountain.
- Geochemical samples for the Crater Flat volcanic field were compared with other volcanic fields in the Basin and Range, and with Mauna Kea volcano in Hawaii.

1992 Deliverables:

Due Date	Deliverable	Participant	Delivered ?
	Crowe, et al., "The Lathrop Wells Volcanic Center: Status of Field and Geochronology Studies", Proc. Third International High-Level Radioactive Waste Management Conference, Vol 2, pp 1997-2013.	LANL	4/92
	Perry and Crowe, "Geochemical Evidence for Waning Magmatism and Polycyclic Volcanism at Crater Flat, Nevada", Proc. Third International High-Level Radioactive Waste Management Conference, Vol 2, pp 2356-2365.	LANL	4/92

Impact of FY'92 on FY'93: None.

FY'94 Scenario:

Total Budget- $1,442,000[1] Mission 2001: 1,286,000

Activity	Budget[2]
Geochemistry of Eruptive Sequences	$150,000
Evolution Patterns of Basaltic Volcanic Fields	$300,000
Volcanic Drillholes	$269,000
Geochronology Studies	$350,000
Field Geologic Studies	$200,000
TOTAL	**$1,269,000**

Notes:

1. Value from PACS run of 21 DEC 92
2. Value from PACS run of 16 JUL 92

1.2.3.2.5.5.2 CHARACTERIZATION OF IGNEOUS INTRUSIVE FEATURES

Purpose:

- To provide a direct indication of the presence or absence of igneous intrusions that are sufficiently young or large to produce a thermal anomaly within the crust.
- To evaluate the potential for geothermal resources that might attract future exploration
- To identify distortion of the geothermal regime by ground-water movement.

Description:

- Measure vertical temperature profiles, principally in deep boreholes beneath the perturbing effects of the unsaturated zone,
- Measure thermal conductivities of core and cuttings samples,
- Produce cross-sections showing the temperature profiles, geothermal gradients, and contours of isotherms,
- Produce maps depicting areal temperature variations at defined vertical datums, and maps and cross sections showing ambient heat flow.

FY'93 Funding: **$100,000** (Mission 2001: $120,000)

Rationale for FY'93 Funding:

- Supports resolution of the volcanism issue;

- Supports determinations on the Geohydrology disqualifying condition by the end of Fiscal year 1995 and qualifying condition by the end of Fiscal Year 1997 by helping to identify the hydrogeologic framework and preferential flow paths.

- Supports evaluation of the qualifying and potentially adverse conditions of the Postclosure Tectonics Guideline with respect to the potential for igneous intrusion and geothermal influences on the hydrologic system.

- Supports a determination on the postclosure Tectonic Qualifying Condition by the end of FY'97.

- Supports a determination on the Human Interference (Natural Resources) qualifying condition, with respect to the presence of geothermal-energy resources, by the end of FY'97.

- Supports Level 3 Milestone 'Characteristics of Site Ambient Thermal Conditions', scheduled for 4/97

ITE Test Prioritization: Middle Study Plan (Two out of three)

STUDY	UNSUITABILITY	REGULATORY COMPLIANCE	SCIENTIFIC CONFIDENCE
Igneous Intrusive Features	**Low(unranked)**	**Medium (4)**	**Medium (8)**

WBS Elements (1.2.3..) / Participant

2.5.5.2	Participant	CHARACTERIZATION OF INTRUSIVE IGNEOUS FEATURES	Scope	Budget
	USGS	Heat Flow at Yucca Mountain	Conduct studies to assess the thermal regime at YM	$100,000
			TOTAL	**$100,000**

Principal Investigator:

P&S Account: John Whitney, USGS

Summary Account: John Sass, USGS

FY'93 Scope:

Complete Study Plan Resolution - Revise Study Plan through Comment Resolution.

Continue Field Measurements - In FY93 data collection will be controlled primarily by the availability of existing drill holes, in which thermal profiles have stabilized, and of new holes drilled for other purposes.

Collect Core Samples and Prepare Thermal Specimens

Temperature Variations in Thermal Conductivity - In existing wells, measure spatial variations of temperature with depth, and measure thermal conductivity of core samples.

Evaluate Drilling Plans and Recommendations - Provide input to drilling program on optimal locations for new drill holes from the perspective of heat flow studies.

Maintain/Calibrate Equipment

Status at Beginning of FY'93:

Study Plan:

8.3.1.8.5.2 'Characterization of Igneous Intrusive Features' - Submitted to Project Office, 10/13/92; Screening review complete; undergoing Project Office technical review.

JP/TPP:

None initiated.

Environmental Studies:

None required.

Prerequisite Predecessor:

Measurements are made in existing drill holes. Thus, program depends to some degree on progress of drilling.

1993 Deliverables:

Due Date	Deliverable	Participant	Delivered ?
4/93	Interim Report: Status of Laboratory and Equipment Calibration	USGS	
7/93	Data Submission/PDA - Thermal Conductivity	USGS	
9/93	Progress report: Field measurements of subsurface temperatures in Yucca Mountain	USGS	

FY'92 Scenario:

Budget: $70,000; 97 % ($68,000) spent.

Budgeted	Spent		Variance
	Amount	Percent	
$ 70,000	$ 68,000	97	No significant variance.

1992 Milestones accomplished:

- Completed revised Study Plan and submitted it to YMPO for review/approval.
- Carried out calibration and maintenance of equipment.
- Prepared technical procedures for work to be performed
- Conducted temperature logging in several holes that penetrate Tertiary volcanic rocks adjacent to faults on Yucca Mountain to determine the possible thermal effects of the June 29, 1992 earthquake at Little Skull Mountain.

1992 Deliverables:

Due Date	Deliverable	Participant	Delivered ?
4/92	Technical Procedure GPP-20 Approval	USGS	4/30/92 per USGS
4/92	Approval: Technical Procedure Calibration	USGS	4/30/92 per USGS
4/92	Approval: Measurement of Thermal Conductivity	USGS	4/30/92 per USGS
7/92	Study Plan to YMPO	USGS	10/13/92

Impact of FY'92 on FY'93:

None

FY'94 Scenario:

Budget: $140,000

Activity	Participant	Budget
Heat Flow at Yucca Mountain - Continue to measure thermal properties in available boreholes and from samples. Maintain lab and equipment.	USGS	$140,000
	USGS TOTAL	$140,000

1.2.3.2.6.2 SOIL AND ROCK PROPERTIES OF POTENTIAL LOCATIONS OF SURFACE FACILITIES

Purpose:

Required for surface and subsurface design and performance studies. The activities provide data for:

- characterize the soil and rock at and near the surface to provide the necessary geotechnical information to help locate the surface facilities.
- conduct foundation design analyses
- evaluate soil-structure interactions
- provide hydraulic-related soil information for evaluating erosion
- potential and infiltration runoff characteristics

Description:

Characterization of soil and rock properties at the ESF Portal sites, ramp alignments, and at surface and subsurface access facilities.

1.2.3.2.6.2.1	Field activities along Ramps, including geologic mapping, monitoring of core drilling, test pit excavation, and field soil and geophysical testing
1.2.3.2.6.2.2	Laboratory tests on soil and rock samples for surface facilities and portal structures
1.2.3.2.6.2.3	Characterize the in-situ physical, mechanical and dynamic properties of the soil and rock and develop 3-D model of soil and rock strata

FY'93 Budget: **$398,000** (Mission 2001: $390,000)

Rationale for FY'93 Funding:

Priority 1 study that directly supports access to underground testing in ESF.

ITE Test Prioritization:

STUDY	UNSUITABILITY	REGULATORY COMPLIANCE	SCIENTIFIC CONFIDENCE
Soil and Rock Properties	Low (unranked)	Low (13)	Low (16)
PROVIDES DATA FOR ESF ACCESS, WHICH WILL BE USED FOR:			
ESF UZ Percolation	High (2)	High (2)	High (2)
Site Specific Underground Information	Low(unranked)	High (9)	High (4)

WBS Elements (1.2.3..)/Participant:

2.6.2	Participant	SURFACE FACILITIES EXPLORATION PROGRAM	Scope	Budget
2.6.2.1	USGS/ USBR	Surface Facility Exploration Program	mapping, drilling, test pits, geophysics	$158,000
2.6.2.2	USGS /USBR	Surf. Facil. Lab Tests & Mater. Prop. Measurement	laboratory materials testing of soil and rock samples	160,000
2.6.2.3	USGS /USBR	Surface Facilities Field Tests	in situ testing of soil and rock	80,000
			USGS/USBR TOTAL	**$398,000**

Principal Investigator:

P&S Account: Mark McKeown, USBR

Summary Account: Mark McKeown, USBR

FY'93 Scope:

1.2.3.2.6.2.1: Surface Facility Exploration Program

- Geologic mapping of the North Portal site and ramp alignment for stratigraphy, structure, petrologic features
- Conduct core drilling, test pit excavation and field soil and geophysical testing.

1.2.3.2.6.2.2: Surface Facility Lab Tests and Material Properties Measurement

- Perform soil and rock testing in the lab for the north ramp.
- Laboratory soil tests: gradation (about 100), possible triaxial and direct shear testing (about 15); one dimensional consolidation; relative densities and/or Proctor densities (about 50); compaction tests
- Laboratory rock tests: uniaxial and triaxial shear and direct shear testing (about 30); direct tension testing; dynamic tests, including sonic tests (about 50); other indirect tests (Brazilian, point load, Schmidt Hammer) to determine tensile strengths and uniaxial compressive strengths.

1.2.3.2.6.2.3: Surface Facility Field Tests

- Prepare report on North ramp studies

Status at Beginning of FY'93:

Study Plan:

8.3.1.14.2 Studies to Provide Soil/Rock Properties of Potential Locations of Surface Facilities: Complete through NRC Phase I Review

TPP:

92-1 - Soil and Rock Properties (All NRG and SRG boreholes)
Rev 0, approved
Rev 1, approved
Rev 2, in process, awaiting signatures
Related JPs: 92-2 (NRG-1 & Test Pits)
92-8 (Phase II test pits)
92-10 (NRG-6 roads and pad)

92-15 - NRG-6 Drilling and Testing:
R0, approved
Related JPs: 92-11 (NRG-6 Drilling and Testing)

JP: 92-2 - Soil and Rock Properties, North Portal Drill Hole and Surface Facility Test Pits, Rev 2

Pit construction complete; NRG-1 drilling complete 6/24/92; FCR planned to include geologic mapping

92-8 - Soil and Rock Properties, Phase II Test Pits

Excavations complete 9/23/92; testing in progress

92-10 - NRG-6 Drill Pad Construction

JP complete; need to revise JP reference in Work Program

92-11 - NRG-6 Drilling and Testing

JP complete

Environmental Studies:

2008.00 - Phase II - Soil and Rock: approval letter sent to Participants

2015.01 - NRG-1 Access Road, land access (done), Bio survey (done), Arch. survey (done), Rad, survey (done), EMMP (done), permits (done)

2015.04 - North Portal Pad, land access (done), Bio survey (done), Arch. survey (done), EMMP (done), permits (done)

2019.00 - UZ-NRG-6, land access (done), Bio survey (done), Arch. survey (done), Rad survey (done), (EMMP, permits not as of 11/9/92)

2022.00 - Borehole SRG-1, land access (not as of 11/9/92)

2026.00 - Rock Pavement Studies at NRG-1 - EG&G site specific reclamation stipulations for NRG-1 at the north portal facility pad; letter dated 9/1/92

3002.00 - Borehole NRG-2, (10/05/92), land access (10/19/92), Arch. survey (10/22/92)

3003.00 - Borehole NRG-3, (10/26/92)

3004.00 - Borehole NRG-4, (10/26/92)

3005.00 - Borehole NRG-5, (10/26/92)

1993 Deliverables:

Due Date	Deliverable	Parti-cipant	Delivered ?
1.2.3.2.6.2.1 Surface Facilities Exploration Program			
5/93	Preliminary Data Report: North Ramp Design	USGS	
7/93	Preliminary Data Report: NRG-4	USGS	
9/93	Report/TDIF: North Ramp Geotechnical Investigations	USGS	
1.2.3.2.6.2.2 Surface Facilities Laboratory Tests & Material Property Measurements			
4/93	Preliminary Report: NRG-6/NRG-2	USGS	
6/93	Preliminary Report: NRG-5/NRG-3	USGS	
9/93	Final Report/TDIF: Soil and Rock Testing - North Ramp	USGS	
1.2.3.2.6.2.3 Surface Facilities Field Tests and Characteristics Measurements			
3/93	Preliminary Report: North Ramp Studies	USGS	

1992 Scenario:

Budget:

Budgeted	Spent		Variance
	Amount	Percent	
$ 388,000	$ 562,000	145	

1992 Milestones accomplished:

- Monitored NRG-1 drilling
- 33 North ramp test pits were excavated and tested.
- Began testing of core from NRG-1
- Alluvium/colluvium removed from area near the top of the North Portal cut for surface mapping of fracture systems
- Percent of activities associated with Soil and Rock Properties Testing completed during 1992: 14%

1992 Deliverables:

Due Date	Deliverable	Participant	Delivered ?
7/92	Final Rept: Engineering Geophysics	USGS/USBR	
8/92	Final Rept: Field Testing, Physical Properties	USGS/USBR	
8/92	Final Rept: Field Testing, Mechanical Properties	USGS/USBR	
9/92	Final Rept: Lab Testing, Physical Properties	USGS/USBR	
9/92	Final Rept: Lab Testing, Mechanical Properties	USGS/USBR	

Impact of FY'92 on FY'93:

Field work has not progressed as originally planned, and has required more time than originally scheduled. Thus, deliverables have been delayed. As these reports are needed for ESF design, design of the ESF could be impacted. Values may have to be assumed, and verified when the work is completed.

North Ramp studies are 20% complete at the end of FY'92

FY'94 Scenario:

Budget:

WBS	Description	Budget
1.2.3.2.6.2.1	Surface Facilities Exploration Program	$90,000
1.2.3.2.6.2.2	Surface Facilities Laboratory Tests & Material Property Measurements	$166,000
1.2.3.2.6.2.3	Surface Facilities Field Tests & Characteristics Measurements	$82,000
	USGS/USBR TOTAL	**$338,000**

FY'94 Scope:

Perform soil and rock properties tests along the south ramp alignment. Support drilling of SRG boreholes.

1.2.3.2.7.1.1 LABORATORY THERMAL PROPERTIES

Purpose:

This activity is designed to obtain all of the laboratory data on thermal conductivity and heat capacity that are required for site characterization, as well as being the primary activity for obtaining data on in situ bulk density. All of these properties will be used as input to calculations of the thermal response to the presence of heat-producing waste in Unit TSw2. In addition, bulk density data are required as an input to estimation of in situ stress and radiation-shielding properties.

Description:

The activity includes, for each property, the development and approval of procedures, performance of scoping tests, performance of site characterization tests and analysis of site characterization data. For each property, products include one or more data reports from the data collection phase and one or more analysis reports from the data analysis phase; the latter report(s) will contain the results of analyses of potential spatial variability of the property and of potential correlations between the thermal properties and other rock properties.

FY'93 Funding: $185,000 Mission 2001: $202,000

Rationale for FY'93 Funding: A priority 3 study. Scoping studies to be continued in preparation for actual tests in FY'94.

ITE Test Prioritization: Low, three out of three in the lower 16.

STUDY	UNSUITABILITY	REGULATORY COMPLIANCE	SCIENTIFIC CONFIDENCE
Laboratory Thermal Properties	Low (Not Ranked)	Low (11)	Low (11)

WBS Elements (1.2.3..) / Participant: SNL

WBS #	Participant	LABORATORY THERMAL PROPERTIES	Scope	Budget
.2.7.1.1	SNL	DEVELOP PROCEDURES AND SCOPING STUDIES	Conduct scoping studies to evaluate effects of confining pressure and fractures on thermal conductivity.	$200,000
			SNL TOTAL	**$200,000**

Principal Investigator: C. S. Chocas, SNL

FY'93 Scope:

Conduct scoping studies to evaluate effects of confining pressure and fractures on thermal conductivity. Complete reports on thermal conductivity scoping studies to determine the effects of sample saturation and the effects of fractures. Update technical procedures as required. Complete SAND 88-2820, " Density and Porosity of Tuffaceous Units at Yucca Mountain, Nevada". Submit laboratory thermal properties data to the YMP technical data base. Update technical procedures as required.

Status at Beginning of FY'93:

Study Plan:

8.3.1.15.1.1, Laboratory Thermal Properties, submitted to NRC on 1/25/91. Must be revised for new ESF configuration.

JP/TPP:

None needed: Laboratory studies

Environmental Studies:

None needed: Laboratory studies

Prerequisite Predecessor:

SD Holes and MPBS holes in the ESF.

1993 Deliverables:

Due Date	Deliverable	Participant	Delivered ?
9/93	SAND 88-2820: Density and Porosity of Tuffaceous Units at Yucca Mountain	SNL	
9/93	Submit Thermal Properties data to Database.	SNL	

FY'92 Scenario:

Budget:

Budgeted	Spent		Variance
	Amount	Percent	
$ 222,000	$ 197,000	89	

1992 Accomplishments:

- Overhaul of the instrument for measuring thermal conductivity at low temperatures (20 to 100 degrees C) completed.
- Preliminary draft of Technical Procedure TP-215 for calibrating the Lawson Thermocouple and A/Board prepared.
- Rev 1 of EP-0041 "Saturation Effects on Thermal Conductivity" issued.

1992 Deliverables:

Due Date	Deliverable	Participant	Delivered ?
	None		

Impact of FY'92 on FY'93: Because of reduced budget:

1. Cannot purchase percussive grinder and develop technical procedure for its use (required for sample preparation).
2. Cannot develop technical procedures (s) for scoping study on the effects of sample size of thermal conductivity (Study Plan 8.3.1.15.1.1).
3. Cannot develop technical procedure for heat capacity testing (Study Plan 8.3.1.15.1.1)
4. Cannot purchase a thermogravimetric analyzer and develop the technical procedures for its use (Study Plan 8.3.1.15.1.1)
5. Cannot develop the technical procedure (s) for laboratory bulk properties measurements.

FY'94 Scenario:
As new core samples become available, actual tests are expected to be performed in FY'94.

Budget: $253,000

FY'94 Scope:

- Develop technical procedure for heat capacity testing and complete heat capacity scoping study.
- Compare data from heat capacity scoping study with predictive model, and modify model as required.
- Complete data report and analysis report for heat capacity scoping study.
- Develop technical procedure for the scoping study on the effects of sample size on thermal conductivity.
- Develop technical procedure for percussive grinder.

1.2.3.2.7.1.2 LABORATORY THERMAL EXPANSION TESTING

Purpose:

The purpose of this activity is to obtain laboratory thermal-expansion data that can be used to evaluate the thermal expansion behavior expected to occur in the tuffs at Yucca Mountain as the result of the emplacement of heat-producing waste in unit TSw2.

Description:

This activity is designed to obtain all of the thermal-expansion data required for site characterization. It included the development and approval of FBN 3/26/90 procedures, performance of scoping tests, performance of site characterization tests and analysis of site characterization data. Products include one or more data reports from the data collection phase and one or more analysis reports from the data analysis phase; the latter report(s) will contain the results of analysis of potential spatial variability and of potential correlations between thermal expansion behavior and other rock properties.

FY'93 Funding: $157,000 Mission 2001: $165,000

Rationale for FY'93 Funding:

A priority 3 study. Scoping studies to be continued in preparation for actual tests in FY'94.

ITE Test Prioritization: Low (3 of 3 bottom 16)

STUDY	UNSUITABILITY	REGULATORY COMPLIANCE	SCIENTIFIC CONFIDENCE
Laboratory Thermal Expansion	Low (Not Ranked)	Low (12)	Low (12)

WBS Elements (1.2.3..) / Participant:

WBS #	Participant	LABORATORY THERMAL EXPANSION TESTING	Scope	Budget
.2.7.1.2	SNL	DEVELOP PROCEDURES AND CONDUCT TESTS	Develop procedures and carry out scoping tests	$164,000
			SNL TOTAL	**$164,000**

Principal Investigator:

P&S Account: SNL
Summary Account C. S. Chocas, SNL

FY'93 Scope:

Continue tests for the scoping study on the effects of sample size on thermal expansion. Continue tests for scoping study on the effects of sample saturation on thermal expansion. Complete SAND 88-2821, Thermal Expansion Behavior of Tuffaceous Units at Yucca Mountain Nevada.

Status at Beginning of FY'93:

Study Plan: **8.3.1.15.1.2**, Laboratory Thermal Expansion Testing submitted to NRC 10/4/90. Must be revised for new ESF configuration.

JP/TPP: None needed: Laboratory tests

Environmental Studies: None needed: Laboratory tests

Prerequisite Predecessor: SD holes and MPBX holes in the ESF.

1993 Deliverables:

Due Date	Deliverable	Participant	Delivered ?
9/93	SAND 88-2821 Thermal Expansion Behavior of Tuffaceous Units at Yucca Mountain	SNL	
9/93	Submit Coefficient of Thermal Expansion Data to Database.	SNL	

FY'92 Scenario:

Budget:

Budgeted	Spent		Variance
	Amount	Percent	
$ 183,000	$ 181,000	98	No significant variance.

1992 Accomplishments:

- Issued SAND 88-1581, "Linear Thermal Expansion Data for Tuffs from the Unsaturated Zone at Yucca Mountain".
- Five verification runs of the dilatometer with the saturation test apparatus (STA) has been completed using 4-inch borosilicate glass.
- Draft of EP-0042, "Effects of Sample Size on Thermal Expansion" has been prepared.

1992 Deliverables:

Due Date	Deliverable	Participant	Delivered ?
	SAND 88-1581, "Linear Thermal Expansion Data for Tuffs from the Unsaturated Zone at Yucca Mountain"	SNL	Yes

Impact of FY'92 on FY'93: None

FY'94 Scenario:

As new core samples become available actual tests are expected to be performed in FY'94.

Budget: $238,000

FY'94 Scope:

- Complete scoping studies that could not be finished in FY 93 because of reduced budget.
- Conduct scoping study on effects of fractures on thermal expansion.
- Conduct scoping study on effects of irradiation on thermal expansion
- Carry out data analysis and produce analysis reports for the scoping studies.

1.2.3.2.7.1.3 LABORATORY DETERMINATION OF MECHANICAL PROPERTIES OF INTACT ROCK
1.2.3.2.7.1.4 LABORATORY DETERMINATION OF MECHANICAL PROPERTIES OF FRACTURES

Purpose:

1.2.3.2.7.1.3

- To obtain all the laboratory data on mechanical properties of intact rock (using non-fractured tuffs) that are required for site characterization .
- Used as input to calculations of the thermo-mechanical response of the rock units in Yucca Mountain to the presence of heat-producing waste in Unit TSw2.

1.2.3.2.7.1.4

- To evaluate the effects of varying displacement and stress rates, saturation states, temperatures, mineralogies, roughnesses, normal stresses, and sample sizes on the mechanical properties of fractures.

Description:

1.2.3.2.7.1.3

- develop and approve procedures
- perform scoping tests
- perform site characterization tests
- analyze site characterization data
- produce data reports, and analysis reports, containing the results of analysis of potential spatial variability and of potential correlations between mechanical behavior and other rock properties.

1.2.3.2.7.1.4

- perform scoping tests to investigate experimental methods, techniques, and equipment;
- determine whether preliminary baseline conditions are suitable for the baseline testing;
- investigate variable conditions that may require further study; and
- determine whether preliminary plans are overlooking any physical phenomena in the behavior of fractures
- carry out site characterization tests, analyze data, and produce analysis reports

FY'93 Funding:

1.2.3.2.7.1.3: **$353,000** (Mission 2001: $353,000)
1.2.3.2.7.1.4: **$211,000** (Mission 2001: $255,000)

Rationale for FY'93 Funding:

Priority 1 study. Laboratory data are needed to select design values for the ESF.

ITE Test Prioritization:

STUDY	UNSUITABILITY	REGULATORY COMPLIANCE	SCIENTIFIC CONFIDENCE
Rock Mechanical Properties	Low (Not ranked)	Low (2)	Low (7)
Fracture Mechanical Properties	Middle (12)	Low (9)	Low (9)

WBS Elements (1.2.3..) / Participant:

2.7.1.3	Participant	LABORATORY DETERMINATION OF MECHANICAL PROPERTIES OF INTACT ROCK	Scope	Budget
	SNL	Conduct Tests for Environmental Effects	test samples from proposed repository horizon for time-dependent deformation	$328,000
		Scoping and Planning Mechanical Properties Tests	develop technical procedures, establish measures of precision	25,000
			SNL TOTAL:	**$353,000**

2.7.1.4	Participant	LABORATORY DETERMINATION OF THE MECHANICAL PROPERTIES OF FRACTURES	Scope	Budget
	SNL	Scoping and Planning Test	develop technical procedures, begin baseline testing	$211,000
			SNL TOTAL:	**$ 211,000**

Principal Investigator: Ronald H. Price, SNL

FY'93 Scope:

1.2.3.2.7.1.3 Laboratory Determination of Mechanical Properties of Intact Rock

Conduct Tests for Environmental Effects

- Continue series of experiments on intact tuff from proposed repository horizon to study time-dependent deformation. Tested at nominal strain rate of 10^{-9}/sec, under creep (constant stress) conditions (stress = 80 MPa).
- Reduce and analyze data as experiments are conducted and completed.

Scoping and Planning Mechanical Properties Tests

- Complete technical procedures for some of the experiment types to be run for environmental effects.
- Continue support to ISR/ASTM study to establish measures of precision for published rock-property standard test methods.
- Run some experiments to develop techniques to be used in ESF sample testing.

1.2.3.2.7.1.4 Laboratory Determination of the Mechanical Properties of Fractures

Scoping and Planning Tests

- Prepare/complete technical procedures for baseline testing of fractures.
- Run some experiments to develop techniques and approaches to be used in fracture testing.
- Begin testing of site-characterization samples at baseline conditions.
- Continue analysis/characterization of natural fracture surfaces with a laser profilometer.

Status at Beginning of FY'93:

Study Plan:

8.3.1.15.1.3 - Laboratory Determination of Mechanical Properties of Intact Rock: Submitted to NRC 6/21/91; NRC Phase I Review is deferred

8.3.1.15.1.4 - Laboratory Determination of Mechanical Properties of Fractures: Comments sent to PI on 5/12/92

JP/TPP: May need TPP for laboratory experiments

Environmental Studies: None needed

Prerequisite Predecessor: Possibly TPP for laboratory experiments

1993 Deliverables:

Due Date	Deliverable	Participant	Delivered ?
	Results will be presented as SAND reports, journal articles, and other reports, as appropriate. None specifically identified.		

FY'92 Scenario:

Budget:

Budgeted	Spent		Variance
	Amount	Percent	
1.2.3.2.7.1.3 Laboratory Determination of Mechanical Properties of Intact Rock			
$ 322,000	$ 340,000	105	No significant variance.
1.2.3.2.7.1.4 Laboratory Determination of Mechanical Properties of Fractures			
$206,000	$208,000	101	No significant variance.

1992 Accomplishments:

- Completed series of six experiments on saturated samples tested at a nominal axial strain rate of 10^{-9} s^{-1}.
- Began series of creep experiments.
- Continued project to determine the roughness of fractures, including those in Yucca Mountain tuff.
- Continued study of whether secondary effects should be considered in modeling fractures.
- Continued studies to investigate how environmental factors affect the time-dependent mechanical properties of fractures.

1992 Deliverables:

Due Date	Deliverable	Participant	Delivered ?
	Connolly, J.R., "Mineralogy, Petrology, and Whole-Rock Chemistry Data Compilation for Selected Samples of Yucca Mountain Tuffs," SAND90-7058	SNL	Yes
	Connolly, J.R., "Mineralogy, Petrology, and Whole-Rock Chemistry of Selected Mechanical Test Samples of Yucca Mountain Tuffs, SAND90-4025.	SNL	Yes
	Wibowo, J.T., B. amadei, S. Sture, A.B. Robertson, and R.H. Price, "Shear Response of a Rock Joint Under Different Boundary Conditions: An Experimental Study," SAND-0386C, in Proc. Fractured and Jointed Rock Masses Conference.	SNL	Yes

Impact of FY'92 on FY'93: None

FY'94 Scenario:

Budget: 1.2.3.2.7.1.3: $698,000

Conduct Baseline Tests on SD Drillhole Samples -	$ 228 K
Scoping Tests for Environmental Effects -	$ 436 K
Scoping and Planning Mechanical Properties Tests -	$ 34 K

1.2.3.2.7.1.4: $795,000

Begin Baseline Studies on SD Samples	$ 364 K
Scoping and Planning Tests	$ 431 K

FY'94 Scope:

1.2.3.2.7.1.3 -

- Conduct Baseline Tests on SD Samples
- Scoping Tests for Environmental Effects
- Scoping and Planning Mechanical Properties Tests

1.2.3.2.7.1.4 -

- Begin Baseline Studies on SD Samples
- Scoping and Planning Tests

1.2.3.2.8.1 POTENTIAL FOR ASH FALL AT THE SITE

Purpose:

Determine the potential for ash fall at the site by surveying literature regarding Quaternary silicic volcanic centers in the western Great Basin, assessing the potential ash-fall thickness at the stie, and assessing the potential particle density and size distribution of ash fall at the site.

Description:

- Compile information on locations of silicic volcanic centers, rates of past eruptions, volumes of past eruptions, and tephra dispersal and particle size distributions in past eruptions.
- Assess the probability of ash fall at the site based on observed Quaternary ash fall in the western Great Basin.
- Also, provide age-dating support using the rock-varnish method.

FY'93 Funding: $79,000

Rationale for FY'93 Funding:

Support for rock-varnish age dating method.

ITE Test Prioritization: Not included in prioritization because sufficient data are already available to address this issue.

WBS Elements (1.2.3..) / Participant:

2.8.1	Participant	POTENTIAL FOR ASH FALL AT THE SITE	Scope	Budget
	LANL	Rock Varnish Dating of Surfaces	Provide control for surface vents by dating Quaternary alluvial surfaces using rock varnish dating techniques	$ 79,000
			LANL TOTAL	**$79,000**

Principal Investigator:

P&S Account:	Potential for Ash Fall at the Site	J. Canepa, LANL
Summary Account:	Rock Varnish Age Dating	E. Springer, LANL

FY'93 Scope:

Date, using the rock varnish method, alluvial surfaces in the Yucca Mountain region to provide data on recurrence intervals of geomorphic events.

Status at Beginning of FY'93:

Study Plan: None. The rock varnish age dating work is carried out to support other studies that are conducted under approved Study Plans.

JP/TPP: None.

Environmental Studies: None.

Prerequisite Predecessor: None.

1993 Deliverables:

Due Date	Deliverable	Participant	Delivered ?
	Monthly Progress Reports	LANL	

FY'92 Scenario:

Budget:

Budgeted	Spent		Variance
	Amount	Percent	
$ 49,000	$ 55,000	112	Work required more time than was planned.

1992 Milestones accomplished:

1992 Deliverables:

Due Date	Deliverable	Participant	Delivered ?

Impact of FY'92 on FY'93: None.

FY'94 Scenario:

Budget: $ 133,000

FY'94 Scope: Provide rock-varnish age-dating support to other studies.

1.2.3.2.8.3.1 RELEVANT EARTHQUAKE SOURCES

Purpose:

Identify relevant earthquake sources for use in deterministic and probabilistic assessments of seismic hazard at Yucca Mountain.

Description:

Compile and synthesize data from published sources and from other site characterization studies to identify potential earthquake sources. Include information on

- the depth, dimension and geometry of mapped surface faults and buried faults,
- seismic activity,
- gravity, magnetic and heat-flow anomalies

Assess the relevancy of identified sources by evaluating their potential to produce severe ground motion at the site.

FY'93 Funding: $ 160,000

Rationale for FY'93 Funding:

This activity supports assessment of seismic hazards (Priority 5) and the issue resolution effort (Priority 6).

ITE Test Prioritization: This study was not ranked.

WBS Elements (1.2.3..) / Participant:

8.3.1	Participant	RELEVANT EARTHQUAKE SOURCES	Scope	Budget
	USGS	Identify Relevant Earthquake Source	Compile existing data to define earthquake sources relevant to seismic hazard at the site.	$ 100,000
		Characterize 10,000-year Cumulative Slip Earthquake	Determine the 10,000-year cumulative slip earthquake for each source.	$ 60,000
			USGS TOTAL	**$ 160,000**

Principal Investigator:

P&S Account:	Relevant Earthquake Sources	J. Whitney, USGS
Summary Accounts:	Identify Relevant Earthquake Sources	Pezzopane, USGS
	Characterize 10,000-year Cum. Slip EQ	Whitney, USGS

FY'93 Scope:

Identify Relevant Earthquake Sources

- Compile information from existing sources
- Identify relevant earthquake sources

Characterize 10,000-year Cumulative Slip Earthquake

- Evaluate and revise deterministic seismic hazard methodology
- Contribute to DOE Topical Report on Seismic Hazard Methodology for YM
- Conduct scoping study for magnitude estimates

Status at Beginning of FY'93:

Study Plan: 8.3.1.17.3.1 "Relevant Earthquake Sources" - NRC Phase I review complete - 5/18/92

JP/TPP: None required

Environmental Studies: None required

Prerequisite Predecessor:

While this study can begin, it will not be able to finish until studies that characterize Quaternary faults at the site and within 100-km of Yucca Mountain are completed. The study "Historical and Current Seismicity" also supports this activity.

