

*enclosure in  
109 Pack 1*



**Department of Energy**

Washington, DC 20585

NOV 30 1987

Mr. John Linehan, Section Leader  
Projects Section  
Operations Branch  
Division of High Level Waste Management  
U.S. Nuclear Regulatory Commission  
Washington, D.C. 20555

Dear Mr. Linehan:

Enclosed is information requested by your staff, namely:

- a list of Study Plans for the three projects and tentative dates of availability
- the Study Plan Checklist dated 5/87
- the DOE-HQ Review Procedure for Study Plans dated April 11, 1987
- revision 1 of the Annotated Outline for Site Characterization Plans (OGR/B-5), April 1987

The list of Study Plans with the tentative schedule for issuance is only a best estimate at this time and the schedules could change significantly. In the attached list, the NNWSI Study Plans (pages N-1 to N-10) are identified by SCP section and the list includes details of the activities that are part of each Study Plan. The BWIP Study Plans (pages B-1 to B-4) are arranged by subject; they have identification numbers SD-BWI-xxx (yy), where xxx is the study number and yy is the estimated number of pages. The SRPO Study Plans (pages S-1 to S-4) are listed in the approximate sequential order that they will be released but the SRPO list is more uncertain than the others-- both the release dates and titles are likely to change.

The Study Plan Checklist will be used by the OGR staff to initiate the review of Study Plans when they are received from the Project Offices.



8803240208 871130  
PDR WASTE  
WM-1b 11

PDR

*Celebrating the U.S. Constitution Bicentennial — 1787-1987*

*entered 5/31/88*

The Review Procedure for Study Plans is intended to provide guidance rather than be rigid. For example, the time-frames are flexible and complex Study Plans are expected to require a review and comment resolution period that is longer than given in the procedure. Additionally, the OGR review process is intended to identify substantive concerns and not to focus on minor, editorial-type comments. Thus, the OGR effort will be adjusted to an appropriate level of intensity for the individual Study Plans.

The Annotated Outline document (OGR/B-5) has been revised to incorporate editorial changes and correct inconsistencies in the earlier version that your staff reviewed.

If you have any question on these documents, please call me at 586-5003.

Sincerely,



Owen O. Thompson,  
Licensing Project Manager  
Office of Civilian Radioactive  
Waste Management

Encl.: As stated

cc: (w/o OGR/B-5)

