



Department of Energy
Washington, DC 20585

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JUN 05 1991

Mr. John J. Linehan
Deputy Director
Division of High-Level
Waste Management
Office of Nuclear Material
Safety and Safeguards
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Mr. Linehan:

This letter responds to the U.S. Nuclear Regulatory Commission's (NRC) request for information on near-term activities the U.S. Department of Energy (DOE) considers important so that NRC may better organize its review of study plans (letter from Linehan to Shelor, dated November 27, 1990). According to Attachment 4 of the Summary of the NRC/DOE Meeting (May 7-8, 1986) on the Level of Detail for Site Characterization Plans and Study Plans, DOE agrees to have study plans made available sufficiently in advance of the start of the study to allow for review. NRC is to notify the DOE of major concerns in the study plans during the first 3 months of availability. In general, study plans for ongoing studies represent the highest priority for NRC review, followed by those describing new work.

Enclosure 1 shows a listing of Site Characterization Plan (SCP) studies and activities; those indicated with an asterisk are ongoing. If an activity is ongoing, the study plan is considered ongoing. Among these, there is not specific priority and the Office of Geologic Disposal (OGD) regards all of them to be at an equal level of importance and priority. Start-work reviews should be conducted for all ongoing study plans upon NRC receipt. Ongoing studies that include borehole drilling are especially important because they support many other studies by providing samples for them. Enclosure 2 shows the ongoing study plans that NRC has already received and that need review.

Ongoing studies include virtually all field geology, hydrology, and geochemistry studies, which encompass the unsaturated zone drilling program, the saturated zone drilling program, the C-well pumping, and the trenching program for the prospective Midway Valley site area. The aspects of these activities involving new surface-disturbing work are held up pending the resolution of permitting issues with the State of Nevada; however, monitoring and other components are continuations of testing programs which are in place. As a point of clarification, there are two controlled documents containing the description for ongoing Study 8.3.1.2.3.1, each of which represents work to be done by

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separate participants. Activity 7 is to be done by Los Alamos National Laboratories and Activities 1-6 are to be done by the U.S. Geological Survey. Both of these documents have been sent to the NRC and DOE would like to begin this work as soon as possible.

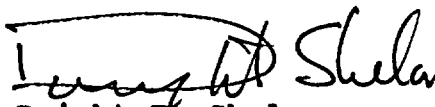
Study plans describing new work include those not indicated with an asterisk in Enclosure 1, and include, for example, rock mechanics investigations. NRC has the five ESF study plans (8.3.1.2.2.2, 8.3.1.2.2.4, 8.3.1.4.2.2, 8.3.1.15.1.5, and 8.3.1.15.2.1) delivered with the SCP. DOE agrees that it is premature for NRC to conduct start-work reviews for some of the activities in the five ESF study plans. However, there are activities in these study plans that are ongoing (consult Enclosure 1). For this reason, they should be reviewed. Following a decision by DOE on the findings evolved from the ESF Alternatives Study on a configuration for an ESF, the five ESF study plans will be reviewed by DOE at the same time that the Site Characterization Program Baseline is reviewed for impacts resulting from any new configuration.

NRC has two study plans describing new site characterization work (8.3.1.15.1.1 and 8.3.1.15.1.2). NRC start-work review of study plans containing new work involving surface-disturbing activities may be initiated after other ongoing studies have been reviewed.

For those study plans listed as likely to be approved within the next two months (Enclosure 2), the generalization made above for priority for those study plans containing ongoing work applies. NRC will be informed of special priorities in future transmittal letters.

Should you have any questions, please contact Linda Desell of my office at (202) 586-1462.

Sincerely,



Dwight E. Shelor
Acting Associate Director for
Systems and Compliance
Office of Civilian Radioactive
Waste Management

2 Enclosures:

1. Listing of Site Characterization Plan Studies and Activities
2. Status of Study Plans

cc w/Enclosures:

C. Gertz, YMPO
R. Loux, State of Nevada
M. Baughman, Lincoln County, NV
D. Bechtel, Clark County, NV
S. Bradhurst, Nye County, NV
P. Niedzielski-Eichner, Nye County, NV
K. Stablein, NRC

Study Plan	Description of Study/Activity
8.3.1.2.1.1	Study: Characterization of the meteorology for regional hydrology 8.3.1.2.1.1.1 Activity: Precipitation and meteorological monitoring *
8.3.1.2.1.2	Study: Characterization of runoff and streamflow 8.3.1.2.1.2.1 Activity: Surface-water runoff monitoring * 8.3.1.2.1.2.2 Activity: Transport of debris by severe runoff *
8.3.1.2.1.3	Study: Characterization of the regional ground-water flow system 8.3.1.2.1.3.1 Activity: Assessment of regional hydrogeologic data needs in the saturated zone * 8.3.1.2.1.3.2 Activity: Regional potentiometric-level distribution and hydrologic framework studies * 8.3.1.2.1.3.3 Activity: Fortymile Wash recharge study 8.3.1.2.1.3.4 Activity: Evapotranspiration studies *
8.3.1.2.1.4	Study: Regional hydrologic system synthesis and modeling 8.3.1.2.1.4.1 Activity: Conceptualization of regional hydrologic flow models 8.3.1.2.1.4.2 Activity: Subregional two-dimensional areal hydrologic modeling 8.3.1.2.1.4.3 Activity: Subregional two-dimensional cross-section hydrologic modeling 8.3.1.2.1.4.4 Activity: Regional three-dimensional hydrologic modeling
8.3.1.2.2.1	Study: Characterization of unsaturated-zone infiltration 8.3.1.2.2.1.1 Activity: Characterization of hydrologic properties of surficial material * 8.3.1.2.2.1.2 Activity: Evaluation of natural infiltration * 8.3.1.2.2.1.3 Activity: Evaluation of artificial infiltration
8.3.1.2.2.2	Study: Water movement tracer tests using chloride and chlorine-36 measurements of percolation at Yucca Mountain 8.3.1.2.2.2.1 Activity: Chloride and chlorine-36 measurements of percolation at Yucca Mountain *
8.3.1.2.2.3	Study: Characterization of percolation in the unsaturated zone--surface-based study 8.3.1.2.2.3.1 Activity: Matrix hydrologic properties testing * 8.3.1.2.2.3.2 Activity: Site vertical borehole studies * 8.3.1.2.2.3.3 Activity: Solitario Canyon horizontal borehole study
8.3.1.2.2.4	Study: Characterization of Yucca Mountain percolation in the unsaturated zone--exploratory shaft facility study 8.3.1.2.2.4.1 Activity: Intact-fracture test in the exploratory shaft facility 8.3.1.2.2.4.2 Activity: Infiltration tests in the exploratory shaft facility 8.3.1.2.2.4.3 Activity: Bulk-permeability test in the exploratory shaft facility 8.3.1.2.2.4.4 Activity: Radial borehole tests in the exploratory shaft facility 8.3.1.2.2.4.5 Activity: Excavation effects test in the exploratory shaft facility 8.3.1.2.2.4.6 Activity: Calico Hills test in the exploratory shaft facility 8.3.1.2.2.4.7 Activity: Perched-water test in the exploratory shaft facility 8.3.1.2.2.4.8 Activity: Hydrochemistry tests in the exploratory shaft facility 8.3.1.2.2.4.9 Activity: Multipurpose-borehole testing near the exploratory shafts 8.3.1.2.2.4.10 Activity: Hydrologic properties of major faults encountered in main test level of the exploratory shaft facility (ESF)
8.3.1.2.2.5	Study: Diffusion tests in the exploratory shaft facility