1993 Deliverables:

Due Date	Deliverable	Participant	Delivered ?
9/93	Progress Report: Identification of Relevant Earthquake Sources	USGS	
6/93	Progress Report: Methodologies to Estimate Earthquake Magnitude for Southern Great Basin Faults	USGS	

FY'92 Scenario:

Not funded in FY 92.

FY'94 Scenario:

Budget: $ 160,000

FY'94 Scope:

- Continue to synthesize data and define earthquake sources
- Investigate the need to qualify old data. If necessary, develop an approach for doing so.
- Develop a method for earthquake moment estimates
- Identify preliminary controlling events

1.2.3.2.8.3.3 GROUND MOTION FROM REGIONAL EARTHQUAKES AND UNDERGROUND NUCLEAR EXPLOSIONS

Purpose:

Develop a model to characterize the ground motions from earthquakes affecting Yucca Mountain.

Description:

Select from available models, or develop a new model, that describes the ground motion from potential future earthquakes that could affect Yucca Mountain.

FY'93 Funding: $ 80,000

Rationale for FY'93 Funding:

This is a priority 6 study. It supports both seismic hazard assessment and issue resolution efforts.

ITE Test Prioritization:

This study was not ranked in the ITE effort. It is a modelling study.

WBS Elements (1.2.3..) / Participant:

2.8.3.1	Participant	GROUND MOTION FROM REGIONAL EARTHQUAKES AND UNDERGROUND NUCLEAR EXPLOSIONS	Scope	Budget
	USGS	Select or Develop Empirical Models for Earthquake Ground Motion	Determine whether available ground motion models are adequate for YM. Develop new models if required.	$80,000
			USGS TOTAL	**$80,000**

Principal Investigator:

P&S Account:	Ground Motion from Regional Earthquakes and Underground Nuclear Explosions	J. Whitney, USGS
Summary Account:	Select or Develop Empirical Models for EQ Ground Motion	J. Whitney, USGS

FY'93 Scope:

- Develop earthquake ground motion methodology
- Prepare study plan in agreement with methodologies described in DOE Topical Report on seismic hazard assessment.
- Contribute to DOE Topical Report on Seismic Hazard Assessment Methodologies

Status at Beginning of FY'93:

Study Plan:

8.3.1.17.3.3.2 (SNL)	"Ground Motion from Regional Earthquakes and Underground Nuclear Explosions," Technical review complete; comments sent to PI for Study Plan revision on 2/27/92.
8.3.1.17.3.3.1 (USGS)	Not yet written. Initiation of the study plan will be carried out under this activity once a methodology for seismic hazard assessment has been decided upon.

JP/TPP:

None required.

Environmental Studies:

None Required

Prerequisite Predecessor:

None.

1993 Deliverables:

Due Date	Deliverable	Participant	Delivered ?
7/93	Draft Study Plan	USGS	

FY'92 Scenario:

Budget:

For SNL:

Budgeted	Spent		Variance
	Amount	Percent	
$ 214,000	$ 165,000	77	It did not require as many hours as planned to accomplish the work.

1992 Milestones accomplished:

SNL -
- Modified canister for downhole seismometer placement to ensure accurate placement and orientation.
- Initiated quality assurance of software to be used for statistical analysis of ground motion from UNE's.
- Formulated plan to carry out statistical analysis of UNE related ground motion

USGS -
- Not funded in FY 92.

1992 Deliverables:

Due Date	Deliverable	Participant	Delivered ?

Impact of FY'92 on FY'93: None.

FY'94 Scenario:

Budget: $170,000

FY'94 Scope:
- Continue to review models for earthquake ground motion
- Continue to develop a model of earthquake ground motion that is appropriate for Yucca Mountain.

1.2.3.2.8.3.4 EFFECTS OF LOCAL SITE GEOLOGY ON SURFACE AND SUBSURFACE MOTION

Purpose:

- To understand how local site conditions will affect seismic ground motions at Yucca Mountain, both at the surface and in the subsurface.
- Provide input to development of a seismic-design basis for repository FITS.
- Assist in characterizing credible accidents initiated by seismic events that might lead to the release of radioactive materials.
- Contribute to the evaluation of the preclosure Tectonic Guideline in 10 CAR 960, including determinations on the Disqualifying Condition by the end of FY 95 and the Qualifying Condition by the end of FY 97

Description:

- Analyze ground motion recorded by stations of the Southern Great Basin Seismic Network, temporary stations, and in one or more boreholes to assess empirically the effects of the local site geology on surface and subsurface motions;
- Use aftershock data gathered from the June 29, 1992 earthquake at Little Skull Mountain to predict behavior of ground motion through different geologic materials and landforms;
- Develop and calibrate theoretical site-effects models using wave properties of the local geology.
- Using spectral ratios, estimate spectral amplification functions for different site conditions and depths;

FY'93 Funding: **$50,000** (Mission 2001: $50,000)

Rationale for FY'93 Funding: This is a priority 2 study.

- Capitalize on data acquired by monitoring aftershocks of the Little Skull Mountain earthquake
- Emphasis on activities supporting the assessment of seismic hazard at Yucca Mountain (Seismic Action Plan)

ITE Test Prioritization: This activity was not included in the ITE Test Prioritization effort.

WBS Elements (1.2.3..) / Participant:

2.8.3.4	USGS	EFFECTS OF LOCAL SITE GEOLOGY ON SURFACE AND SUBSURFACE MOTIONS	Scope	Budget
	USGS	Determine Site Effects/Ground Motion	Model site effects as documented by local recordings.	$50,000
			USGS TOTAL	**$50,000**

Principal Investigator:

P&S Account: J. Whitney, USGS

Summary Account: J. Whitney, USGS for John Anderson, UNR

FY'93 Scope:

- Study aftershock data gathered from the June 29, 1992 earthquake at Little Skull Mountain to learn how site effects, landforms and depth affect seismic ground motion
- Continue to monitor aftershock activity from the Little Skull Mountain earthquake by deploying portable stations at locations of interest.
- Gather seismograms from prior studies
- Gather geological and geophysical site information
- Develop initial standard ground motion model
- Conduct seismic field experiment 1: deploy a linear profile across YM, SMF, and Crater Flat, teleseisms, and any regional events, tie recordings into SGBSN stations, simultaneously monitor downhole locations
- Compare initial standard model with initial observations
- Develop 1-D velocity model based on site information and incorporate results of Field Experiment 1

Status at Beginning of FY'93:

Study Plan: 8.3.1.17.3.4 'Effects of Local Site Geology on Surface and Subsurface Motions':
Approved 11/14/91 and sent to NRC on 12/4/91.
Phase 1 NRC review complete 6/8/92, no NRC Phase II review
Revision 1 approved, 9/16/92

JP/TPP: None. (Test Interference letter for temporary seismic stations.)

Environmental Studies: Required for siting of temporary seismic stations.

Prerequisite Predecessor: None

1993 Deliverables

Due Date	Deliverable	Participant	Delivered ?
5/93	Preliminary Ground Motion Model	USGS	
9/93	Progress Report on the effects of site geology on ground motions	USGS	

1992 Scenario:

Budget: $ 0

1992 Milestones accomplished:
Study Plan approved by DOE - 11/14/91
Revision 1 of Study Plan approved by DOE - 9/16/92

1992 Deliverables:
Revision 1 of Study Plan, 9/16/92

Impact of FY'92 on FY'93:
The Little Skull Mountain earthquake of June '92 raised public concern over seismic hazard at Yucca Mountain. The aftershocks from the earthquake have provided more data for the empirical approach than were originally anticipated.

FY'94 Scenario:

Budget: $65,000

FY'94 Workscope

Receive new geological and geophysical site information
Update the standard ground motion model with observations from experiment 1
Conduct field experiment 2
Update standard ground motion model with observations from field experiment 2
Conduct field experiment 3
Analyze data from field experiment 2
Conduct physical modeling

FY'94 Deliverables

Progress Report on the effects of site geology on ground motions - 9/94

1.2.3.2.8.4.1 HISTORICAL AND CURRENT SEISMICITY

Purpose:

- determine orientation, depth, and style of faulting at Yucca Mountain and within the southern Great Basin
- provide information to be used in other studies, including:
  - identify relevant earthquake sources
  - define appropriate ground motion/attenuation relation for Yucca Mountain vicinity
  - evaluate the degree to which ground motion may vary with depth
  - develop site correction factors and response functions
  - assess seismic hazard to determine appropriate seismic design basis, and to support performance assessment

Description:

- Continue seismic monitoring in the southern Great Basin;
- Maintain seismographs and data collection system;
- Compile EQ catalog;
- Investigate potential of precariously balanced rocks to provide information on seismic stability of Yucca Mountain.

FY'93 Funding: **$1,190,000** **(Mission 2001: $1,093,000)**

Rationale for FY'93 Funding: A priority 2 study.

- Monitoring is an ongoing activity to collect seismic data that would otherwise be lost.

- Consistent with directive from DOE-HQ to emphasize activities that contribute to the assessment of seismic hazard at the site.

- Supports:
  - Determination of Tectonics Disqualifying Conditions by end of FY'95
  - Determination of Tectonics Qualifying Conditions by end of FY'97
  - Development of Geologic Model (preliminary model, 6/94, interim model, 6/96, and final model, 6/99)
  - Development of ESF Seismic Design Data by 6/94
  - Development of Repository Seismic Design Data by 6/96

ITE Prioritization:

Activity not included in ITE effort because it is a monitoring activity that must be continued to avoid loss of otherwise irretrievable data.

WBS Elements (1.2.3)/Participant:

WBS Element	Participant	HISTORICAL AND CURRENT SEISMICITY	Scope	Budget
2.8.4.1	USGS	Compile Historical Earthquake Record	Develop earthquake catalog; develop methodology for establishing constraints on local peak ground acceleration from precariously balanced rocks	$60,000
		Monitor Current Seismicity	Select SGBSN sites, test lab and field equipment, prepare SGBSN sites, monitor seismicity, prepare EQ catalog for calendar year 1992	$ 1,130,000
			USGS TOTAL	**$1,190,000**

Principal Investigator:

P&S Account:	Historical and Current Seismicity	J. Whitney, USGS
Summary Accounts:	Compile Historical Earthquake Record	J. Brune, UNR
	Monitor Current Seismicity	J. Brune, UNR

FY'93 Scope:

- Maintain operation of Southern Great Basin Seismic Network
- Continue to monitor local and regional seismicity
- Compile earthquake catalog for calendar year 1992
- Develop methodology for using precariously balanced rocks to constrain past level of local peak ground acceleration.

Status at Beginning of FY'93:

Study Plan: 8.3.1.17.4.1 "Historical and Current Seismicity", NRC Phase I review completed 5/14/91.

TPP/JP: None required

Environmental Studies:
Establishment of new seismic stations may require environmental studies

Prerequisite Predecessor: None

1993 Deliverables:

Due Date	Deliverable	Participant	Delivered?
10/92	Report: Initial Assessment of the Little Skull Mtn EQ	USGS/UNR	
5/93	Earthquake Catalog for calendar year 1992	UNR/USGS	
9/93	Report: Little Skull Mtn EQ	USGS/UNR	

1992 Scenario:

Budget:

Budgeted	Spent		Variance
	Amount	Percent	
$ 744,000	$ 920,000	124	Costs associated with monitoring and analyzing data from the Little Skull Mtn earthquake sequence caused a significant overrun.

1992 Milestones Accomplished:
- Maintained operation of Southern Great Basin Seismic Network
- Deployed portable instruments to record aftershocks of the June, 1992 Little Skull Mountain earthquake
- Effected transfer of network responsibility from USGS to UNR
- Prepared "white paper" on Little Skull Mountain earthquake

1992 Deliverables:

Due Date	Deliverable	Participant	Delivered?
3/92	FY'91 EQ Catalog	USGS	7/21/92 per USGS

Impact of FY'92 on FY'93:

Costs associated with monitoring and analyzing data collected from aftershocks of the Little Skull Mountain earthquake resulted in postponement of efforts to upgrade the seismic network. Budget constraints in FY'93 will continue to place limits on upgrading.

FY'94 Scenario:

Budget: $1,100,000

Scope: Continue monitoring effort at same level

1.2.3.2.8.4.2 LOCATION AND RECENCY OF FAULTING NEAR PROSPECTIVE SURFACE FACILITIES

Purpose:

To identify and characterize any Quaternary faults located near the prospective site of the waste-handling surface facilities. If no faults, to document their lack of occurrence.

- Assess potential for surface faulting at the surface facilities;
- Provide input for location of surface facilities
- Provide input to assess seismic hazards and determine seismic design basis for the repository and surface facilities.
- Provide input for performance assessment.
- Evaluate Preclosure Tectonics Disqualifying Condition by end of FY'95
- Evaluate Preclosure Tectonics Qualifying Condition by end of FY'97

Description:

Geologic mapping, age assessments of soils, trench excavating and logging in Midway Valley, report writing.

FY'93 Funding: **$350,000** (Mission 2001: $328,000)

Rationale for FY'93 Funding: A priority 1 study.

- Need to perform surface faulting evaluations prior to ground disturbing/ESF construction activities in Midway Valley
- Consistent with directive from DOE-HQ to emphasize activities that contribute to the assessment of seismic hazard at the site.

- Supports:
  - Determination of Tectonics Disqualifying Conditions by end of FY'95
  - Determination of Tectonics Qualifying Conditions by end of FY'97
  - Development of Geologic Model (preliminary model, 6/94, interim model, 6/96, and final model, 6/99)
  - Development of ESF Seismic Design Data by 6/94
  - Development of Repository Seismic Design Data by 6/96

ITE Test Prioritization:

STUDY	UNSUITABILITY	REGULATORY COMPLIANCE	SCIENTIFIC CONFIDENCE
Faulting Near Facilities	**Low (Unranked)**	**Medium (5)**	**High (8)**

WBS Elements (1.2.3..) / Participants:

2.8.4.2	Participant	LOCATION AND RECENCY OF FAULTING NEAR PROSPECTIVE SURFACE FACILITIES	Scope	Budget
	USGS	Identify Appropriate Trench Locations, Midway Valley	geologic mapping, write report	$ 31,000
		Conduct Exploratory Trenching, Midway Valley	assemble JPs, excavate and log trenches, write reports	319,000
			USGS TOTAL	**$350,000**

Participants:

P&S Account:	Location and Recency of Faulting near Prospective Surface Facilities	J. Whitney, USGS
Summary Accounts:	Identify Appropriate Trench Locations, Midway Valley	B. Swan, Geomatrix
	Conduct Exploratory Trenching, Midway Valley	B. Swan, Geomatrix

FY'93 Scope:

Geologic mapping, trenching and logging, reporting

- Complete report and map of surficial geology of Midway Valley
- Prepare preliminary draft report (with trench logs) on exploratory trenches through potential surface facilities locality
- Excavate trench across the northern Paintbrush fault in northeastern Midway Valley
- Excavate trench in central Midway Valley to investigate significance of geophysical anomaly

Status at Beginning of FY'93:

Study Plan:

8.3.1.17.4.2 - Location and Recurrence of Faulting near Prospective Surface Facilities : Complete through NRC Phase II Review

TPP: **90-1** - Midway Valley/Trench 14: Closed, field work complete, Records being compiled and JPs being decontrolled (9/11/92). Related JPs: 91-1, Midway Valley; and 91-2, Trench 14. Records Package No. NNA.910307.0106.

92-3 - Midway Valley Investigations. Revision 1 approved. Field work is 90% complete. Records are being completed, and JP is being decontrolled. Related records packages:
RPS-385, RSP-386

JP: **92-5** - Midway Valley Excavation, Phase I and II: Phase I is 100% complete; Phase II: 2 additional trenches added to activities. FCR approved 10/8/92.

92-14 - Midway Valley Phase III Trenches and Test Pits: (9/11/92) - planned status; scheduled for FY'93.

Environmental Studies: **2009.00** - Phase II Midway Valley: Approval Letter sent to Participant 5/29/92.

Prerequisite Predecessor: None.

1993 Deliverables:

Due Date	Deliverable	Participant	Delivered ?
4/93	Report/TDIF: Results of Logging from Trench 17	USGS	
6/93	Report: Final Geologic Map of Midway Valley	USGS	
8/93	Report/TDIF: Trench Log on A-3	USGS	
8/93	Report/TDIF: Results of Trench Logging from the ESF Trench	USGS	
9/93	Report/TDIF: Preliminary Quaternary Fault Map		

FY'92 Scenario:

Budget: $349,000; 0% spent USGS

*USGS is responsible for this activity, but SNL had the contract with Geomatrix in FY92.

322,000; 102% spent SNL

1992 Milestones accomplished:

28 test pits completed
Trench MWV-T4 (old Trench 17) completed - 100 ft
Trench MWV-T5 completed - 1100 ft
Trench MWV-T6 completed - 20 ft

1992 Deliverables:

Due Date	Deliverable	Participant	Delivered ?
2/92	Report: Swan, F.B., et al., "Geologic Interpretation of Trench A/BR-3 for Site Characterization Study 8.3.1.17.4.2, Midway Valley Area, Yucca Mountain Site, Nevada"	USGS	Completed 4/92, but not yet published by SNL.
	Wesling, J.R., et al., "Preliminary Mapping of Surficial Geology of Midway Valley, Yucca Mountain Project, Nye County, Nevada," SAND91-0607.	SNL	1992

Impact of FY'92 on FY'93: May need to excavate two or three additional trenches to address features seen in Trench 6 or on geophysical survey.

FY'94 Scenario:

- Work is anticipated to be completed in FY'93.
- Likelihood of some small amount of funding required to finish Final Report.
- This study aims to demonstrate that some site exists at which surface facilities can be sited. When location for surface facilities is finalized, some additional work may be necessary.

1.2.3.2.8.4.3 QUATERNARY FAULTING WITHIN 100 KM OF YUCCA MOUNTAIN

Purpose:

- Characterize the abundance, distribution, and geographic orientation of known and suspected Quaternary faults within 100 km of Yucca Mountain

- Characterize those faults capable of future earthquakes with magnitude such that associated ground shaking could impact design or affect performance of the waste facility.

- Provide input to evaluation of preclosure disqualifying condition of potential for future earthquakes of a magnitude sufficient to affect safety of the waste facility.

- Provide input for construction of a Quaternary kinematic tectonic model for use in the tectonic models and synthesis (8.3.1.17.4.12).

- Provide input for determining relevant earthquake sources and associated levels of ground shaking for design of repository facilities.

Description:

- Evaluate crustal structure and subsurface expression of Quaternary faults, using deep geophysical surveys.
- Identify and characterize known and suspected Quaternary faults within 100 km of the site, using map compilation and field verification.
- Evaluate the Cedar Mountain earthquake of 1932 and its bearing on wrench tectonics of the Walker Lane within 100 km of the site.
- Evaluate the Bare Mountain fault zone, using field geologic mapping and trenching.
- Evaluate the structural domain of Yucca Mountain, the NTS, and vicinity with respect to regional patterns of faults and fractures, using remote sensing techniques.

FY'93 Funding: **$300,000** (Mission 2001: $321,000)

Rationale for FY'93 Funding: A Priority 6 study.

- Consistent with directive from DOE-HQ to emphasize activities that contribute to the assessment of seismic hazard at the site.
- Supports:
  - Determination of Tectonics Disqualifying Conditions by end of FY'95
  - Determination of Tectonics Qualifying Conditions by end of FY'97
  - Development of Geologic Model (preliminary model, 6/94, interim model, 6/96, and final model, 6/99)
  - Development of ESF Seismic Design Data by 6/94
  - Development of Repository Seismic Design Data by 6/96

ITE Test Prioritization:

STUDY	UNSUITABILITY	REGULATORY COMPLIANCE	SCIENTIFIC CONFIDENCE
Quaternary Faulting Within 100 km of Yucca Mountain	Low (Unranked)	Low (14)	Middle (14)

WBS Elements (1.2.3..) / Participant:

2.8.4.3	Participant	QUATERNARY FAULTING WITHIN 100 KM OF YUCCA MOUNTAIN.	Scope	Budget
	USGS	Evaluate Quaternary faults within 100 km of Yucca Mountain	map compilation, field verification, trenching, report writing.	$145,000
		Evaluate Bare Mountain fault	trenching, geologic mapping, report writing	$155,000
			USGS TOTAL	**$300,000**

Principal Investigator:

P&S Account: John Whitney, USGS

Summary Accounts: Larry Anderson, USBR

FY'93 Scope:

Evaluate Quaternary Faults Within 100 km of Yucca Mountain-

Continue compilation of Quaternary fault map within 100 km of Yucca Mountain;
Conduct detailed evaluation of the Death Valley-Furnace Creek fault zone;
Evaluate Pahrump-Stateline-Ash Meadows fault systems;
Continue evaluation of Beatty scarp.

Evaluate Bare Mountain fault Zone-

Conduct detailed Quaternary surficial geologic mapping on the east side of Bare Mountain;
Log and analyze trenches excavated across faults.

Status at Beginning of FY'93:

Study Plan:

8.3.1.17.4.3 - Quaternary faulting within 100 km of Yucca Mountain, including Walker Lane. Complete through Comment Resolution (12/28/92).

TPP: T-92-17 - Initiated, R0 approved 8/19/92; Planning information received 10/5/92. Awaiting environmental clearance (3/93). Records Package No. TM-010.

JP: 92-13 - On hold; will not be required, with all work being off-site. Records Package No. DRC-021.

Environmental Studies: See TPP section.

Prerequisite Predecessor: None

1993 Deliverables:

Due Date	Deliverable	Participant	Delivered ?
5/93	Map of known and suspected Quaternary faults within 100 km of Yucca Mountain	USGS	
5/93	Decision on need for additional trenches on Beatty scarp	USGS	
9/93	Preliminary report on age and segmentation of Death Valley-Furnace Creek fault zone	USGS	
9/93	Report on need for in depth, detailed study of Pahrump-Stateline-Ash Meadows fault system	USGS	
9/93	Preliminary report on Bare Mountain fault with trench logs	USGS	

1992 Scenario:

Budget: $ 170,000 $197,000 (116%) spent.

Budgeted	Spent		Variance
	Amount	Percent	
$ 170,000	$ 197,000	116	

1992 Milestones accomplished:

- Compiled, reviewed and synthesized existing data to evaluate its usefulness and quality.
- Developed a computer database for information on Quaternary faults.
- Conducted field reconnaissance of the Furnace Creek fault zone, Bare Mountain fault, Beatty scarp, and Ash Meadows fault zone.

1992 Deliverables:

Due Date	Deliverable	Participant	Delivered ?
4/92	Submit study plan to NRC	USGS	Not yet
9/92	Report: Preliminary assessment on the Quaternary tectonics and faulting	USGS	Open-file report completed 9/92, but not yet published.

Impact of FY'92 on FY'93:

Study Plan is not yet approved by project office. Need to resolve comments, have project office approve, and submit to NRC before field work can commence.

FY'94 Scenario:

Budget: $ 660,000

FY '94 Workscope:

Quaternary Faulting Within 100 km of Yucca Mountain

Deep Geophysical Surveys- $300,000; Evaluate additional regional seismic lines, evaluate locations for additional seismic profiles in the vicinity of Yucca Mountain; Write additional contracts for seismic profiles; Oversee collection of additional data; Process and interpret data, and write report.

Evaluate Quaternary Faults Within 100 km of Yucca Mountain- $280,000; Prepare a photogeologic map of Quaternary fault scarps within 100 km of Yucca Mountain, verify scarps and lineaments in the field.

Evaluate Cedar Mountain Earthquake - 1932- $40,000; Begin study to evaluate Stewart and Monte Cristo Valleys, their relationship to the Walker Lane, and the 1932 Cedar Mountain earthquake.

Evaluate Bare Mountain Fault Zone- $40,000; Analyze Bare Mountain fault, excavate additional trenches, if required.

1.2.3.2.8.4.4 QUATERNARY FAULTING WITHIN NE-TRENDING ZONES

Purpose:

- To characterize the style and rate of past movement on Quaternary left-lateral strike-slip faults located east and southeast of Yucca Mountain.
- Provide input to evaluation of the tectonics disqualifying condition.
- Provide input evaluations of seismic hazard at Yucca Mountain.
- Provide input in developing tectonic models for the Yucca Mountain region.

Description:

- Evaluate the Rock Valley fault system through field mapping trenching and geophysical studies
- Evaluate the Mine Mountain fault system through synthesis and evaluation of the results from geologic mapping, and geophysical investigation
- Evaluate the Cane Spring fault system through field mapping, trenching, and geophysics.

FY'93 Funding: $120,000 (Mission 2001: $121,000)

Rationale for FY'93 Funding: A priority 6 study.

- Consistent with directive from DOE-HQ to emphasize activities that contribute to the assessment of seismic hazard at the site.
- Supports:
  - Determination of Tectonics Disqualifying Conditions by end of FY'95
  - Determination of Tectonics Qualifying Conditions by end of FY'97
  - Development of Geologic Model (preliminary model, 6/94, interim model, 6/96, and final model, 6/99)
  - Development of ESF Seismic Design Data by 6/94
  - Development of Repository Seismic Design Data by 6/96

ITE Test Prioritization:

STUDY	UNSUITABILITY	REGULATORY COMPLIANCE	SCIENTIFIC CONFIDENCE
Quaternary Faulting Within NE-Trending Zones	Middle (13)	Middle (17)	Middle (12)

WBS Elements (1.2.3..) / Participant:

2.8.4.4	USGS	**QUATERNARY FAULTING IN NE-TRENDING FAULT ZONES**	**Scope**	**Budget**
		Evaluate the Rock Valley fault system	field mapping and sampling, report writing	$100,000
		LOE Activities	carry out planning and administrative tasks associated with this activity	$20,000
			USGS TOTAL	**$120,000**

Principal Investigator:

P&S Account: Dennis O'Leary, USGS

Summary Account: Dennis O'Leary, USGS

FY'93 Scope:

Evaluate the Rock Valley fault system

- Complete study plan comment resolution
- Conduct reconnaissance field work along Rock Valley fault system
- Write preliminary report on Rock Valley fault system.
- Excavate trench in the central Rock Valley south of Skull Mountain, or possibly in southwestern Rock Valley at northwest edge of the Specter Range (Note: this trench is not incorporated in the 5-Jan-93 PACS statement of work, but is included in a letter from Menges (USGS) to Sullivan (YMPO) dated 25-Jan-93 that lists expected trenching activity for FY 93.)

Status at Beginning of FY'93:

Study Plan: **8.3.1.17.4.4-** Quaternary faulting proximal to site within NE trending fault zones. PI has revised study plan in accordance with reviewer comments (10/26/92)

TPP: Not initiated at this time.

JP:

Environmental Studies: Pre-activity survey needed for trench work.

Prerequisite Predecessor: None

1993 Deliverables:

Due Date	Deliverable	Participant	Delivered ?
4/93	Interim Report: Rock Valley Fault System	USGS	
9/93	Report on fault-slip analysis of the Rock Valley fault system	USGS	

1992 Scenario:

Budget:

Budgeted	Spent		Variance
	Amount	Percent	
$ 140,000	$ 113,000	81	

1992 Milestones accomplished:

- Submitted Study Plan for Project Office Review.
- Revised Study Plan to address review comments.

1992 Deliverables:

Due Date	Deliverable	Participant	Delivered ?
1/92	Study plan for 8.3.1.17.4.4.1 for USGS review	USGS	6/11/92 per USGS
4/92	Study plan for 8.3.1.17.4.4.1 to DOE	USGS	8/3/92
9/92	Report: Rock Valley, Mine Mountain and Cane Spring faults	USGS	9/28/92 per USGS

Impact of FY'92 on FY'93:

- The pattern of aftershocks from the June 29, 1992 Little Skull Mountain earthquake suggests that the main shock may have occurred on the Mine Mountain fault system. This may warrant a change in the order in which NE-trending faults are studied.
- Study Plan not yet complete. If not finished in a timely manner in FY 93, could impact the possibility of doing any trench work in FY 93.

FY'94 Scenario:

Budget: $120,000

FY'94 Scope:

- Evaluate the Rock Valley fault system- $50,000; Identify trench locations; Evaluate Quaternary displacement- Rock Valley ; Excavate trenches; Log trenches.

- Evaluate Mine Mountain fault system- $50,000; Conduct field mapping of Mine Mountain fault.

- Evaluate Cane Springs fault system- $20,000; Conduct reconnaissance mapping.

1.2.3.2.8.4.5 DETACHMENT FAULTS

Purpose:

- To provide an understanding of the role and history of detachment faulting in the geologic evolution of the Yucca Mountain vicinity.

- To provide information that can be used to assess the likelihood that detachment faults are contemporary earthquake sources.

Description:

- Map areas of know or suspected detachment faulting in the vicinity of Yucca Mountain, including the Miocene-Paleozoic contact in the Calico Hills and the Beatty-Bare Mountain area.
- Examine the distinctive breccia masses proximal to Yucca Mountain.
- Provide age constraints on detachment fault movement.

FY'93 Funding: $120,000 (Mission 2001: $275,000)

Rationale for FY'93 Funding: This is a priority 6 study.

ITE Test Prioritization:

STUDY	UNSUITABILITY	REGULATORY COMPLIANCE	SCIENTIFIC CONFIDENCE
Detachment Faults	Low (Unranked)	Low (15)	Low (13)

WBS Elements (1.2.3..) / Participant:

2.8.3.1	Participant	DETACHMENT FAULTS	Scope	Budget
	USGS	Evaluate Miocene/Paleozoic Contact in the Calico Hills	Conduct field investigations and prepare a map.	$ 35,000
		Evaluate Detachment Faults near Beatty/Bare Mountain	Collect and analyze data to study postulated detachment fault.	$ 55,000
		Evaluate Age of Detachment Faults	Conduct fission track and K-Ar dating	$ 90,000
			USGS TOTAL	**$180,000**

Principal Investigator:

P&S Account:	Detachment Faults	J. Whitney, USGS
Summary Account:	• Evaluate Miocene/Paleozoic Contact in the Calico Hills	Simonds, USGS
	• Evaluate Detachment Faults in Vicinity of Beatty/Bare Mountain	Hamilton, USGS
	• Evaluate Age of Detachment Faults	Hamilton, USGS

FY'93 Scope:

- Evaluate the Miocene-Paleozoic contact in the Calico Hills at locations where it is proximal to proposed detachment faults
- Complete geologic map of Calico Hills and describe work in a report
- Collect field and lab data to define the evolution through time of the 3-D crustal dismemberment of the Bare Mountain - Yucca Mountain system
- Examine extension in Miocene rocks provide input to tectonic models of YM
- Compile published maps of Beatty-Bare Mountain area and field check them. Carry out mapping where published data are lacking and needed to assess potential detachment faults.
- Examine samples to determine the thermal and pressure conditions under which rocks near proposed detachment surfaces were metamorphosed.
- Conduct fission track dating on lower plate samples from Bare Mountain.
- Conduct K-Ar or Ar/Ar dating of the lower and upper plate rocks in the vicinity of Bare Mountain.

Status at Beginning of FY'93:

Study Plan: 8.3.1.17.4.5 "Detachment Faults at or Proximal to Yucca Mountain", submitted to NRC on 8/12/92.

JP/TPP: None required. Not surface disturbing work.

Environmental Studies: None required.

Prerequisite Predecessor: None

1993 Deliverables:

Due Date	Deliverable	Participant	Delivered ?
6/93	Final Report/TDIF: Geologic Map of Calico Hills	USGS	
6/93	Map: Northern Bare Mountain	USGS	
9/93	Interim Report/TDIF: Miocene/Paleozoic contact in Calico Hills	USGS	
9/93	Interim Report: Extension of Miocene rocks in the vicinity of YM	USGS	
9/93	Progress Report: Age of Detachment Faulting in the Vicinity of Yucca Mtn	USGS	

FY'92 Scenario:

Budget:

Budgeted	Spent		Variance
	Amount	Percent	
$ 132,000	$132,000	100	A slight cost and schedule variance resulted in FY 92. About $7K of work was not accomplished.

1992 Milestones accomplished:

- Revised Study Plan to resolve comments. Submitted Study Plan to YMPO for final approval and submittal to NRC.
- Initiated a scoping study on conodont alteration in possible lower plate rocks.
- Reconnaissance field work conducted to examine proposed detachment faults in the California-Nevada border region and at Bare Mountain.
- Preliminary map of Calico Hills was completed.

1992 Deliverables:

Due Date	Deliverable	Participant	Delivered ?
	Revised Study Plan for YMPO approval	USGS	3/92

Impact of FY'92 on FY'93: None

FY'94 Scenario:

Budget: $345,000

FY'94 Scope:

- 1.2.3.2.8.4.5.2 - Complete thermobarometric analysis of rocks from the lower plate in the Beatty-Bare Mountain region, and describe results in a report. ($180,000)
- 1.2.3.2.8.4.5.3 - Evaluate relation between observed megabreccia and detachment faulting. Evaluate geologic mapping in Crater Flat. ($40,000)
- 1.2.3.2.8.4.5.4 - Evaluate postulated detachment faults in the Specter Range and Camp Desert Rock areas ($40,000)
- 1.2.3.2.8.4.5.5 - Conduct fission track and K/Ar dating of samples from the Specter Range. Report on previous age dating. ($85,000)

1.2.3.2.8.4.6 QUATERNARY FAULTING WITHIN THE SITE AREA

Purpose:

- Characterize Quaternary faults within the site area. Provide information on the rates, amounts, directions, and recurrence intervals of surface faulting events.

