



Department of Energy
Washington, DC 20585

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Mr. John J. Linehan, Director
Repository Licensing and Quality
Assurance Project Directorate
Division of High-Level Waste Management
U.S. Nuclear Regulatory Commission
Washington, DC 20555

References:

- 1) Letter from R. Bernero to S. Rousso; dated March 1, 1989, regarding: Acceptability of SCP for Review.
- 2) Letter from John Linehan to Ralph Stein; dated March 3, 1989, regarding: Transmittal of Meeting Summary for DOE/NRC. December 15, 1988 meeting on Study Plans.

Dear Mr. Linehan:

During the Department of Energy (DOE)/Nuclear Regulatory Commission (NRC) meeting on Study Plans held December 15, 1988, DOE agreed to provide NRC an evaluation supporting the conclusion that the five study plans related to Exploratory Shaft Facility (ESF) construction-phase testing, transmitted to NRC February 9, 1989, are of the same technical quality as if they had been prepared under a Quality Assurance (QA) Level I program (Reference 1). In addition, DOE agreed to provide to the NRC a list of the studies and subordinated activities to be covered by study plans (Reference 2). This list also identifies participants preparing study plans and activities which are ongoing. This letter addresses the status and activities related to these two items.

DOE is currently reviewing the Study Plan Assessment (SPA). We expect to transmit the results of this evaluation to the NRC by the Mid-April 1989.

The potential concern mentioned in Reference 2, regarding inadvertent inconsistencies between ongoing study plans and SCP content has been, and will continue to be carefully addressed by DOE. As was discussed during the DOE/NRC meeting held on December 15, 1988, DOE/HQ review, conducted under the Interim Procedure for the Review of Study Plans, emphasizes both technical concerns and integration between the study plan and the SCP. For example, DOE verified that the ESF testing described in the 5 construction-phase study plans is consistent with the ESF testing described in the SCP. All major changes in ESF testing developed subsequent to the release of the Consultation Draft Site Characterization Plan (e.g., addition of the multiple purpose boreholes and deferral of penetration of the Calico Hills) were consistently incorporated into the five ESF construction-phase study plans. Likewise, study plans for ongoing studies are carefully being prepared and reviewed to ensure consistency with the content of the SCP.

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As requested in Reference 2, Enclosure 1 contains a listing of all studies and the activities that support each specific study to be presented in study plans. Also as requested, Enclosure 2 contains a list of the activities which are ongoing and indicates the participant organization responsible for preparation of the study plan. DOE is continuing to refine the integrated project activity networks and anticipates being in a position to inform the NRC, by the end of April, of the updated schedule for study plan submittal to the NRC for near-term study plans. DOE intends to provide the NRC with a revised schedule for receipt of study plans based on the recent experience for time cycles required to prepare, review, and approve study plans under a QA Level 1 program. DOE anticipates, based on detailed outyear planning currently underway, that some of the study plans scheduled for transmittal to the NRC in 1989, as discussed during the meeting held December 15, 1988, will be delayed 1-3 months.

The preparation and completion of study plans, including those for ongoing studies, is a high priority activity for DOE. Should you have any questions pertaining to this correspondence, please contact me at FTS 896-1462.



Gordon Appel, Chief
Licensing Branch
Office of Civilian Radioactive
Waste Management

Enclosure

cc: J. Youngblood, NRC
R. Loux, State of Nevada
C. Johnson, State of Nevada
D. Bechtel, Clark County, NV
J. Bradhurst, Nye County, NV
B. Baugham, Lincoln County, NV

YUCCA MOUNTAIN PROJECT SCP STUDY PLAN REPORT

Explanation

Priorities

1. Exploratory Shaft-Construction Phase
2. First Year
3. Second Year and Beyond
4. Ongoing

Symbol

* Ongoing Activity

Study Plan/Scp Section	Title of Studies and Activities	Participant	Priority
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 *	USGS	4
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 *	USGS	4
8.3.1.2.1.3	Study: Characterization of the 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 *	USGS	4
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	USGS	2
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	USGS	4
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 *	LANL	1
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	USGS	4
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: Percolation tests in the exploratory shaft facility 8.3.1.2.2.4.3 Activity: Bulk-permeability test in the exploratory shaft facility	USGS	1