Study Plan	Description of Study/Activity
	8.3.1.2.2.5.1 Activity: Diffusion tests in the exploratory shaft facility
8.3.1.2.2.6	Study: Characterization of gaseous-phase movement in the unsaturated zone
	8.3.1.2.2.6.1 Activity: Gaseous-phase circulation study *
8.3.1.2.2.7	Study: Hydrochemical characterization of the unsaturated zone
	8.3.1.2.2.7.1 Activity: Gaseous-phase chemical investigations *
	8.3.1.2.2.7.2 Activity: Aqueous-phase chemical investigations *
8.3.1.2.2.8	Study: Fluid flow in unsaturated, fractured rock
	8.3.1.2.2.8.1 Activity: Development of conceptual and numerical models of fluid flow in unsaturated, fractured rock
	8.3.1.2.2.8.2 Activity: Validation of conceptual and numerical models of fluid flow through unsaturated, fractured rock
8.3.1.2.2.9	Study: Site unsaturated-zone modeling and synthesis
	8.3.1.2.2.9.1 Activity: Conceptualization of the unsaturated-zone hydrologic system
	8.3.1.2.2.9.2 Activity: Selection, development, and testing of hydrologic-modeling computer codes
	8.3.1.2.2.9.3 Activity: Simulation of the natural hydrologic system
	8.3.1.2.2.9.4 Activity: Stochastic modeling and uncertainty analysis
	8.3.1.2.2.9.5 Activity: Site unsaturated-zone integration and synthesis
8.3.1.2.3.1	Study: Characterization of the site saturated-zone ground-water flow system
	8.3.1.2.3.1.1 Activity: Solitario Canyon fault study in the saturated zone
	8.3.1.2.3.1.2 Activity: Site potentiometric-level evaluation *
	8.3.1.2.3.1.3 Activity: Analysis of single- and multiple-well hydraulic-stress tests *
	8.3.1.2.3.1.4 Activity: Multiple-well interference testing
	8.3.1.2.3.1.5 Activity: Testing of the C-hole sites with conservative tracers
	8.3.1.2.3.1.6 Activity: Well testing with conservative tracers throughout the site
	8.3.1.2.3.1.7 Activity: Testing of the C-hole sites with reactive tracers
	8.3.1.2.3.1.8 Activity: Well testing with reactive tracers throughout the site
8.3.1.2.3.2	Study: Characterization of the saturated-zone hydrochemistry
	8.3.1.2.3.2.1 Activity: Assessment of saturated-zone hydrochemical data availability and needs
	8.3.1.2.3.2.2 Activity: Hydrochemical characterization of water in the upper part of the saturated zone
	8.3.1.2.3.2.3 Activity: Regional hydrochemical characterization
	8.3.1.2.3.2.4 Activity: Synthesis of saturated-zone hydrochemistry
8.3.1.2.3.3	Study: Saturated zone hydrologic system synthesis and modeling
	8.3.1.2.3.3.1 Activity: Conceptualization of saturated zone flow models within the boundaries of the accessible environment
	8.3.1.2.3.3.2 Activity: Development of fracture network model
	8.3.1.2.3.3.3 Activity: Calculation of flow paths, fluxes, and velocities within the saturated zone to the accessible environment