Description:

- Prepare maps of the site area for Quaternary faults and for surficial deposits.
- Characterize, through geologic mapping and trenching, potentially significant Quaternary faults in the Yucca Mountain area.
- Define interconnections among faults at the surface with special attention to the Paintbrush Canyon, Bow Ridge, Windy Wash, and Solitario Canyon fault zones
- Examine other suspected or possible Quaternary faults and their potential significance to design or performance issues
- Collect and chemically analyze volcanic ashes from the Yucca Mountain area and compare these analyses with analyses of reference samples from the western United States.
- Collect and analyze carbonate samples to aid in constraining the time of movement on Quaternary faults

FY'93 Funding: $334,000 (Mission 2001: $322,000)

Rationale for FY'93 Funding: This is a priority 5 study.
Also supports priority 6 (emphasize studies to resolve seismic hazard issues) and priority 7 (issue resolution of seismic hazard).

ITE Prioritization:

STUDY	UNSUITABILITY	REGULATORY COMPLIANCE	SCIENTIFIC CONFIDENCE
Site Area Faulting	Middle (14)	Middle (3)	High (7)

WBS Elements (1.2.3..):

2.8.4.6	Participant	QUATERNARY FAULTING WITHIN THE SITE AREA	Scope	Budget
	USGS	Evaluate Quaternary Geology/Potential Faulting	Synthesize and evaluate data on Quaternary faults at Yucca Mountain.	$55,000
		Evaluate Age/Recurrence of Movement	Trenching, cleaning and logging natural exposures, scarp morphology studies, shallow geophysical survey	$205,000
		LOE	Planning and other administrative activities associated with this study.	$74,000
			USGS TOTAL	**$334,000.00**

Principal Investigator:

P&S Account	Quaternary Faulting Within the Site Area	Whitney, USGS
Summary Accounts:	• Evaluation of Quaternary Geology and Potential Faulting	Chris Menges, USGS
	• Evaluate Age and Recurrence of Movement on Quaternary faults	Chris Menges, USGS
	• LOE	Chris Menges, USGS

FY'93 Work Scope:

- Complete field mapping / strip maps - compile detailed fault mapping of previous workers, conduct field mapping of unmapped faults, produce a map showing all characteristics of each fault in the site area.
- Locate and excavate trenches on the Solitario Canyon, Bow Ridge and Windy Wash faults
- Study faults on the east and west sides of Busted Butte.
- Conduct study of scarp degradation and evolution on the north Windy Wash fault
- Study previously excavated trenches on Yucca Mountain faults (central Solitario Canyon fault, Bow Ridge fault, and Stagecoach Road fault)
- Begin study of scarp morphology on Quaternary faults
- Conduct shallow geophysical surveys at the south end of the Windy Wash fault to assess the depth of buried downfaulted Pliocene basalt flows.

Status at Beginning of FY'93:

Study Plan: **8.3.1.17.4.6** Quaternary Faulting within the Site Area:
NRC Phase I review completed 10/3/91; No Phase II review conducted.

JP/TPP:

JP 92-12 Quaternary Faulting in Site Area
JPC: Savino 4-7427
DD: Dyer
Status: Approved 5/12/92
Percent Complete: 100
Approvals: TPO, DD
Final Approval: 7/29/92
Records Package I.D.: DRC-011

TPP 92-5 Quaternary Faulting - Site Area
Status: Initiated, RO Approved
Percent Complete: 100
TPP Remarks: Investigation controls approved 6/10/92.
PE: T. Sullivan Tel. 4-7915
YMPO Contact: Sullivan
Records Package I.D.: NNA.920923.0068

Environmental Studies:
"Quaternary Fault Studies Trenches" in progress

Prerequisite Predecessor: None

1993 Deliverables:

Due Date	Deliverable	Participant	Delivered?
1/93	Report/TDIF: Excavated Trenches on the Solitario Canyon Fault	USGS	
1/93	Interim Report: Quaternary Fault Studies in the Midway Valley Area	USGS	
3/93	Report: Quaternary Fault Map	USGS	
4/93	Report/TDIF: 14C/D Trench Studies on the Bow Ridge Fault	USGS	
5/93	Report/TDIF: Trench Across Fault Splay of the Southern Windy Wash	USGS	
7/93	Report/TDIF: Trenches on the Stagecoach Road Fault	USGS	

Due Date	Deliverable	Participant	Delivered?
8/93	Report/TDIF: Results of ?Geophysical Study across Windy Wash Fault	USGS	
9/93	Report/TDIF: Quaternary Activity on Paintbrush Canyon Faults at Busted Butte	USGS	
9/93	Report/TDIF: Scarp Degradation & Evolution - North Windy Wash Fault	USGS	

1992 Scenario:

Budget: (Note: Responsibility for this study is being transferred from SNL to the USGS)

USGS:

Budgeted	Spent		Variance
	Amount	Percent	
$ 334,000	$ 202,000	60	Invoice for work subcontracted to Geomatrix not included in amount spent.

SNL:

Budgeted	Spent		Variance
	Amount	Percent	
$ 42,000	$ 52,000	124	

1992 Milestones accomplished:

- Continued preparation of strip map of Quaternary faults within the site area
- Completed four new trenches, re-excavated two existing trenches, and cleaned four natural exposures on the Solitario Canyon, Fatigue Wash, and Paintbrush Canyon-Stagecoach Road faults.
- Began investigations of Paintbrush Canyon fault at Busted Butte.
- Began logging Solitario Canyon trenches
- Collected samples of pedogenic carbonate to help constrain the age of faulting at Busted Butte.

Impacts of 92 on 93: None.

FY'94 Scenario:

Budget: $340,000

FY'94 Scope:

- Evaluate Age / Recurrence of Movement
  - Continue study of scarp morphology on Q faults
  - Define segmentation patterns of faults
  - Integrate trenching results with map of Quaternary faults within the site
  - Continue trench logging

1.2.3.2.8.4.10 GEODETIC LEVELING

Purpose:

- To evaluate historical and contemporary displacement across potentially significant faults within 100 km of Yucca Mountain.
- To characterize historical and contemporary uplift and subsidence, if any, in the Yucca Mountain region.
- To aid in evaluating the possible existence of tectonic boundaries that may separate domains with differing rates of uplift and subsidence.
- To provide input to the seismic hazard assessment for the repository and surface facilities,
- To evaluate if there were any land surface changes during the Little Skull Mountain earthquake in June, 1992.
- To determine present strain rates in the Yucca Mountain region,
- To assist in determining the probability for changes in elevation greater than 30 m and/or repository lowering of more than 100 m within the next 10,000 years.

Description:

- Conduct biennial resurvey of existing first-order level lines across Yucca Mountain.
- Observe junction points and benchmarks with global positioning satellites;
- Perform gravity-dependent correction on terrestrial measurements.
- Review results of re-leveling;
- Search archives, collect and analyze leveling data.

FY'93 Funding: **$190,000** (Mission 2001: $100,000)

Rationale for FY'93 Funding: A priority 2 study.

- No geodetic measurements have been made in the last two years because of budget constraints.
- Assess whether the Little Skull Mountain earthquake caused any changes in land elevation.
- Provide constraints for modeling ground water paths to the accessible environment.
- Consistent with directive from DOE-HQ to emphasize activities that contribute to the assessment of seismic hazard at the site.

- Supports:
  - Determination of Tectonics Disqualifying Conditions by end of FY'95
  - Determination of Tectonics Qualifying Conditions by end of FY'97
  - Development of Geologic Model (preliminary model, 6/94, interim model, 6/96, and final model, 6/99)
  - Development of ESF Seismic Design Data by 6/94
  - Development of Repository Seismic Design Data by 6/96

ITE Test Prioritization: This activity was not included in the ITE test prioritization effort because it is considered an ongoing monitoring effort.

WBS Elements (1.2.3..) / Participant:

2.8.4.10	Participant	GEODETIC LEVELING	Scope	Budget
	USGS	Re-leveling Base-Station Network	Continue to re-level network	$ 130,000
		GPS Base-Station Survey	Re-survey GPS stations in the southern Great Basin	$ 60,000
			USGS TOTAL	**$ 190,000**

Principal Investigator:

P&S Account: Geodetic Leveling John Whitney, USGS

Summary Accounts: Re-Leveling Base Stations Perasso, USGS
GPS Base Station Survey Whitney, USGS

FY'93 Scope:

- Re-survey level line at Yucca Mountain
- Prepare report on geodetic leveling
- Re-survey GPS southern Great Basin network
- Prepare report summarizing changes in GPS network over the past 10 years

Status at Beginning of FY'93:

Study Plan: **8.3.1.17.4.10**: 'Geodetic Leveling'
Complete through NRC Phase I review; no Phase II review (approved by the Project Office, 1/18/91).

JP/TPP: None initiated. Not surface-disturbing work.

Environmental Studies: May need pre-activity surveys for surveys on NTS.

Prerequisite Predecessor: None

1993 Deliverables:

Due Date	Deliverable	Participant	Delivered ?
8/93	Report: GPS Summary - Changes in the Last 10 Years	USGS	
9/93	Progress Report: Geodetic Leveling at Yucca Mountain	USGS	

1992 Scenario:

Budget: $ 0k

1992 Milestones accomplished:

No measurements made in FY 1992 because the study was unfunded.

1992 Deliverables: None

Impact of FY'92 on FY'93:

Failure to re-survey parts of geodetic network in FY 92 and earlier years give added emphasis to need for carrying out this activity in FY 93.

FY'94 Scenario:

Budget: $130,000

FY'94 Scope:

- Continue evaluation of geodetic data.
- Produce status report: 'Geodetic Leveling at Yucca Mountain'

1.2.3.2.8.4.12 TECTONIC MODELS AND SYNTHESIS

Purpose:

- Compile and interpret geologic and geophysical information from the site characterization program to develop and evaluate tectonic models for Yucca Mountain and its vicinity

Description:

- Gather information on previously proposed models for the tectonics of Yucca Mountain.
- Compile, interpret and synthesize all available geologic and geophysical data to test existing tectonic models and develop new ones if warranted.
- Interactively evaluate the degree to which tectonic models agree with available data, and use results of such evaluations to guide future data acquisition.
- Provide input to studies evaluating the consequences of tectonic disruptive events.

FY'93 Funding: $ 146,000 (Mission 2001: $ 146,000)

Rationale for FY'93 Funding: This is a priority 6 study.

This study contributes to the assessment of seismic hazard at the site, and thus is consistent with program direction to emphasize seismic hazard assessment activities. It also supports issue resolution for volcanic and seismic hazards.

ITE Test Prioritization:

This is a modeling and synthesis activity. It was not ranked by the ITE process.

WBS Elements (1.2.3..) / Participant:

2.8.4.12	Participant	TECTONIC MODELS AND SYNTHESIS	Scope	Budget
	USGS	Tectonic Models and Synthesis	Compile, synthesize and interpret available data to test existing tectonic models and develop new ones if warranted.	$ 146,000
			USGS TOTAL	**$146,000**

Principal Investigator:

P&S Account:	Tectonic Models and Synthesis	Dennis O'Leary, USGS
Summary Account:	• Evaluate Tectonic Processes	Dennis O'Leary, USGS
	• Evaluate Tectonic Models	Dennis O'Leary, USGS

FY'93 Scope:

- Integrate tectonic data
- Compile geologic map of Death Valley area
- Evaluate tectonic models
- Conduct scoping study for using boundary element modeling to test tectonic models and make predictions on their future consequences

Status at Beginning of FY'93:

Study Plan: 8.3.1.17.4.12 Tectonic Models and Synthesis
Not yet submitted to YMPO. Scheduled for submission - 2/93

JP/TPP: Not required for this study.

Environmental Studies: **Not required for this study.**

Prerequisite Predecessor: Many other studies contribute information to this study, but initiation of this activity is not dependent on their completion.

1993 Deliverables:

Due Date	Deliverable	Participant	Delivered ?
2/93	Study Plan	USGS	
9/93	Map: Geology of the Death Valley region at 1:250,000 scale	USGS	
9/93	Preliminary Report/TDIF: Tectonic Models	USGS	

FY'92 Scenario:

Budget:

Budgeted	Spent		Variance
	Amount	Percent	
$ 70,000	$ 73,000	104	

1992 Milestones accomplished:

- Prepared Study Plan for internal review. Revised to address internal review comments.
- Ordered enhanced thematic mapper images
- Carried out a reconnaissance survey of Landers, CA earthquake rupture to evaluate similarities and differences to Yucca Mountain.

1992 Deliverables:

Due Date	Deliverable	Participant	Delivered ?
	None.		

Impact of FY'92 on FY'93: None.

FY'94 Scenario:

Budget: $ 170,000

FY'94 Scope:

Evaluate Tectonic Processes ($130,000)

- Synthesize magnetic and gravity data
- Compile Beatty fault map

Evaluate Tectonic Models ($40,000)

- Synthesize in-situ stress measurements
- Synthesize kinematic and tectonic data
- Continue boundary-element modeling
- Assess present day stress field

1.2.3.3.1.1.1 PRECIPITATION AND METEOROLOGICAL MONITORING FOR REGIONAL HYDROLOGY (USGS)

Purpose:

Upgrade and expand the currently operating network to provide a better accounting of precipitation and other meteorologic conditions in the area surrounding Yucca Mountain. Develop an integrated precipitation network to characterize and track storm movements and intensity within the regional study area, and to relate amount and timing of precipitation to the amount and timing of runoff, and to provide input to water budget calculations for infiltration studies. Collect meteorological data at network stations located within the boundaries of the site to provide input to the gas-phase circulation study, percolation, hydrochemistry and infiltration studies.

Studies Support:

- Determination on Geohydrology Disqualifying Conditions by end of FY'95
- Determination on Geohydrology Qualifying Conditions by end of FY'97
- Determination on Climatic Changes Qualifying Conditions by end of FY'97
- Evaluation of Natural Infiltration, by providing precipitation data (Initial flux conditions) at neutron-access boreholes, to support water-budget calculations
- Fortymile Wash Recharge studies, providing precipitation data at neutron-access boreholes in Fortymile Wash to determine conditions that produce runoff events at Yucca Mountain

Description:

Maintenance and monitoring of collection gage network, lightning detectors, and archival of satellite imagery plus supporting analyses.

FY'93 Funding: Total: $135,000 (Mission 2001: $228,000)
(Carry over: $0)

ITE Test Prioritization:

STUDY	UNSUITABILITY	REGULATORY COMPLIANCE	SCIENTIFIC CONFIDENCE
Meteorology for Regional Hydrology	Middle (16)	Middle (20)	Low (6)

WBS Elements (1.2.3..)/Participant:

3.1.1.1	USGS	Precipitation and Meteorological Monitoring for Regional Hydrology	anal. '92 site and regional data, acquire regional data, install new tipping-bucket gauges	$135,000
			TOTAL	$135,000

Principal Investigator: Alan Flint, USGS

FY'93 Scope: USGS operates:

5 weather stations: 4 on Yucca Mountain, 1 in Jackass Flats
_ stations of the collection gauge network (????);
7 stations of the tipping-bucket network;
_ stations of the plastic rain wedge gauge network;
_ stations of the optical lightning network

Precipitation and Meteorological Monitoring for Regional Hydrology

COLLECT AND ANALYZE SYNOPTIC WEATHER/REGIONAL/SITE METEOROLOGICAL DATA FY93 [3GMM035]

Analyze '92 Station Data
Analyze '92 YM Precipt Data
Analyze '92 Regional Data
Install New Tipping Bucket Gauges
Acquire Regional Meteor. Data
Collect NTS Lightning Data
Monitor Stations and Tipping-bucket Gauges
Monitor Collection Gauge Network
Continue Implementation of all QA Requirements

Collect GOES (meteor. satellite) Data
Monitor Optical Lightning Detectors
Monitor Daily Weather Patterns

PREPARE TECHNICAL REPORT FY92 SYNOPTIC/REGIONAL/SITE METEOROLOGICAL DATA [3GMM038]

Prepare OFR on meteor. station Data, FY'92
Prepare OFR on YM Precip. Data, FY'92
Prepare Interpretative Rept, Regional Meteor.
Prepare Interpretative Rept., (5) Meteor. Stations, FY'92
Prepare Interpretative Rept., YM Precipitation, FY'92

REVIEW DATA AND PREPARE TDIF SYNOPTIC/REGIONAL/SITE METEOROLOGICAL DATA FY92 [GMM008]

Prepare and submit TDIF for synoptic, regional and site meteorological data collected during FY92

Status at Beginning of FY'93:

Study Plans: 8.3.1.2.1.1 - Characterization of Meteorology for Regional Hydrology: complete through NRC Phase I review; NRC Phase II not needed.

JP/TPP: May require TPP for field data acquisition activities.

Environmental Studies: May require environmental work for installation of new gauges.

Prerequisite Predecessor:

1993 Deliverables:

Due Date	Deliverable	Participant	Delivered?
12/92	Report Synoptic/Regional/Site Meteorological data for FY92 to PDA	USGS	
6/93	Report Synoptic/Regional/Site Meteorological Data for FY92 to TDIF	USGS	
FY93	Technical Report: Interpretative report of Synoptic/Regional/Site meteorological Data for FY92	USGS	

1992 Scenario:

Budget: $208,000; 84% spent.

1992 Accomplishments:

Documented precipitation, runoff, snowpack, and high-water marks from storms of January 3-6, February 6-7, February 9-14. The latter storm produced the first major runoff event in nearly eight years, five more major storms during March made 1992 one of the wettest years on record. Expanded collection gage network. Investigated correlation of lightning strikes with rainfall amounts. Installed new satellite data ingest system.

1992 Deliverables:

Due Date	Deliverable	Participant	Delivered?
10/91	NRC Approval of Study Plan (RP01M)	USGS	10/21/91
9/92	Open File Report: YM Precipitation Data - FY 91 (M043M)	USGS	Not on Current Schedule
9/92	Report: Regional Met-FY91 (M35M)	USGS	Not on Current Schedule

Impact of FY'92 on FY'93:

???

FY'94 Scenario

Budget: $278,000

FY'94 Scope:

1.2.3.3.1.1.2 RUNOFF AND STREAMFLOW MONITORING TRANSPORT OF DEBRIS BY SEVERE RUNOFF

Purpose:

- document surface runoff resulting from storms in the vicinity of Yucca Mountain
- data used in:

  (1) Water balance calculations for unsaturated zone infiltration studies
  (2) Understanding the potential for recharge to the saturated zone along Fortymile Wash
  (3) Runoff/flooding considerations for facility design

  Studies Support:

  - Determination of Geohydrology Disqualifying Condition by end of FY'95
  - Determination of Geohydrology Qualifying Conditions by end of FY'97

Description:

Design a measurement network for the compilation of a meteorological data base which includes the quantity and timing of precipitation, air temperature and snow pack (at selected sites). Design a regional and a site-specidifc stream gauging network for the creation of a stream flow data base. Monitor five existing primary measurement sites with continuous stream stage recorders. Monitor periodic and runoff-event of ten secondary measurement sites equipped with crest-stage gauges for peak level flow data. Measure ungauged sites (tertiary) to supplement primary and secondary station data. Apply statistical analysis to long-term data to determine runoff frequencies. Determine sediment component of runoff through automated sample collection. Note times, locations, areal extent and depths of severe erosion and deposition caused by intense runoff. Measure amount of channel or hillslope erosion caused by a given flood. Measure resultant sediment deposition. Quantify physical characteristics of the debris that is eroded, transported and deposited by flood. Utilize land-surface and areal photography and remote sensing in post-fact analyses.

FY'93 Funding: $396,000 (Mission 2001: $421,000)

Rationale for FY'93 Funding: A Priority 2 Study; necessary for:

maintaining a continuous monitoring record in the development of a baseline data base.

ITE Test Prioritization: Activity is not included on the ITE prioritization list

WBS Elements (1.2.3..) / Participant:

WBS NO.	PARTICIPANT	ACTIVITY	SCOPE (see below)	BUDGET
3.1.1.2	USGS	RUNOFF AND STREAM FLOW		
	USGS	Surface-Water Runoff Monitoring	(a)	$396,000
	USGS			
			TOTAL	$396,000

Principal Investigator: Tom Kane (USGS)
Dave Beck (USGS - LV)

FY'93 Scope:

- Continue operation of 11 continuous-record and 13 peak-flow stations
- Install 2 additional continuous-record stations near Yucca Mountain
- Plan for additional runoff-monitoring sites in washes on eastern slope of Yucca Mountain to support unsaturated-zone infiltration studies

(a) Surface Water Runoff Monitoring

Collect FY'93 Runoff and Streamflow Data
Complete Reduction of FY86-89 Data and Prepare Rept.
Compile/Reduce FY'92 Data
Reduce FY'90-91 Data, Prepare Rept
Reduce FY'92 Data, Prepare Rept.
Apply for Site Prerequisite Surveys
Install Additional Fortymile Wash Gauges
Support Project Operations

Status at Beginning of FY'93:

Study Plan: **8.3.1.2.1.2** - "Characterize Runoff and Streamflow," NRC Phase II review completed 8/14/92.

JPP/TPP: May require TPP for field data acquisition activities. May require JP for installation of runoff gauges.

Environmental Studies: Environmental studies are scheduled for completion by 2/24/93 for USGS water guaging stations.

Prerequisite Predecessor: Possibly TPP, JP, and environmental studies (see above).

1993 Deliverables:

Due Date	Deliverable	Parti-cipant	Delivered ?
11/92	Submit FY 92 Runoff Data to PDA (3GRS024M)	USGS	
1/93	Report/TDIF: Streamflow and precipitation FY 83-85 (3GRS030M)	USGS	
6/93	Report/TDIF: Streamflow and Precipitation FY 86-91 (3GRS031M)	USGS	
9/93	Report/TDIF: Streamflow and Precipitation FY 92 (3GRS025M)	USGS	

FY'92 Scenario:

Budget: $358,000; 100% spent.

1992 Accomplishments:

- Documented effects of major storms of January through March, which resulted in first major runoff in nearly eight years.

- Attempted to obtain BLM permits for installation of stream flow gauges on the Amargosa River near the state line and near Eagle Mountain; BLM did not act and effort was redirected toward establishing a gauging station on the east slope of Yucca Mountain.

1992 Deliverables:

Due Date	Deliverable	Parti-cipant	Delivered ?
7/92	Submit FY'92 Runoff Data to PDA (3GRS002M)	USGS	YES (7/31/92)
8/92	Reduced FY 83-85 Data to PDA (3GRS022M)	USGS	NO Rescheduled 1/31/93 (3GRS030M)

Impact of FY'92 on FY'93:

???

FY'94 Scenario:

Budget: $763,000

FY'94 Scope:

Surface Water Runoff Monitoring

Compile/Reduce FY'93 Data
Reduce FY'93 Data, Prepare Rept
Procure Equipment for New Gauges - to install 8 stream gauges in washes on eastern slope of Yucca Mountain
Submit Application for Site Surveys from DRI, SAIC, and DOE
Complete Installation of Eight YM Stream Gauges
Collect FY'94 Runoff and Streamflow Data
Support Project Operations

Transport of Debris by Severe Runoff

Continue Summary of Reconnaissance Activities
Continue Site-Specific Aerial Investigations
Conduct Site-specific field investigations
Prepare reports/maps summarizing site-specific findings

1.2.3.3.1.1.3 REGIONAL GROUND WATER FLOW SYSTEM

Purpose:

Define the potentiometric distribution hydraulic properties, and recharge and discharge for the regional ground-water flow system to determine the magnitude and direction of ground-water flow. Assess data needs and identify variables necessary to build a Saturated Zone Groundwater Flow model

Description:

Assess data needs and identify variables necessary to build a saturated zone ground-water flow model. Perform sensitivity analysis with finite element model to prioritize effects of key variables. Form a hierarchy of variables to focus data collection on minimizing uncertainties. Conduct field reconnaissance and information source research for ground-water level and subsequent geophysical logging. Utilize boreholes of mining companies for sampling, testing, logging and water-level measurements. conduct drilling, testing and monitoring of new boreholes at Fortymile Wash, Franklin Lake Playa, Crater Flat, eastern edge of Funeral Mountains, southwest of Lathrop Wells and at the site. Sample for chemical and isotopic data, using a small capacity pump. Log temperatures and measure thermal conductivity in new or newly located wells for heat-flow analyses. Conduct slug and/or pumping tests to extend hydraulic properties database. Conduct hydrochemical and isotopic analysis of Fortymile Wash runoff, unsaturated and saturated-zone water samples. Conduct continuous coring of three deep boreholes and monitoring for unsaturated and saturated zone response during artificial and natural recharge events. Conduct drilling and coring of 20-30 neutron access holes to define the upper limit of the saturated zone and to monitor moisture content flux during recharge events. Determine matrix potential using tensiometer in small diameter holes. Conduct core analyses of rock properties and mineral and lithologic characterization. Conduct steady state and dynamic infiltration tests. Conduct water-level measurements and vertical hydraulic potential determination of the saturated zone. Analyze stream flow data and transmission loss studies. Determine basic characteristics of Forty mile Wash drainage. Conduct conceptual and numerical modeling. Install piezometer nests to determine upward hydraulic gradient. Estimate evapotranspiration using the Bowen ratio method, the eddy-correlation method and the chamber method.

FY'93 Funding: Total: **$275,000** (Mission 2001: $395,000
(Carry over: $0)

Rationale for FY'93 Funding: A Priority 4 study.

Rated a Dominant Study Plan by ITE Test Prioritization

ITE Test Prioritization: Regional Saturated Zone Flow System, dominant study plan

Study	Unsuitability	Regulatory Compliance	Scientific Confidence
Regional Saturated Zone Flow System	High (18)	High (17)	High (16)

WBS Elements (1.2.3..) / Participant:

.3.1.1.3	USGS	REGIONAL GROUND WATER FLOW SYSTEM		$90,000
	USGS	Regional Potentiometric Levels and Hydrology		$130,000
	USGS	Fortymile Wash Recharge Study		$55,000
			TOTAL	$275,000

Principal Investigator: John Czarnecki, USGS

FY'93 Scope:

Regional Potentiometric Levels and Hydrology

Continue preparation of report on Hydrostratigraphy, Amargosa Desert
Revise Water-Level data report
Survey Water Wells in Amargosa Desert FY93
Finalize Report: Areal Hydrochemistry Franklin Lake Playa

Fortymile Wash Recharge Study

Write and Revise Fortymile Recharge Data Report
Evaluate Southern Nevada and California Streamflow
Prepare Groundwater Recharge Poster
Conduct Ponding and infiltration tests

Regional Groundwater Flow System

Support Project Operations
Write scientific notebook, test small diameter wells
Collect FY93 Moisture Data

Status at Beginning of FY'93:

Study Plan: 8.3.1.2.1.3, "Characterization of Regional Ground Water Flow System", NRC Phase I review 10/4/91; No NRC Phase II review

JP/TPP: May require JP and TPP for data acquisition

Environmental Studies: Environmental studies are scheduled to completed by 5/18/93 for pump test and water sampling for existing wells in the Armagosa Desert.

Prerequisite Predecessor: JPs and TPPs?

1993 Deliverables:

Due Date	Deliverable	Parti-cipant	Delivered ?
4/93	Report/TDIF: Existing Regional Water Level Data (3GRG054M)	USGS	
5/93	Interim Status Report (3GRG010M)	USGS	
9/93	Submit small diameter well data to PKA (3GRG011M)	USGS	
9/93	Submit FY93 Water level Data (Amargosa) to PDA (3GRG068M)	USGS	
9/93	Report/TDIF: Areal Hydrochemistry of Franklin Lake Playa (3GRG032M)	USGS	
12/92	Poster: Groundwater Recharge (3GRG024M)	USGS	
5/93	Interim Status Report (3GRG020M)	USGS	
9/93	Report/TDIF: Fortymile Wash Recharge Data FY93 (3GRG021M)	USGS	
9/93	Streamflow Chaos Journal Article (3GRG023M)	USGS	
9/93	Submit Fortymile Wash Infiltration Test Data to PDA (3GRG026M)	USGS	

FY'92 Scenario:

Budget: $359,000; 97% spent.

1992 Accomplishments:

1992 Deliverables:

Due Date	Deliverable	Parti-cipant	Delivered ?
5/92	Regional water-level data to PDA (3GRG003M)	USGS	YES (5/20/92)
8/92	Regional water-level data to PDA (3GRG004M)	USGS	Rescheduled for 9/30/93 (3GRG068M)
8/92	Regional water-level data to PDA (3GRG04AM)	USGS	
8/92	Regional water-level data to PDA (3GRG05AM)	USGS	
9/92	Criteria for ponding sites (3GRG001M)	USGS	LOE Activity
9/92	Criteria letter for FM and FMN holes (3GRG006M)	USGS	YES (9/30/92)
9/92	Preliminary Channel width and recharge Forty Mile Wash (G1A5)	USGS	Deleted
9/92	Submit FY92 Moisture Data to PDA (3GRG028M)	USGS	YES (9/30/92)
12/92	Vertical Multilevel Sampler, Franklin Lake Playa (G2A4)	USGS	YES (12/24/91)
9/92	Submit Piezometer Nest Data to PDA (3GRG031M)	USGS	Canceled

Impact of FY'92 on FY'93:

???

FY'94 Scenario

Budget: $681,000

FY'94 Scope:

???

1.2.3.3.1.1.4 REGIONAL HYDROLOGIC SYSTEM SYNTHESIS AND MODELING

Purpose: Synthesize hydrologic, geologic, hydrochemical, and geophysical data into a model and make a qualitative analysis of how the system is functioning. Represent quantitative observations of hydrogeologic data pertaining to the ground-water flow system in a comprehensive flow model.

Description: All efforts required to:

-assemble all hydrologic, geologic, geochemical, and geophysical data and all reasonable interpreatations of the data into a description of the regional flow system of the saturated zone

-model subregional two-dimensional areal hydrology by incorporating potentiometric data and hydraulic properties data from new drillholes; appropriate data on the distribution, type, and properties of stratigraphic and structural units from geophysical studies; additional hydrogeologic data from exploration boreholes in the Amargosa Desert; annual average estimates of evapotranspiration of Franklin Lake; recharge estimates at Forty mile wash; and additional data from hydrochemical studies at site and regional scales

-construct a subregional two-dimensional cross-sectional model to estimate the ground-water flow direction and magnitude along a potential flow path through the repository block to the accessible environment and extending into the region.

Construct a numerical, quasi-three-dimensional groundwater flow model of one saturated zone of the Yucca Mountain region using hydrogeologic data compiled from previous drilling programs, geologic report, well-scheduling efforts, the regional and site characterization studies, the USGS Great Basin Regional Aquifer System analysis, and the USGS WATSTORE data base; and calibrate the model for steady conditions using available water-level data

FY'93 Funding: **$265,000** (Mission 2001: $117,000)
(Carry over: $0)

Rationale for FY'93 Funding: A Priority 8 Study:

Saturated Zone may be important to know about when determining whether or not site meets liscensing criteria.

ITE Test Prioritization:

Not ranked.

WBS Elements (1.2.3..) / Participant:

3.1.1.4	USGS	REGIONAL HYDROLOGIC SYSTEM SYNTHESIS AND MODELING	SCOPE (see below)	
		Subregional 2-D Areal Hydrologic Model	(a)	$23,000
		Regional 3-D Hydrology	(b)	$197,000
		Regional Hydrologic System Synthesis and Modeling	(c)	$45,000
			Total	$265,000

Principal Investigator: Czarnecki, USGS

FY'93 Scope:

(a) Subregional 2-D Areal Hydrologic Model
- Prepare Draft Report on Preliminary Simulations of Large Hydraulic Gradient
- Calibrate 2D FE Model

(b) Regional 3-D Hydrology
- General Model Input Arrays
- Refine 3-D Hydrologic Framework
- Continue Testing with Chemical Models
- Evaluate GSIS Methods

(c) Regional Hydrologic System Synthesis and Modeling
- Support Project Operations
- Begin QA for MODFE Code
- Support Hydrology Integration Task Force

Status at Beginning of FY'93:

Study Plan: 8.3.1.2.1.4, "Regional Hydrologic System Synthesis and Modeling" approved 12/18/91, Completed Phase I review 5/6/92

JP/TPP: Not necessary; no field work involved.

Environmental Studies: Not necessary; no field work involved.

Prerequisite Predecessor: Not necessary; no field work involved.

1993 Deliverables:

Due Date	Deliverable	Parti-cipant	Delivered ?
5/93	Paper on Structural Flow-Path with Transport and Chemical (3GFH009M)	USGS	
9/93	Application of GSIS to 3D Ground Water Modeling (3GFH014M)	USGS	
9/93	Paper on Model Units (3GFH022M)	USGS	

1992 Scenario:

Budget: $; % spent.

1992 Accomplishments:

The Study Plan was approved by the DOE and the NRC Phase I Review was completed.

1992 Deliverables:

No scheduled deliverables.

Impact of FY'92 on FY'93:

FY'94 Scenario:

Budget: $223,000

FY'94 Scope:

1.2.3.3.1.2.1 UNSATURATED ZONE INFILTRATION

Purpose:

1. To characterize and delineate surficial materials and rock covering Yucca Mountain with regard to infiltration character

2. To monitor natural infiltration in neutron boreholes

3. To artificially simulate natural infiltration for each map unit to estimate maximum infiltration rates

The activity supports:

- Determination on Geohydrology Disqualifying Condition by end of FY'95 - provides input for boundary flux

- Determination on Geohydrology Qualifying Condition by end of FY'97 - provides input for boundary flux

- Development of hydrologic model for site

- Performance Assessment model, providing input for Post Closure System Guideline evaluation

Description:

- Continue moisture- meter logging, providing present day infiltration rates for differing topographic and lithologic settings.