Study Plan/Sec Section	Title of Studies and Activities	Participant	Priority
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 ESF		
8.3.1.2.2.5	Study: Diffusion tests in the exploratory shaft facility	LANL	2
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	USGS	4
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	USGS	4
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	USGS	2
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	USGS	2
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	USGS	4
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 *		

Study Plan/Scp Section	Title of Studies and Activities	Participant	Priority
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	USGS	2
8.3.1.2.3.2.1	Activity: Assessment of site 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	USGS	2
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/Scp Section	Title of Studies and Activities	Participant	Priority
8.3.1.3.1.1	Study: Ground-water chemistry model	LANL	3
8.3.1.3.2.1	Study: Mineralogy, Petrology, and Chemistry along transport pathways	LANL	4
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	LANL	4
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	LANL	3
8.3.1.3.3.2	Study: Kinetics and thermodynamics of mineral evolution	LANL	4
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 description of clinoptilolite-heulandite and analcime		
8.3.1.3.3.3	Study: Conceptual model of mineral evolution *	LANL	4
8.3.1.3.4.1	Study: Batch sorption studies	LANL	4
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 *	LANL	4
8.3.1.3.4.3	Study: Development of sorption models *	LANL	4
8.3.1.3.5.1	Study: Dissolved species concentration limits	LANL	4
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	LANL	4
8.3.1.3.5.2.1	Activity: Colloid formation characterization and stability *		

Study Plan/Scp Section	Title of Studies and Activities	Participant	Priority
	8.3.1.3.5.2.2 Activity: Colloid Modeling		
8.3.1.3.6.1	Study: Dynamic transport column experiments	LANL	4
	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 *		
8.3.1.3.6.2	Study: Diffusion	LANL	4
	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	LANL	4
	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	LANL	3
8.3.1.3.8.1	Study: Gaseous radionuclide transport calculations and measurements	LANL	3
	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		

NNWSI SCP Study Plan Report
8.3.1.4 ROCK CHARACTERISTICS PROGRAM (POSTCLOSURE)

Study Plan/Scp Section	Title of Studies and Activities	Participant	Priority
8.3.1.4.2.1	Study: Characterization of the vertical and lateral distribution of stratigraphic units within the site area	USGS	2
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		
8.3.1.4.2.1.6	Activity: Integration of geophysical activities		
8.3.1.4.2.2	Study: Characterization of the structural features within the site area	USGS	1
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 studies		
8.3.1.4.2.3	Study: Three-dimensional geologic model	USGS	2
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	SNL	3
8.3.1.4.3.1.1	Activity: Systematic drilling program		
8.3.1.4.3.2	Study: Three-dimensional rock characteristics models	SNL	3
8.3.1.4.3.2.1	Activity: Development of three-dimensional models of rock characteristics at the repository site		

Study Plan/Scp Section	Title of Studies and Activities	Participant	Priority
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	USGS	2
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 desposits 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	USGS	2
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	USGS	2
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	USGS	4
8.3.1.5.1.5	Study: Paleoclimate-paleoenvironmental synthesis 8.3.1.5.1.5.1 Activity: Paleoclimate-paleoenvironmental synthesis	USGS	3
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	USGS	3
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 *	USGS	4
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	USGS	3

Study Plan/Scp Section	Title of Studies and Activities	Participant Priority
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/Scp Section	Title of Studies and Activities	Participant	Priority
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	USGS	3
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	USGS	3
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	USGS	3
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	USGS	3