Study Plan	Description of Study/Activity
8.3.1.3.1.1	Study: Ground-water chemistry model
8.3.1.3.2.1	Study: Mineralogy, petrology, and chemistry of transport pathways
8.3.1.3.2.1.1	Activity: Petrologic stratigraphy of the Topopah Spring Member *
8.3.1.3.2.1.2	Activity: Mineral distributions between the host rock and the accessible environment *
8.3.1.3.2.1.3	Activity: Fracture mineralogy *
8.3.1.3.2.2	Study: History of mineralogic and geochemical alteration of Yucca Mountain
8.3.1.3.2.2.1	Activity: History of mineralogic and geochemical alteration of Yucca Mountain *
8.3.1.3.2.2.2	Activity: Smectite, zeolite, manganese minerals, glass dehydration and transformation *
8.3.1.3.3.1	Study: Natural analog of hydrothermal systems in tuff
8.3.1.3.3.2	Study: Kinetics and thermodynamics of mineral evolution
8.3.1.3.3.2.1	Activity: Kinetic studies of zeolite and related framework silicates *
8.3.1.3.3.2.2	Activity: Determination of end-member free energies for clinoptilolite, heulandite, albite, and analcime *
8.3.1.3.3.2.3	Activity: Solid solution descriptions of clinoptilolite-heulandite and analcime
8.3.1.3.3.3	Study: Conceptual model of mineral evolution *
8.3.1.3.4.1	Study: Batch sorption studies
8.3.1.3.4.1.1	Activity: Batch sorption measurements as a function of solid phase composition *
8.3.1.3.4.1.2	Activity: Sorption as a function of sorbing element concentrations (isotherms) *
8.3.1.3.4.1.3	Activity: Sorption as a function of ground-water composition *
8.3.1.3.4.1.4	Activity: Sorption on particulates and colloids *
8.3.1.3.4.1.5	Activity: Statistical analysis of sorption data *
8.3.1.3.4.2	Study: Biological sorption and transport
8.3.1.3.4.3	Study: Development of sorption models *
8.3.1.3.5.1	Study: Dissolved species concentration limits
8.3.1.3.5.1.1	Activity: Solubility measurements *
8.3.1.3.5.1.2	Activity: Speciation measurements *
8.3.1.3.5.1.3	Activity: Solubility modeling
8.3.1.3.5.2	Study: Colloid behavior
8.3.1.3.5.2.1	Activity: Colloid formation characterization and stability *
8.3.1.3.5.2.2	Activity: Colloid Modeling
8.3.1.3.6.1	Study: Dynamic transport column experiments
8.3.1.3.6.1.1	Activity: Crushed tuff column experiments *
8.3.1.3.6.1.2	Activity: Mass transfer kinetics *
8.3.1.3.6.1.3	Activity: Unsaturated tuff columns
8.3.1.3.6.1.4	Activity: Fractured tuff column studies *
8.3.1.3.6.1.5	Activity: Filtration *

Study Plan	Description of Study/Activity
8.3.1.3.6.2	Study: Diffusion
8.3.1.3.6.2.1	Activity: Uptake of radionuclides on rock beakers in a saturated system *
8.3.1.3.6.2.2	Activity: Diffusion through a saturated tuff slab *
8.3.1.3.6.2.3	Activity: Diffusion in an unsaturated tuff block
8.3.1.3.7.1	Study: Retardation sensitivity analysis
8.3.1.3.7.1.1	Activity: Analysis of physical/chemical processes affecting transport *
8.3.1.3.7.1.2	Activity: Geochemical/geophysical model of Yucca Mountain and integrated geochemical transport calculations *
8.3.1.3.7.1.3	Activity: Transport models and related support *
8.3.1.3.7.2	Study: Demonstration of applicability of laboratory data to repository transport calculations
8.3.1.3.8.1	Study: Gaseous radionuclide transport calculations and measurements
8.3.1.3.8.1.1	Activity: Physical transport mechanisms and rates--retardation mechanisms and transport with retardation
8.3.1.3.8.1.2	Activity: Gas transport measurements

Study Plan	Description of Study/Activity
8.3.1.4.2.1	Study: Characterization of the vertical and lateral distribution of stratigraphic units within the site area
8.3.1.4.2.1.1	Activity: Surface and subsurface stratigraphic studies of the host rock and surrounding units
8.3.1.4.2.1.2	Activity: Surface-based geophysical surveys
8.3.1.4.2.1.3	Activity: Borehole geophysical surveys
8.3.1.4.2.1.4	Activity: Petrophysical properties testing
8.3.1.4.2.1.5	Activity: Magnetic properties and stratigraphic correlations
8.3.1.4.2.2	Study: Characterization of the structural features within the site area
8.3.1.4.2.2.1	Activity: Geologic mapping of zonal features in the Paintbrush Tuff *
8.3.1.4.2.2.2	Activity: Surface-fracture network studies *
8.3.1.4.2.2.3	Activity: Borehole evaluation of faults and fractures *
8.3.1.4.2.2.4	Activity: Geologic mapping of the exploratory shaft and drifts
8.3.1.4.2.2.5	Activity: Seismic tomography/vertical seismic profiling
8.3.1.4.2.3	Study: Three-dimensional geologic model
8.3.1.4.2.3.1	Activity: Development of a three-dimensional geologic model of the site area
8.3.1.4.3.1	Study: Systematic acquisition of site-specific subsurface information
8.3.1.4.3.1.1	Activity: Systematic drilling program
8.3.1.4.3.2	Study: Three-dimensional rock characteristics models
8.3.1.4.3.2.1	Activity: Development of three-dimensional models of rock characteristics at the repository site

Study Plan	Description of Study/Activity
8.3.1.5.1.1	Study: Characterization of modern regional climate 8.3.1.5.1.1.1 Activity: Synoptic characterization of regional climate
8.3.1.5.1.2	Study: Paleoclimate study: lake, playa, marsh deposits 8.3.1.5.1.2.1 Activity: Paleontologic analyses 8.3.1.5.1.2.2 Activity: Analysis of the stratigraphy-sedimentology of marsh, lacustrine, and playa deposits 8.3.1.5.1.2.3 Activity: Geochemical analyses of lake, marsh, and playa deposits 8.3.1.5.1.2.4 Activity: Chronologic analyses of lake, playa, and marsh deposits
8.3.1.5.1.3	Study: Climatic implications of terrestrial paleoecology 8.3.1.5.1.3.1 Activity: Analysis of pack rat middens 8.3.1.5.1.3.2 Activity: Analysis of pollen samples 8.3.1.5.1.3.3 Activity: Determination of vegetable-climate relationships
8.3.1.5.1.4	Study: Analysis of the paleoenvironmental history of the Yucca Mountain region 8.3.1.5.1.4.1 Activity: Modeling of soil properties in the Yucca Mountain region * 8.3.1.5.1.4.2 Activity: Surficial desposits mapping of the Yucca Mountain area 8.3.1.5.1.4.3 Activity: Eolian history of the Yucca Mountain region
8.3.1.5.1.5	Study: Paleoclimate-paleoenvironmental synthesis 8.3.1.5.1.5.1 Activity: Paleoclimate-paleoenvironmental synthesis
8.3.1.5.1.6	Study: Characterization of the future regional climate and environments 8.3.1.5.1.6.1 Activity: Global climate modeling 8.3.1.5.1.6.2 Activity: Regional climate modeling 8.3.1.5.1.6.3 Activity: Linked global-regional climate modeling 8.3.1.5.1.6.4 Activity: Empirical climate modeling
8.3.1.5.2.1	Study: Characterization of the Quaternary regional hydrology 8.3.1.5.2.1.1 Activity: Regional paleoflood evaluation * 8.3.1.5.2.1.2 Activity: Quaternary unsaturated zone hydrochemical analysis 8.3.1.5.2.1.3 Activity: Evaluation of past discharge areas 8.3.1.5.2.1.4 Activity: Analog recharge studies * 8.3.1.5.2.1.5 Activity: Studies of calcite and opaline silica vein deposits *
8.3.1.5.2.2	Study: Characterization of the future regional hydrology due to climate changes 8.3.1.5.2.2.1 Activity: Analysis of future surface hydrology due to climate changes 8.3.1.5.2.2.2 Activity: Analysis of future unsaturated zone hydrology due to climate changes 8.3.1.5.2.2.3 Activity: Synthesis of effects of possible future recharge due to climate changes on hydrologic characteristics of the Yucca Mountain saturated zone