- Conduct artificial infiltration study, to provide infiltration data for simulated wetter climatic conditions.

- Characterize surficial materials, to provide hydraulic properties of upper flux boundary.

- Develop ___ additional neutron holes **is any money applied to this activity from this budget ??**

FY'93 Funding: $835,000 (Mission 2001: $943,000)

Rationale for FY'93 Funding: A Priority 2 study. High priority given to maintain on-going monitoring activities.

ITE Test Prioritization:

STUDY	UNSUITABILITY	REGULATORY COMPLIANCE	SCIENTIFIC CONFIDENCE
UZ Infiltration	High (6)	High (7)	High (12)

WBS Elements (1.2.3..) / Participant:

WBS NO.	PARTICIPANT	ACTIVITY	SCOPE (see below)	BUDGET
3.1.2.1	USGS	UNSATURATED ZONE INFILTRATION		
	USGS	Characterization of Hydrologic Properties of Surficial Materials	(a)	145,000
	USGS	Evaluation of Natural Infiltration	(b)	315,000
	USGS	Evaluation - Artificial Infiltration	(c)	170,000
	USGS	Unsaturated Zone Infiltration	(d)	205,000
			TOTAL	$835,000

Principal Investigator: Al Flint, USGS

FY'93 Scope:

(a) Characteristics of Hydrologic Properties of Surficial Material

Collect/Analyze Unconsolidated Materials
Collect/Analyze Consolidated Materials
Conduct Borehole Geophysical Surveys
Develop Preliminariy Infiltration/Runoff Map
Develop Preliminary Geohydrologic/Surficial Map
Support Project Operations

(b) Evaluation of Natural Infiltration

Conduct Water Balance Studies
Develop Small Scale Watershed Model
Evaluate Shallow/Deep Infiltration Processes
Review Data and Prepare TDIF Historical Neutron Hole Data

(c) Evaluation - Artificial Infiltration

Conduct Infiltrometer Study: Development /Testing
Conduct Infiltrometer Study
Prepare TDIF Infiltrometer Study: Development/Testing
Prepare OFR Infiltrometer Study: Development/Testing
Conduct Prototype Ponding/SPRS/LPRS Study
Develop Field Strategy Ponding/SPRS/LPRS Studies
Prepare TDIF Prototype Ponding/SPRS/LPRS Studies

(d) Unsaturated Zone Infiltration

Support project operations
Neutron Moisture Monitoring

Status at Beginning of FY'93:

Study Plan: **8.3.1.2.2.1** "Characteristics of Unsaturated Zone Infiltration," Rev. 1 submitted to NRC review on 6/1/92

JP/TPP:	**JP 91-9, Rev. 3**	Neutron Access Boreholes (Phase 2): (second 12 boreholes): Approved and 100% complete, Field Change Order (9/3/92) for N31, N32, and N35 submitted to FCCB. Beginning operations on N50 series.
	TPP 91-34	Neutron Access Boreholes (Phase 2), Rev. 2: Approved and 100% complete. Rev. 3 underway.

Environmental Studies:

Prerequisite Predecessor:

1993 Deliverables:

Due Date	Deliverable	Participant	Delivered?
5/93	Interim Status Report (3GUI630M)	USGS	
5/93	Interim Status Report (3GUI010M)	USGS	
5/93	Interim Status Report (3GUI300M)	USGS	
9/93	Report, Historical Neutron Hole Data (3GUI050M)	USGS	
9/93	OFR/TDIF, Infiltrometer Study: Development/Testing (3GUI636M)	USGS	
?	Data, Preliminary Infiltration Runoff and Geohydrology/Surficial Map	USGS	
12/92	Historical neutron Hole Data to PDA (3GUI400M)	USGS	
9/93	Prototype Ponding/ SPRs/LPRs Study Data to PDA (3GUI640M)	USGS	

FY'92 Scenario:

Budget: $598,000; 83% spent.

1992 Accomplishments:

- Continued analysis of moisture profiles using geophysical and video logging and core sample analysis
- Completed 16 new neutron access boreholes
- Conducted modeling of moisture profiles to allow detailed analysis of infiltration from winter storms
- Increase frequency of moisture logging
- Redirected deterministic modeling activities in response to Mission 2001

- Developed comparative analysis of infiltration on alluvium, channel, terrace, sideslope, and ridgetop locations

- Began assessment of the horizontal variability of deep moisture profiles.

1992 Deliverables: None.

Impact of FY'92 on FY'93: No impact identified.

FY'94 Scenario:

Budget: $1,065,000

FY'94 Scope:

Characteristics of Hydrologic Properties of Surficial Material

Prepare TDIF Unconsolidated Materials
Collect/Analyze Unconsolidated Materials
Prepare TDIF Consolidated Materials
Collect/Analyze Consolidated Materials
Prepare TDIF Borehole Geophysical Surveys
Conduct Borehole Geophysical Surveys
Prepare TDIF Preliminary Infiltration/Runoff Map Data
Refine Infiltration/Runoff Map
Prepare TDIF Preliminary Geohydrologic/Surficial Map
Refine Geohydrologic/Surficial Map
Support Project Operations

Evaluation of Natural Infiltration

Conduct Water Balance Studies
Prepare TDIF Water Balance Studies
Prepare Technical Report, Water Balance Studies
Continue Small Scale Watershed Model
Develop Large Scale Watershed Model
Prepare EDIF Small Scale Watershed Model
Prepare Report, Small Scale Watershed Model
Evaluate Shallow Infiltration Processes
Prepare TDIF Shallow Infiltration
Evaluate Deep Infiltration Processes
Prepare TDIF Deep Infiltration Processes

Evaluation - Artificial Infiltration

Conduct Infiltrometer Study
Prepare TDIF Infiltrometer Study
Establish Ponding/SPRS/LPRS Plots
Conduct Ponding and SPRS Study
Prepare OFR Ponding/SPRS/LPRS Prototype Study

1.2.3.3.1.2.2 WATER MOVEMENT TRACER TESTS

Purpose:

The objective of the Water Movement Tracer Tests is to obtain information from isotopic measurements of soil, tuff and water samples collected at Yucca Mountain to determine the rate of water movement downward through the unsaturated zone. This effort will develop chlorine-36 analytical procedures, and measurements of chloride concentration and chlorine isotopic compositions in samples of soil, tuff and water are planned. Analysis of technetium-99 could be considered as an alternative or supplement to data on chlorine 36. Analyses of noble gases of helium, argon and neon could also be used to evaluate mixing of water. Level 2 milestone M623, Issue Report: Chlorine 36 Analysis of Unsaturated Zone and no level 1 milestones are planned for this area.

Description:

This effort will develop chorine-36 analytical procedures, and measurements of chloride concentration and chlorine isotopic compositions in samples of soil, tuff and water. Analysis of technetium-99 could be considered as an alternative or supplement to data on chlorine 36. Analyses of noble gases of helium, argon and neon could also be used to evaluate mixing of water.

FY'93 Funding: $445,000 (Mission 2001: same)
(Carry over: $0)

Rationale for FY'93 Funding: A Priority 3 study.

ITE Test Prioritization: Dominant Study Plan (Top two out of three)

STUDY	UNSUITABILITY	REGULATORY COMPLIANCE	SCIENTIFIC CONFIDENCE
WATER MOVEMENT TRACER TESTS	High (17)	High (19)	Middle (5)
related to: Unsaturated Zone Infiltration	High (6)	High (7)	High (12)

WBS Elements (1.2.3..) / Participant:

3.1.2.2	LANL	WATER MOVEMENT TRACER TESTS	SCOPE (see below)	
	LANL	Analyze cuttings from surface based holes	(a)	$205,000
	LANL	Collect and analyze near-surface samples	(b)	$240,000
			TOTAL	$445,000

Principal Investigator: June Fabryka-Martin, LANL

FY'93 Scope: Specific work to be performed under Water movement tracer tests includes: analyze cuttings from surface-based holes, analyze and collect ESF samples for CL36, analyze and collect near surface samples

(a) Analyze Cuttings from Surface Based Holes

Collect and analyze cuttings from deep surface-based holes in the unsaturated zone in order to:

1) determine the depth to which bomb-pulse 36Cl has penetrated and to correlate such distribution with lithology and structural features

2) estimate the average residence time of infiltrating water as a function of depth.

(b) Collect and Analyze Near-Surface Samples

Collect surface soil samples, soil profiles and cuttings from neutron-access boreholes and the Exploratory Studies Facility to:

1) determine the prebomb meteoric 36Cl/Cl ratio
2) assess the variability in meteoric Cl/Br and 37Cl/35Cl ratios
3) estimate present-day shallow infiltration

Status at Beginning of FY'93:

Study Plan: **8.3.1.2.2.2**, "Water Movement Test" Rev 1, (major revision) PI revision complete 12/10/92

JP/TPP: May require TPP for sample collection and laboratory work

Environmental Studies: May require studies for sample collection.

Prerequisite Predecessor:

1993 Deliverables:

Due Date	Deliverable	Parti-cipant	Delivered ?
FY93	Progress report on FY93 progress and available results (level 3 milestone 3356)	LANL	

FY'92 Scenario:

Budget: $426,000; 101% spent.

1992 Accomplishments:

1992 Deliverables:

Due Date	Deliverable	Parti-cipant	Delivered ?
9/30/92	Procedure for Chlorine-36 Analysis of unsaturated Zone samples MS 3191	LANL	(a)

(a) 95% complete 8/92

Impact of FY'92 on FY'93:

FY'94 Scenario:

Budget: $700,000

FY'94 Scope:

Analyze Cuttings from Surface Based Holes	$403,000
Collect and Analyze Near-Surface Samples	$300,000

Select sampling locations.
Collect surface soil samples, soil profiles from pits and cuttings from neutron access boreholes.
Analyze samples for chlorine-36 and other environmental tracers.
Coordinate sampling with USGS and SMF as appropriate.
Report results in project documents.

1.2.3.3.1.2.3 PERCOLATION IN THE UNSATURATED ZONE SURFACE-BASED STUDY

Purpose: Determine the present in situ hydrologic properties of the unsaturated zone hydrogeologic units and structural features. Determine the present vertical and lateral variation of percolation flux through the hydrogeologic units and structural features. Investigate the relationships between present flux and past climatic conditions. Determine the effective hydraulic conductivity, storage properties, and transport properties as functions of moisture content and water potential. Develop integrated data aquisition system (IDAS). Conduct vertical seismic profiling of boreholes. Record process, transmit and archive data.

Description: All efforts required to:

Develop a matrix-property data base to be used in calculation of matrix flux within the UZ of Yucca Mountain under both present and future climatic conditions

Define the potential field and in situ bulk permeability characteristics of the unsaturated media within the proposed repository host rocks and surrounding units by performing studies in 17 vertical boreholes.

Conduct Solitario Canyon horizontal borehole study involving penetrating the Solitario Canyon fault structure where the fault plane is bounded on both sides by Topopah Spring welded tuff.

FY'93 Funding: $2,319,000 (Mission 2001: $3,276,000)
(Carry over: $0)

Rationale for FY'93 Funding: A Priority 4 Study:

Rated as the dominant study plan in all three categories of ITE Test Prioritization

ITE Test Prioritization:

STUDY	UNSUITABILITY	REGULATORY COMPILIANCE	SCIENTIFIC CONFIDENCE
Surface-Based UZ Percolation	High (1)	High (1)	High (1)

WBS Elements (1.2.3..) / Participant:

3.1.2.3	USGS	PERCOLATION IN THE UZ-SURFACE BASED STUDY	SCOPE (see below)	
		Matrix Hydrologic Properties Testing	(a)	$134,000
		Surface Based Borehole Studies	(b)	$775,000
		Vertical Seismic Profiling	(c)	$225,000
		Integrated Data Acquisition System	(d)	$325,000
		Air-Permeability and Gaseous Tracer Testing	(e)	$185,000
		Percolation in the UZ, Surface Based Study	(f) (LOE)	$675,000
			TOTAL	$2,319,000

Principal Investigator: Joe Rousseau, USGS

FY'93 Scope:

(a) Matrix Hydrologic Properties Testing

Measure rock physical properties/state variables FY93
Determine moisture characteristic curves
Determine matrix permebility/Develop 3D Model
Prepare interim status report

(b) Surface Based Borehole Studies

Drill UZ Boreholes
Instrument UZ-16 (VSP-2)
Prepare UZ-16 Completion Report
Calibrate Sensors
Assemble and Test IDAS
Test and Calibrate Equipment
Prepare interim status report

(c) Vertical Seismic Profiling

Provide design input to zero offset VSP UZ-16
Conduct reconnaissance survey VSP UZ-16
Provide velocity measurements- UZ-16 Core
Conduct VSP prototype field test and data analysis
Conduct VSP Laboratory/ Physical and computer simulation: 3D of Yucca Mountain
Plan for and instrument UZ-16 for VSP

(d) Integrated Data Acquisition System

Develop, test, review, integrate software
Evaluate prototype data from HRF Boreholes
Install and Test microwave communications
Prepare for instrumenting UZ Borehole
Prepare interim status report

(e) Air-Permeability and Gaseous Tracer Testing

Prepare for UZ-16 Air-Permeability Testing
Prepare, test, write reports for UZ Air-permeaiblity testing
Construct and test backup packer assembly
Set up instrumentation, store and repair at NTS

(f) Percolation in the UZ, Surface Based Study (LOE)
Complete writing and processing technical procedure for instrumentating VSP boreholes
Procure stemming materials for VSP-2
Complete preparation and processing of criteria letter, UZ-14
Procure stemming materials for SD-1, UZ-7a
Prepare/ process criteria letter for SD-1
Prepare/ process criteia letter for UZ-7a
Develop/ write, process technical procedure for stemming UZ-boreholes
Procure materials and supplies for stemming UZ-14
Support project operations
Procure DAS, DISAS, sensors for SD-1, and UZ-7a
Begin to prepare and process criteria letter for UZ-9, 9a, 9b
Monitor HRF Boreholes and recalibrate sensors
Process technical procedure for gas sampling
Process technical procedures for in-situ pressure transducer recalibration
Order components for second gas sampling system
Process electronic diagnostics technical procedure
Contract zero offset VSP UZ-16
Contract seismic source services, VSP, UZ16
Process contract for recording services VSP-UZ-16
Process inst. technical procedure for QA approval
Process VSP data acquisition procedure for QA
Develop, write technical procedure cross hole survey UZ9a/UZ16
Process Technical Procedure UZ9a Crosshole seismic survey for QA

Contract recording services UZ9a crosshole survey
Hire and train 2nd field testing crew
Hire and train staff
Purchase parts second packer assembly and trailer
Procure instrument shelters for SD-1/ UZ-7a
Prcure microwave comm. equip-- two sites, second relay
Write, review, revise IDAS Computer procedures
QA review, rewrite IDAS Instrument procedures
QA review, rewrite ISAS user and general operating procedures
Revise IDAS procedures during prototype evaluation
PI and technician training, IDAS final procedures

Status at Beginning of FY'93:

Study Plan: 8.3.1.2.2.3, "Characterization of Percolation in the UZ, Surface-Based Study", approved, no objections by the NRC (NRC Phase I review 3/26/92)

JP/TPP: TPP-92-16, TPP for UZ-14 Drilling and Testing, R0 Approved.
JP 92-17, UZ-14 Drilling, scheduled finish 10/1/92, 50% complete.

Environmental Studies: Priority for environmental pre-activity survey for UZ-14

Prerequisite Predecessor: Finish TPP, JP, and environmental studies

1993 Deliverables:

Due Date	Deliverable	Parti-cipant	Delivered ?
2/93	Submit Velocity Data to PDA (3GUP084M)	USGS	
5/93	Interim status report (3GUP050M)	USGS	
5/93	Interim status report (3GUP000M)	USGS	
5/93	Interim status report (3GUP070M)	USGS	
7/93	UZ-16 Air-K data	USGS	
12/92	Report: Prototype Testing, Bergen Park (3GUP081M)	USGS	
12/92	Report: 3D Model (3GUP080M)	USGS	

1992 Scenario:

Budget: $3,089,000; 84% spent.

1992 Accomplishments:

1992 Deliverables:

Due Date	Deliverable	Parti-cipant	Delivered ?
9/92	Technical Procedure for Pressure Transducer Calibration (3GP15M)	USGS	LOE Activity
9/92	Technical Procedure for mass-flow controller calibration (3GP015M)	USGS	LOE Activity
9/92	Technical Procedure: VSP data acquisition (P30M)	USGS	LOE Activity
9/92	Report: Prototype field test, Bergen Park (P25M)	USGS	Rescheduled 4/15/93 (3GUP081M)
5/92	Report: 2D Fault Method (P17M)	USGS	YES (5/15/92)
9/92	QA drawings, 8-12" Packers/trailers (3GP004M)	USGS	LOE Activity)
9/92	Engineering drawings/manuals for 8-12" Packers/Trailers (3GP010M)	USGS	
9/92	Technical procedure for thermistors (3GP16M)	USGS	YES (7/29/92)
7/92	Scientific Notebook Procedure for Air-K Testing (3G012M)	USGS	YES (7/29/92)
9/92	Technical Procedure: Instrumentation of VSP Boreholes (P33M)	USGS	LOE Activity
9/92	HP, Thermistor/Press/Psychro/Tech Procedure Cal (3GUP059M)	USGS	LOE Activity
8/92	3D Model Report (P20M)	USGS	YES (8/31/92)

Impact of FY'92 on FY'93:

FY'94 Scenario:

Budget: $4,954,000

FY'94 Scope:

1.2.3.3.1.2.4 PERCOLATION IN UNSATURATED ZONE - ESF STUDY

Purpose:

This activity will contribute to an understanding of the instate hydrologic characteristics of the unsaturated zone and the impact of ESF construction of the in situ hydrologic characteristics. The results of unsaturated-zone hydrologic testing in the ESF will provide hydrologic data for performance assessment calculations of UZ ground-water travel time and the prediction of radionuclide releases to the accessible environment. Hydrologic properties determined in the study will be used in design analysis of the underground facility, repository seals, and waste package. This activity provides the principal basis for determinations of the preclosure hydrology disqualifying conditions by the end of fiscal year 1995 and qualifying conditions by the end of fiscal year 1997.

Description:

- Map individual fractures and fracture networks,
- Conduct radial and axial flow studies in core samples,
- Determine hydraulic properties or rock matrix under a range of applied stresses.
- Conduct tracer-injection tests and flow channelization tests.
- Collect intact fracture samples for stress-permeability tests, tracer injection/dispersivity tests.
- Design and implement a local data acquisition system (IDAS) to collect data on laboratory analyses.
- Evaluate the applicability of psychrometers, tensiometers, conductivity probes and time-domain reflectometry for characterizing the moisture state of fractured tuff.
- Evaluate optimal borehole orientation and spacing, and time requirements for various phases of the test.
- Conduct bulk rock conductivity and percolation rate test, and determine hydraulic properties of excavated block on welded tuff from repository horizon
- Develop detailed testing procedure for tests conducted within the ESF
- Perform single-hole packer air-injection tests, cross-hole tests and tracer tests at four sites within the ESF to assess fluid transport properties.
- Conduct borehole instrumentation and monitoring of temperature, atmospheric pressure, humidity and matrix potential in the ESF
- Evaluate hydrogeologic unit contacts in ESF
- Monitor stress-strain within boreholes and stress displacements.
- Conduct gas sampling in ESF boreholes.
- Develop a combined hydrologic-mechanical model to use in the ESF Excavation Effects Test.
- Measure shaft wall seepage and conduct seepage water sampling by container or lysimeter and pore water sampling from core by extraction.
- Determine how hydrogeologic conditions affect flux, flow paths, and travel time in the rock which lead to the development of perched-water zones.
- Maintain capability to collect and analyze perched water samples, and conduct pump test of any perched water zone having sufficient flow.
- Determine hydraulic properties of major faults or fault zones encountered in the ESF.
- Determine hydraulic and air permeability properties across major fault zones encountered in ESF.
- Provide data to Activity 8.3.1.15.2.2.1.

FY'93 Funding: **$669,000** (Mission 2001: $839,000)
(Carry over: $49,000)
Rationale for FY'93 Funding: Priority 3 study addreses groundwater travel time issue.

ITE Test Prioritization:

STUDY	UNSUITABILITY	REGULATORY COMPLIANCE	SCIENTIFIC CONFIDENCE
Percolation in the UZ - ESF Study	High (2)	High (2)	High (2)

WBS Elements (1.2.3..) / Participant:

.3.1.2.4	USGS		Scope (see below)	
	USGS	Intact Fracture Test	(a)	($364,000)
	USGS	Percolation Testing	(b)	($120,000)
	USGS	Radial Borehole Testing	(c)	($20,000)
	USGS	Excavation Effects Test	(d)	($20,000)
	USGS	Perched Water Testing	(e)	($24,000)
	USGS	Hydrochemistry Test	(f)	($20,000)
	USGS	Percolation in the UZ-ESF Study	(g)	($101,000)
			TOTAL	$669,000

Principal Investigator: Michael P. Chornack, USGS

FY'93 Scope: (a) Design/Fabricate vessel; axial core (3GUS028J)
Select Analog site for fracture sampling-evaluate/develop axial fracture (3GUS038J)
Complete OFR on Projection Moire (3GUS024J)
Design and Conduct Tests: Gaseous Phase (3GUS020J)
Design and conduct tests: Aqueous Phase (2GUS026J)
Complete Journal Paper: Detailed Moire (eGUSo15J)
Design Radial Fracture Test Vessel/ prep for Gaseous Phase Tests: Radial Core (3GUS017J)

(b) Continue Phase of large block test (3GUSO32B)
Plan and design ESF Percolation Test (2GUSO35B)

Prepare Prototype Percolation Test Report (3GUSP33B)
Prepare Analytical Report on imbibition experiments (3GUSO34B)

(c) Design Construct Test Borehole packer System (3GUSO41O)
Redesign in -Situ monitor packer system (3GUSO412)
Review Borehole Packer-System Tests (3GUSP411)
Write Study Plan (3GUSO418)

(d) Plan and Design ESF excavation effects test (3GUDOO3d)
Write Study Plan (3GUSOO5D)

(e) Evaluation/prepare report on borehole instrumentation 93GUGO10G)
Develop conceptual model (3GUSO11g)
Begin Monitoring ESF for Perched Water (3GUSO12G)
Begin Conducting Perched-water Tests in ESF (3GUSO13G)
Write Study Plan (3GUSO17G)

(f) Investigate loacations, short--hole drilling, ESF (3GUS400)
Research Borehole Gas-sampling system (3GUS403)
Begin Short hole drilling and gas sampling (3GUS401)
Write Study Plan (3GUS409)

(g) Support Project operations

Prepare procedure; Moire fracture profiles
Complete procedure; moire fracture profiles
solicit confining vessel fabrication
Document computer software; Moire QA
Write TDR Technical Procedure
Write Data Acquisition System Technical Procedure
Write Infiltrometer Design Technical Procedure
Write Tracer Detection Technical Procedure
Prepare Technical Procedure for fracture air permeability, rock stress and fracture deformation measurement
Initiate and conduct technical procedure training
Prepare Technical Procedures
Start procurement of borehole instrument system
Prepare Hydrologic procedures

Status at Beginning of FY'93:

Study Plan: **8.3.1.2.2.4** Characterize percolation in the unsaturated zone - Exploratory Studies Facility
Rev. 0 submitted to NRC 2/9/91 (Activities .4,.5,.7,.8,.9); NRC Phase I Review deferred.
Activity 2.2.4.4 - radial borehole tests
2.2.4.5 - excavation effects tests in ESF
2.2.4.7 - perched water tests in ESF

2.2.4.8 - hydrochemistry tests in ESF
2.2.4.9 - multipurpose borehole testing near ESF

Rev. 1, verification of comment resolution (Activities .1,.2,.3,.6,.10)
Activity 2.2.4.1 - conduct the ultra-fracture test in the laboratory
2.2.4.2 - conduct the percolation test
2.2.4.3 - conduct the bulk permeability test
2.2.4.6 - conduct a risk-benefit analysis and selection of appropriate test options
2.2.4.10 - investigate the permeability and flow conditions of the major faults encountered in the long drifts at the main test level of ESF

JP/TPP: **TPP-92-12** Hydrochemistry tests in the ESF, RO approved
TPP-92-13 Radial borehole test in the ESF; RO approved
TPP-92-11 Perched water testing in the ESF; RO approved
JP-92-20B Perched water test in ESF; in progress

Environmental Studies:
Prerequisite Predecessor:

1993 Deliverables:

Due Date	Deliverable	Parti-cipant	Delivered ?
9/93	OFR on Projection Moire (3GUSO24M)	USGS	
4/93	Journal Paper/TDIF: Detailed Moire (3GUSO15m)	USGS	
7/93	Analytical Report: Imbibition Experiments (3GUSO34M)	USGS	
9/93	Preliminary Report/TDIF: Borehole Instrumentation (3GUSO10m)	USGS	
12/92	Submit Study Plan to DOE(3GUS418M)	USGS	YES
FY93	Write Technical procedures, Moire Fracture profiles, TDR, Resistivity,Data Acquisition System, Infiltrometer Design, Tracer Detection, Fracture, Air, permeability, rock stress and fracture deformation measurement, recognition of perched water in ESF, Sampling and instrumenting perched-water boreholes, sampling seeps	USGS	
FY93	Develop hydrologic procedures for pertinent activities	USGS	
5/93	Interim status report (3GUS018M)	USGS	
9/93	Report on Borehole Packer System (SEAMIST) (3GUS411M)	USGS	
9/93	Status Report on Excavation Effects Test (3GUS003M)	USGS	

9/93	Status Report on Perched Water Test (3GUS012M)	USGS	
9/93	Status Report on Gas Sampling (3GUS403M)	USGS	

* Also 3GUS005M, 3GUS017M, 3GUS409M

FY'92 Scenario:

Budget: $491,000; ($458,000)

1992 Accomplishments:

1992 Deliverables:

Due Date	Deliverable	Parti-cipant	Delivered ?
8/92	TP: HP Fracture Air Permeability (S003M)	USGS	Yes (8/26/92)
9/92	Journal Paper: FFT Moire (3G013M)	USGS	Rescheduled 9/30/92; Combined three into one OFR - 3GUS024M
9/92	Journal Paper: Moire Automation (3GU12M)	USGS	
9/92	Journal Paper: Stereo Viewing Moire (3GU14M)	USGS	
9/92	Journal Paper:Detailed Moire (3GU15M)	USGS	Rescheduled 4/30/93 3GUS015M
9/92	Benchmark: Moire Equipment (S23M)	USGS	Cancelled
9/92	Rept: Large Block Ponding Test (S26M)	USGS	Rescheduled 9/30/93 3GUS033M
9/92	Data Rept: Imbibition Experiments (S29M)	USGS	Rescheduled 7/31/93 3GUS034M
9/92	Analytical Rept: Inbibition Experiments (S32M)	USGS	
9/92	Rept: Hydrologic Properties (S35M)	USGS	Not on current schedule
9/92	Tech. Proc.: HP Tensiometry (S013M)	USGS	LOE Activity
9/92	Tech Proc.: HP Psychrometry (S07M)	USGS	LOE Activity

Impact of FY'92 on FY'93: No major impact.

FY'94 Scenario:

Budget: $3,293,000

FY'94 Scope:

1.2.3.3.1.2.6 Gaseous Phase Movement in the Unsaturated Zone

Purpose:

Describe the pre-waste-emplacement gas-flow field. Identify structural controls on fluid flow. Determine conductive and dispersive properties of the unsaturated zone for gas flow. Model the transport of water and tracers in the gas phase. Resolve the effects of topography, barometric pressure, and wind in driving the circulation of rock gas.

Measure air circulation in open boreholes using anemometers and propeller anemometers, temperature probes and relative humidity probes. Determine contribution to flow by periodic logging to assess depth profiles of air-flow velocities, temperature and rock-gas composition. Conduct flow interference tests between wellbores. conduct gas tracer tests: divergent flow, divergent-convergent flow and convergent flow. Develop gas-phase model by 3-D finite difference numerical model.

Description: All efforts required to:

1) describe and model the pre-waste-emplacement gas-flow field and its effect on net water-vapor transport from the unsaturated zone by modeling the western portions of Yucca Mountain as a two-dimensional and/or three-dimensional boundary problem in compressible nonisothermal flow,

2) provide parameters necessary for modeling gas flow from and to the repository and the potential transport of radionuclides as well as the gaseous flux of mois-ture affecting deep percolation after the repository is in place,

3) reconstruct the air circulation history at instru-mented boreholes from the time of drilling until stemmed and instrumented. Estimate the time required for post-stemming recovery of ambient gas and moisture conditions as an aid in interpreting gas composition and thermocouple psychrometer data,

4) determine, by flow and pressure measurements in single holes, and by cross-hole interference tests, the near-field air conductivities, storativity, and aniso-tropy of the unit above the repository horizon, and

5) determine effective porosities and dispersivities of the fracture system by the interpretation of natural and artificial gas tracer data as an aid in the modeling described in the first two items above.

FY'93 Funding: $50K (Mission 2001:$97K)

(Carry over: $0)

Rationale for FY'93 Funding: A priority 5 study.

ITE Test Prioritization: Ranked forty in overall utility

STUDY	UNSUITABILITY	REGULATORY COMPLIANCE	SCIENTIFIC CONFIDENCE
UZ GASEOUS PHASE MOVEMENT	HIGH (12)	Middle (9)	Middle (20)

WBS Elements (1.2.3)/Participant: USGS

.3.1.2.6	USGS	UZ GASEOUS PHASE MOVEMENT	SCOPE:	
		Gaseous Phase Circulation Study		$50,000
			TOTAL:	$50,000

Principal Investigator: Mike Chornack (USGS)

FY'93 Scope:

GASEOUS PHASE CIRCULATION STUDY
- Collect UZ Borehole Data -FY93 (3GGPO2b)
- Tabulate and Analyze Gas Samples (3GGPO4B)
- Plan Modeling and gas flow interference tests (3GGP08B)
- Plan Tracer tests in selected UZ boreholes (3GGOo6B)

Status at Beginning of FY'93:

Study Plan: **8.3.1.2.2.6** - Characterization of Gas-Phase Movement in the Unsaturated Zone, NRC Phase I review 10/7/91; No Phase II review

JPP/TPP:

Environmental Studies:

Prerequisite Predecessor:

1993 Deliverables:

Due Date	Deliverable	Parti-cipant	Delivered ?
9/93	Submit FY93 UZ Borehole Data to PDA (3GGP02M)	USGS	
9/93	Submit Gas Sample Data to PDA (3GGP04M)	USGS	
5/93	Interim Status Report (3GGP01M)	USGS	

FY'92 Scenario:

Budget: $80K

1992 Accomplishments:

Conducted annual sampling of gases from boreholes UZ-1 and UZ-6

1992 Deliverables:

Due Date	Deliverable	Parti-cipant	Delivered ?
9/92	OPEN FILE REPORT (P17A)	USGS	Not on current schedule
6/92	NRC APPROVAL OF STUDY PLAN (3GG01M)	USGS	Yes - 10/91

Impact of FY'92 on FY'93:

FY'94 Scenario:

Budget: $125,000

1.2.3.3.1.2.7 UNSATURATED ZONE HYDROCHEMISTRY

Purpose:

Understand the gas transport mechanism, direction, flux and travel time within the UZ. Design and implement methods for extracting pore fluids from the tuff. Provide independent evidence of flow direction, flux, and travel time of water in the UZ. Determine the extent of the water-rock interaction. Model geochemical evolution of ground water in the unsaturated zone.

Collect gas samples for gas composition, carbon-13/carbon-12 ratios, carbon-14 and water vapor analyses. Prepare and analyze samples. Collect, preserve and transport core samples. Conduct extraction of water samples from core by triaxial and uniaxial compression, high speed centrifuge, vacuum distillation and immiscible displacement. Conduct analyses and age dating of water samples. Interpret data and write-up reports.

Description:

Perform gaseous-phase chemical investigations; understand the gas transport mechanism; and provide evidence of gas flow direction, flux and travel time within the UZ

Perform aqueous phase chemical investigations, by design and implementation of methods for extracting pore fluids from UZ tuff units; provision of evidence of flow direction, flux and travel time of water in the UZ; and determination of the extent of the water-rock iteration, modeling geochemical evolution of ground water in the UZ

FY'93 Funding: **$600,000** (Mission 2001: $613,000)
(Carry over: $0)

Rationale for FY'93 Funding: A Priority 4 study.