Study Plan/Scp Section	Title of Studies and Activities	Participant	Priority
8.3.1.8.1.1	Study: Probability of a volcanic eruption penetrating the repository 8.3.1.8.1.1.1 Activity: Location and timing of volcanic events * 8.3.1.8.1.1.2 Activity: Evaluation of the structural controls of basaltic volcanic activity * 8.3.1.8.1.1.3 Activity: Presence of magma bodies in the vicinity of the site * 8.3.1.8.1.1.4 Activity: Probability calculations and assessment *	LANL	4
8.3.1.8.1.2	Study: Effects of a volcanic eruption penetrating the repository 8.3.1.8.1.2.1 Activity: Effects of Strombolian eruptions * 8.3.1.8.1.2.2 Activity: Effects of hydrovolcanic eruptions *	LANL	4
8.3.1.8.2.1	Study: Analysis of waste package rupture due to tectonic processes and events 8.3.1.8.2.1.1 Activity: Assessment of waste package rupture due to igneous intrusion 8.3.1.8.2.1.2 Activity: Calculation of the number of waste packages intersected by a fault 8.3.1.8.2.1.3 Activity: Probability and rate of faulting 8.3.1.8.2.1.4 Activity: Assessment of waste package rupture due to faulting 8.3.1.8.2.1.5 Activity: Assessment of postclosure groundmotion in the subsurface 8.3.1.8.2.1.6 Activity: Nature, age, and rate of folding and deformation in the repository horizon 8.3.1.8.2.1.7 Activity: Assessment of waste package rupture due to folding and deformation	SAIC	3
8.3.1.8.3.1	Study: Analysis of the effects of tectonic processes events on average percolation flux rates over the repository 8.3.1.8.3.1.1 Activity: Annual probability of volcanic or igneous events in the controlled area 8.3.1.8.3.1.2 Activity: Assessment of the effects of igneous intrusions and volcanic events on flux rates 8.3.1.8.3.1.3 Activity: Faulting rates, recurrence intervals, and probable cumulative offset in 10,000 yr 8.3.1.8.3.1.4 Activity: Effects of faulting on average flux rates 8.3.1.8.3.1.5 Activity: Assessment of the effects of faulting on flux rates 8.3.1.8.3.1.6 Activity: Uplift rates in the controlled area 8.3.1.8.3.1.7 Activity: Assessment of the effects of folding, uplift, and subsidence on flux rates	SAIC	3
8.3.1.8.3.2	Study: Analysis of the effect of tectonic processes and events on changes in water-table elevation 8.3.1.8.3.2.1 Activity: Thermal and barrier-to-flow effects of igneous intrusions on water-table elevation 8.3.1.8.3.2.2 Activity: Assessment of the effects of igneous intrusions on water-table elevations	SAIC	3

Study Plan/Scp Section	Title of Studies and Activities	Participant	Priority
	8.3.1.8.3.2.3 Activity: Assessment of the effect of strain changes on water-table elevation		
	8.3.1.8.3.2.4 Activity: Assessment of the effect of folding, uplift, or subsidence on water-table elevation		
	8.3.1.8.3.2.5 Activity: Effects of faulting on water-table elevation		
	8.3.1.8.3.2.6 Activity: Assessment of the effect of faulting on water-table elevation		
8.3.1.8.3.3	Study: Analysis of the effects of tectonic processes and events on local fracture permeability and effective porosity	SAIC	3
	8.3.1.8.3.3.1 Activity: Assessment of the effects of igneous intrusions on local fracture permeability and effective porosities		
	8.3.1.8.3.3.2 Activity: Assessment of the effects of faulting on local fracture permeability and effective porosities		
	8.3.1.8.3.3.3 Activity: Assessment of the effects of stress or strain on hydrologic properties of the rock mass		
8.3.1.8.4.1	Study: Analysis of the effects of tectonic processes and events on rock geochemical properties	SAIC	3
	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	LANL	4
	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	USGS	3
	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	USGS	3
	8.3.1.8.5.3.1 Activity: Evaluation of folds in Neogene rocks of the region		