Study Plan	Description of Study/Activity
8.3.1.6.1.1	Study: Distribution and characteristics of present and past erosion 8.3.1.6.1.1.1 Activity: Development of a geomorphic map of Yucca Mountain 8.3.1.6.1.1.2 Activity: Analysis of the downcutting history of Fortymile Wash and its tributaries 8.3.1.6.1.1.3 Activity: An analysis of hillslope erosion at Yucca Mountain
8.3.1.6.2.1	Study: Influence of future climatic conditions on locations and rates of erosion 8.3.1.6.2.1.1 Activity: Synthesis and data evaluation of impact of future climatic conditions on locations and rates of erosion
8.3.1.6.3.1	Study: Evaluation of the effects of future tectonic activity on erosion at Yucca Mountain 8.3.1.6.3.1.1 Activity: Synthesis and data evaluation of the impact of future uplift or subsidence and faulting on erosion at Yucca Mountain and vicinity
8.3.1.6.4.1	Study: Development of a topical report to address the effects of erosion on the hydrologic, geochemical, and rock characteristics at Yucca Mountain

Study Plan	Description of Study/Activity
8.3.1.8.1.1	<p>Study: Probability of a volcanic eruption penetrating the repository</p> <p>8.3.1.8.1.1.1 Activity: Location and timing of volcanic events *</p> <p>8.3.1.8.1.1.2 Activity: Evaluation of the structural controls of basaltic volcanic activity *</p> <p>8.3.1.8.1.1.3 Activity: Presence of magma bodies in the vicinity of the site *</p> <p>8.3.1.8.1.1.4 Activity: Probability calculations and assessment *</p>
8.3.1.8.1.2	<p>Study: Effects of a volcanic eruption penetrating the repository</p> <p>8.3.1.8.1.2.1 Activity: Effects of Strombolian eruptions *</p> <p>8.3.1.8.1.2.2 Activity: Effects of hydrovolcanic eruptions *</p>
8.3.1.8.2.1	<p>Study: Analysis of waste package rupture due to tectonic processes and events</p> <p>8.3.1.8.2.1.1 Activity: Assessment of waste package rupture due to igneous intrusion</p> <p>8.3.1.8.2.1.2 Activity: Calculation of the number of waste packages intersected by a fault</p> <p>8.3.1.8.2.1.3 Activity: Probability and rate of faulting</p> <p>8.3.1.8.2.1.4 Activity: Assessment of waste package rupture due to faulting</p> <p>8.3.1.8.2.1.5 Activity: Assessment of postclosure ground motion in the subsurface</p> <p>8.3.1.8.2.1.6 Activity: Nature, age, and rate of folding and deformation in the repository horizon</p> <p>8.3.1.8.2.1.7 Activity: Assessment of waste package rupture due to folding and deformation</p>
8.3.1.8.3.1	<p>Study: Analysis of the effects of tectonic processes events on average percolation flux rates over the repository</p> <p>8.3.1.8.3.1.1 Activity: Annual probability of volcanic or igneous events in the controlled area</p> <p>8.3.1.8.3.1.2 Activity: Assessment of the effects of igneous intrusions and volcanic events on flux rates</p> <p>8.3.1.8.3.1.3 Activity: Faulting rates, recurrence intervals, and probable cumulative offset in 10,000 yr</p> <p>8.3.1.8.3.1.4 Activity: Effects of faulting on average flux rates</p> <p>8.3.1.8.3.1.5 Activity: Assessment of the effects of faulting on flux rates</p> <p>8.3.1.8.3.1.6 Activity: Uplift rates in the controlled area</p> <p>8.3.1.8.3.1.7 Activity: Assessment of the effects of folding, uplift, and subsidence on flux rates</p>
8.3.1.8.3.2	<p>Study: Analysis of the effect of tectonic processes and events on changes in water-table elevation</p> <p>8.3.1.8.3.2.1 Activity: Thermal and barrier-to-flow effects of igneous intrusions on water-table elevation</p> <p>8.3.1.8.3.2.2 Activity: Assessment of the effects of igneous intrusions on water-table elevations</p> <p>8.3.1.8.3.2.3 Activity: Assessment of the effect of strain changes on water-table elevations</p> <p>8.3.1.8.3.2.4 Activity: Assessment of the effect of folding, uplift, or subsidence on water-table elevation</p> <p>8.3.1.8.3.2.5 Activity: Effects of faulting on water-table elevation</p> <p>8.3.1.8.3.2.6 Activity: Assessment of the effects of faulting on water-table elevation</p>
8.3.1.8.3.3	<p>Study: Analysis of the effects of tectonic processes and events on local fracture permeability and effective porosity</p> <p>8.3.1.8.3.3.1 Activity: Assessment of the effects of igneous intrusions on local fracture permeability and effective porosities</p> <p>8.3.1.8.3.3.2 Activity: Assessment of the effects of faulting on local fracture permeability and effective porosities</p> <p>8.3.1.8.3.3.3 Activity: Assessment of the effects of stress or strain on hydrologic properties of the rock mass</p>