ITE Test Prioritization: Rank 21 in overall utility

Study	Unsuitability	Regulatory Compliance	Scientific Confidence
UZ Hydrochemistry	High (3)	High (8)	Middle (1)

WBS Elements (1.2.3..) / Participant:

.3.1.2.7	USGS	UNSATURATED ZONE HYDROCHEMISTRY	SCOPE (see below)	$120,000
	USGS	Gaseous Phase Chemical Investigation	(a)	$270,000
	USGS	Aqueous-Phase Chemical Investigation	(b)	$210,000
				Total $600,000

Principal Investigator: Al Yang, USGS

FY'93 Scope:

Conduct information seminars on model for project staff
Procure, Test borehole sampling system
Procure ITI leakmeter
Prpare Hydrologic procedures
Support Project Operations
Procure lab chem and labware and field
Submit geochemical model software package to QA approval
Prepare OFR-SP, DTPS, Protoype and Site UZ hydrochemistry
Set up ion chromatograph in the mobile lab

(a) Gaseous Phase Chemical Investigation
Oversee Drilling/Collect Gas samples
Prepare Analyze and Tabulate data
Evaluate existing transport models for gaseous carbon 14 transport
Review data and prepare TDIF for UZ-1 Data for FY92
Prepare interpretive report/OFR: UZ-1 Gas and Water Vapor data 1984-1991
Modify/develop selected geochemical codes
Write monitoring gas tracer WRIR report
Design build and test equipment
Acquire capital equipment- leak detectors

(b) Aqueous Phase Chemical Investigation
Acquire capital equipment- Compaq deskpro
Prepare report on effects of core sealing
Prepare Report: rubble collection and coring
Test Water Collection methods from fractures and begin report
Prepare 3H and 14C Method Development report

Export, prepare, extract and analyze core
Prepare/review journal paper on pressure v. pore water chemistry
Design aqueous tracer container size and prepare solution

Status at Beginning of FY'93:

Study Plan: **8.3.1.2.2.7**, Hydrochemical Characterization of the UZ, NRC Phase I review 5/1/92; Phase II review deferred

JP/TPP: JP 92-3 - 100% complete as of 4/28/92
TPP 92-2 - R0, approved; R1, approved; R2, in process (1/26/93)

Environmental Studies:

Prerequisite Predecessor: Complete UZ-16

1993 Deliverables:

Due Date	Deliverable	Parti-cipant	Delivered ?
11/92	Submit UZ-1 Data to PDA (3GUHO18M)	USGS	
3/93	Interpretive Report/OFR: UZ-1 Gas and Water Vapor Data (3GUHo15M)	USGS	
9/93	Submit UZ-1 Gas and Water Vapor Data to PDA (3GUHO13M)	USGS	
9/93	WRIR/TDIF: Monitoring Gas Tracer (3GUHO16M)	USGS	
3/93	Report/TDIF: 3H and 14C method development (3GUH036M)	USGS	
4/93	Report: Effects of core sealing (3GUH029M)	USGS	
5/93	Interim Status Report (3GUH009M)	USGS	
5/93	Interim Status Report (3GUH029M)	USGS	

1992 Scenario:

Budget: $511,000; 85% spent.

1992 Accomplishments:

1992 Deliverables:

Due Date	Deliverable	Parti-cipant	Delivered ?
6/91	TDIF for UZ1 Raw Data to LRC 1984-1991 (H27MA)	USGS	YES (11/6/91)
6/92	TDIF (HA0M)	USGS	YES (6/2/92)
5/92	HP Portable GC, SF6 Meter (H19M)	USGS	YES (5/29/92)
7/92	TDIF (HO2M)	USGS	YES (2/1/92)
9/92	HP Fracture Water (H013M)	USGS	LOE Activity
9/92	Straddle-Packer Evaluation (H21M)	USGS	Rescheduled 3/31/92 3GUH014M

Impact of FY'92 on FY'93:

FY'94 Scenario:

Budget: $1,360,000

FY '94 Scope:

1.2.3.3.1.2.8 FLUID FLOW IN UNSATURATED FRACTURED ROCK - USGS/LBL

Purpose: Develop and validate conceptual and numerical models describing gas flow and liquid water and solute movement in UZ, fractured rock a the laboratory and sub-REV scales.

Description:

apply detailed models of fluid flow and transport in U, fractured rock at Yucca Mountain to volumes of fractured rock at or below the dimensions at which the rock can be replaced conceptually by an equivalent porous medium

evaluate the effects of different conditions on fluid flow and transport

evaluate the reasonableness on the concepts of which the models developed under SCP Activity 8.3.1.2.2.8.1 are based by using the results of laboratory tests and tests performed in the ESF to assess the adequacy of model performance

validate conceptual and numerical models of fluid flow and transport in variably saturated fractured rock by use of results from the ESF intact-fracture, percolation, and bulk perm. tests

FY'93 Funding:

USGS: $193,000
LLBL: 90,000 Carry over: $0
$283,000 Total (Mission 2001: $452,000)

Rationale for FY'93 Funding: A Priority 4 study.

ITE Test Prioritization: Overall utility High- ranked 13

STUDY	UNSUITABILITY	REGULATORY COMPLIANCE	SCIENTIFIC CONFIDENCE
UZ FRACTURE FLOW	MIDDLE (11)	HIGH (11)	HIGH (13)

WBS Elements (1.2.3..) / Participant:

.3.1.2.8		FLUID FLOW IN UZ FRACTURED ROCK		
	USGS	Development of conceptual and numerical models		$193,000
	LBL	Development of conceptual and numerical models		$90,000
			TOTAL	$283,000

Principal Investigators: Lawrence Anna (USGS), Bodvarsson (LLNL)

FY'93 Scope:

USGS

Development of Conceptual and Numerical Models
- Conduct scoping and bounding calculations
- Model imbibition investigations
- Model large block percolation experiment
- Adapt fracture network model to unsataturated flow
- Perform numerical experiments/model fracture network

LBL

Development of Conceptual and Numerical Models
- Compare dual-porosity model to FMMG code
- Analyze effect of block size sitribution
- Complete semi-analytical methods report
- Complete and publish paper in RWNFC journal
- Prepare rough-walled permeability report

Status at Beginning of FY'93:

Study Plan: **8.3.1.2.2.8**, Fluid Flow in UZ, Fractured Rock, approved by PO 8/12/92, sent to NRC 9/1/92; Rev. 2 Screening review completed 12/2/92

JP/TPP: May require TPP for experiments for review 9/1/92

Environmental Studies: Probably none needed.

Prerequisite Predecessor:

1993 Deliverables:

Due Date	Deliverable	Parti-cipant	Delivered ?
3/93	Section of Percolation Test Report (for 8312242) (3GUF022M0	USGS	
5/93	Interim Status Report (3GUF029M)	USGS	
9/93	Status Report on Preliminary Modeling (3GUF021M)	USGS	
3/93	Report - Semi-Analytical methods	LBL	
12/92	Report - Fracture roughness	LBL	

FY'92 Scenario:

Budget: $412,000; 85% spent.

1992 Accomplishments:

no information

1992 Deliverables:

Due Date	Deliverable	Parti-cipant	Delivered ?
4/92	Rept: 1992 IHLRMN Conference (F06L)	USGS	YES (4/15/92)
4/92	Rept: RWMNFC Journal (F05L)	USGS	YES (4/28/92)
9/92	Rept: SCoping Calculations of Perc. Test (FA03)	USGS	
9/92	NRC Approval of Study Plan (F00MA)	USGS	

Impact of FY'92 on FY'93:

FY'94 Scenario:

Budget: $801,000

FY'94 Scope:

1.2.3.3.1.2.9 SITE UZ MODELING AND SYNTHESIS- USGS/LBL

Purpose:

Develop conceptual and numerical models for the site UZ hydrogeologic system. Apply the models to predict the system response to changing external and internal conditions. Evaluate the accuracy of the models using stochastic modeling, conventional statistical analyses, and sensitivity analyses. Integrate data and analyses to synthesize a comprehensive qualitative and quantitative description of the site UZ hydrogeology system under present as well as probable, or possible, future conditions.

LBL:

Select and verify compuiter codes that will be used to simulate specific elements of the conceptual model of the unsatured zone hydrogeoligc system.. Select appropriate code-verification and model-validation and testing exercises to be performed. document code. Construct 2 and 3D, two phase, couped heat and moisture flow models for variably saturated, variably fractued prous media. Define hydrogeologic boundary and initial conditions. Collect, evaluate and compile hydrologic, thermal mechanical properties for the site unsatured zone. Conduct baseline analyses.

USGS:

conduct hypothesis testing of the current conceptual models using field and laboratory tests in conjection wiht numerical modeling of the site hydrogeoligc system. Conduct hypothesis testing of alternative conceptual models. Refine conceptual model with emphasis placed on the macroscopic sit-escale aspects of moisture flow. conduct independent peer review to examine the completeness and consistency of the conceptual-model hypothesis. Select and verify computer codes that weill be used to simulate specific elelemtns of the conceputal model of the UZ hydrogeologic system. select appropriate code verification and model validation and testing exercises to berperformed. Document code. Construct 3 and 3 dimuenional two-phase, coupled heat and moisture flow models for variably saturated, varialgby fractred porous media. Define hydrogeoligc boundary and initial conditions. Collect, evaluate and compile hydroligic, thermal amechanical preperties for the site UZ. conduct baseline analyses. Estimate hydroligic property uncertainy distribution functions. Conduct Monte carlo simulation. Conduct sensitivty analyses on selected material prerty data . Integrate and synthesize site characterization data analyses and interpretations. Conduct peer review to ensure that consistency and integrity of the model of the system. Select empirical testing exercixze to be performed on the codes.

Description:

develop conceptual models for the overall moisture flow system within the uz at Yucca Mountain; and develop an internally consistent set of hypotheses that describes those aspects of the site hydrologic system that are needed to assess the waste isolation capability of the site.

select, evaluate, and adapt existing numerical hydrologic modeling codes for application to the site uz hydrogeologic system; and modify existing codes or develop new codes, as needed, to simulate particular problems or aspects that are unique to the Yucca Mountain system

construct appropriate hydrologic models for the natural site hydrogeologic system

assess the probable limits of uncertainty of numerical-model predictions caused by uncertainties in the material-property and boundary condition data

integrate all applicable site data and analyses to synthesize a continually updated, comprehensive representation for the site uz hydrogeologic system

FY'93 Funding:

LLBL: $266,000 (Carry over: $0)
USGS: 70,000 (Carry over: $0)
$336,000 Total (Mission 2001: $339,000)

Rationale for FY'93 Funding: A Priority 4 study.

ITE Test Prioritization : Not Ranked.

WBS Elements (1.2.3..) / Participant:

.3.1.2.9	USGS/LBL	SITE SATURATED ZONE MODELING AND SYNTHESIS	SCOPE (see below)	
	USGS	Conceptualization of the UZ Hydrogeology	(a)	$70,000
	LBL	Selection, development and testing of models	(b)	$90,000
	LBL	Simulation of the Natural Hydrogeologic Environment	(c)	$176,000
				$336,000

Principal Investigators: Ed Kwicklis (USGS); Bodvarsson (LLBL)

FY'93 Scope:

(a) USGS

Conceptualization of UZ Hydrology
Develop alternative conceptual models of UZ
Conduct hypothesis testing with 2-D cross-sectional numerical models
Complete study plan revision and resolution of comments
Prepare interim status report
Support project operations

(b) LBL

Selection, Development, and Testing of Unsaturated Zone Modeling and Synthesis
Complete testing of decoupled tough simulator
Prepare tough testing report
Revise study plan and resolve comments

(c) Simulation of the natural Hydrogeologic System
Evaluate gas flow data and develop gas component in moisture-flow model
Begin investigating the effect of infiltration
Collect and incorporate new data into moisture-flow model
Prepare report on grid effects
Complete report on moisture flow model
Complete and publish paper in RWMNFC Journal
Prepare paper for HLRWM Conference
Evaluate gas-effects using sub-models
Complete study plan comment resolution and revison

Status at Beginning of FY'93:

Study Plan: **8.3.1.2.2.9**, Site Unsaturated Zone Saturated Zone Modeling and Synthesis, review comments sent to PI 2/27/92

JP/TPP: Not necessary; no field work planned.

Environmental Studies: Probably not necessary. No field work or tests or experiments planned.

Prerequisite Predecessor:

1993 Deliverables:

Due Date	Deliverable	Parti-cipant	Delivered ?
9/93	LBL Report: Tough Testing (3GUM12M)	LBL	
11/92	Report: Moisture Flow (3GUM32M)	LBL	
12/92	RWMNFC paper (3GUM25M)	LBL	
1/93	Report: Grid Effect (3GUM20M)	LBL	
12/92	Submit Revised Study Plan to DOE (3GUM015M)	USGS	
5/93	Interim Status Report (3GUM00m)	USGS	
9/93	Status Report on conceptual Models (3GUM002M)	USGS	

4/93	Report: HLRWM paper (3GUM26M)	LBL	

* Not on PACS list of deliverables

1992 Scenario:

Budget: $287,000; 99% spent.

1992 Accomplishments:

1992 Deliverables:

Due Date	Deliverable	Parti-cipant	Delivered ?
4/92	LBL Report: ANS Paper (B11M)	LBL/ USGS ?	YES (4/30/92)
5/92	LBL Report: WMNFC Paper (B12M)	LBL/ USGS ?	YES (5/31/92)
6/92	Report: Preliminary Moisture-flow model *	LBL	yes
9/92	Report: Grid Effects *	LBL	yes
	Draft alternate conceptual models report WRIR *	USGS	?

* Not on PACS list of deliverables (10/1/92)

Impact of FY'92 on FY'93:

FY'94 Scenario:

Budget: $415,000

FY'94 Scope:

1.2.3.3.1.2.10 Prototype Hydrologic Tests that Support Multiple Site Characterization Activities

Purpose:

Perform prototype hydrologic tests to minimize costly stand-by times; develop quality assurance procedures; determine feasibility of the proposed tests; train new personnel; help increase likelihood of success of the tests; and test new instruments, equipment, and procedures.

Description: All efforts required to:

1) evaluate drilling methods in tuffaceous rock to (1) determine how the drilling fluids used while coring tuffs affect the hydrologic properties of core samples and the formation surrounding the core holes, and (2) establish the technical feasibility of coring relatively short horizontal and angled holes in fractured welded tuff or nonwelded tuff using air as the drilling fluid,

2) develop methods and drillhole instrumentation and instrument calibration to (1) develop acceptable methods for instrumenting horizontal, inclined, and vertical holes; and (2) examine alternative instrumentation designs that would provide a capability for recalibrating installed sensors,

3) determine blast effects on instrumentation by examining blast characteristics and evaluating the performance of hydrologic instruments subjected to blasting operations,

4) perform cross-hole pneumatic and hydraulic testing to (1) develop standard procedures by conducting cross-hole tests, including tracer tests; (2) test the design of a straddle packer system; and (3) evaluate the effectiveness of humidity sensors in the test inter-vals,

5) perform prototype tracer testing to (1) evaluate suitable ground-water tracers for use in ES and prototype tests and in construction; and (2) develop methods and procedures for safe injection, sampling, and analysis of tracers,

6) determine optimum rubble size (from blasting) for laboratory core sampling to determine the optimal size of blasting rubble in which the pore water is not contaminated by either gas or liquid chemicals, and (2) develop effective bulk rubble sampling and handling techniques and QA procedures,

7) develop and test an effective method of obtaining undamaged rock cores from the blast rubble of welded and nonwelded tuff; and develop a coring technique that will have minimal impact on the pore-water chemistry and produce smooth, unbroken rock cores that meet the requirements of laboratory extraction methods, and

8) develop operating procedures for pore-water extraction from rock cores using both uniaxial and triaxial compression.

FY'93 Funding: $70K (Mission 2001: $100K)
(Carry over: $0)
(USGS requested $100K)

Rationale for FY'93 Funding:

Priority 5

Significant Risk Factors/Impact of Underfunding:

1) Underfunding will severely limit the final products of prototype tests conducted for this activity. Reports documenting equipment development, field techniques, and analytical methods for air-permeability testing, gaseous tracer testing, and pore-water extraction methods will not be completed.

2) A reduction in expert staff (0.3 FTE) will result if this account is underfunded.

ITE Test Prioritization:

No Ranking.

WBS Elements(1.2.3.)/Participant: REECo, RSN, USGS

.3.1.2.10	USGS	PROTOTYPE HYDROLOGIC TESTS THAT SUPPORT MULITPLE SITE CHARACTERI ZATION ACTIVITIES	SCOPE	$70,000
			Prototype Cross-Hole Testing	$20,000
			Prototype Tracer Testing	$10,000

			Prototype Pore Water Extraction	$40,000

Principal Investigator: M. Chornack, USGS

FY'93 Scope:

a) The tests conducted in this study in FY'93 are the prototype crosshole, tracer, and pore-water extraction tests. These tests are conducted to develop concepts, procedures, and equipment for site characterization activities at Yucca Mountain. The majority of the work in FY'93 for these activities will consist of writing final reports on the results of the prototype tests. The report on the cross-hole testing at the Apache Leap site will include equipment design and construction, test methods and analysis, and conclusions. The gaseous-tracer report will present the results obtained from experiments testing the sorptive characteristics of tracer gases. Reports on pore-water extraction will include documentation of the 1-D, high-pressure compression method and effects of high pressure on the chemistry of extracted water.

Status at Beginning of FY'93:

Study Plan: No SCP reference in WBS dictionary

JPP/TPP:

Environmental Studies:

Prerequisite Predecessor:

1993 Deliverables:

Due Date	Deliverable	Parti-cipant	Delivered ?
3/93	Final Report for Prototype Testing (3GUTOO4M)	USGS	
3/93	OFR: Pore-Water Chemistry v. Pressure Data (3GUTO52M)	USGS	
8/93	Journal Paper; One-Dimensional Compression (3GUTO53M)	USGS	

7/93	WRI Report/TDIF: Gaseous Tracers (3GUTO16M)	USGS	

FY'92 Scenario:

Budget: $409K

1992 Milestones accomplished:

1992 Deliverables:

Due Date	Deliverable	Parti-cipant	Delivered ?
7/92	Prototype Air-K Data set to PKA (T02M)	USGS	YES (7/29/92)
9/92	Alts Data Report: Prototype Air-K Testing (T05M)	USGS	Rescheduled 5/31/93 (3GUT004 M)
9/92	WRI Report - Aqueous Tracers (TD03M)	USGS	Rescheduled 7/31/92 3GUT004M
9/92	WRI Report - Gas Tracers (T14MA)	USGS	
9/92	Report: Monitoring Gas Tracer (TD08)	USGS	Rescheduled 9/93 (3GUH016 M)
8/92	Complete WRI Report on G-Tunnel (T03M)	USGS	YES (8/3/92)
9/92	Technical Procedure on Rubble Coring (T07MA)	USGS	LOE Activity
9/92	Technical Procedure on Core Sealing (T04MA)	USGS	YES (9/22/92)
9/92	Report: Effects of Core Sealing (T02MA)	USGS	
2/92	HP-1D Compression (T19M)	USGS	YES (2/28/92)
9/92	Triaxial and 1D methods Report (T12M)	USGS	Deleted

1/92	Second Data Acquisiiton System Procured (T21M)	USGS	YES (1/17/92)
9/92	Additional High Pressure 1-D Cell (T22M)	USGS	LOE Activity)
9/92	HP- High Pressure Cell (T17M)	USGS	LOE Activity
9/92	QA Submittal of Software Requirements (T23M)	USGS	LOE Activity

Impact of FY'92 on FY'93:

FY'94 Scenario:

Total Budget: 0K

1.2.3.3.1.3.1 SITE SATURATED ZONE GROUND-WATER FLOW SYSTEM USGS/LANL

Purpose:

To provide information on the potentiometric surface, hydraulic and transport properties, and the nature of the saturated-zone flow system within the immediate vicinity of the site. Will improve understanding of fracture flow at Yucca Mountain and provide input to performance assessment (effectiveness of the saturated zone as a barrier to radionuclide transport to the accessible environment).

Study Supports:

- Determination of Geohydrology Disqualifying Condition by end of FY'95
- Determination on Geohydrology and Climate Qualifying Conditions by end of FY'97.

Description:

Begin hydraulic tests at the C-Well Complex, continue monitoring of water levels and for effects of earthquakes; finalize plans for one additional borehole to better define large hydraulic gradient north of site.

FY'93 Funding: USGS: $ 1,130,000 (Mission 2001: $1,170,000)
LANL: $ 475,000 (Mission 2001: same)
Total: $ 1,605,000

Rationale for FY'93 Funding: A Priority 2 Study

- Important to maintain monitoring to show water level response to earthquakes and rainfall.
- High visibility of tests at C-Well Complex.

ITE Test Prioritization:

STUDY	UNSUITABILITY	REGULATORY COMPLIANCE	SCIENTIFIC CONFIDENCE
Site Saturated Zone Flow System	High (7)	High (5)	High (3)

WBS Elements (1.2.3..) / Participant:

WBS NO.	PARTICIPANT	ACTIVITY	SCOPE (see below)	BUDGET
3.1.3.1	USGS	SITE SATURATED ZONE GROUND-WATER FLOW SYSTEM		
3.1.3.1	USGS	Site Potentiometric-Level Evaluation	(a)	$220,000
	USGS	Analysis of Single- & Multiple Well Borehole Flow	(b)	44,000
	USGS	Multiple Well Interference Testing	(c)	404,000
	USGS	Testing of the C-Hole Sites with Conservative Tracers	(d)	92,000
	USGS	Site Saturated Zone Ground Water Flow System	(e)	$370,000
			Subtotal: $1,130,000	
3.1.3.1	LANL	Design C-Well Tests	(f)	236,000
	LANL	Conduct Preliminary Fehmn & Fracnet Modeling and Analysis	(g)	120,000
	LANL	Conduct Column Experiments with Lithium	(h)	119,000
			Subtotal: $475,000	
			TOTAL	$1,623,000

Principal Investigator: Luckey (USGS), Canepa (LANL)

FY'93 Scope: USGS

(a) Site Potentiometric-Level Evaluation

Complete 1990 Water Level Report
Incorporate 1990 Water Level Report into 1991 Water Level Report
Prepare for Drilling
Support Project Operations
Continue 1992 Water-Level Data Collection
Reduce 1992 Periodic Water-Level Measurements
Reduce 1992 Transducer Calibrations
Evaluate Quality of 1992 Transducer Data
Begin 1993 Water-Level Data Collection
Reduce 1992 continuous Water-Level Data

(b) Analysis of Single - & Multiple-Well Tests

Reanalyze analyze Past C-Hole Data with Aquifer Test Program and Fracman
Support Project Operations FY93
Continue Monitoring Strain-Related Pressure Response
Write Journal Article: Reanalysis of Past C-Hole Aquifer Tests
Analyze Strain-Related Pressure Response: Uncased Holes

(c) Multiple-Well Interference Testing

Conduct Cross Hole Test at C-Hole Complex
Oversee LBL, Complete Analysis of Seismic Profile
Support Project Operations, FY93
Convert Cross-Hole Test Scientific Notebook to Technical Procedure
Continue Conducting Cross-Hole Tests at C-Hole Complex
Continue Development of Techniques to Analyze Cross-Hole Test Results
Develop Software QA for Analysis Programs: 8.3.1.2.3.1.4 Activity
Expand Packer Strings to 5-zone (USBR)
Obtain Approval QA Drawings

(d) Testing of the C-Hole Sites with Conservative Tracers

Develop Software QA for Analysis Programs: 8.3.1.2.3.1.5 Activity
Continue to Develop Techniques for Analysis of Tracer Test Results
Develop Scientific Notebook for Tracer Tests
Oversee Field Simulation Tracer Tests
Continue Oversight of Field Simulation Tracer Tests
Continue Development of Scientific Notebook for Tracer Tests
Support Project Operations, FY93

(e) Site Saturated-Zone Groundwater Flow System

Support Project operations
Oversee LBL's effort to complete analysis of sismic profile
Convert scientific notebook to technical procedure
Develop software QA for analysis programs
Develop scientific notebook for tracer tests
Continue 1992 Water level data collection
Reduce 1992 Transducer calibrations:
Begin 1993 Water-level data Collection

FY'93 Scope: LANL

(f) Design C-Well Tests

Select Flow Rates, Test Duration, Injection Amount, Concentration, etc.
Develop Detailed Procedure

(g) Conduct Preliminary FEHMN & FRACNET Modeling and Analysis

Simulate Behavior of Tracers at the C-Wells

(h) Conduct Column Experiments with Lithium

Develop Parameter Values for Reactive Tracer Test

Status at Beginning of FY'93:

Study Plans: **8.3.1.2.3.1** (.1 - .6)(USGS): "Characterize Site Saturated Zone Ground Water Flow System," complete through NRC Phase I review; Phase II review is deferred.

(.7)(LANL): complete through NRC Phase I review; Phase II review is deferred.

JPP/TPP: **TPP 92-9** - "Characterization of Site Saturated-Zone Ground Water Flow System": 100% complete, but undergoing revisions for tasks 92-21, b1-b9 - waiting on PI. Task b2JP is 92-21.

JP 92-21 - "C-Well Complex Pumping Tests," - in progress, criteria letter pending.

Environmental Studies: Discharge Pipe for USGS C-Well Pump Tests RSED: TBD (8/25/92) TP&S: 3rd priority

Prerequisite Predecessor:

1993 Deliverables:

Due Date	Deliverable	Participant	Delivered ?
4/93	Report/TDIF - Water-Level Data at Yucca Mt, 1990-91 (3GWF064M)	USGS	
?	Report - Past Hydraulic Tests at C-Well Complex	USGS	
2/93	Submit 1992 - Water-Level Data to PDA (3GWF002M)	USGS	
	Data - New Hydraulic Tests at C-Well Complex	USGS	
4/93	Intraborehole Flow and Stress Test Report (3GWH010M)	USGS	
5/93	Interim Status Report (3GWF001M)	USGS	
9/93	Report/TDIF: Well Test Fracture Network and Dual Porosity Analysis (3GWF004M)	USGS	
9/93	Submit Strain-related C-Hole Data to PDA (3GWF008M)	USGS	
12/92	Design memoranda for Five-Zone Packer String (3GWF007M)	USGS	
5/93	Interim Status Report (3GWF006M)	USGS	
5/93	Completion of Five-Zone Packer System (3GWF030M)	USGS	
5/93	Interim Status Report (3GWF168M)	USGS	
9/93	Completion of Tracer Injection System (3GWF170M)	USGS	

1992 Scenario:

Budget: $1,534,000; 106% spent.

1992 Accomplishments:

- Fabricated downhole equipment for multiple-well interference testing at the C-wells.
- Reviewed and tabulated fracture data from the C-wells.
- Prepared for cross-hole seismic studies.
- Developed prototype test locality at Raymond Quarry, and test-pumped new boreholes.
- Analyzed water-level response to Landers, Big Bear, and Little Skull Mountain earthquakes.

1992 Deliverables:

Due Date	Deliverable	Participant	Delivered ?
11/92	C-Hole Temp Data to PDA ((3GWF029M)	USGS	YES (11/29/91)
12/91	1991 Water level data submitted to PDA (3G01M)	USGS	YES (12/30/91)
9/92	Cross hole seismic data to PDA (3GWF03CM)	USGS	YES (9/25/92)
9/92	Water-level data at Yucca Mtn (1989) (G007)	USGS	YES (10/92)
9/92	Accuracy-Precision of water-level data (G009)	USGS	YES (9/30/92)
9/92	SCI NTBK Cross hole tests (3GWF025M)	USGS	LOE Activity
6/92	Six Sites going into NWIS Data Files (3G03M)	USGS	YES (6/05/92)
4/92	Revision of HP-93 for Conversion of Transducer (3G04M)	USGS	YES (4/29/92)
9/92	Z412: Analysis of Water Fluctuation at Yucca Mountain (Z412)	USGS	YES (9/28/92)

Impact of FY'92 on FY'93:

FY'94 Scenario

Budget: USGS: $1,051,000
LANL: $1,018,000

TOTAL: $2,069,000

FY'94 Workscope: USGS:
LANL:

1.2.3.3.1.3.2 SATURATED ZONE HYDROCHEMISTRY

Purpose:

Identify and compile existing hydrochemical data. Identify data deficiencies and designate new data collection locations. Collect water samples for chemical analyses. Determine pH, conductance, temperature, inorganic carbon species, dissolved oxygen, and Eh of water samples. Conduct chemical and isotopic analyses of water samples. including atomic adsorption spectrometry, inductivity coupled plasma emission spectrometry, gas and liquid scintillation counting ion chromatography, and various mass spectrometric techniques. Collect gas samples for chemical analysis. Conduct chemical and isotopic analyses of gas samples, including liquid and gas scintillation counting, accelerator mass spectrometry, and gas source spectrometry. Integrate new existing hydrochemical, geochemical, and geohydrologic data. Describe spatial distributions and relative concentration variations of selected chemical and isotopic data using graphical methods. Calculate dissolved material specification by geochemical modeling. Determine the saturation states of relevant solids by geochemical modeling. Develop reaction models for evolution of ground-water chemistry.

Description:

assess saturated zone hydrochemical data availability and needs

describe the hydrochemistry of the upper 100m of the saturated zone. Estimate flux to or from the saturated zone

describe regional spatial variations in ground water chemistry in the saturated zone

describe the saturated zone hydrochemistry; identify the chemical and physical processes that influence ground-water chemistry; and aid in the identification and/or quantification of GWTT

FY'93 Funding: **$125,000** (Mission 2001: $263,000)
(Carry over: $0)

Rationale for FY'93 Funding: A Priority 4 study.

ITE Test Prioritization:

STUDY	UNSUITABILITY	REGULATORY COMPLIANCE	SCIENTIFIC CONFIDENCE
SZ Hydrochemistry	High (11)	High (12)	Middle (2)

WBS Elements (1.2.3..) / Participant:

.3.1.3.2	USGS	SATURATED ZONE HYDROCHEMISTRY	Scope (see below)	
	USGS	Assessment of SZ Hydrochemical Data	(a)	$60,000
	USGS	Hydrochemical Characterization of Water in Upper Saturated Zone	(b)	$50,000
	USGS	Regional Hydrochemical Characterization	(c) TOTAL	$15,000 $125,000

Principal Investigator: William Steinkampf, USGS

FY'93 Scope:

(a) Assessment of SZ Hydrochemical Data
Assess Data, extant, phase II
Complete data assessment, extant, phase II
Support project operations

(b) Hydrochemical Characterization of Water in the Upper Solitario Canyon
Collect hydrochemical data and samples
Develop Borehole data/sample collection methods
Develop mobile laboratory and downhole coollection equipment
Incorporate hydrrochemical test results

(c) Regional Hydrochemical Characterization
Select Sample Sites, FY93
Collect Regional Samples

Status at Beginning of FY'93:

Study Plan: 8.3.1.2.3.2, "Characterization of Saturated Zone Hydrochemistry", PO approved 4/22/92, submitted to NRC 6/5/92

JP/TPP: May require TPP for sampling archives

Environmental Studies: May not be necessary, depending on sample sites.

Prerequisite Predecessor: None?

1993 Deliverables:

Due Date	Deliverable	Parti-cipant	Delivered ?
9/93	Rpt/TDIF: Assessment of Site SZ Hydrochemical Data (3GWFOO1M)	USGS	
9/93	Submit hydrochemical data to PDA (3GWHOO4M)	USGS	
9/93	Submit Regional data, FY-93 to PDA (3GWH910M)	USGS	
5/93	Interim Status Report (3GWH000A)	USGS	
5/93	Interim Status Report (3GWH002M)	USGS	
5/93	Interim Status Report (3GWH900M)	USGS	

FY'92 Scenario:

Budget: $153,000; 71% spent.

1992 Accomplishments:

No milestones for FY'92

1992 Deliverables:

Due Date	Deliverable	Parti-cipant	Delivered ?
8/92	Submit weapons-holes data to PDA	USGS	(a)

(a) Data not generated; activity dropped

Impact of FY'92 on FY'93:

FY'94 Scenario:

Budget: $2,052,000

FY'94 Scope:

1.2.3.3.1.3.3 SATURATED ZONE HYDROLOGIC SYSTEM SYNTHESIS AND MODELING - USGS/LBL

Purpose:

Synthesize available data to develop a conceptual model. Make a qualitiative analysis of how the system is functioning. Develop and evaluate porous-media and fracture-network methods for simulating gw flow and solute transport. Estimate gw flow direction and magnitude for input to GWTT calculations.

Description:

synthesize the available hydrogeologic data to develop a conceptual model and make a qualitative analysis of how the site saturated-zone hydrogeologic system is functioning

develop and evaluate methods for simulating gw flow and transport in saturated fractured rock beneath Yucca Mountain, relate reults of hydraulic and conservative tracer tests in wells to fracture-network characteristics at Yucca Mountain; develop methods for identifying transmissive fracture zones in rocks penetrated by boreholes; and identify geohydrologic conditions at Yucca MOuntain where groun water flow and transport can be evaluated using the porous media assumption

estimate gw flow direction and magnitude for input into travel time calcualtions; and evaluate the equivalent porous-media dual porosity, and fracture-network concept for determining flow paths, fluxes and velocitieis; theoretically extend to the large, site scale those techniques that are proved most applicable at the scale of well tests.

LBL: Develop and verify model capable of simulating ground-water flow and solute transport in fracture networks. Evaluate fracture network model and investigate equivalent porous media assumption. Select, modify, and document porous-media models. Conduct data analysis at UE-25 C wells. Conduct model validation at proposed second multiple-well location.

USGS: Form hypothesis for ground-water flow. Simulate groundwater flow using numerical models. Develop conceptual model based on comparison of simulated and observed flow characteristics. Revise numerical model to represent conceptual model. Validate numerical model by comparing simulated and observed potentiometric surface. Perform sensitivity analysis on model. Develop and verify model capable of simulating ground-water flow and solute transport in fracture networks. Evaluate fracture network model and investigate equivalent porous media assumption. Select, modify, and document porous-media models. Conduct data analysis at UE-25 C wells. Conduct model validation at proposed second multiple-well location. Evaluate hypotheses for ground-water flow and solute transport by analyses of hydraulic and tracer tests and numerical modeling. Form conceptual model from evaluation of ground-water flow hypotheses. Select or construct numerical model describing behavior of conceptual model. Document and verify numerical model. Validate numerical model against cases of solute migration in fractured rock at scales similar to Yucca Mountain. Evaluate effects of scale changes from validation cases to scale of Yucca Mountain. Use geophysical model, geostatistical methods. and inverse modeling to estimate spatial distribtuion of aquifer properties.