Study Plan/Scp Section	Title of Studies and Activities	Participant	Priority
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	SAIC	3
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	SAIC	2
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	SAIC	2
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	SAIC	3
8.3.1.9.3.1.1	Activity: Compilation of data to support the assessment of 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	SAIC	3
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 to be sufficiently credible or significant to warrant further investigation		

Study Plan/Scp Section	Title of Studies and Activities	Participant	Priority
8.3.1.12.2.1	Study: Meteorological data collection at the Yucca Mountain site	SAIC	4
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/Scp Section	Title of Studies and Activities	Participant	Priority
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	SNL	3
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	SNL	3
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	SNL	3

Study Plan/Scp Section	Title of Studies and Activities	Participant	Priority
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	SNL	2
8.3.1.15.1.2	Study: Laboratory thermal expansion testing 8.3.1.15.1.2.1 Activity: Thermal expansion characterization	SNL	2
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 *	SNL	4
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	SNL	2
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	SNL	1
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	SNL	3
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 response experiment	SNL	3
8.3.1.15.1.8	Study: In situ design verification 8.3.1.15.1.8.1 Activity: Mining methods 8.3.1.15.1.8.2 Activity: Monitoring 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	SNL	3
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	USGS	1

Study Plan/Scp Section	Title of Studies and Activities	Participant	Priority
8.3.1.15.2.2	Study: Characterization of the site ambient thermal condtions	USGS	2
8.3.1.15.2.2.1	Activity: Surface-based evaluation of ambient thermal conditions		

Study Plan/Scp Section	Title of Studies and Activities	Participant	Priority
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	USGS	4
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	SAIC	2
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	USGS	3

Study Plan/Scp Section	Title of Studies and Activities	Participant	Priority
8.3.1.17.1.1	Study: Potential for ash fall at the site	LANL	2
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	SNL	1
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	USGS	2
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	SNL	4
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	USGS	3
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	USGS	2
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	USGS	2
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	SNL	3
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	USGS	4

Study Plan/Scp Section	Title of Studies and Activities	Participant	Priority
	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	SNL	4
	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	USGS	2
	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	USGS	2
	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	USGS	2
	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-Barc 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	USGS	4
	8.3.1.17.4.6.1 Activity: Evaluate Quaternary geology and potential Quaternary faults at Yucca Mountain *		

Study Plan/Scp Section	Title of Studies and Activities	Participant	Priority
	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	USGS	2
	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	USGS	2
	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 application of these methods within and proximal to the site		
	8.3.1.17.4.8.3 Activity: Evaluate published and unpublished distributions 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	USGS	2
	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		

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8.3.1.17 TECTONICS PROGRAM (PRECLOSURE)

Study Plan/Scp Section	Title of Studies and Activities	Participant	Priority
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 *	USGS	4
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 historic faulting, seismicity, and trilateration surveys	USGS	2
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	USGS	3

Study Plan/Scp Section	Title of Studies and Activities	Participant	Priority
8.3.3.2.2.1	Study 1.12.2.1: Seal material properties development	SNL	3
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		

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8.3.4.2 WASTE PACKAGE CHARACTERISTICS

Study Plan/Scp Section	Title of Studies and Activities	Participant	Priority
8.3.4.2.4.1	Study 1.10.4.1: Characterize chemical and mineralogical changes in the postemplacement environment	LLNL	4
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	LLNL	4
8.3.4.2.4.2.1	Activity 1.10.4.2.1: Single fluid phase 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	LLNL	4
8.3.4.2.4.3.1	Activity 1.10.4.3.1: Waste package environment temperature field analysis *		
8.3.4.2.4.3.2	Activity 1.10.4.3.2: Waste package environment stress field analysis		
8.3.4.2.4.4	Study 1.10.4.4: Engineered barrier system field tests	LLNL	3
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		