Study Plan	Description of Study/Activity
8.3.1.8.4.1	Study: Analysis of the effects of tectonic processes and events on rock geochemical properties
8.3.1.8.4.1.1	Activity: Assessment of the change in rock geochemical properties due to igneous intrusions
8.3.1.8.4.1.2	Activity: Assessment of the degree of mineral change along fault zones in 10,000 yr
8.3.1.8.4.1.3	Activity: Assessment of the effects of fault offset on travel pathway
8.3.1.8.4.1.4	Activity: Assessment of the degree of mineral change in the controlled area resulting from tectonically induced change in water-table elevations
8.3.1.8.5.1	Study: Characterization of volcanic features
8.3.1.8.5.1.1	Activity: Volcanism drillholes *
8.3.1.8.5.1.2	Activity: Geochronology studies *
8.3.1.8.5.1.3	Activity: Field geologic studies *
8.3.1.8.5.1.4	Activity: Geochemistry of scoria sequences *
8.3.1.8.5.1.5	Activity: Geochemical cycles of basaltic volcanic fields *
8.3.1.8.5.2	Study: Characterization of igneous intrusive features
8.3.1.8.5.2.1	Activity: Evaluation of depth of curie temperature isotherm
8.3.1.8.5.2.2	Activity: Chemical and physical changes around dikes
8.3.1.8.5.2.3	Activity: Heat flow at Yucca Mountain and evaluation of regional ambient heat flow and local heat flow anomalies
8.3.1.8.5.3	Study: Investigation of folds in Miocene and younger rocks of region
8.3.1.8.5.3.1	Activity: Evaluation of folds in Neogene rocks of the region

Study Plan	Description of Study/Activity
8.3.1.9.1.1	Study: An evaluation of natural processes that could affect the long-term survivability of the surface marker system at Yucca Mountain
8.3.1.9.1.1.1	Activity: Synthesis of tectonic, seismic, and volcanic hazards data from other site characterization activities
8.3.1.9.1.1.2	Activity: Synthesis: evaluation of the effects of future erosion and deposition on the survivability of the marker system at Yucca Mountain
8.3.1.9.2.1	Study: Natural resource assessment of Yucca Mountain, Nye County, Nevada
8.3.1.9.2.1.1	Activity: Geochemical assessment of Yucca Mountain in relation to the potential for mineralization
8.3.1.9.2.1.2	Activity: Geophysical/geologic appraisal of the site relative to mineral resources
8.3.1.9.2.1.3	Activity: Assessment of the potential for geothermal energy at Yucca Mountain, Nevada
8.3.1.9.2.1.4	Activity: Assessment of hydrocarbon resources at and near the site
8.3.1.9.2.1.5	Activity: Mineral and energy assessment of the site, comparison to known mineralized areas, and the potential for undiscovered resources and future exploration
8.3.1.9.2.2	Study: Water resource assessment of Yucca Mountain, Nevada
8.3.1.9.2.2.1	Activity: Projected trends in local and regional ground-water development, and estimated withdrawal rates in southern Nevada, proximal to Yucca Mountain
8.3.1.9.3.1	Study: Evaluation of data needed to support an assessment of the likelihood of future inadvertent human intrusion at Yucca Mountain as a result of exploration and/or extraction of natural resources
8.3.1.9.3.1.1	Activity: Compilation of data to support the assessment calculation of the potential for inadvertent human intrusion at Yucca Mountain
8.3.1.9.3.2	Study: An evaluation of the potential effects of exploration for, or extraction of, natural resources on the hydrologic characteristics at Yucca Mountain
8.3.1.9.3.2.1	Activity: An analysis of the potential effects of future ground-water withdrawals on the hydrologic system in the vicinity of Yucca Mountain, Nevada
8.3.1.9.3.2.2	Activity: Assessment of initiating events related to human interference that are considered not to be sufficiently credible or significant to warrant further investigation

Study PlanDescription of Study/Activity

8.3.1.12.2.1

Study: Meteorological data collection at the Yucca Mountain site

8.3.1.12.2.1.1 Activity: Site meteorological monitoring program *

8.3.1.12.2.1.2 Activity: Data summary for input to dose assessments

Study Plan	Description of Study/Activity
8.3.1.14.2.1	Study: Exploration program 8.3.1.14.2.1.1 Activity: Site reconnaissance 8.3.1.14.2.1.2 Activity: Preliminary exploration 8.3.1.14.2.1.3 Activity: Detailed exploration
8.3.1.14.2.2	Study: Laboratory tests and material property measurements 8.3.1.14.2.2.1 Activity: Physical property and index laboratory tests 8.3.1.14.2.2.2 Activity: Mechanical and dynamic laboratory property tests
8.3.1.14.2.3	Study: Field tests and characterization measurements 8.3.1.14.2.3.1 Activity: Physical property field tests and characterization measurements 8.3.1.14.2.3.2 Activity: Mechanical property field tests 8.3.1.14.2.3.3 Activity: Geophysical field measurements