FY'93 Funding: $265,000

USGS: $115,000
LLBL: 150,000
$265,000 Total (Mission 2001: $314,000)
(Carry over: $0)

Rationale for FY'93 Funding: A Priority 4 study.

ITE Test Prioritization: No ITE Test Prioritization

WBS Elements (1.2.3..) / Participant:

.3.1.3.3	USGS/LBL	SZ HYDROLOGIC SYSTEM SYSTHESIS AND MODELING	Scope (see below)	$265,000
	USGS	Development of fracture network model	(a)	$75,000
	USGS	Conceptualization of SZ flow models	(b)	$40,000
	LBL	Development of Fracture Network Model	(c)	$150,000
			TOTAL	$265,000

Principal Investigator: Elisabeth Ervin (USGS), Karasaki (LLNL)

FY'93 Scope:

USGS

(a) Development of Fracture-network model
Support project operations
Develop conceptual model of fracture network and prepare report
Coordinate LBL fracture network modeling

Conceptualization of SZ Flow Models
Develop porous media flow model for site
Collect outcrop samples for Hydrologic properties
Complete report on potentiometric map
Support project operations

LBL

(c) Development of Fracture-network model
Study outcrop fracture data bias and prepare report
Study prediction error and design tests
Complete trinet user's manual

Status at Beginning of FY'93:

Study Plan: **8.3.1.2.3.3**, Site Saturated Zone System Synthesis and Modeling, verify comment resolution 10/19/92

JP/TPP: May not be necessary; no laboratory or field tests or experiments planned.

Environmental Studies:

Prerequisite Predecessor:

1993 Deliverables:

Due Date	Deliverable	Parti-cipant	Delivered ?
12/92	Report - Revised potentiometric-surface map of Yucca Mt (USGS) (3GWMO6M)	USGS	YES
9/93	Submit outcrop properties data to PDA (3GWM10M)	USGS	
6/93	Report/TDIF: Crater Flat tuff fracture mapping (3GWMO13M)	USGS	
5/93	Interim Status Report (3GWM000M)	USGS	
5/93	Interim Status Report (3GWM004M)	USGS	
6/93	Report/TDIF: Crater Flat Tuff Fracture Mapping (3GWM013M)	USGS	
9/93	Status Report: conceptual Model Fracture Network (3GWM005M)	USGS	
9/93	Report on outcrop fracture data bias (3GWM18CM)	LBL	
9/93	Trinet fracture network model users manual (3GWM21CM)	LBL	
9/93	Input to multiwell test design (3GWM23CM)	LBL	

1992 Scenario:

Budget: $415,000; 87% spent.

1992 Accomplishments:

No milestones.

1992 Deliverables:

Due Date	Deliverable	Parti-cipant	Delivered?
5/92	Potentiometric Map Reports	USGS	
12/91	Prepare and present fracture mapping results (3GWM014M)	USGS	YES (12/13/91)
3/92	Submit fracture data to PDA (3GW011M)	USGS	YES (3/31/92)
9/92	Submit fracture data to PDA (3GW012M)	USGS	Yes (9/30/92)
3/92	Incorp. outcrop data in frac. network model	LBL	
6/92	Report borehole frac. data bias	LBL	
9/92	Trinet fracnet model draft users manual	LBL	
3/31/92	Report: hydrologic and seismic data correlation	LBL	
9/92	Report on results of cross hole seismic profiles	LBL	

Impact of FY'92 on FY'93:

FY'94 Scenario:

Budget:

LBL: $225,000
USGS: $225,000
Total: $450,000

FY'94 Scope:

1.2.3.4.1.1 Groundwater Chemistry Model

Purpose:

Provide a ground-water chemistry model that will (1) explain the present ground-water compositions as a result of ground-water interactions with minerals, (2) be able to predict the future variations in ground-water chemistry under anticipated and unanticipated conditions, and (3) support and be integrated with other modeling efforts within the geochemistry program.

Description: All efforts required to:

1) develop a ground-water chemistry model that uses ground-water chemistry data, including the processes that control ground-water compositions, and determines their relative importance,

- integrates the unsaturated and saturated zone data with the processes of water infiltration, water flow, and mineralogic changes in order to develop a mechanistic description of the current ground-water chemistry

- considers future changes in these properties and processes to evaluate the chemistry of water interacting with the emplaced waste in the post-emplacement period.

FY'93 Funding: $186,000 (Mission 2001: same)
(Carry over: $0)

Rationale for FY'93 Funding:

ITE Test Prioritization: Not Ranked.

WBS Elements (1.2.3)/Participant:

.4.1.1	LANL	GROUNDWATER CHEMISTRY MODEL	SCOPE	$186,000
			Conduct Sensitivity Analyzes, Model Eh and pH	$186,000
			TOTAL	$186,000

Principal Investigator: J. A. Canepa (LANL)

FY'93 Scope:

Ground Water Chemistry Model

Conduct Sensitivity Analyzers, Model Eh and pH

Stability of Eh and pH and Yucca Mountain groundwater investigated using EQ3/6 code. Includes elucidation of parameters controlling or affecting pH and Eh constants. Results used to test specific hypotheses related to geochemical conditions. Define most active groundwater as that which produces the highest radionuclide solubilities. Integrates with the sorption and solubility studies. This activity is a predecessor to the conceptual groundwater modeling activity. A report (level 3 milestone R704) is due at the end of this activity.

Status at Beginning of FY'93:

Study Plan: 8.3.1.3.1.1 - Ground-Water Chemistry Model, In Revision by PI, 5/6/92

JPP/TPP:

Environmental Studies:

Prerequisite Predecessor:

1993 Deliverables:

Due Date	Deliverable	Participant	Delivered ?
9/93	Report: Modeling and Experimental Results of Saturated and Unsaturated Zone Water Chemistry (MS2:T534)	LANL	
9/93	Report: Water Chemistry (MS2:M374)	LANL	
9/93	Report: Sensitivity Analyses for Ground water Chemistry Model (MS3: R704)	LANL	

FY'92 Scenario:

Budget: $186,000; __% spent.

1992 Milestones accomplished:

1992 Deliverables:

Due Date	Deliverable	Participant	Delivered ?

Impact of FY'92 on FY'93:

FY'94 Scenario:

Total Budget: $537,000

1.2.3.4.1.2.1 BATCH SORPTION STUDIES

Purpose:

- Obtain data and models for the sorption behavior of key radionuclides under the physical and chemical conditions anticipated at the proposed repository.

- Provide sorption coefficients for key radionuclides as a function of solid phase composition, ground-water composition, waste element concentration, and the presence of particulates and colloids.

- Support determination of the Geochemical Qualifying Condition by end of FY'96 ???

Description:

Conduct studies of sorption behavior with detailed investigation and modeling of the interactions between radionuclides in aqueous solutions and solid rock materials:

- Conduct measurements of batch sorption coefficients on tuff samples representative of Yucca Mountain as a function of solid phase composition

- Characterize the dependence of sorption coefficients on the concentration of the element being sorbed by developing isotherms for the radionuclide

- Measure changes in sorption coefficients as a function of changes in ground-water composition, and evaluate the Kd values

- Study the sorption of radionuclides (Sr, Sc, Am, Pu) on particulates or colloids that may be present in ground water along potential transport pathways

- Produce statistical correlations and error estimates

FY'93 Funding: **$771,000** (Mission 2001: same)
(Carry over: $0)

Rationale for FY'93 Funding:

A Priority 2 Study

- Continues ongoing experiments

- Supports determination of Geochemical Qualifying Condition

ITE Test Prioritization:

STUDY	UNSUITABILITY	REGULATORY COMPLIANCE	SCIENTIFIC CONFIDENCE
Batch Sorption	High (13)	Medium (2)	High (15)

WBS Elements (1.2.3..)/Participant:

4.1.2.1	LANL	BATCH SORPTION STUDIES	SCOPE (see below)	
	LANL	Conduct Whole Rock Sorption Experiments	(a)	$176,000
	LANL	Conduct Isotherm Studies on Whole Rocks	(b)	345,000
	LANL	Conduct Sorption Experiments on Single Mineral	(c)	250,000
			TOTAL	$771,000

Principal Investigator: J. A. Canepa, LANL

FY'93 Scope:

(a) Conduct Whole Rock Sorption Experiments

Develop experimental techniques and optimize them for batch sorption experiments using whole rock material obtained by drilling and from the ESF at Yucca Mountain. Resolve analytical artifacts and uncertainties. Prepare and revise detailed procedures as necessary,. A report (level 3 milestone 3218) on the Effects of Water/ Rock Ratios on Sorption Coefficients will be delivered at the end of this activity.

(b) Conduct Isotherm Studies on Whole Rocks

Conduct experiments to obtain data on the dependence of Kds on radionuclide concentration in the solution. Focus on key radionuclides as developed from the sorption strategy (eg Np,

Pu) and specific groundwater compostiions. Use whole rock obtained by drilling and from the ESF at YM. Conduct scoping experimetns at higher temperatures to determine the effect of temperature on sorption. A report (level 3 milestone 3346) summarizing results of sorption experiments at higher temperatures will be delivered at the end of this activity.

(c) Conduct Sorption Experiments on Single Mineral Type of Effort
Carry out experiments on pure separates of the minerals found in Yucca Mountain Tuffs. These experiments involve various solution composition and all of the important radionuclides. The resulting data is interpreted and used to extrapolate the whole-rock Kd data. Priority is determineed by the sorption strategy (EG Np, Pu). Continue neptunium sorption experiments on feldspar to obtain surface complexation constants and try to predict Np sorption onto tuffs with high feldspar content in J-3 water. Progress on this effort will be tracked through monthly progrss reports. A level 3 milestone 3345 report on Neptunium Sorption onto Feldspars will be delivered on 6/30/93.

Status at Beginning of FY'93:

Study Plan: **8.3.1.3.4.1** "Batch Sorption Studies and Development of Sorption Models," comment resolution meeting 2/14/90. Screening review completed 11/4/92.

JP/TPP: May require TPP for laboratory experiments.

Environmental Studies: None; no field activities planned.

Prerequisite Predecessor: ??

1993 Deliverables:

Due Date	Deliverable	Parti-cipant	Delivered ?
9/93	Report : Effects of Water/ Rock Ratios on Sorption Coefficients (Level 3 MS 3218)	LANL	
9/93	Report: Summary of results of sorption experiments at higher temperatures (Level 3 MS 3346)	LANL	
6/30/93	Report: Neptunium Sorption onto Feldspars (level 3 MS 3345)	LANL	

1992 Scenario:

Budget: $580,000; 86% spent.

1992 Milestones accomplished:

1992 Deliverables:

Due Date	Deliverable	Parti-cipant	Delivered ?
9/30/92	Variation of Water-Rock Ratio Sorption Coefficients on Zeolitic Tuff MS 3009	LANL	?
9/30/92	Progress Report on Single Mineral Experiments MS 3212	LANL	?

Impact of FY'92 on FY'93:

FY'94 Scenario:

Budget: Mission 2001: $1,601,000
PACS: $1,587,000

FY'94 Scope:

Conduct Whole Rock Sorption Experiments $250,000

Develop/optimize techniques for batch sorption experiments.
Prepare and revise detailed procedures as necessary.
Report on whole rock sorption by radionuclides.

Conduct Isotherm Studies on Whole Rocks $324,000

Conduct experiments to determine dependence of Kds on radionuclide concentrations in solution.
A report on sorption isotherms will be produced.

Conduct Sorption Experiments on Single Mineral Type of Effort	$427,000
Conduct experiments on pure separates of the minerals found in Yucca Mountain tuffs. Interpret data and extrapolate whole-rock Kd data (focus on Np) Report on sorption of radionuclides by single minerals	
Capital Equipment- Mass Spectrometer	$600,000

1.2.3.4.1.2.2 BIOLOGICAL SORPTION AND TRANSPORT

Purpose:

To estimate the effects of the microbiological activity found at Yucca Mountain on the movement of actinide waste elements (neptunium, plutonium, and americium) through the unsaturated zone.

To determine whether microbial activity can influence the movement of plutonium in tuff. Because fluids are used extensively in the exploration of locations for a nuclear repository, those microorganisms capable of utilizing drilling fluids as growth substrates are of special interest.

Description:

1) Develop analytical methods for ESF samples
2) Analyze ESF samples for microorganisms
3) Analyze microbial effects on transport of radionuclides through tuff
4) Determine sorption rate of radionuclides by microorganisms and microbial by-products
5) Develop biological term for transport model

FY'93 Funding: $275,000 (Mission 2001: same)
(Carry over: $0)

Rationale for FY'93 Funding: A Priority 2 Study: experiments are ongoing; they relate to plutonium sorption and colloidal agglomeration.

ITE Test Prioritization:

STUDY	UNSUITABILITY	REGULATORY COMPLIANCE	SCIENTIFIC CONFIDENCE
Biological Sorption	Medium (8)	Medium (15)	Medium (19)

WBS Elements (1.2.3..):/Participant

4.1.2.2	LANL	BIOLOGICAL SORPTION AND TRANSPORT		$275,000
			TOTAL	$275,000

Principal Investigator: Larry Hersman, LANL

FY'93 Scope:

Coordinate biological sorption and transport task
Support QA program by training and developing procedures
Support ESF design activities
Meet LANL andDOE environmental, health and safety requirements
Respond to requests for information
Prepare required monthly and semiannual reports

Status at Beginning of FY'93:

Study Plan: **8.3.1.3.4.2** - "Biological Sorption and Transport," approved 11/25/92, submitted to NRC 12/24/92.

JP/TPP: May require TPP for laboratory experiments.

Environmental Studies: Probably none needed; no field activities planned.

Prerequisite Predecessor: None

1993 Deliverables:

Due Date	Deliverable	Parti-cipant	Delivered ?
9/93	Report: Microbial and Colloid transport Models (MS2: T537)	LANL	

FY'92 Scenario:

Budget: $273,000; 100% spent.

1992 Milestones accomplished:

1992 Deliverables:

Due Date	Deliverable	Parti-cipant	Delivered ?
9/30/92	"Report on Chelation" MS 3080	LANL	In prep 8/92
9/30/92	"Report on Colloidal Agglomeration" MS 3092	LANL	In prep 8/92
9/30/92	"Procedure for Determination of Formation Constraints" MS 3176	LANL	In progress 8/92
9/30/92	"Procedure for Determination of Effects on Colloidal Agglomeration" MS 3177	LANL	In prep 8/92

Impact of FY'92 on FY'93:

Spent all the money so there's no carryover

FY'94 Scenario:

Budget: $613,000 (Mission 2001)
$417,000 (PACS)

FY'94 Scope: (Mission 2001)

Develop Analysis Methods for ESF $189,000
Develop procedures for aseptic sampling in the ESF
Report on sampling techniques
Develop detailed technical procedures for sampling process

Analyze Microbial Effects on Transport $332,000
Develop procedures to determine the effect of microorganisms on colloidal agglomeration.

Study the effects of microorganisms on transport in columns.
Report on colloidal agglomeration studies.

Capital Equipment: Flow Through Calorimeter $92,000

1.2.3.4.1.2.3 Sorption Models

Purpose:

Model the sorption experiments on rocks and minerals representing the proposed repository block, and derive a capability to predict sorption coefficients for key radionuclides under water-rock conditions not included in the experimental program.

Description: All efforts required to:

1) describe the expected sorption of key radionuclides along the potential transport paths from the repository to the accessible environment as a function of the mineralogy, ground-water composition, and radionuclide concentration,

2) determine the solubility of using equilibrium models (isotherms) on the sorption data, and

3) use kinetic models, if necessary, to provide estimates of pseudo-equilibrium or equilibrium sorption

FY'93 Funding: $162,000 (Mission 2001: same)

Rationale for FY'93 Funding:

ITE Test Prioritization: Related to: Batch Sorption: Top two out of three, dominant study plans

STUDY	UNSUITABILITY	REGULATORY COMPLIANCE	SCIENTIFIC CONFIDENCE
BATCH SORPTION	High (15)		High (17)

WBS Elements (1.2.3):/Participant:

.4.1.2.3	LANL	SORPTION MODELS	SCOPE	$162K
			Develop Sorption Models	$162K

Principal Investigator: J.A. Canepa, LANL

FY'93 Scope:

The purpose of this study, development of sorption models, is to model the sorpiton experiments on rocks and minerals representing the proposed block and to derive a capaiblity to predict sorption coefficients for key radionuclides under water-rock conditions not included within the experimental program.

Status at Beginning of FY'93:

Study Plan:8.3.1.3.4.3/.1- Batch Sorption studies and develop sorption models: screening review complete 11/4/92

TPP/TPP:

Environmental Studies:

Prerequisite Predecessor:

1993 Deliverables:

Due Date	Deliverable	Participant	Delivered ?
	Final Report on Sorption (MS 376)	LANL	
9/30/93	AFM Analysis of Hematite and Goethite (3347)	LANL	

FY'92 Scenario:

Budget: $211K; __% spent.

1992 Milestones accomplished:

1992 Deliverables:

Due Date	Deliverable	Participant	Delivered ?

Impact of FY'92 on FY'93:

<u>FY'94 Scenario:</u>

Budget: $213,000 (Mission 2001: same)

1.2.3.4.1.3.1 DISSOLVED SPECIES CONCENTRATION LIMITS

Purpose:

Determine the solubilities or concentration limits for dissolved species of important waste elements under conditions characteristic of the repository and along flow paths from the repository, in order to calculate radionuclide transport along potential transport pathways from the proposed repository to the accessible environment.

- Provides data for addressing the Geochemical Qualifying Condition by FY'__

- Provides input for two Level 2 milestones: "Issue Report on Solubility of Radionuclides in Yucca Mountain Water," and "Solubility Calculations for Elements on the EPA Critical List."

Description:

Determine the conditions (Water compositions, oxidation-reduction state and temperatures) for solubility measurements:

- Measure the solubilities or concentration limits of important waste elements under these conditions

- Identify important aqueous species of waste elements under these conditions, and determine their formation constants

- Develop the thermodynamic data base and modeling capabilities necessary to calculate waste element solubilities under conditions expected at the repository and along flow paths toward the environment.

FY'93 Funding: **$986,000** (Mission 2001: same)
(Carry over: $0)

Rationale for FY'93 Funding:

A Priority 2 Study:

- Supports ongoing experiments at LBL

ITE Test Prioritization:

STUDY	UNSUITABILITY	REGULATORY COMPLIANCE	SCIENTIFIC CONFIDENCE
Dissolved Species Concentrations	High (16)	High (13)	Medium (3)

WBS Elements (1.2.3..)/Participant:

4.1.3.1	LANL	DISSOLVED SPECIES CONCENTRATION LIMITS	SCOPE (see below)	
	LANL	Determine Solubility of Np, Pu, Am from Undersaturation	(a)	$350,000
	LANL	Develop and Implement Photothermal Spectroscopy	(b)	$433,000
	LANL	Radionuclides Speciation Measurements	(c)	$203,000
			TOTAL	$986,000

Principal Investigator: Dave Morris, LANL

FY'93 Scope:

(a) **Determine Solubility of Np, Pu, Am from Undersaturation**
Complete solubility measurements for Np, Pu and Am at three pH values and three temperatures from undersaturated conditions. This involves preparation and characterization of solid compounds of the above actinides, followed by dissolution to steady-state concentration. Conduct scoping calculations to examine the agreement between experiments and model simulations for neptunium in J-13 and UE25p #1 waters. Prepare a report comparing the reuslts of solubility experiments for Am, Np, and Pu from J-13 and p#1 waters for oversaturation and undersaturation conditions (level 3 ms 3344).

(b) **Develop and Implement Photothermal Spectroscopy**
Extreme dilution including integration of all detection methods (photoacoustic, thermal lensing, thermal deflection and development of detailed procedures for system applications. A report is due (1/31/93) on implementation of this system. Complete studies of Pu (IV) carbonate speciation at concentrations of less than 10**-6 M by

Photoacoustic spectroscopy (PAS) and prepare report due at end of activity . Collaborate with Dynamic Transport and Sorption Tasks to study speciation of Np (V) in solutions following batch and colum sorption experiemnts. Support YMP solubility working group. Examine speciation of Pu in J-13 water with samples supplied from Solubility task. Provide oxidation state pure solutions of actinides for use by Dynamic Transport and Sorption Tasks.

(c) **Radionuclides Speciation Measurements**
Determine speciation of Np, Pu, and Am in synthetic YM groundwater using spectroscopic techniques. Determine speciation of other solubility limited radionculides by PAS, PDA, LIF where applicable. Prepare and characterize model actinide complexes. Conduct other , higher-concentration species studies using visible ultraviolet and near infrared and nuclear magnetic resonance spectroscopies. Collaborate with Dynamic Transport and Sorption tasks to study speciation of Np (V) in soutions following batch and column sorption experiments. Initiate C-13 and O-17 NMR studies of the speciation of Np (V) and Pu (IV) in carbonate media in the concentration range from 10**-2 to 10**-6 M. A report will be delivered at the end of this activity on the NMR studies.

Status at Beginning of FY'93:

Study Plan: **8.3.1.3.5.1/2**: "Dissolved Species Concentration Limits and Colloid Behavior." Principal Investigator revision completed 10/21/92.

JP/TPP: May require TPP for experiments.

Environmental Studies: Probably not needed; no surface rupturing field activities planned.

Prerequisite Predecessor:

1993 Deliverables:

Due Date	Deliverable	Parti-cipant	Delivered ?
1/14/93	Report:Development of PTS MS 3330	LANL	No
9/30/93	Report on comparison of solubilities of NP, Am, Pu in J-13 and P-1 waters MS 3344	LANL	No
9/30/93	PAS analyses of Pu (IV) Carbonate Speciation MS 3350	LANL	No
9/30/93	Speciation Measurements (3031)	LANL	
9/30/93	NMR analyses of Np(v) and Pu(v) Carbonate Systems MS 3351	LANL	No

FY' 92 Scenario:

Budget: $1,146,000; 105% spent.

1992 Milestones accomplished:

1992 Deliverables:

Due Date	Deliverable	Parti-cipant	Delivered ?
9/30/92	Plutonium (iv) and Plutonium (vi) Carbonate Speciation studies by NMR and PAS Spectroscopies MS 3031		On schedule 8/92
9/30/92	Report on Neptunium, Plutonium, and Americium solubility experiments in UE-25p#1 water from oversaturation MS 3329		On schedule 8/92

Impact of FY'92 on FY'93:

Alpha radiolysis effects have hampered analysis of both 13-C and 17-0 NMR data.

FY'94 Scenario:

Budget: $1,928,000 (Mission 2001)

FY'94 Scope: (Mission 2001)

Development and Implementation of Data Base $225,000

Identify, acquire, and modify computer code for making model calculations of radionuclide speciation in solution.
Identify data base and supplement with data from solubility and speciation experiments.
Provide interim reports on data base.

Solubility and Speciation Modeling $283,000

Part of data base development effort
Interim reports on status of modeling, data base
Produce final report on solubility of radionuclides in YM waters, and solubility of elements on EPA critical list

Determine solubility of Np, Pu, Am, from Undersaturation $400,000

Determine solubility of Np, Pu, and Am in J-13, UE25p#1 ?? , and possibly H-3 ground waters as a function of solution pH and room temperature undersaturation.

Radionuclide Speciation Measurements (same scope as FY'93) $796,000

Determine speciation of Np, Pu, and Am in synthetic YM ground water by PAS and/or PDS;
Determine speciation of other solubility limited radionuclides by PAS, PDS, LIF where applicable;
Prepare and characterize model actinide complexes;
Conduct other, higher-concentration speciation study using uv-vis and NMR spectroscopies.

Capital Equipment: Rotating Ring Disk Electrode $100,000

Required to resolve overlapping spectra which will allow very dilute samples expected at Yucca Mountain to be measured.

Capital Equipment: Upgrade of PAS System $124,000

Needed for maintenance and additional capabilities for photoacoustic spectrometer system.

1.2.3.4.1.3.2 COLLOID BEHAVIOR - LANL

Purpose:

Determine the stability of waste element colloids under conditions characteristic of the repository and along flow paths from the repository and along flow paths from the repository to the accessible environment. The study will attempt to characterize the true radiocolloids. The investigation will supply data and models that can be used to calculate the concentration limits of dissolved radionuclides in local water at the Yucca Mountain site. These concentration limits will be used directly by performance assessment models of radionuclide transport.

Description:

determine the formation and stability of waste element colloids, develop models and model parameters to calculate natural colloid concentrations and stability and to describe the disposition of the waste elements species as the colloids break up.

FY'93 Funding: $14,000

Rationale for FY'93 Funding: A Priority 4 study.

ITE Test Prioritization:

STUDY	UNSUITABILITY	REGULATORY COMPLIANCE	SCIENTIFIC CONFIDENCE
Dissolved Species and Colloid Behavior	High (14)	High (16)	Medium (25)

WBS Elements (1.2.3..) / LANL:

.4.1.3.2	LANL	COLLOID BEHAVIOR	Determine the stability of waste element colloids under conditions characteristic of the repository and along flow paths from the repository to the accessible environment.	$14,000

Principal Investigator: David Morris, LANL

FY'93 Scope: All non-discrete activities including monthly and semi-annual reporting, quality assurance issues, training and procurements and personnel actions. What is being reported?

Status at Beginning of FY'93:

Study Plan: **8.3.1.3.5.1/2**, Dissolved Species Concentration Limits and Colloid Behavior, PI Revision complete 10/21/92

JP/TPP: Probably not necessary; no tests, expriments, or surface-rupturing field activities planned

Environmental Studies: probably not necessary - see above.

Prerequisite Predecessor:

1993 Deliverables:

Due Date	Deliverable	Parti-cipant	Delivered ?

1992 Scenario:

Budget: $11,000; 100% spent.

1992 Accomplishments:

1992 Deliverables:

Due Date	Deliverable	Parti-cipant	Delivered ?
	None - LOE only		

Impact of FY'92 on FY'93:

FY'94 Scenario:

Budget: $312,000 (Mission 2001)
$263,000 (PACS)

FY'94 Scope:

1.2.3.4.1.4.1 DYNAMIC TRANSPORT COLUMN EXPERIMENT

Purpose:

To determine the rate of movement of radionuclides along the potential flow paths to the accessible environment by describing sorption behavior as a function of dynamic physical conditions that simulate those at Yucca Mountain.

Supports Level 2 milestone: Summary Dynamic Transport Results Required by Performance Assessment. Provides data m geochemical qualifying condition.

Description:

Examine the effect of diffusion, absorption, dispersion, anion exclusion, sorption kinetics, and colloid movement in the flow geometries and hydrologic conditions that are expected to exist along the flow paths to the accessible environment in the scenarios to be used for performance assessment. This includes:

- Investigate the effects of sorption kinetics, dispersion, diffusion and speciation on the transport model, which could alter the level of detail required to model repository performance.
- Perform crushed tuff column studies to verify the results of batch sorption measurements and study mass transfer kinetics.
- Perform solid tuff column tests to study transport under variable conditions of saturation.
- Perform column studies of fractured tuff to investigate the transport of radionuclides with transverse matrix diffusion and channeled flow in fractures
- Perform filtration studies to examine the efficacy of tuff in filtering or absorbing colloids of various sizes and surface charges.

FY'93 Funding: **$752,000** (same as Mission 2001)
(Carry over: $0)

Rationale for FY'93 Funding: A Priority 2 study.

ITE Test Prioritization:

STUDY	UNSUITABILITY	REGULATORY COMPLIANCE	SCIENTIFIC CONFIDENCE
Dynamic Transport	Medium (5)	Medium (10)	Medium (14)

WBS Elements (1.2.3..)/Participant:

3.4.1.4.1	LANL	DYNAMIC COLUMN TRANSPORT EXPERIMENTS	SCOPE (see below)	
	LANL	Conduct Fractured Tuff Column Experiments	(a)	$116,000
	LANL	Column Experiment with Crushed Material	(b)	$183,000
	LANL	Conduct Filtration Experiments on Yucca Mountain Tuff	(c)	$163,000
	LANL	Solid Tuff Column Experiments	(d)	$290,000
			TOTAL	$752,000

Principal Investigator: Inez Triay, LANL

FY'93 Scope:

(a) Conduct Fractured Tuff Column Experiments
Fractured tuff columns will investigate the transport of radionuclides with transverse matrix diffusion and channeled flow in fractures. Tuff samples containing natural fractures will be selected form YM. The fractures are encapsulated to ensure that flow is confined to the fracture planes and maintained under constant temperature. Progress will be tracked through monthly reports.

(b) Conduct Column Experiment with Crushed Material
Column experiments with crushed material will be performed to verify the results of batch sorption measurements under flowing conditions. The water velocity will be varied to study kinetic effects. Columns are packed, tracers are injected into the columns and tritiated water is utilized to determine the column parameters. Crushed material will include both individual minerals used in sorption, and tuff from YM.

Provide solutions to Speciation task to characterize Np speciation. Prepare paper for IHLWM conference. Support Sorption task. Progress will be tracked through monthly reports.

(c) Conduct Filtration Experiments on YM Tuff

Develop and conduct colloid workshop for the YMP. This workshop will produce a report that will be delivered at the end of this activity. Develop and submit YMP colloid strategy for Project review. Conduct experiments on the formation and stability of colloidal mateial. Progress will be tracked through monthly reports.

(d) Conduct Solid Tuff Column Experiments

Manage the Dynamic Transport task, the purpose of which is to study the chemical and physical processes such as sorption, diffusion, and dispersion in an advective flowing system. Develop work scope, support planning activities, provide capital input and ensure work progress. Continue efforts to study transport under unsaturated flow conditions. Prepare summary report on Np transport in tuff collating data from Sorption, Solubility, Speciation and Diffusion tasks. This summary report is due at the end of this activity.

Status at Beginning of FY'93:

Study Plan: **8.3.1.3.6.1**, "Dynamic Transport Column Experiments": in revision by the Principal Investigator as of 8/29/90

JP/TPP: May require TPP for experiments.

Environmental Studies: Possibly none needed; no surface rupturing field activities planned.

Prerequisite Predecessor:

1993 Deliverables:

Due Date	Deliverable	Parti-cipant	Delivered ?
9/30/93	Colloid Workshop Report MS 3348	LANL	No
9/30/93	Summary Report: Np Transport in Tuffs MS 3349	LANL	No

FY'92 Senario:

Budget: $539,000; 96% spent.

1992 Milestones accomplished:

1992 Deliverables:

Due Date	Deliverable	Parti-cipant	Delivered ?
3/31/92	Report on sorption by batch and column techniques MS 3027		a.
8/31/92	Letter report on assessment of available techniques for unsaturated column transport experiments MS 3044		b.
9/30/92	Kinetics of sorption on columns of pure minerals MS 3040		c.

a.
b. In prep 8/92
c.

Impact of FY'92 on FY'93:

FY'94 Scenario:

Total Budget: $2,311,000 (Mission 2001)
$1,929,000 (PACS)

FY'94 Scope: (Mission 2001)

Large Block Experiment	$500,000
Conduct Fractured Tuff Column Experiments	271,000
Conduct Filtration Experiments on Tuff	580,000
Solid Tuff Column Experiments	323,000
Column Experiments with Crushed Material	390,000
Capital Equipment Adcam Multichannel Analyzer	14,000
Capital Equipment Robotic System for Isotherm Measurements	109,000
Capital Equipment Control Atmosphere System Robotics	81,000
Capital Equipment: Delca model 440	23,000
Capital Equipment: PC station	20,000
TOTAL	$2,311,000

1.2.3.4.1.4.2 DIFFUSION

Purpose:

- To investigate the effective retardation of radionuclides by diffusive processes.

- Supports Level 2 milestone, Preliminary Report on Retardation by Diffusion, due __??

Description:

- Perform diffusion studies to investigate the rate of movement of radionuclides through tuff in the absence of an advective flux.

- Perform kinetics studies using solid tuff to provide kinetic rate constants by determining the time dependence of the uptake of radionuclides in solid tuff.

- Perform unsaturated diffusion experiments to investigate diffusivity as a function of saturation in blocks of intact tuff.

FY'93 Funding: **$112,000** (Mission 2001: same)
(Carry over: $0)

Rationale for FY'93 Funding:

A Priority 2 Study:

- Supports on-going experiments that represent the only diffusion data being collected for Yucca Mountain

ITE Test Prioritization:

STUDY	UNSUITABILITY	REGULATORY COMPLIANCE	SCIENTIFIC CONFIDENCE
Diffusion	Middle (4)	High (20)	Middle (6)

WBS Elements (1.2.3..) / Participant:

4.1.4.2	LANL	DIFFUSION	SCOPE (See below)	
		Transport under Diffusive Conditions	(a)	
			TOTAL	$112,000

Principal Investigator: Inez Triay, LANL

FY'93 Scope:

(a) **Transport Under Diffusive Conditions -**
Develop techniques and conduct experiments to study the diffusion behavior of radionuclides under unsaturated conditions using blocks of intact tuff. The radionuclides to be studied are simple cations, anions, and actinides. Inputs: well-characterized actinide solutions, tuff samples representative of hydrologic units. Support Sorption task by studying Np diffusion through tuffs. Support Dynamic Transport task by providing data for Np diffusion to summary report. Progress will be tracked through monthly reports. A presentation on results on ongoing experiments will be given at the HLW Conference in April 1993.