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Enclosure 2

Priority: 4 Ongoing Studies

Study Plan	Title of Study/Activity	Part	DOE/State Letter	Comments
8.3.1.2.1.1	Study: Characterization of the meteorology for regional hydrology	USGS		
8.3.1.2.1.1.1	Activity: Precipitation and meteorological monitoring *		3.3	MONITORING
8.3.1.2.1.2	Study: Characterization of runoff and streamflow	USGS		
8.3.1.2.1.2.1	Activity: Surface-water runoff monitoring *		3.1.4	MONITORING
8.3.1.2.1.2.2	Activity: Transport of debris by severe runoff *		3.1.6	MONITORING
8.3.1.2.1.3	Study: Characterization of the regional ground-water flow system	USGS		
8.3.1.2.1.3.1	Activity: Assessment of regional hydrogeologic data needs in the saturated zone *		3.1	
8.3.1.2.1.3.2	Activity: Regional potentiometric-level distribution and hydrologic framework studies *		3.1.2 3.1.7 3.1.8	MONITORING
8.3.1.2.1.3.3	Activity: Fortymile Wash recharge study			
8.3.1.2.1.3.4	Activity: Evapotranspiration studies *		3.1.8	MONITORING
8.3.1.2.2.1	Study: Characterization of unsaturated-zone infiltration	USGS		
8.3.1.2.2.1.1	Activity: Characterization of hydrologic properties of surficial material *		3.1.11	
8.3.1.2.2.1.2	Activity: Evaluation of natural infiltration *		3.1.3	MONITORING
8.3.1.2.2.1.3	Activity: Evaluation of artificial infiltration			
8.3.1.2.2.3	Study: Characterization of percolation in the unsaturated zone--surface-based study	USGS		
8.3.1.2.2.3.1	Activity: Matrix hydrologic properties testing *		3.1.11	M -LAB ANALYSIS OF TRANSIENT PROPERTIES

*Indicates ongoing activities

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Priority: 4 Ongoing Studies

Study Plan	Title of Study/Activity	Part	DOE/State Letter	Comments
8.3.1.2.2.3.2	Activity: Site vertical borehole studies *		3.1.1	MONITORING
8.3.1.2.2.3.3	Activity: Solitario Canyon horizontal borehole study			
8.3.1.2.2.6	Study: Characterization of gaseous-phase movement in the unsaturated zone	USGS		
8.3.1.2.2.6.1	Activity: Gaseous-phase circulation study *		3.1.1	
8.3.1.2.2.7	Study: Hydrochemical characterization of the unsaturated zone	USGS		
8.3.1.2.2.7.1	Activity: Gaseous-phase chemical investigations *		3.1.1 3.1.11	MONITORING
8.3.1.2.2.7.2	Activity: Aqueous-phase chemical investigations *		3.1.11	
8.3.1.2.3.1	Study: Characterization of the site saturated-zone ground-water flow system	USGS		
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 *		3.1.7	MONITORING
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			

*Indicates ongoing activities

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Priority: 4 Ongoing Studies

Study Plan	Title of Study/Activity	Part	DOE/State Letter	Comments
8.3.1.3.2.1	Study: Mineralogy, petrology, and chemistry of transport pathways	LANL	3.5.2.2	
8.3.1.3.2.1.1	Activity: Petrologic stratigraphy of the Topopah Spring Member *			LAB WORK ON EXISTING SAMPLES
8.3.1.3.2.1.2	Activity: Mineral distributions between the host rock and the accessible environment *			LAB WORK ON EXISTING SAMPLES
8.3.1.3.2.1.3	Activity: Fracture mineralogy *			LAB WORK ON EXISTING SAMPLES
8.3.1.3.2.2	Study: History of mineralogic and geochemical alteration of Yucca Mountain	LANL	3.5.2.2	
8.3.1.3.2.2.1	Activity: History of mineralogic and geochemical alteration of Yucca Mountain *			LAB WORK ON EXISTING SAMPLES
8.3.1.3.2.2.2	Activity: Smectite, zeolite, manganese minerals, glass dehydration and transformation *			LAB WORK ON EXISTING SAMPLES
8.3.1.3.3.2	Study: Kinetics and thermodynamics of mineral evolution	LANL	3.5.2	
8.3.1.3.3.2.1	Activity: Kinetic studies of zeolite and related framework silicates *			LAB WORK ON EXISTING SAMPLES
8.3.1.3.3.2.2	Activity: Determination of end-member free energies for clinoptilolite, heulandite, albite, and analcime *			LAB WORK ON EXISTING SAMPLES
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 *	LANL	3.5.2	
8.3.1.3.4.1	Study: Batch sorption studies	LANL	3.5.2.3	
8.3.1.3.4.1.1	Activity: Batch sorption measurements as a function of solid phase composition *			