Study Plan	Description of Study/Activity
8.3.1.15.1.1	Study: Laboratory thermal properties 8.3.1.15.1.1.1 Activity: Density and porosity characterization 8.3.1.15.1.1.2 Activity: Volumetric heat capacity characterization 8.3.1.15.1.1.3 Activity: Thermal conductivity characterization
8.3.1.15.1.2	Study: Laboratory thermal expansion testing 8.3.1.15.1.2.1 Activity: Thermal expansion characterization
8.3.1.15.1.3	Study: Laboratory determination of mechanical properties of intact rock 8.3.1.15.1.3.1 Activity: Compressive mechanical properties of intact rock at baseline experiment conditions * 8.3.1.15.1.3.2 Activity: Effects of variable environmental conditions on mechanical properties *
8.3.1.15.1.4	Study: Laboratory determination of the mechanical properties of fractures 8.3.1.15.1.4.1 Activity: Mechanical properties of fractures at baseline experiment conditions 8.3.1.15.1.4.2 Activity: Effects of variable environmental conditions on mechanical properties of fractures
8.3.1.15.1.5	Study: Excavation investigations 8.3.1.15.1.5.1 Activity: Shaft convergence 8.3.1.15.1.5.2 Activity: Demonstration breakout rooms 8.3.1.15.1.5.3 Activity: Sequential drift mining
8.3.1.15.1.6	Study: In situ thermomechanical properties 8.3.1.15.1.6.1 Activity: Heater experiment in unit TSw1 8.3.1.15.1.6.2 Activity: Canister-scale heater experiment 8.3.1.15.1.6.3 Activity: Yucca Mountain heated block 8.3.1.15.1.6.4 Activity: Thermal stress measurements 8.3.1.15.1.6.5 Activity: Heated room experiment
8.3.1.15.1.7	Study: In situ mechanical properties 8.3.1.15.1.7.1 Activity: Plate loading tests 8.3.1.15.1.7.2 Activity: Rock-mass strength experiment
8.3.1.15.1.8	Study: In situ design verification 8.3.1.15.1.8.1 Activity: Evaluation of mining methods 8.3.1.15.1.8.2 Activity: Monitoring of ground-support systems 8.3.1.15.1.8.3 Activity: Monitoring drift stability 8.3.1.15.1.8.4 Activity: Air quality and ventilation experiment
8.3.1.15.2.1	Study: Characterization of the site ambient stress conditions 8.3.1.15.2.1.1 Activity: Anelastic strain recovery experiments in core holes 8.3.1.15.2.1.2 Activity: Overcore stress experiments in the exploratory shaft facility
8.3.1.15.2.2	Study: Characterization of the site ambient thermal conditions 8.3.1.15.2.2.1 Activity: Surface-based evaluation of ambient thermal conditions

Study Plan	Description of Study/Activity
8.3.1.16.1.1	Study: Characterization of flood potential of the Yucca Mountain site * 8.3.1.16.1.1.1 Activity: Site flood and debris hazards studies
8.3.1.16.2.1	Study: Location of adequate water supply for construction, operation, closure, and decommissioning of a mined geologic disposal system at Yucca Mountain, Nevada 8.3.1.16.2.1.1 Activity: Assessment of the cost, feasibility, and adequacy of wells J-12 and J-13 for use as the alternative water supply for a mined geologic disposal system at Yucca Mountain, Nevada 8.3.1.16.2.1.2 Activity: Location of a primary water supply for a mined geologic disposal system at Yucca Mountain, Nevada 8.3.1.16.2.1.3 Activity: Location of alternative water supplies for a mined geologic disposal system at Yucca Mountain, Nevada 8.3.1.16.2.1.4 Activity: Identification and evaluation of potential effects of repository related withdrawals on the local flow system at Yucca Mountain, Nevada
8.3.1.16.3.1	Study: Determination of the preclosure hydrologic conditions of the unsaturated zone at Yucca Mountain, Nevada 8.3.1.16.3.1.1 Activity: Synthesis of data from Site Program 8.3.1.2 to determine the preclosure hydrologic characteristics of the unsaturated zone at Yucca Mountain, Nevada

Study Plan	Description of Study/Activity
8.3.1.17.1.1	Study: Potential for ash fall at the site
8.3.1.17.1.1.1	Activity: Survey literature regarding Quaternary silicic volcanic centers in the western Great Basin
8.3.1.17.1.1.2	Activity: Assess potential ash-fall thickness at the site
8.3.1.17.1.1.3	Activity: Assess potential particle density and size distribution of ash fall at the site
8.3.1.17.2.1	Study: Faulting potential at the repository
8.3.1.17.2.1.1	Activity: Assess the potential for surface faulting at prospective sites of surface facilities that are important to safety
8.3.1.17.2.1.2	Activity: Assess the potential for displacement on faults that intersect underground facilities
8.3.1.17.3.1	Study: Relevant earthquake sources
8.3.1.17.3.1.1	Activity: Identify relevant earthquake sources
8.3.1.17.3.1.2	Activity: Characterize 10,000-year cumulative slip earthquakes for relevant seismogenic sources
8.3.1.17.3.2	Study: Underground nuclear explosion sources
8.3.1.17.3.2.1	Activity: Determine the range of UNE sources *
8.3.1.17.3.2.2	Activity: Determine maximum underground nuclear explosion source(s) *
8.3.1.17.3.3	Study: Ground motion from regional earthquakes and underground nuclear explosions
8.3.1.17.3.3.1	Activity: Select or develop empirical models for earthquake ground motions
8.3.1.17.3.3.2	Activity: Select or develop empirical models for ground motion from underground nuclear explosions
8.3.1.17.3.4	Study: Effects of local site geology on surface and subsurface motions
8.3.1.17.3.4.1	Activity: Determine site effects from ground-motion recordings
8.3.1.17.3.4.2	Activity: Model site effects using the wave properties of the local geology
8.3.1.17.3.5	Study: Ground motion at the site from controlling seismic events
8.3.1.17.3.5.1	Activity: Identify controlling seismic events
8.3.1.17.3.5.2	Activity: Characterize ground motion from the controlling seismic events
8.3.1.17.3.6	Study: Probabilistic seismic hazards analyses
8.3.1.17.3.6.1	Activity: Evaluate earthquake sources
8.3.1.17.3.6.2	Activity: Evaluate ground motion probabilities
8.3.1.17.4.1	Study: Historical and current seismicity
8.3.1.17.4.1.1	Activity: Compile historical earthquake record *
8.3.1.17.4.1.2	Activity: Monitor current seismicity *
8.3.1.17.4.1.3	Activity: Evaluate potential for induced seismicity at the site
8.3.1.17.4.2	Study: Location and recency of faulting near prospective surface facilities
8.3.1.17.4.2.1	Activity: Identify appropriate trench locations in Midway Valley
8.3.1.17.4.2.2	Activity: Conduct exploratory trenching in Midway Valley
8.3.1.17.4.3	Study: Quaternary faulting within 100 km of Yucca Mountain, including the Walker Lane