Status at Beginning of FY'93:

Study Plan: **8.3.1.3.6.2:** ' Diffusion' - PI Revison complete 12/4/92, in verification process.

JP/TPP: TPP may be required for experiments

Environmental Studies: None needed; no surface rupturing field activities planned.

Prerequisite Predecessor: Well-characterized actinide solutions,
tuff samples representative of the hydrologic units.

1993 Deliverables:

Due Date	Deliverable	Parti-cipant	Delivered ?
9/93	Report: Techniques to study diffusion in saturated tuff	LANL	
4/93	Presentation at HLW Conference	LANL	

FY'92 Scenario:

Budget: $105,000; 94% spent

1992 Milestones accomplished:

1992 Deliverables:

Due Date	Deliverable	Parti-cipant	Delivered ?

Impact of FY'92 on FY'93:

FY'94 Scenario:

Budget: **Pacs: $519,000**
(Mission 2001: $580,000)

FY'94 Scope: (Mission 2001)

Transport under diffusive conditions	$330,000
Capital Equipment: Unsaturated Flow Apparatus	$250,000

1.2.3.4.1.5.1 RETARDATION SENSITIVITY ANALYSIS

Purpose:

Identify the processes to which transport of radionuclides is most sensitive, to guide geochemical site characterization. Construct a geophysical/geochemical description of Yucca Mountain based on the results of the other geochemistry and mineralogy/petrology tasks. Examine physical and chemical controls of radionuclide transport along flow paths.

Level two milestones will include;

M390, Issue Report on Geochemical /Geophysical Model
T513, Report on Retardation Sensitivity Analysis
T012, Topical Report; Summary Radionuclide Retardation at Yucca Mountain

Support Dynamic Transport Fracture Column Study.
Support field test study, Use results of field observations and tests for model testing.

Description:

- analyze all the processes that may affect transport: geochemical transport processes, physical transport processes, particulate transport heat-load effects, and coupled phenomena

- perform calculations of radionuclide transport from the repository to the accessible environment using, as a basis, an integrated, conceptual geochemical-geophysical model of Yucca Mountain

- verify the computer codes, validate models, and identify important contributors to the uncertainties in retardation calculations (sensitivity analysis).

FY'93 Funding: **$425,000** (Mission 2001: same)

Rationale for FY'93 Funding: A Priority 4 study.

ITE Test Prioritization: No prioritization

WBS Elements (1.2.3..) / LANL:

.4.1.5.1	LANL	RETARDATION SENSITIVITY ANALYSIS		
		Simulate Fracture Matrix Transport Coupling	(a)	$50,000
		Develop and Optimize Transport Codes	(b)	$42,000
		Perform Integrate Transport Calculations and Geochemical Geophysical Model	(c)	$333,000
			TOTAL	$425,000

Principal Investigator: Julie Canepa, LANL

FY'93 Scope:

(a) Simulate Fracture Matrix Transport Coupling -
The retardation sensitivity task will study processes that affect the transport of radionuclides at YM in order to support simplifying assumptions made by performance assessment for transport models. Understanding the effects of different assumptions about fracture/matrix interactions is important for predicting radionuclide retardation and transport. This activity will investigate the different assumptions using a more fundamental model that avoids the equilibrium assumption imposed on both pressure and concentration inherent in the effective continuum approach. Simulate effects that fracture flow and fracture/matric interactions have on transport through YM tuffs. Studies will investigate conditions under which transport in fracture is significant, and will determine appropriate transport modeling techniques for these conditions. Use results of field observations and tests for model testing. Compare dual porosity/permeability model to effective continuum model for parameters from the Calico Hills unit at Yucca Mountain. Progress will be tracked through monthly reports.

(b) Develop and Optimize Transport Codes,
The retardation sensitivity task will study processes that affect the transport of radionuclides at YM in order to support simplifying assumptions made by performance assessment for transport models. Code development is required to simulate various transport processes that may occur at YM. Software QA is required if the codes or their results will be used to support license application. This activity supports the development of algorithms for various processes and optimization of the transport codes TRACRN, FEHMN, and CTCN. Produce baseline documentation and bring verification report, user's manuals, and model and methods summaries. Complete certification of TRACRN and deliver the report.

(c) Perform Integration of Transport Calculation and Geochemical/Geophysical Models- The retardation sensitivity task will study processes that affect the transport of radionuclides at YM. In order to support simplifying assumptions made by performance assessment for transport models, large scale transport calculations in three dimensions are needed to estimate the effectiveness of the geochemical barrier at YM. This activity will develop a Geophysical/Geochemical model that describes processes determined by laboratory and field experiments, field observation, and sensitivity studies that are determined to be important to transport at YM. Site data from both hydrology and tranport studies are used to develop a model for YM. The activity will begin testing eh minimum Kd approach using available hydrologic data and various conceptual models of flow and transport at YM. Develop 3D mesh of YM for the ESHM code. Simulate transport using dual porosity/permeability on essentially the same grid as previous effective continuum simulations have been conducted. Check concepts with Cl-36 data fom Water Movement Tests study. Prepare report on the results of the three-dimensional simulation.

Status at Beginning of FY'93:

Study Plan: 8.3.1.3.7.1, Retardation Sensitivity Analysis, PO approved 8/11/92; submit to NRC 9/1/92

JP/TPP: Probably not necessary; no field or laboratory tests or experiments planned.

Environmental Studies: Probably not necessary; no field or laboratory tests or experiments planned.

Prerequisite Predecessor:

1993 Deliverables:

Due Date	Deliverable	Parti-cipant	Delivered ?
FY93	Interim report , Update of Geophysical/Geochemical Model	LANL	
11/92	Baseline documentation for TRACRN (MS 3052)	LANL	

1992 Scenario:

Budget: $531,000; 124% spent.

1992 Accomplishments:

1992 Deliverables:

Due Date	Deliverable	Parti-cipant	Delivered ?
9/92	Baseline documentation for TRACRN (MS3052)	LANL	
	Report - Three-dimensional simulations of radionuclide transport at Yucca Mountain	LANL	Yes
	Report - Sensitivity analysis of integrated radionuclide transport	LANL	Yes

Impact of FY'92 on FY'93:

FY'94 Scenario:

Budget: (PACS: $2,046,000)
(Mission 2001: $1,867,000)

FY'94 Scope:

1.2.3.4.2 GEOCHEMICAL MODELING (Formerly 1.2.1.4.3)

Purpose: Develop and verify computer codes used in assessment of performance, following applicable quality assurance procedures. Develop tools necessary for predicting behavior of the waste package environment, site geochemistry, and for waste package performance assessment. Expand existing EQ3/6 code to provide capabilities to handle nuclear waste applications.

Description:

-develop the EQ3/6 code package by incorporating various new submodels into the codes. Design submodels to expand the ability of the EQ3/6 codes to model geochemical reactions involving the waste package and repository geochemical environment (Geochemical Modeling Code Development)

-provide necessary documentation of the software, handling the distribution and release of the code ensuring verification of the codes and performing limited validation of the model (Code Release and Documentation)

-ensure the continued viability of previously available code options in each new version of the software packages (Code Maintenance)

FY'93 Funding: $380,000 (Mission 2001: $0)
(Carry over: $0)

Rationale for FY'93 Funding: A Priority 8 study.

ITE Test Prioritization: No ITE Test Prioritization

WBS Elements (1.2.3..)/Participant:

.3.4.2	LLNL	GEOCHEMICAL MODELING		$380,000
	LLNL	Geochemical Model/Database Development, Capital Equipment	SPARC station 10	$32,000
	LLNL	Verify/Validate EQ3/6 Code	(a)	$121,000
	LLNL	Revise Database	(b)	$152,000
	LLNL	Geochemical Model and Database Development, Management and Administration	(c)	$75,000
			TOTAL	$380,000

Principal Investigator: Wilder/Halsey

FY'93 Scope:

(a) Verify Validate EQ3/6 Code
-Develop code qualification plan and begin implementation

(b) Revise database
-Restructure code ver. 7 of the EQ3/6 code to allow for greater flexibility in dealing with redox disequilibrium states
-Add to the restructured code the ability to deal with calculations of the liquid-vapor curve of water

(c) Geochemical Modeling and Database Development
-Overall management of Geochemical Modeling and Database Development activities including planning, scheduling, budgeting and reporting
-Interact with other participants in Geochemical Modeling and Database Development activities

Status at Beginning of FY'93:

Study Plan: N/A
JP/TPP: N/A
Environmental Studies: N/A

1993 Deliverables:

Due Date	Deliverable	Parti-cipant	Delivered ?

1992 Scenario:

Budget: $552,000; _____% spent.

1992 Milestones accomplished:

1992 Deliverables:

Due Date	Deliverable	Parti-cipant	Delivered ?
	Issue GT output option of DOOUT	LLNL	
	Issue DOOut users manual	LLNL	
	Prepare draft/rvw/rev/issue EQ3 users manual	LLNL	
	Prepare/issue EQ3/6 package overview manual	LLNL	
	Prepare draft qualifications plan	LLNL	
	Prepare test case library	LLNL	
	Prepare/issue DBERROR documentation	LLNL	
	Prepare draft/rvw/rev/issue EQ6 users manual	LLNL	

Impact of FY'92 on FY'93:

FY'94 Scenario:

Budget: $608,000 (Mission 2001: $607,000)

FY'94 Scope:

ESF Support

1.2.3.5.1 SMF (Ramp Holes Support)
1.2.3.5.2.1 Common-to-Drilling (Ramp Holes Support)
1.2.3.5.2.2 Engineering, Design and Drilling (Ramp Holes Support)
1.2.3.5.3.20 Drilling Ramp Holes

Purpose: To provide field and drilling support in collecting information characterizing the rock conditions (stratigraphy and structure) to be encountered in, or which will be affected by, the construction of ESF subsurface access facilities (see also WBS 1.2.3.2.6.2). Test pits provide samples/exposures for geotechnical foundation evaluations and design data at Surface Facility.

Description:

- Drilling, logging, sampling, and testing of boreholes along the North Ramp alignment and South Ramp alignment of ESF;
- Handling of soil and rock samples acquired from boreholes and soil pits.

FY'93 Funding:

1.2.3.5.1	SMF (Ramp Holes Support)	$2,635,000
1.2.3.5.2.1	Common-to-Drilling (Ramp Holes Support)	3,514,000
1.2.3.5.2.2	Engineering, Design and Drilling (Ramp Holes Support)	2,067,000
1.2.3.5.3.20	Drilling Ramp Boreholes	1,538,000
	TOTAL:	$9,754,000

Rationale for FY'93 Funding:
Priority 1 Studies:

- Underground testing/ESF construction has been given high priority by the Program Director
- Budget amount allocated to task 1.2.3.5.1, 1.2.3.5.2.1, and 1.2.3.5.2.2 are 2/3 of total Mission budget for the SMF, common to Drilling and Drilling Support for FY'93.
- Budget allocation for 1.2.3.5.2.2 supports 3 drilling crews for entire year

ITE Test Prioritization:

WBS Elements (1.2.3..) / Participant:

..5.1		SMF		
	T&MSS	Sample Management Facility	handle, store, process, distribute core samples	$2,310,000
	REECo	Sample Management Facility	provide personnel, supplies, equipment, etc. to SMF	325,000
			SUBTOTAL	$2,635,000

.5.2.1	REECo.	COMMON-TO-DRILLING SUPPORT		$3,514,000
.5.2.2		DRILLING SUPPORT		
	T&MSS	Engineering, Design, and Drilling Support	layout, review, reporting, geophysical logging, borehole pumping, cementing, and surveying	$667,000
	RSN	Engineering, Design, and Drilling Support	engineering, design, geophysical logging, drill rig services	$1,200,000
	JC			$200,000
			SUBTOTAL	$2,067,000
5.3.20	REECo	Surface Facilities Drill Holes	provide labor, material, equipment	$1,538,000
			TOTAL	$9,754,000

Principal Investigators:

T&MSS:	SMF - Kenton Beale
REECo:	SMF - Robert Pritchett
	Drilling - Clarence Mason, Thomas Leonard
RSN:	Drilling - Eddie Wright

FY'93 Scope:

1.2.3.5.1	T&MSS	At drill site and SMF, handle, store, process, and distribute all core and rock geotechnical samples derived from the ramp boreholes. Provide sample information as requested and sample inventory tracking.
	REECo	Provide personnel, supplies, equipment, minor modifications, etc. for operation of the SMF.
1.2.3.5.2.1	REECo	provide labor, material, equipment, and services to support drilling of ESF boreholes.

1.2.3.5.2.2 T&MSS

- initiate design for drilling and testing activities
- prepare design criteria letters
- provide underground design calculations, drawings,photographs, cost estimates, and Project engineering
- Reviews final designs
- Prepare work orders for construction authorization
- report on current progress of drilling operations
- Prepare completion reports for drill holes
- T&MSS monitors and reviews the design of geophysical logging

Status at Beginning of FY'93:

Study Plan: N/A

JP/TPP:

TPP 92-15 NRG-6 Drilling and Testing
TPP 92-1 Soil and Rock Properties 60% complete
JP 92-19 Drill Pads, Access Roads and Drilling for NRG-2
JP 93-1 Drilling NRG-3 90% complete
JP 93-2 Access Road NRG-4 60% complete
JP 93-2A Drilling of Borehole NRG-4
JP 93-3 Access Road and Drill Pad NRG-5 75% complete
JP 93-3A Drilling of Borehole NRG-5 75% complete
JP 92-10 NRG-6 Drill Pad Construction
JP 92-11 NRG-6 Drilling and Testing
JP 92-2 Soil and Rock Properties, North Portal Drill Hole and Surface Facility Test Pits
JP 92-16 Construction of Drill Pad and Access Road and Drilling of SRG-1: 75% complete, on hold

Environmental Studies:

Pre-Activity Surveys
NRG-3 estimated completion: 1/25/93
NRG-5 estimated completion: 3/9/93
NRG-4 estimated completion: 4/7/93
SRG-5 estimated completion: 9/16/93
SRG-1 estimated completion: 8/2/93
SRG-4 estimated completion: 10/14/93

Prerequisite Predecessor:

1993 Deliverables:

Due Date	LOE / Dis	Deliverables	Participant
FY'93	LOE	Operate YMPO's SMF	T&MSS
FY'93	LOE	Support SOC	T&MSS
FY'93	LOE	Complete development of computer-based sample inventory database	T&MSS
FY'93	LOE	Onsite drill hole engineering, geophysical logging, record keeping, report writing, technical consulting for drilling	RSN

FY'92 Scenario:

Budget:

1.2.3.5.1	SMF (Ramp Holes Support)	$ 3,524,000
1.2.3.5.2.1	Common-to-Drilling (Ramp Holes Support)	5,250,000
1.2.3.5.2.2	Drilling Support includes IDAS support @$100K	1,889,000
1.2.3.5.3.20	Drilling Ramp Boreholes	318,000
	TOTAL	$10,981,000

1992 Milestones accomplished:

- Completion of excavation and field testing of Phase II test pits for Soil and Rock Properties
- Cleared alluvium/colluvium area above NRG-1 pad for fracture mapping
- Drilled NRG-1

1992 Deliverables:

Due Date	LOE/ Dis	Deliverable	Parti-cipant	Delivered?
FY'92	LOE	Operate YMPO's SMF	T&MSS	Yes
FY'92	LOE	Support SOC	T&MSS	Yes
FY'92	LOE	Complete development of computer-based sample inventory database	T&MSS	No
FY'92	LOE	Onsite drill hole pumping, geophysical logging, record keeping, report writing, technical consulting for drilling	RSN	Yes
FY'92	DIS	Provide labor and support to build access roads, drill pads, and drill NRG & SRG boreholes	REECo	partially-NRG-1 completed

Impact of FY'92 on FY'93:

1.2.3.5.1	$371,000 under budget (T&MSS) - budgeted personnel positions not filled
1.2.3.5.2	$834,000 under budget (REECo) - did not accomplish planned 2-shift drilling schedule

FY'94 Scenario:

1.2.3.5.1	T&MSS	$13,936,000 for total SMF operations
	REECo	$689,000 for total SMF operations
1.2.3.5.2.1	REECo	$19,218,000
1.2.3.5.2.2	T&MSS	$0
	RSN	$4,348,000
	JC	$363,000
1.2.3.5.3.20	REECo	$1,702,000

DRILLING SUPPORT FOR GWTT DISQUALIFIER

1.2.3.5.1 Sample Management Facilities
1.2.3.5.2.1 Common-to-Drilling
1.2.3.5.2.2 Drilling Support
1.2.3.5.3.3 Natural Infiltration Drillholes and Construction
1.2.3.5.3.5 Unsaturated Zone, Vertical Seismic Profile and Prototype Drillholes and Tests

Purpose:

To provide support for obtaining information to characterize the unsaturated zone through drilling of UZ boreholes, VSP, Prototype drillholes and neutron-access boreholes.

Provide construction and testing support for characterization of present-day infiltration processes and net-infiltration rates in surficial soils and rock covering Yucca Mountain, prototype and UZ drilling for definition of the potential field and determination of the in situ bulk permeability characteristics of the unsaturated media within the proposed repository host rock and surrounding units at Yucca Mountain.

Description:

- support for drilling and monitoring of neutron access holes located with the intent of sampling the range in expected surficial hydrologic properties and conditions at Yucca Mountain,
- support for dry drilling and coring of vertical boreholes ranging in depth from 60 to 610 m, support for dry drilling of a vertical borehole for vertical seismic profiling, support for short-term pneumatic testing, placing instruments in holes as required for long-term testing, and conducting prototype drilling for determining dry drilling and coring techniques to be used for UZ drillholes;

FY'93 Funding:

1.2.3.5.1	Sample Management Facilities	$1,318,000
1.2.3.5.2.1	Common-to-Drilling	$1,757,000
1.2.3.5.2.2	Drilling Support	$933,000
1.2.3.5.3.3	Natural Infiltration Drillholes and Construction	$300,000
1.2.3.5.3.5	UZ Drilling	$2,000,000
TOTAL:		$6,308,000

Rationale for FY'93 Funding:

- WBS Elements # 1.2.3.5.1, 1.2.3.5.2, 1.2.3.5.3.3 and 1.2.3.5.3.5 are Priority 4 studies, GWTT disqualifiers.

- Budget amount allocated to 1.2.3.5.1, 1.2.3.5.2.1 and 1.2.3.5.2.2. are 1/3 of total budget for the SMF, Common-to-drilling and Drilling Support for FY'93.

ITE Test Prioritization:

1.2.3.5.3.3 supports UZ Infiltration study, 1.2.3.5.3.5 supports Surface-Based UZ Percolation Study.

STUDY	UNSUITABILITY	REGULATORY COMPLIANCE	SCIENTIFIC CONFIDENCE
UZ INFILTRATION	HIGH (6)	HIGH (11)	HIGH (6)
SURFACE-BASED UZ PERCOLATION	HIGH (1)	HIGH (1)	HIGH (1)

WBS Elements (1.2.3..) / Participant:

1.2.3.5.1 SMF	T&MSS	$1,155,000
	REECo	$163,000
Subtotal:		$1,318,000
1.2.3.5.2.1 Common-to-drilling	REECo	$1,757,000
1.2.3.5.2.2 Drilling Support	T&MSS	$333,000
	RSN	$600,000
Subtotal:		$933,000
1.2.3.5.3.3 Natural Infiltration	REECo	$300,000
1.2.3.5.3.5 UZ Drilling	REECo	$2,000,000
Subtotal:		$2,300,000
TOTAL:		$6,308,000

Principal Investigators:

T&MSS: SMF - Kenton Beall
REECo: SMF - Robert Pritchett
Drilling - Clarence Mason, Thomas Leonard
RSN: Drilling - Eddie Wright

FY'93 Scope:

1.2.3.5.1	T&MSS	At SMF, handle, store, process, and distribute all core and rock geotechnical samples. Provide sample information as requested and sample inventory tracking.
	REECo	Provide personnel, supplies, equipment, minor modifications, etc. for operational support of the SMF.
1.2.3.5.2.1	REECo	Provide labor, material, equipment, and services to support drilling.
1.2.3.5.2.2	T&MSS	Support design for drilling and testing activities, review design reviews for drilling, testing, and geophysical logging, provide geotechnical and engineering support for drilling and logging.
1.2.3.5.3.3	REECo	Provide labor, material, and equipment as necssary to support drilling and monitoring of neutron access holes located with the intent of sampling the range in expected surficial hydrologic properties and conditions at Yucca Mountain.
1.2.3.5.3.5	REECo	Provide labor, material, and equipment as necessary for completion of coring, drilling and support of scientific tests of UZ-16 and UZ-14. Also included is construction of the access road and drill pad for UZ-14.

Status at Beginning of FY'93:

Study Plan:

8.3.1.2.2.1, Characterization of Unsaturated Zone infiltration, , Rev. 0, approved 1/18/91, Phase 1 NRC review completed 5/31/91

8.3.1.2.2.3, Charcterization of Percolation in the Unsaturated Zone- Surface-based study, Rev 1, USGS, approved by DOE 1/93

JP/TPP:

1.2.3.5.3.3-

TPP 91-34, Neutron Access Boreholes, Phase 2, Rev. 2, approved 7/13/92
JP 91-9, Neutron Access Holes, Phase 2, Rev. 3, Approved 7/23/92, 9/3/92 comment;
FCR for N31, N32 and N35 submitted to FCCB beginning operations of "N5O" series

1.2.3.5.3.5-

TPP 92-2, Drilling of VSP Drillhole UZ-16 approved
TPP 92-16, UZ-14 Drilling and Testing, in process, scheduled finish 2/1/2/92
JP 92-17, 50% Complete

Environmental Studies:

1.2.3.5.3.5- UZ-14 Pre-activity evaluation priority 10
Toxic cleanup on UZ-1 drill pad scheduled for completion during 2/93

Prerequisite Predecessor:

8.3.1.5.3.3- Complete FY-92 Neutron Drilling
1.2.3.5.3.5- Drilling of JF-3, a monitoring well near J-13

<u>1993 Deliverables:</u>

Due Date	Deliverable	Parti-cipant	Delivered ?
9/28/93	Drilling UZN-39, 61	REECo	No (as of 1/93)
9/28/93	Initial geophysical logging of above boreholes	USGS	No (as of 1/93)
4/93	Drill UZ-16	REECo	No (as of 1/93)
9/29/93	Drill UZ-14	REECo	No (as of 1/93)

FY'92 Scenario:

Budget:

WBS NO	ACTIVITY	FY'92 BUDGET	% SPENT	$$ SPENT
1.2.3.5.1	Sample Management Facilities			
1.2.3.5.2.1	Common-to-drilling			
1.2.3.5.2.2	Drilling Support			
1.2.3.5.3.3	Natural Infiltration drillholes and construction	$562,000	100%	$562,000
1.2.3.5.3.5	UZ, VSP and Prototype drillholes and tests	$2,600,000	65%	$1,690,000
TOTAL:				

1992 Accomplishments:

1992 Deliverables:

Due Date	Deliverable	Parti-cipant	Delivered ?
9/29/92	Drill UZ-16	REECo	No
5/27/92	Construct access road and drill pad for UZ-16	REECo	Yes
9/29/92	Drilling UZN-11, 15,16, 17, 27, 36, 37, 38, 53, 54, 55	REECo	Yes
9/29/92	Initial Geophysical logging of the above boreholes	USGS	Yes

Impact of FY'92 on FY'93:

1.2.3.5.3.5-Completion of UZ-16 in FY'93 required that budgeted funds during FY'92 be carried over into FY'93. This was done by financially planning the drilling support needs for FY'93 drilling of UZ-16 using that amount for the FY'93 budget, and using the carryover as additional funds available for FY'93.

FY'94 Scope:

1.2.3.5.1-$689,000
1.2.3.5.2.1-$19,218,000, (REECo)
12.3.5.2.2-$4,711,000, $363,000 (JC), $4,438,000 (RSN)
1.2.3.5.3.3- $31,000 (REECo)
1.2.3.5.3.5- $11,114,000, $2,175,000 (REECo)

1.2.3.5.2.3 INTEGRATED DATA ACQUISITION SYSTEM (IDAS)

Purpose:

Description: Furnish necessary labor, material, and equipment to provide routine maintenance and operational support to the USGS prototype IDAS system in Area 25. (IDAS = computerized system for the collection of hydrologic data from wells; to tbe used in C-wells, in U3 Percolitions tests and in ESF)

FY'93 Funding: **$100,000** (Mission 2001: same)

Rationale for FY'93 Funding:

ITE Test Prioritization: No ITE Test Prioritization

WBS Elements (1.2.3..)/Participant:

5.2.3	REECo	INTEGRATED DATA ACQUISITION SYSTEM		$100,000

Principal Investigator: Leonard, REECO

FY'93 Scope:

Status at Beginning of FY'93:

Study Plan: **8.3.1.2.2.3**, "Characterization in UZ - surface based study; NRC Phase I review 3/26/92

JP/TPP: May require JP

Environmental Studies:

Furnish necessary labor, material, and equipment to provide routine maintenance and operational suppor to the USGS prototype IDAS system in Area 25.

Prerequisite Predecessor:

1993 Deliverables:

Due Date	Deliverable	Parti-cipant	Delivered ?
	None given in Mission 2001		

1992 Scenario:

Budget: $100,000; 100% spent.

1992 Accomplishments:

1992 Deliverables:

Due Date	Deliverable	Parti-cipant	Delivered ?
	None given in Mission 2001		

Impact of FY'92 on FY'93:

FY'94 Scenario:

Budget: $175,000

FY'94 Scope:

Furnish necessary labor, material, and equipment to provide routine maintenance and operational support to the USGS prototype IDAS system in Area 25.

1.2.3.5.3.3 NATURAL INFILTRATION DRILLHOLES AND CONSTRUCTION

Purpose:

Provide construction and testing support for charcterization of present-day infiltration processes and net-infiltration rates in the surficial soils and rocks covering Yucca Mountain.

Support UZ infiltration studies.

Description:

All efforts required to:

- support drilling and monitoring of neutron access holes located with the intent of sampling the range in expected surficial hydrologic properties and conditions at Yucca Mountain.

FY'93 Funding: $300,000 (Mission 2001: $158,000)

Rationale for FY'93 Funding: A Priority 4 study.

ITE Test Prioritization: Supports study plan ranked 6th overall

STUDY	UNSUITABILITY	REGULATORY COMPLIANCE	SCIENTIFIC CONFIDENCE
UZ INFILTRATION	HIGH (6)	HIGH (11)	HIGH (6)

WBS Elements (1.2.3..) / Participant:

.5.3.3	REECo	NATURAL INFILTRATION DRILLHOLES AND CONSTRUCTION	Labor, material, and equipment to support drilling and monitoring of NAH	$300,000

FY'93 Scope:

Account Manager for REECO: LEONARD

REECO: Provide labor, material, and equipment as necessary to support drilling and monitoring of neutron access holes located with the intent of sampling the range in expected surficial hydrologic properties and conditions at Yucca mountain. The CME rig will be used. Phase II Neutron Access Hole drilling will be complete.

Status at Beginning of FY'93:

Study Plan: **8.3.1.2.2.1**, "Characterization of Unsaturated Zone Infiltration", NRC Phase I review completed 5/31/91; No Phase II review

JP/TPP: TPP 91-34, Neutron Access Boreholes, Phase 2, Rev.2 approved 7/13/92

JP 91-9, Neutron Access Holes, Phase 2, Rev. 3, Approved 7/23/92; 9/3/92 comment: FRC for N31, N32 and N35 submitted to FCCB beginning operations on "NSO" series

Environmental Studies: Pre-Activity Evaluations(as of 01/08/93) are Priority 5-N#85 Ponding Study, Priority 10-UZN-62; letter to initiate postactivity for all completed neutron boreholes dated 8/31/92

Prerequisite Predecessor:
COMPLETE FY'92 NEUTRON DRILLING

1993 Deliverables:

Due Date	Deliverable	Parti-cipant	Delivered ?
9/28/93	DRILLING UZN-31, 32, 33, 34, 35, 39, 57, 58, 59, 61, 62, 63	REECO	NO(AS OF 01/93)
9/28/93	INITIAL GEOPHYSICAL LOGGING OF ABOVE BOREHOLES	USGS	NO(AS OF 01/93)

FY'92 Scenario:

Budget: $562,000; 100% spent.

1992 Accomplishments:

1992 Deliverables:

Due Date	Deliverable	Parti-cipant	Delivered ?
09/29/92	DRILLING UZN-55, 54, 53, 36, 37, 38, 27, 64, 17, 11, 15, 16	REECO	YES
09/29/92	INITIAL GEOPHYSICAL LOGGING OF THE ABOVE BOREHOLES	USGS	YES

Impact of FY'92 on FY'93:
Provided borehole access for infiltration measurements of saturation and near-surface porosity.

FY'94 Scenario:

Budget:

REECO - $31,000

FY'94 Scope:

REECO
Water Movement Tracer Tests
Deliverables: WBS 1.2.3.3.1.2.2: Labor, material, and equipment to support scientific efforts in quantifying the amount of percolation from precipitation into the unsaturated zone at Yucca Mountain

1.2.3.5.3.19 Volcanic Drillholes Support

Common-to-Drilling (Drillholes Support)

Purpose: To provide labor, material, and equipment as necessary to support the drilling and coring of drillholes in southwest Crater Flat and in the Amargosa Valley to a depth of approximately 1000 feet in support of volcanic studies.

Description:

- Drilling, sampling, logging, and testing of boreholes in Crater Flat and in the Amargosa Valley.

FY'93 Funding:

- Trenching support in Lathrop Wells volcanics $16,000

FY'94 Funding:

- Common-to-Drilling Support $1,111,000

Rationale for FY'94 Funding:

- Priority 7 - Issue Resolution Study

ITE Test Prioritization:

- No direct ITE ranking. Study fits under Priority 7 as an Issue Resolution Study. Activities support Study Plan 8.3.1.8.5.1 (Characterization of Volcanic Features)

Principal Investigators:

REECO:	Drilling Support
T&MSS:	Sample Handling(FY'94)
LANL:	Scientific Study

1.2.3.5.3.22 **In Situ Stress Drillhole & Quaternary Fault Trenches Support**

Common-to-Drilling Support

Purpose: To provide labor, material and equipment as necessary to trench in Midway Valley and in the vicinity of Yucca Mountain, support drilling and preliminary in situ stress tests in a single preliminary drillhole, and in situ stress tests in existing wells, based upon the results of testing in the first in situ stress drillhole.

Description: Drilling, sampling, logging and testing a single preliminary borehole. Associated trenching in Midway Valley, and subsequent in situ stress testing of existing wells.

FY'93 Funding: Trenching support and preliminary in situ stress drillhole-$100,000

Rationale for FT'93 Funding:
Priority 6 Studies - Seismic Hazards

- Budget allocation supports drilling activity in the latter part of FY'93.
- Initial activity in FY'93 has been fault trenching.

Status at Beginning of FY'93:

Study Plan 8.3.1.17.4.8

JP/TPP: JP: 92-05(Trenching)
USGS Site Investigation Plan

Principal Investigators:

REECO: Drilling Support
USGS: Scientific Studies

Environmental Studies:

- Midway Valley evaluation' 1q completed 05/04/89
- Preliminary in situ stress drillhole not yet under consideration by Environmental Group.

FY'94 Scenario:

Budget:

1.2.3.5.3.22	REECO	$344,000

Paleoclimate Studies

1.2.3.6.2.1.1 Modern Regional Climate
1.2.3.6.2.1.2 Paleoclimate Study of Lake, Playa, and Marsh Deposits
1.2.3.6.2.1.3 Climatic Implications of Terrestrial Paleoecology
1.2.3.6.2.1.4 Paleoenvironmental History of Yucca Mountain
1.2.3.6.2.1.6 Future Regional Climate and Environment

Purpose: To develop an understanding of the nature, timing, duration, and amplitude of potential climate changes that may affect the hydrologic regime in the vicinity of the repository, and can be used in making performance assessments for the repository.

SUPPORTS:	6.2.1.1	6.2.1.2	6.2.1.3	6.2.1.4	6.2.1.6
Determination of Geohydrology Disqualifying Condition, FY'95	X				
Determination of Tectonics Disqualifying Condition, FY95				X	
Determination of Preclosure Rock Characteristics Disqualifying Condition, FY'95				X	
Determination of Geohydrology Qualifying Condition, FY'97		X	X	X	
Determination on Climate Changes Qualifying Condition, FY'97	X	X	X	X	
Determination of Tectonics Qualifying Conditions, FY'97				X	
Recom of Nat'l Res. Council, "Ground Water at Yucca Mountain, How High Can It Rise?"	X	X	X	X	
Unsaturated Zone Infiltration Studies	X	X	X		
Saturated Zone Flow Models	X			X	
Resolution of Calcite-Silica Issue					
Continuous Monitoring Activity	X	X			

Description:

1.2.3.6.2.1.1 Develop a synoptic, baseline characterization of the modern regional climate to provide the basis for developing vegetation-climate relationships, lake-climate relationships, and climate-circulation models. Provide an understanding of spatial and temporal variation in climate. Determine the climatic conditions under which recharge occurs. Use the isotopic composition of precipitation to indicate variability in climate.

1.2.3.6.2.1.2 Conduct paleontologic, stratigraphic-sedimentologic, chemical, and mineralogic analyses of lacustrine sediments in or near southern Nevada. Obtain a chronologic framework for this paleoclimatic information.