*Indicates ongoing activities

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Priority: 4 Ongoing Studies

Study Plan	Title of Study/Activity	Part	DOE/State Letter	Comments
8.3.1.3.4.1.2	Activity: Sorption as a function of sorbing element concentrations (isotherms) *			SCHED FOR COMPLETION FY88 PRESENTLY SHUT DOWN
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	LANL		
8.3.1.3.4.3	Study: Development of sorption models *	LANL	3.5.2.3	
8.3.1.3.5.1	Study: Dissolved species concentration limits	LANL	3.5.2.1	
8.3.1.3.5.1.1	Activity: Solubility measurements *		3.5.2.1	
8.3.1.3.5.1.2	Activity: Speciation measurements *			
8.3.1.3.5.1.3	Activity: Solubility modeling			PRESENTLY SHUT DOWN HIGH PRIORITY
8.3.1.3.5.2	Study: Colloid behavior	LANL		
8.3.1.3.5.2.1	Activity: Colloid formation characterization and stability *		3.5.2.1	
8.3.1.3.5.2.2	Activity: Colloid Modeling			
8.3.1.3.6.1	Study: Dynamic transport column experiments	LANL	3.5.2.1	
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 *			
8.3.1.3.6.2	Study: Diffusion	LANL		

*Indicates ongoing activities

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Priority: 4 Ongoing Studies

Study Plan	Title of Study/Activity	Part	DOE/State Letter	Comments
8.3.1.3.6.2.1	Activity: Uptake of radionuclides on rock beakers in a saturated system *			DEVELOPMENTAL
8.3.1.3.6.2.2	Activity: Diffusion through a saturated tuff slab *		3.5.2.1	
8.3.1.3.6.2.3	Activity: Diffusion in an unsaturated tuff block			
8.3.1.3.7.1	Study: Retardation sensitivity analysis	LANL	3.5.2	
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 *			
8.3.1.5.1.4	Study: Analysis of the paleoenvironmental history of the Yucca Mountain region	USGS		
8.3.1.5.1.4.1	Activity: Modeling of soil properties in the Yucca Mountain region *		3.2.4	MONITORING
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			
8.3.1.5.2.1	Study: Characterization of the Quaternary regional hydrology	USGS		
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 *		3.1.9	M MONITORING