Study Plan	Description of Study/Activity
8.3.1.17.4.3.1	Activity: Conduct and evaluate deep geophysical surveys in an east-west transect crossing the Furnace Creek fault zone, Yucca Mountain, and the Walker Lane
8.3.1.17.4.3.2	Activity: Evaluate Quaternary faults within 100 km of Yucca Mountain
8.3.1.17.4.3.3	Activity: Evaluate the Cedar Mountain earthquake of 1932 and its bearing on wrench tectonics of the Walker Lane within 100 km of the site
8.3.1.17.4.3.4	Activity: Evaluate the Bare Mountain fault zone
8.3.1.17.4.3.5	Activity: Evaluate structural domains and characterize the Yucca Mountain region with respect to regional patterns of faults and fractures
8.3.1.17.4.4	Study: Quaternary faulting proximal to the site within northeast-trending fault zones
8.3.1.17.4.4.1	Activity: Evaluate the Rock Valley fault system
8.3.1.17.4.4.2	Activity: Evaluate the Mine Mountain fault system
8.3.1.17.4.4.3	Activity: Evaluate the Stagecoach Road fault zone
8.3.1.17.4.4.4	Activity: Evaluate the Cane Spring Fault system
8.3.1.17.4.5	Study: Detachment faults at or proximal to Yucca Mountain
8.3.1.17.4.5.1	Activity: Evaluate the significance of the Miocene-Paleozoic contact in the Calico Hills area to detachment faulting within the site area
8.3.1.17.4.5.2	Activity: Evaluate postulated detachment faults in the Beatty-Bare Mountain area
8.3.1.17.4.5.3	Activity: Evaluate the potential relationship of breccia within and south of Crater Flat to detachment faulting
8.3.1.17.4.5.4	Activity: Evaluate postulated detachment faults in the Specter Range and Camp Desert Rock areas
8.3.1.17.4.5.5	Activity: Evaluate the age of detachment faults using radiometric ages
8.3.1.17.4.6	Study: Quaternary faulting within the site area
8.3.1.17.4.6.1	Activity: Evaluate Quaternary geology and potential Quaternary faults at Yucca Mountain *
8.3.1.17.4.6.2	Activity: Evaluate age and recurrence of movement on suspected and known Quaternary faults *
8.3.1.17.4.7	Study: Subsurface geometry and concealed extensions of Quaternary faults at Yucca Mountain
8.3.1.17.4.7.1	Activity: Evaluate intermediate depth (2 to 3 km) reflection and refraction methods and plan potential application of these methods within the site area
8.3.1.17.4.7.2	Activity: Detailed gravity survey of the site area
8.3.1.17.4.7.3	Activity: Detailed aeromagnetic survey of the site area
8.3.1.17.4.7.4	Activity: Detailed ground magnetic survey of specific features within the site area
8.3.1.17.4.7.5	Activity: Evaluate surface geoelectric methods and plan potential applications of these methods within the site area
8.3.1.17.4.7.6	Activity: Evaluate methods to detect buried faults using gamma-ray measurements, and plan potential application of these methods within the site area
8.3.1.17.4.7.7	Activity: Evaluate thermal infrared methods and plan potential applications of these methods within the site area
8.3.1.17.4.7.8	Activity: Evaluate shallow seismic reflection (mini-sosie) methods and, if appropriate, conduct surveys of selected structures at and proximal to the site area
8.3.1.17.4.8	Study: Stress field within and proximal to the site area
8.3.1.17.4.8.1	Activity: Evaluate present stress field within the site area
8.3.1.17.4.8.2	Activity: Evaluate and test shallow borehole hydrofrac and triaxial strain recovery methods for the determination of in situ stress, and if appropriate, plan potential

Study Plan	Description of Study/Activity
	application of these methods within and proximal to the site
8.3.1.17.4.8.3	Activity: Evaluate published and unpublished data on paleostress orientation at and proximal to the site and assess the relevance of these data to Quaternary tectonics
8.3.1.17.4.8.4	Activity: Evaluate theoretical stress distributions associated with potential tectonic settings (wrench fault, normal fault, detachment fault setting, etc.) of the site
8.3.1.17.4.9	Study: Tectonic geomorphology of the Yucca Mountain region
8.3.1.17.4.9.1	Activity: Evaluate age and extent of tectonically stable areas at and near Yucca Mountain
8.3.1.17.4.9.2	Activity: Evaluate extent of areas of Quaternary uplift and subsidence at and near Yucca Mountain
8.3.1.17.4.9.3	Activity: Evaluate variations in the nature and intensity of Quaternary faulting within 100 km of Yucca Mountain through morphometric and morphologic analysis
8.3.1.17.4.10	Study: Geodetic leveling
8.3.1.17.4.10.1	Activity: Relevel base-station network, Yucca Mountain and vicinity *
8.3.1.17.4.10.2	Activity: Survey selected base stations, Yucca Mountain and vicinity, using global positioning satellite
8.3.1.17.4.10.3	Activity: Analyze existing releveling data, Yucca Mountain and vicinity *
8.3.1.17.4.11	Study: Characterization of regional lateral crustal movement
8.3.1.17.4.11.1	Activity: Analyze lateral component of crustal movement based on historical faulting, seismicity, and trilateration surveys
8.3.1.17.4.12	Study: Tectonic models and synthesis
8.3.1.17.4.12.1	Activity: Evaluate tectonic processes and tectonic stability at the site
8.3.1.17.4.12.2	Activity: Evaluate tectonic models
8.3.1.17.4.12.3	Activity: Evaluate tectonic disruption sequences

Study Plan	Description of Study/Activity
8.3.3.2.2.1	Study 1.12.2.1: Seal material properties development 8.3.3.2.2.1.1 Activity 1.12.2.1.1: Detailed property determination of cementitious-based and earthen materials 8.3.3.2.2.1.2 Activity 1.12.2.1.2: Hydraulic conductivity and consolidation testing of crushed tuff