1.2.3.6.2.1.3 Determine aspects of past vegetation change. Use vegetation records to provide quantitative estimates of changes in climatic variables for the southern Great Basin.

1.2.3.6.2.1.4 Evaluate the paleoenvironmental record at Yucca Mountain and surroundings in light of inferred paleoclimatic history of the southern Great Basin. Model soil properties in the Yucca Mountain region. Map surficial deposits. Reconstruct the eolian history of the region.

1.2.3.6.2.1.6 Identify and estimate the factors that control global climate. Model the distribution of ice sheets during the nest 10,000 years (PNL) and the next 100,000 years (SNL) to determine the effect on upon the climate system. Evaluate the feasibility of using a global-scale climate model (PNL); and a regional-scale numerical climate model for predicting future climatic conditions at YM (SNL). Formulate a basis for predicting future climate in YM region over the next 10,000 years (PNL) and the next 100,000 years (SNL)

FY'93 Funding

WBS No.	Title	FY'93 Funding	Mission 2001
1.2.3.6.2.1.1	Modern Regional Climate	**$ 22,000**	$ 22,000
1.2.3.6.2.1.2	Paleoclimate, Lakes, Playa, and Marsh Deposits	**264,000**	438,000
1.2.3.6.2.1.3	Climatic Implications of Terrestrial Paleoecology	**58,000**	100,000

1.2.3.6.2.1.4	Paleoenvironmental History of Yucca Mountain	**114,000**	114,000
1.2.3.6.2.1.6	Future Regional Climate and Environment	**475,000**	1,015,000
	TOTALS	**$933,000**	$1,689,000

Rational for FY'93 Funding: Priority 5 studies.

ITE Test Prioritization:

STUDY	UNSUITABILITY	REGULATORY COMPLIANCE	SCIENTIFIC CONFIDENCE
Modern Regional Climate	**High (13)**	**Medium (12)**	**Low (2)**
Lake, Playa, and Marsh	**High (19)**	**Medium (11)**	**Low (1)**
Terrestrial Paleoecology	**High (20)**	**Middle (18)**	**Low (4)**
Paleoenvironmental History	**Middle (1)**	**Middle (19)**	**Low (5)**
Future Regional Climate and Environment was not ranked			
Related to:			
Post-emplacement Environmental Change	**High (8)**	**High (4)**	**High (19)**

WBS Elements (1.2.3..) / Participant:

6.2.1.1	USGS	MODERN REGIONAL CLIMATE Synoptic Characterization of Regional Climate	SCOPE: see below (a)	22,000
6.2.1.2	USGS	PALEOCLIMATIC STUDY OF LAKE, PLAYA & MARSH		
		Analysis of Stratigraphy-Sedimentalogy	(b)	224,000
		Lakes , Playas, and Marshes	LOE	40,000

6.2.1.3	USGS	CLIMATIC IMPLICATIONS OF TERRESTRIAL PALEOECOLOGY Analysis of Pack Rat Middens	(c)	58,000
6.2.1.4	USGS	PALEOENVIRONMENTAL HISTORY OF YUCCA MOUNTAIN		
		Surficial Deposits Mapping of Yucca Mountain	(d)	90,000
		Eolian History of Yucca Mountain Region	(e)	24,000
			SUBTOTAL: $114,000	
6.2.1.6	PNL/ SNL	FUTURE REGIONAL CLIMATE AND ENVIRONMENT		
	PNL	ditto	(f)	300,000
	SNL	ditto	(g)	175,000
			SUBTOTAL: $475,000	
			TOTAL:	$ 933,000

Principal Investigator: Rick Forrester, USGS
Dennis Grasso, USGS - 1.2.3.6.2.2.1.1
Dick Luckey, USGS - 1.2.3.6.2.2.1.3 to ...5

FY'93 Scope:

1.2.3.6.2.1.1 - Modern Regional Climate

Synoptic Characterization of Modern Regional Climate:

- Develop and submit study plan for approval
- Conduct stable/radiogenic isotope analysis of precipitation
- Analyze precipitation data from the regional network - will become an on-going monitoring activity with data generated as it is collected

1.2.3.6.2.1.2 - Paleoclimate Study of Lake, Playa, and Marsh Deposits

Analysis of Stratigraphy-Sedimentological Features:

- Write draft report on microfossils as indicators of paleohydrology and

paleoclimate

- Collect cores from lakes/playas/marshes in southern Nevada (DRI)
- Stratigraphic Analysis - Process cores from selected sites; cut, describe cores for paleontology, sedimentology, and isotope chemistry.
- Paleontological preparation/assessment of core samples
- Paleontological analysis
- Reconstruction of past climate and hydrology from isotopic analysis: run isotopic analysis, write data report

(c) **1.2.3.6.2.1.3 - Climatic Implications of Terrestrial Paleoecology**

- Management, oversight, and scientific coordination of DRI contract, Coordinate with Lakes/Playas/Marshes activity; write quarterly status reports
- Provide QA evaluation of DRI personnel
- C-14 analysis of selected pack-rat midden samples

1.2.3.6.2.1.4 - Paleoenvironmental History of Yucca Mountain

(d) Surficial Deposits Mapping of YM

- Complete isotopic analysis of selected samples from soil pits in southern Nevada
- Air photo/Field check/Sampling/Analysis of YM area - done in northern, central, and southern thirds of the area. Create map of surficial deposits
- Write report on '92 study

(e) Eolian History of the YM Region

- Write report on lead isotopic composition of carbonate rock and eolian dust from vicinity of YM
- Prepare report on isotopic analysis - concluding study
- Collect sediment samples from wet/dry playas in southern Nevada
- Conduct scoping study to date eolian sand by luminescence analysis
- Submit samples for mineral, selected element, and strontium/oxygen/carbon isotope analysis.

1.2.3.6.2.1.6 - Future Regional Climate and Environment

(f) PNL:

- Revise Study Plan, in conjunction with SNL
- Acquire/reconfigure ice-sheet reconstruction from UN. of Maine for glacial, superglacial, and intermediate-sized glaciations.
- Conduct general circulation model runs for glacial maximum, intermediate glacial, and super glacial climates, and provide results to NCAR.
- Other work that may be specified in transition plan (see SNL below).

(g) SNL:

- Assume responsibility in coordinating revision of Study Plan
- Assume responsibility for coordinating all effort for the characterization of future regional climate; develop transition plan for transitioning modeling studies from PNL to SNL
- Retain services of NCAR for climate modeling
- Develop approach to ensure compliance with QA requirements for all activities and products completed or in progress under Study Plan

Status at Beginning of FY'93:

Study Plan: **8.3.1.5.1.1** - Characterization of Modern Regional Climate: Not submitted to YMPO (11/10/92)
8.3.1.5.1.3 - Climatic Implications of Terrestrial Ecology: Complete through Phase I NRC Review (9/3/92)
8.3.1.5.1.4 - Analysis of the Paleoenvironmental History of the YM Region: Complete through Phase I NRC Review (12/6/91; Phase II Review deferred
8.3.1.5.1.2 - Paleoclimatic Study of Lake, Playa, and Marsh Deposits: Complete through Phase I NRC Review (4/27/92); Phase II Review deferred
8.3.1.5.1.6 - Characterization of Future Regional Climate and Environment: Awaiting PI revisions (11/10/92)

JPP/TPP: None needed ??

Environmental Studies: None needed ??

Prerequisite Studies:

FY'93 Deliverables:

WBS No.	Due Date	Deliverable	Parti-cipant	Delivered ?
6211	1/93	Study Plan Submitted (3GCR005M)	USGS	
6211	9/93	Interim Report/TDIF (3GCR0014M)	USGS	
6212	12/92	TDIF: Cores and Samples, Lakes/Playas/Marshes (3GCL012M)	USGS	
6212	4/93	Interim Assessment: Stratigraphic analysis (3GCL016M)	USGS	
6212	9/93	Interim Assessment: Paleontological Prep/Assessment (3GCL014M)	USGS	

6212	9/93	Status Rept: Past Climate and Hydrological Reconstruction (3GCL018M)	USGS	
6212	9/93	Interim Rept/TDIF: Isotopic Analysis (3GCL019M)	USGS	
6212	9/93	Interim Rept/TDIF: Isotopic Analysis (3GCL019M)	USGS	
6213	4/93	Status Rept/TDIF: DRI Status (3GCL110M)	USGS	
6213	7/93	Status Rept/TDIF: DRI Status (3GCL111M)	USGS	
6213	9/93	Status Rept/TDIF: C-14 Analysis (3GCL109M)	USGS	
6213	2/92	Rept/TDIF: QA Evaluation (3GCL104M)	USGS	
6214	4/93	Draft Rept/TDIF: Northern 1/3 of YM (3GCH035M)	USGS	
6214	7/93	Draft Rept./TDIF: Central 1/3 of YM (3GCH055M)	USGS	
6214	9/93	Final Rept./TDIF: Digitized Map, Northern 1/3 of YM (3GCH036M)	USGS	
6214	1/93	Rept./TDIF: FY'93 Study (3GCH039M)	USGS	
6216	9/93	Revision of global climate modeling activity	PNL	
6216	9/93	Transfer of all study products as specified in transition plan	PNL	
6216	6/93	Syudy Plan submitted to and approved by YMPO	SNL	
6216	4/93	Transition Plan submitted to and approved by YMPO	SNL	

1992 Scenario: **BUDGET**

STUDY	PARTICIPANT	FY'92 BUDGET	% SPENT	ACTUAL $$ SPENT
...6.2.1.1 - Modern Regional Climate	USGS	$ 20,000		
...6.2.1.2 - Lake, Playa, and Marsh Deposits	USGS	264,000		
...6.2.1.3 - Terrestrial Paleoecology	USGS	58,000		

...6.2.1.4 - Paleoenvironmental HIstory	USGS	125,000		
...6.2.1.6 - Future Regional Climate	USGS	621,000		
	SNL	385,000		
	PNL	386,000		

1992 Accomplishments:

..6.2.1.1: - Prepared draft of study plan, is being reviewed internally in USGS
- Decided that stable isotope composition of precipitation should be measured, to provide modern data against which isotope data in tress and packrat middens can be compared.

..6.2.1.2: - Study Plan was sent to NRC in 12/91; it was accepted by NRC in 4/92 with no comments.
- A new thermal mass spectrometer was installed, tested, and accepted. Software code for new spectrometer was written and tested and found to work correctly. A method for accessing previous run data was established.
- Technical planning focused on the issue of how much surface water was supported by past climate states.
- A 19-mile traverse of Spring Mountains was made in the Mt. Charleston area in search of evidence of past glaciers. **Was any found ?**
- Ostracod samples were collected from outcrop near the WIPP site in NM and analyzed for Sr isotope composition. They were found to have Sr composition comparable with coeval waters; i.e., technique may be useful in identifying water sources. **??** and a means of reconstructing mean annual air temperatures and precipitation, and seasonal timing of precipitation events. **??**

..6.2.1.3: - Study Plan was sent to the NRC in 1/92; NRC accepted it in 8/92 and requested copies of specific references sited therein.
- Technical planning focused how to measure the quantity of water in the natural system during climate states.

..6.2.1.4: - Study Plan was accepted by NRC in 12/91, with concern expressed regarding data qualification (under consideration by YMPO).
- DOE responded to State of Nevada's concern regarding rock-varnish dating and application to this Study Plan and site characterization (9/92).
- Activity in soil properties was directed to the Calcite-Silica activity (..6.2.2.1).
- Soil pits were excavated in Midway Valley to assist in establishing surficial stratigraphy. Carbonate-bearing materials were sampled for geochronological purposes. Similar samples were collected from the Midway Valley trench. Will be used to evaluate consistency of U-series dates derived on carbonates from single profile developed on different lithologic units and slope gradients.
- Isotopic studies were conducted on duct samples, and surficial deposits to better define origins of surficial deposits, and to estimate states of effective moisture.

- Samples from playa deposits were analyzed for selected major- and trace-element abundances, and for Sr isotopes, to be used to characterize unique chemical components of individual playas.
- Steps were taken to conduct thermoluminescence age dating.
-
- Initial mapping (1:12,000) of the quadrangle #26 was completed.

..6.2.1.5: Not funded in FY'92.

..6.2.1.6: Reviewers' comments were received for Study Plan, and are being addressed.

Global Climate Modeling:

- Test plan for global ice sheet dynamic model (Un. of Maine) was completed;test and production runs are scheduled for early FY'93.
- Test exercises were developed for the verification and validation of GENESIS, a general circulation model (GCM) acquired from NCAR.
- A GENESIS control run, scheduled for 9/92, will be sent to NCAR for a meso-scale model run in early Fy'93.
- A CLIMAP data base, including sea-surface temperatures, topography, glacial and sea-ice extents, vegetation, and soil types, was purchased from NCAR.

Regional Climate Modeling:

- Phase II continued, in which the present-day climate is derived using the RCM (MM4) nested in a GCM, as part of RCM validation analysis. The analysis is also to identify improvements obtainable with the use of the regional model compared to the GCM.
- A one-dimensional thermal lake model was successfully coupled to the MM4 in an interactive two-way nesting. The coupled lakes model will be used in Phase III to provide lake surface temperatures an evaporation rates for lakes Monneville and Lahontan.
- Three technical papers were prepared/presented/submitted for publication.
- A QA software evaluation of the RCM was undertaken. That for the pre- and post-processing software is completed; that for the main code is on-going; a sample RCM run for documentation purposes has been completed.

1992 Deliverables:

Due Date	Deliverable	Parti-cipant	Delivered ?
5/92	(6212) Submit Study Plan to NRC	USGS	Yes
5/92	(6213) Submit Study Plan to NRC	USGS	Yes
9/92	(6214) Make draft map (Paleoenvironmental History)	USGS	No - (a)

(a): Deliverable is in internal review; will be carried over to FY'93 under No. 3GH035M

Impact of FY'92 on FY'93:

Based on results of the RCM validation analysis performed to date, the RCM validation

analysis will be continued for a year beyond the current plans, shifting the target completion date of the study to the end of FY'95.

FY'94 Scenario:

Budget:

WBS No.	Title	FY'94 Mission 2001 Funding
1.2.3.6.2.1.1	Modern Regional Climate	$ 26,000 (USGS)
1.2.3.6.2.1.2	Paleoclimate, Lakes, Playa, and Marsh Deposits	642,000 (USGS)
1.2.3.6.2.1.3	Climatic Implications of Terrestrial Paleoecology	158,000 (USGS)
1.2.3.6.2.1.4	Paleoenvironmental History of Yucca Mountain	118,000 (USGS)
1.2.3.6.2.1.6	Future Regional Climate and Environments	708,000 (SNL) 400,000 (PNL)
	TOTAL	$ 2,052,000

FY'94 Scope:

..6.2.1.1: Modern Regional Climate

Continue to stable isotope analysis of precipitation
Establish basis for radiogenic isotope analysis of precipitation
Write report and release data as needed.

..6.2.1.2: Paleoclimatic Study of Lake, Playa, and Marsh Deposits

Focus on Pahrump Valley
Establish isotope and paleontology records from outcrops
Acquire cores of marsh deposits
Describe and Sample cores and analyze samples.
Acquire core from Lake Pahranogat (dependent on previous activities)

..6.2.1.3: Terrestrial Implications of Terrestrial Paleoecology

Continue stable isotope analysis
Continue packrat paleoecological studies
Acquire core from Lake Pahranogat (dependent on previous activities)

..6.2.1.4: Paleoenvironmental History of Yucca Mountain

Evaluate northern third of YM and write final report.
Map surficial deposits in YM region.

Complete resolution of eolian issue.
Provide rock-varnish dating support

..6.2.1.6: Future Regional Climate and Environments

Complete QA documentation of MM4.
Complete development of final Future Regional Climate Model, MM4 (Phase I)

1.2.3.6.2.2.1 Quaternary Regional Hydrology

Purpose: Investigate the hydraulic characteristics of paleoflood events. Compare them with modern flooding and related geomorphic processes. Determine past infiltration and percolation history at Yucca Mountain through isotopic and chemical analysis of water from the unsaturated zone. Determine past hydrologic conditions in the regional discharge area. Estimate the conditions and rates of infiltration and ground-water recharge during the Quaternary. Determine the ages, distribution, origin, and paleohydrologic significance of calcite and opaline silica deposits along faults and fractures.

Description: All efforts required to:

1) evaluate evidence for regional paleofloods (involving mapping of debris-flow and flood-flow deposits; evaluation of erosion scars, stone stripes, and other debris deposits; attempted dating of alluvial surfaces and unconsolidated stream-channel deposits) and compare this evidence with the magnitudes and frequencies of historical floods (SCP Activity 8.3.1.5.2.1.1).

2) - conduct Quaternary unsaturated zone hydrochemical analysis (SCP Activity 8.3.1.5.2.1.2) by:
   - determining past infiltration and percolation history at Yucca Mountain by analyzing isotopic and chemical characteristics of water samples from the unsaturated zone collected under SCP Activity 8.3.1.2.2.7.2,
   - modeling past hydrochemistry of the unsaturated-zone hydrologic system to help predict possible future hydrologic conditions,

3) evaluate past discharge areas (SCP Activity 8.3.1.5.2.1.3) by:
   - determining the location of past discharge sites and estimating the distribution of potentiometric head during the Quaternary, through remote-sensing analysis; paleontologic, isotopic, and geochemical analysis of geologic depositions; analysis of mineral deposits in carbonate caverns; drilling and coring of sediments and deep hydrogeologic units,
   - determining the location, type, and extent of hydrogeologic units and paleotectonic features in the regional ground-water discharge area,
   - determining the past quantity and quality of ground-water discharge, from springs and evapotranspiration,
   - understanding past and present discharge areas in

relation to the regional ground-water system,

4) conduct modern analog-recharge studies at appropriate localities in Nevada and Arizona (SCP Activity 8.3.1.5.2.1.4) by :
- measurement of meteorological conditions, surface runoff, evapotranspiration, water chemistry, soil properties, and vegetation cover,
- hydrologic-budget and chloride-ion, mass-balance modeling,
- analysis of chemical and isotopic content of wet and dry atmospheric deposition,
- analysis of unsaturated-zone soil mineralogy and chemistry, and soil moisture chemistry,
- development and calibration of soil mass-balance models for water, chloride, and carbonate,

5) determine ages, distribution, origin, and paleohydrologic significance of calcite and opaline silica deposits along faults and fractures in the vicinity of Yucca Mountain (SCP Activity 8.3.1.5.2.5) by:
- field investigations, including sample collection, deepening of Trench 14, vertical and angle drilling and coring, trench-wall mapping, and field mapping,
- mineralogical tests to place limits on conditions of deposition of vein-like deposits,
- geochemical investigations to examine bulk composition of spring and water-precipitated deposits,
- fluid-inclusion investigations to determine the environment of mineral deposition,
- geochronological investigations for dating of fracture fillings,
- tracer-isotope and stable-isotope investigations,
- paleontological investigations of calcareous remains of aquatic microorganisms preserved in fracture-filling material,
- hydrologic data collection and synthesis, and hydrologic modeling.

FY'93 Funding: **$1,277,000** (Mission 2001: $1,466,000)

Rationale for FY'93 Funding: A Priority 5 study

ITE Test Prioritization:

STUDY	UNSUITABILITY	REGULATORY COMPLIANCE	SCIENTIFIC CONFIDENCE
Quaternary Regional Hydrology	High (17)	High (17)	High (8)

WBS Elements/Participant:

6.2.2.1	USGS	QUATERNARY REGIONAL HYDROLOGY	SCOPE (see below)	
		Regional Paleoflood Evaluation	(a)	126,000
		Evaluation of Past Discharge Areas	(b)	342,000
		Analog Recharge Sites	(c)	128,000
		Studies of Calcite & Opaline Silica	(d)	280,000
		Geochemistry of Arid Zone Infiltration	(e)	216,000
		Quaternary Regional Hydrology	LOE	185,000
			TOTAL:	$1,277,000

Principal Investigator: Dennis Grasso (Section .1)
Luckey (Sections .3,.4,.5)

FY'93 Scope:

(a) Regional Paleoflood Evaluation
Continue Geomorphometric Analysis of YM and Vicinity
Continue Field Reconn. for Paleoflood Studies
Prepare Preliminary Summary of Regional Paleoflood Studies
Prepare Interim Status Report

(b) Evaluation of Past Discharge Areas
Prepare Report on origins of surface deposits
Collect, prepare, analyze faunal, water, soil and outcrop samples

Analyze water and lithologic samples-NWQL, GSP, GD Branch of Geochemistry
Determine Discharge mechanism in hydrologic units, FY93
Complete Report on methods of channel geometry
Prepare Vegetation Map; Phase 2
Prepare interim status report

(c) Analog Recharge Sites
Test PRMS Model
Prepare Data report for FY92
Synthesize results of Chloride and PRMS Models
Test Chloride ion balance model
Prepare interim status report

(d) Studies of Calcite and Opaline Silica
Collect specimens from cores and field sites
Mineralogic and petrologic description of specimens
Isotopic composition and fluid inclusion history
Write Report on uranium ratios
Write report on evidence for higher water table
Write report on evidence for complex groundwater flow
Write reprot on radiogenic tracer isotopes
Write report on isotopic studies for understanding paleohydrology

(e) Geochemistry of Arid Zone Infiltration
Collect watershed inputs and meteorolgical data
Conduct misc. site characterization activities
Analyze/interpret 36Cl and Precipitation data
Prepare Long-Term meteorolgical data report
Prepare interim status report

Quaternary Regional Hydrology (LOE)
Collect hydrologic data FY93
Support Project operations

Status at Beginning of FY'93:

Study Plan: **8.3.1.5.2.1** - "Characterization of the Quaternary Regional Hydrology" - (.3,.4,,.5) is complete through NRC Phase II Review; for (.1),approved 11/10/92, submitted to NRC 12/31/92

JPP/TPP:

Environmental Studies:

Prerequisite Predecessor:

1993 Deliverables:

Due Date	Deliverable	Parti - cipan t	Delivered ?
12/92	Report/TDIF: Uranium Ratios (3GQH08M)	USGS	
12/92	Report/TDIF: Evidence for Higher Water table (3GQH09M)	USGS	
12/92	Report/TDIF: Rediogenic Tracer Isotopes (3GQH10M)	USGS	
12/92	Report/TDIF: Evidence for complex groundwater (3GQH10M)	USGS	
12/92	Report/TDIF: Isotopic Studies/ Paleohydrology (3GQH22M)	USGS	
1/93	TDIF: Cores and Samples (3GQH01M)	USGS	
2/93	RPT/TDIF: Meteorolgical Data FY91-92 (3GQH001M)	USGS	
3/93	Report/EDIF: methods of Channel Geometry(3GQH11M)	USGS	
4/93	TDIF: Specimen Descriptions (3GQH04M)	USGS	
4/93	Status Report/TDIF: Isotopic Composition/ Fluid Inclusion (3GQH06M)	USGS	
4/93	TDIF: Cores and Samples(3GQH02M)	USGS	
4/93	Report/EDIF: Hydrologic Data remote site FY92 (3GQH12CM)	USGS	
5/93	Interim Status Report (3GOH10CM)	USGS	
5/93	Interim Status report (3GQH015M)	USGS	
5/93	Interim Status Report (3GQH000M)	USGS	
5/93	Interim Status Report (3GQH002M)	USGS	
7/93	TDIF: Specimen Descriptions (3GQH05M)	USGS	
7/93	TDIF: Cores and Samples (3GQH03M)	USGS	

9/93	Submit Watershed/meteorolgical Data to PDA (3GQH003M)	USGS	
9/93	Report/TDIF: Origin or Surface Depostis (3GQH019M)	USGS	
9/93	Report: Preliminary Summary of Paleoflood Studies (3GQH010M)	USGS	
9/93	Submit Data to PDA (3GQH005M)	USGS	
9/93	Submit Faunal, Water, soil and outcrop Data to PDA (3GQH021M)	USGS	
9/93	Submit Water Chemistry/Lithologic Data to PDA(3GOH025M)	USGS	
9/93	RPT/TDIF: 36Cl Ages of Soil 1993 (3GQH007M)	USGS	

FY'92 Scenario:

Budget: $1,422,000; __% spent.

1992 Accomplishments:

1992 Deliverables:

Due Date	Deliverable	Parti-cipant	Delivered?
1/92	Data from Kawich - FY85-90	USGS	
1/92	Data from Stewart Creek - FY85-90	USGS	
2/92	Submit Vegetation Map to PDA	USGS	
4/92	Data from Kawich - FY91	USGS	
4/92	Data from Stewart Creek - FY91	USGS	
7/92	Tech. Proc. for Paleoflood Analysis	USGS	
7/92	Topographic Map of Watershed	USGS	
8/92	Reports on Wet/Dry Playas	USGS	
8/92	Report on Contents of Samples	USGS	

9/92	Submit Modern Spring Data to PDA	USGS	
9/92	Faunal Data Discharge Deposits to PDA	USGS	
9/92	Interpretive Report on Faunal Data	USGS	
9/92	Rept: Paleo Streamflow/Recharge-Channel Geometry	USGS	
9/92	Water Chemistry Data to PDA	USGS	
9/92	Faunal Data, Modern Springs to PDA	USGS	
9/92	Progress Rept: 36Cl Ages of Soil 1992	USGS	
9/92	Hydrogenic Deposits, Trench !4 for Comment	USGS	

Impact of FY'92 on FY'93:

<u>FY'94 Scenario:</u>

Budget: $1,937,000

FY'94 Scope:

1.2.3.7.2.1 Natural Resources Assessment

Purpose : **To collect relevant data and conduct appropriate analysis of the data to assess the potential of natural resources occurrence at Yucca Mountain.**

Description:

FY'93 Funding: $80K (Mission 2001: $0)
(Carry over:$80K)

Rationale for FY'93 Funding: Utilize carry over funding to perform activity not previously funded because of lower priority.

ITE Test Prioritization:
Unsuitability : Low(not ranked)
Regulatory Compliance : Middle(13)
Scientific Confidence : High (10)

WBS Elements (1.2.3)/Participant:

.2.3.7.2.1	USGS	Natural Resources Assessment	SCOPE	$80K
8.3.1.9.2.1.1	USGS	Geochemistry assessment of YM	See (a) below	$40K
8.3.1.9.2.1.4	USGS	Assessment of Hydrocarbon Resources	See(b) below	$40K
			Total	$80K

Principal Investigator: Clay Hunter

FY'93 Scope: (a) Collect surface and subsurface geochemical samples and conduct analytical program on the samples to evaluate the potential of the existence of precious and base metals,strategic and industrial minerals and energy resources in the vicinity of Yucca Mountain.
Compile radiometric data on known mineral

occurrences and write report on radiometric age data.

(b) Determine the presence of hydrocarbon source rocks, measure thermal maturity of potential source rocks, reconstruct thermal history and identify potential reservoir rocks as well as traps and seals favorable for hydrocarbon accumulation

Status at Beginning of FY'93:

Study Plan: 8.3.1.9.2.1 Submitted to NRC 12/17/92

JPP/TPP:

Environmental Studies:

Prerequisite Predecessor:

1993 Deliverables:

Due Date	Deliverable	Participant	Delivered?
May 93	Progress Report on Age Data	USGS	
Sep 93	Report on Radiometric Age Data	USGS	
Sep 93	Report: Hydrocarbon Potential, Amargosa Valley and Tertiary Rocks	USGS	
Sep 93	Report : Evaluation of Hydrocarbons in Railroad Valley Analog	USGS	

FY'92 Scenario:

Budget: $0 __% spent.

1992 Milestones accomplished:

1992 Deliverables: None

Due Date	Deliverable	Participant	Delivered ?

Impact of FY'92 on FY'93:

<u>FY'94 Scenario:</u>

Total Budget: $

1.2.3.9 Site Investigations, Special Studies- Geophysical Logging

Purpose: Manage and execute geophysical logging program

Description: All efforts required to:

Manage and execute geophysical logging program as it relates to the site characterization program. All effort required to plan and execute these special studies; may include, but is not limited to, preparation of management plans, creation of task forces, preparation of reports, decision analysis, and submittal of records. Conduct technical assessment, and peer reviews of geophysical logging used in site investigarions.

FY'93 Funding: $25,000 (Mission 2001: same)

Rationale for FY'93 Funding: A Priority 5 study.

ITE Test Prioritization: No ITE Test Prioritization.

WBS Elements (1.2.3)/Participant:

WBS NO. 1.2.3...	PARTICI-PANT	ACTIVITY	SCOPE	BUDGET
.9.1	T&MSS	SYSTEMATIC ACQUSITION OF GEOPHYSICAL LOGGING DATA	(see below)	$25,000
			TOTAL	$25,000

Principal Investigator: Candy Lugo (T&MSS)

FY'93 Scope: See "Description" above.

Status at Beginning of FY'93:

Study Plan: N/A

JP/TPP: N/A

Environmental Studies: N/A

Prerequisite Predecessor: N/A

1993 Deliverables: None identified

Due Date	Deliverable	Parti-cipant	Delivered ?

1992 Scenario:

Budget: $0

1992 Milestones accomplished: N/A

1992 Deliverables: N/A

Impact of FY'92 on FY'93: No impact

FY'94 Scenario: Not identified in Mission 2001

1.2.3.10 ALTERED ZONE CHARACTERIZATION

Purpose:

Develop characterization techniques to analyze performance of the natural system under potential changes that result from waste emplacement and analyze these potential changes that may effect thermal/hydrological/geochemical/geomechanical processes.

Description:

Develop the qualified characterizaiton techniques needed to analyze performance of the natural system under potential changes that result from waste emplacement. These activities consider the coupling of processes under thermal loading scenarios. Waste emeplacement can potentially influence processes which can influence the hydrology, geochemistry and geomechanics of the system and how they couple together. These processes can influence the characteristics and performance of the repository. Techniques msut be developed and/or qualified for use at Yucca Mountain to assess the potential influences on characteristics and performance

Conduct analyses and characterization of post-emplacement natural system performance at a scale sufficient to incorporate coupled thermal/hydrological/geochemical/ geomechanical processes that are likely to occur as a result of emplacement of waste. These analyses will be focused on the altered zone, but will consider processes taking place in the mountain that will influence the characteristics and performance of the entire system. Analysis will be conducted in the lab and in the field.

FY'93 Funding: $250,000 (Mission 2001: same)

Rationale for FY'93 Funding: A Priority 5 study.

Related to Study Plan 8.3.4.2.4.1, Characterization of Chemical and Mineral Changes in the Post Emplacement Environment, rated one of the dominant study plans, ITE Test Prioritization

ITE Test Prioritization:

ITE TEST PRIORITIZATION

STUDY	UNSUITABILITY	REGULATORY COMPLIANCE	SCIENTIFIC CONFIDENCE
POSTEMPLACE MENT ENVIRONMENT CHANGES	HIGH (8)	HIGH (4)	HIGH (19)

Status at Beginning of FY'93:

Study Plan: related to Study Plan 8.3.4.2.4.1, Characterization of Chemical and Mineral Changes in the Post Emplacement Environment, not yet submitted to the Project Office for review

JP/TPP:
Environmental Studies:

Prerequisite Predecessor:

WBS Elements (1.2.3..) / LLNL:

.3.10	LLNL	ALTERED ZONE CHARACTERIZATION	Scope (see below)	
.3.10.1	LLNL	Characterization techniques for the altered zone		
	LLNL		Altered Zone Char Techniques, Mgmt and Admin (LOE)	$10,000
	LLNL		Potential Coupling Effects	$59,000
	LLNL		Code Development	$56,000

.3.10.2	LLNL	Characterization of Thermal Effects on the Altered Zone Performance		
	LLNL		Altered Zone Thermal Effect, Mgmt and Admin (LOE)	$10,000
	LLNL		Bounding Analysis	$115,000
	LLNL			
			TOTAL	$250,000

Principal Investigator: D. Wilder, LLNL

FY93 Scope:

Characterization techniques for the altered zone

Altered Zone Char. Techniques, Mgmt and Admin (LOE)
-Overall management of Altered Zone Characterization Techniques activities including planning, scheduling, budgeting and reporting
-Interact with other participants in the AZ Characterization
-Prepare and implement QA program procedures for AZ Characterization Techniques activities

Potential Coupling Effects
Conduct reconn. simulations and model experiments to determine the magnitude of coupled hydrological, chemical and mechanical effects.

Code Development
- Procure, install, and perform operational testing of available codes/models
-Evaluate available codes/models and identify needed model capabilities

Characterization of Thermal Effects on the Altered Zone Performance

Altered Zone Thermal Effect, Mgmt and Admin (LOE)
-Overall management of Altered Zone Thermal Effect activities including planning, scheduling, budgeting and reporting
-Interact with other participants in the AZ Thermal Effect
-Prepare and implement QA program procedures for AZ Thermal Effect activities

Bounding Analysis

Perform mechanistic simulations and model experiments to determine the bounding conditions for use in more fully coupled simulations.

1993 Deliverables:

Due Date	Deliverable	Parti-cipant	Delivered ?

1992 Scenario:

Budget: $_____; ___% spent.

1992 Milestones accomplished:

1992 Deliverables:

Due Date	Deliverable	Parti-cipant	Delivered ?

Impact of FY'92 on FY'93:

FY'94 Scenario:
$2,539,000

1.2.3.10.1, Charcterization Techniques for the Altered Zone $1,835,000
1.2.3.10.2, Charcterization of Thermal Effects on the Altered Zone $704,000