*Indicates ongoing activities

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Priority: 4 Ongoing Studies

Study Plan	Title of Study/Activity	Part	DOE/State Letter	Comments
8.3.1.5.2.1.5	Activity: Studies of calcite and opaline silica vein deposits *		3.2.5 3.2.6	
8.3.1.8.1.1	Study: Probability of a volcanic eruption penetrating the repository	LANL	3.2.6	
8.3.1.8.1.1.1	Activity: Location and timing of volcanic events *			MAPPING AND SYNTHESIS
8.3.1.8.1.1.2	Activity: Evaluation of the structural controls of basaltic volcanic activity *			MAPPING
8.3.1.8.1.1.3	Activity: Presence of magma bodies in the vicinity of the site *			MAPPING GEOPHYS INTERP.
8.3.1.8.1.1.4	Activity: Probability calculations and assessment *			ASSESSMENT
8.3.1.8.1.2	Study: Effects of a volcanic eruption penetrating the repository	LANL	3.2.6	
8.3.1.8.1.2.1	Activity: Effects of Strombolian eruptions *			ASSESSMENT NO DATA COLLECTION
8.3.1.8.1.2.2	Activity: Effects of hydrovolcanic eruptions *			ASSESSMENT NO DATA COLLECTION
8.3.1.8.5.1	Study: Characterization of volcanic features	LANL	3.2.6	
8.3.1.8.5.1.1	Activity: Volcanism drillholes *			PLANNING ONLY NO DRILLING FY88 MAJOR EFFORT
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 *			
8.3.1.12.2.1	Study: Meteorological data collection at the Yucca Mountain site	SAIC	3.3	
8.3.1.12.2.1.1	Activity: Site meteorological monitoring program *			MONITORING
8.3.1.12.2.1.2	Activity: Data summary for input to dose assessments			
8.3.1.15.1.3	Study: Laboratory determination of mechanical properties of intact rock	SNL	3.4	

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 NNWSI SCP Study Plan Report
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Priority: 4 Ongoing Studies

Study Plan	Title of Study/Activity	Part	DOE/State Letter	Comments
8.3.1.15.1.3.1	Activity: Compressive mechanical properties of intact rock at baseline experiment conditions *			LAB WORK ON EXISTING SAMPLES & ANALYSIS
8.3.1.15.1.3.2	Activity: Effects of variable environmental conditions on mechanical properties *			LAB WORK ON EXISTING SAMPLES & ANALYSIS
8.3.1.16.1.1	Study: Characterization of flood potential of the Yucca Mountain site *	USGS	3.1.4	MONITORING
8.3.1.16.1.1.1	Activity: Site flood and debris hazards studies			
8.3.1.17.3.2	Study: Underground nuclear explosion sources	SNL	3.2.2	
8.3.1.17.3.2.1	Activity: Determine the range of UNE sources *			MONITORING
8.3.1.17.3.2.2	Activity: Determine maximum underground nuclear explosion source(s) *			
8.3.1.17.4.1	Study: Historical and current seismicity	USGS		
8.3.1.17.4.1.1	Activity: Compile historical earthquake record *		3.2.1	
8.3.1.17.4.1.2	Activity: Monitor current seismicity *			MONITORING
8.3.1.17.4.1.3	Activity: Evaluate potential for induced seismicity at the site			
8.3.1.17.4.6	Study: Quaternary faulting within the site area	USGS		
8.3.1.17.4.6.1	Activity: Evaluate Quaternary geology and potential Quaternary faults at Yucca Mountain *		3.2.5 3.2.6	MAPPING, SAMPLING-NO LAND DISTURBANCE
8.3.1.17.4.6.2	Activity: Evaluate age and recurrence of movement on suspected and known Quaternary faults *			MAPPING, SAMPLING-NO LAND DISTURBANCE
8.3.1.17.4.10	Study: Geodetic leveling	USGS		

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 NNWSI SCP Study Plan Report
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Priority: 4 Ongoing Studies

Study Plan	Title of Study/Activity	Part	DOE/State Letter	Comments	Start DOE Review	NRC/State for Review
8.3.1.17.4.10.1	Activity: Relevel base-station network, Yucca Mountain and vicinity *		3.2.3	MONITORING		
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 *					
8.3.4.2.4.1	Study 1.10.4.1: Characterize chemical and mineralogical changes in the postemplacement environment	LLNL	3.5.1		27-may-88	
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 *			DEVELOP METHODOLOGY		
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	LLNL	3.5.1		30-aug-88	
8.3.4.2.4.2.1	Activity 1.10.4.2.1: Single-phase fluid system properties					

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Priority: 4 Ongoing Studies

Study Plan	Title of Study/Activity	Part	DOE/State Letter	Comments	Start DOE Review	NRC/State for Review
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	LLNL	3.5.1		10-mar-89	
8.3.4.2.4.3.1	Activity 1.10.4.3.1: Waste package environment stress field analysis *					

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