Study Plan	Description of Study/Activity
8.3.4.2.4.1	Study 1.10.4.1: Characterize chemical and mineralogical changes in the postemplacement environment
8.3.4.2.4.1.1	Activity 1.10.4.1.1: Rock-water interactions at elevated temperatures *
8.3.4.2.4.1.2	Activity 1.10.4.1.2: Effect of grout, concrete, and other repository materials on water composition
8.3.4.2.4.1.3	Activity 1.10.4.1.3: Composition of vadose water from the waste package environment *
8.3.4.2.4.1.4	Activity 1.10.4.1.4: Dissolution of phases in the waste package environment *
8.3.4.2.4.1.5	Activity 1.10.4.1.5: Effects of radiation on water chemistry *
8.3.4.2.4.1.6	Activity 1.10.4.1.6: Effects of container and borehole liner corrosion products on water chemistry
8.3.4.2.4.1.7	Activity 1.10.4.1.7: Numerical analysis and modeling of rock-water interaction *
8.3.4.2.4.2	Study 1.10.4.2: Hydrologic properties of waste package environment
8.3.4.2.4.2.1	Activity 1.10.4.2.1: Single-phase fluid system properties
8.3.4.2.4.2.2	Activity 1.10.4.2.2: Two-phase fluid system properties *
8.3.4.2.4.2.3	Activity 1.10.4.2.3: Numerical analysis of flow and transport in laboratory systems *
8.3.4.2.4.3	Study 1.10.4.3: Mechanical attributes of the waste package environment
8.3.4.2.4.3.1	Activity 1.10.4.3.1: Waste package environment stress field analysis *
8.3.4.2.4.4	Study 1.10.4.4: Engineered barrier system field tests
8.3.4.2.4.4.1	Activity 1.10.4.4.1: Repository horizon near-field hydrologic properties
8.3.4.2.4.4.2	Activity 1.10.4.4.2: Repository horizon rock-water interaction
8.3.4.2.4.4.3	Activity 1.10.4.4.3: Numerical analysis of fluid flow and transport in the repository horizon near-field environment

Enclosure 2

STATUS OF STUDY PLANS

STUDY PLANS ACCEPTED BY THE NRC

The following Study Plans have been accepted by the NRC.

Identification	Acceptance Date
8.3.1.3.2.1: Mineralogy, Petrology, and Chemistry of Transport Pathways	08/20/90
8.3.1.5.2.1: Characterization of the Quaternary Regional Hydrology	11/24/89
8.3.1.8.5.1: Characterization of Volcanic Features	08/20/90
8.3.1.17.4.2: Evaluating the Location and Recency of Faulting Near Prospective Surface Facilities	11/24/89

STUDY PLANS IN REVIEW AT NRC

The following Study Plans are in review at the NRC.

Identification/Type	Transmittal Date
8.3.1.2.1.2: Characterization of Runoff and Streamflow/Ongoing	10/04/90
8.3.1.2.1.3: Characterization of the Regional Ground-Water Flow System/Ongoing	02/15/91
8.3.1.2.2.1: Characterization of Unsaturated Zone Infiltration/Ongoing	03/01/91
8.3.1.2.2.2: Water Movement Tracer Tests--Cl and Cl-36	02/09/89

8.3.1.2.2.3:	Characterization of Percolation in the Unsaturated Zone--Surface Based Study/Ongoing	05/10/91
8.3.1.2.2.4(.4, .5, .7, .8, .9):	Characterization of the Yucca Mountain Unsaturated Zone Percolation --Exploratory Shaft Facility Study/ESF	02/09/89
8.3.1.2.2.7:	Hydrochemical Characterization of the Unsaturated Zone /Ongoing	05/08/91
8.3.1.2.3.1.1-6:	Characterization of the Site Saturated Zone Ground-Water Flow System/Ongoing	03/07/91
8.3.1.2.3.1.7:	Testing of the C-Hole Site with Reactive Tracers/Ongoing	04/06/90
8.3.1.4.2.2:	(except .3 & .5): Characterization of Structural Features within the Site Area/ESF	02/09/89
8.3.1.8.1.1:	Probability of Magmatic Disruption of the Repository/Ongoing	03/5/91
8.3.1.12.2.1:	Meteorological Data Collection at the Yucca Mountain Site/Ongoing	5/16/91
8.3.1.15.1.1:	Laboratory Thermal Properties/New	01/25/91
8.3.1.15.1.2:	Laboratory Thermal Expansion Testing/New	10/04/90
8.3.1.15.1.5:	Excavation Investigations/ESF	02/09/89
8.3.1.15.2.1.2:	Characterization of Site Ambient Stress Conditions/ESF	02/09/89
8.3.1.16.1.1:	Characterization of Flood Potential of the Yucca Mountain Site/Ongoing	10/11/90

8.3.1.17.4.1:	Historical and Current Seismicity/Ongoing	10/22/90
8.3.1.17.4.6:	Quaternary Faulting Within the Site Area /Ongoing	02/19/91
8.3.1.17.4.10:	Geodetic Leveling/Ongoing	02/14/91

STUDY PLANS APPROVED BY THE PROJECT OFFICE

The following Study Plans have been approved by the Project Office but have not yet been transmitted to the NRC.

Identification/Type	Approval Date
8.3.1.2.1.1: Characterization of the Meteorology for Regional Hydrology/Ongoing	03/13/91

STUDY PLANS THAT WILL BE APPROVED IN THE NEXT TWO MONTHS

Identification/Type

8.3.1.2.2.6:	Characterization of Gas-Phase Movement in the Unsaturated Zone/Ongoing
8.3.1.5.1.4:	Analysis of the Paleoenvironmental History of the Yucca Mountain Region/Ongoing
8.3.1.15.1.3:	Laboratory Determination of the Mechanical Properties of Intact Rock/New
8.3.1.14.2:	Soil and Rock Properties Investigation/New