J. Knight, RW-24  
R. Stein, RW-23  
J. Bresee, RW-22  
J. Antonnen, BWIP  
C. Gertz, WMPO  
J. Neff, SRPO



**NNWSI STUDY PLANS [SCP SECTION: TITLE: ACTIVITIES]****Tent. DATE**

<b>8.3.1.2.2.10</b>	<b>Unsaturated Zone System Analysis and Integration</b>	
<b>8.3.1.2.2.10.1</b>	<b>Conceptualization of the Unsaturated Zone Hydrologic Flow System</b>	<b>2/89</b>
<b>8.3.1.2.2.10.2</b>	<b>Numerical Simulation of the Concepts</b>	
<b>8.3.1.2.2.10.3</b>	<b>System Integration: Definition of Flow Paths and Calculation of Fluxes and Velocities Within the Unsaturated Zone</b>	
<b>8.3.1.2.3.1</b>	<b>Characterization of the Site Saturated Zone Ground Water Flow System</b>	
<b>8.3.1.2.3.1.1</b>	<b>Solitario Canyon Fault Study in the Saturated Zone</b>	<b>8/88</b>
<b>8.3.1.2.3.1.2</b>	<b>Site Potentiometric Level Evaluation</b>	
<b>8.3.1.2.3.1.3</b>	<b>Analysis of Previously Completed Hydraulic-Stress Tests</b>	
<b>8.3.1.2.3.1.4</b>	<b>Multiple-Well Interference Testing</b>	
<b>8.3.1.2.3.1.5</b>	<b>Testing of the C-Hole Sites with Conservative Tracers</b>	
<b>8.3.1.2.3.1.6</b>	<b>Well Testing with Conservative Tracers Throughout the Site</b>	
<b>8.3.1.2.3.1.7</b>	<b>Testing at the C-Hole Sites with Reactive Tracers</b>	
<b>8.3.1.2.3.1.8</b>	<b>Well Testing with Reactive Tracers throughout the Site</b>	
<b>8.3.1.2.3.2</b>	<b>Characterization of the Site Saturated Zone Hydrochemistry</b>	<b>3/89</b>
<b>8.3.1.2.3.2.1</b>	<b>Assessment of Site Hydrochemical Data Availability and Needs</b>	
<b>8.3.1.2.3.2.2</b>	<b>Hydrochemical Characterization of Water in the Upper Part of the Saturated Zone at the Site</b>	
<b>8.3.1.2.3.3</b>	<b>Saturated Zone Hydrologic System Synthesis and Modeling</b>	
<b>8.3.1.2.3.3.1</b>	<b>Conceptualization of Saturated Zone Flow Models Within the Boundaries of the Accessible Environment</b>	<b>4/89</b>
<b>8.3.1.2.3.3.2</b>	<b>Development of Fracture Network Model</b>	
<b>8.3.1.2.3.3.3</b>	<b>Description of Flow Paths, Fluxes, and Velocities Within the Saturated Zone to the Accessible Environment</b>	
<b>8.3.1.3.1.1</b>	<b>Ground-Water Chemistry Model</b>	<b>TBD</b>
<b>8.3.1.3.2.1</b>	<b>Three-Dimensional Mineral Distributions at Yucca Mountain</b>	
<b>8.3.1.3.2.1.1</b>	<b>Petrologic Stratigraphy of the Topopah Spring Member</b>	
<b>8.3.1.3.2.1.2</b>	<b>Mineral Distributions Between the Host Rock and the Accessible Environment</b>	<b>12/87</b>
<b>8.3.1.3.2.1.3</b>	<b>Fracture Mineralogy</b>	
<b>8.3.1.3.2.2</b>	<b>History of Mineralogic and Geochemical Alteration of Yucca Mountain</b>	
<b>8.3.1.3.2.2.1</b>	<b>History of Mineralogic and Geochemical Alteration of Yucca Mountain</b>	
<b>8.3.1.3.2.2.2</b>	<b>Smectite, Zeolite, Manganese Minerals, and Glass Dehydration &amp; Transformation</b>	<b>12/87</b>
<b>8.3.1.3.2.2.2.1</b>	<b>Long-Term Heating Experiments in Unsaturated to Saturated Conditions</b>	
<b>8.3.1.3.3.1</b>	<b>Natural Analog of Hydrothermal Systems in Tuff</b>	<b>TBD</b>
<b>8.3.1.3.3.2</b>	<b>Kinetics and Thermodynamics of Mineral Evolution</b>	
<b>8.3.1.3.3.2.1</b>	<b>Kinetic Studies of Zeolite and Related Framework Silicates (3)</b>	<b>1/88</b>
<b>8.3.1.3.3.2.2</b>	<b>Determination of End-Number Free Energies for Clinoptilolite, Heulandite, Albite, and Analcime</b>	
<b>8.3.1.3.3.2.3</b>	<b>Solid Solution Description of Clinoptilolite, Heulandite, and Analcime</b>	
<b>8.3.1.3.3.3</b>	<b>Conceptual Model of Mineral Evolution</b>	<b>1/88</b>
<b>8.3.1.3.4.1</b>	<b>Batch Sorption Studies</b>	
<b>8.3.1.3.4.1.1</b>	<b>Batch Sorption Measurements as a Function of Solid Phase Composition (5)</b>	
<b>8.3.1.3.4.1.2</b>	<b>Sorption as a Function of Sorbing Element Concentrations (Isotherms) (2)</b>	<b>1/88</b>
<b>8.3.1.3.4.1.3</b>	<b>Sorption as a Function of Ground Water Composition (5)</b>	
<b>8.3.1.3.4.1.4</b>	<b>Sorption on Particulates and Colloids (2)</b>	
<b>8.3.1.3.4.1.5</b>	<b>Statistical Analysis of Sorption Data (5)</b>	
<b>8.3.1.3.4.2</b>	<b>Biological Sorption and Transport</b>	<b>1/88</b>
<b>8.3.1.3.4.3</b>	<b>Development of Sorption Models (Isotherms)</b>	<b>12/87</b>

<u>NNWSI STUDY PLANS [SCP SECTION; TITLE; ACTIVITIES]</u>			<u>Tent. DATE</u>
8.3.1.3.5.1	Dissolved Species Concentration Limits		
8.3.1.3.5.1.1	Solubility Measurements		12/87
8.3.1.3.5.1.2	Speciation Measurements		
8.3.1.3.5.1.3	Solubility Modeling		
8.3.1.3.5.2	Colloid Behavior		12/87
8.3.1.3.5.2.1	Colloid Formation Characterization and Stability		
8.3.1.3.5.2.2	Colloid Modeling		
8.3.1.3.6.1	Dynamic Transport Column Experiments		1/88
8.3.1.3.6.1.1	Crushed Tuff Column Experiments (5)		
8.3.1.3.6.1.2	Mass Transfer Kinetics (3)		
8.3.1.3.6.1.3	Unsaturated Tuff Columns (2)		
8.3.1.3.6.1.4	Fractured Tuff Column Studies (5)		
8.3.1.3.6.1.5	Filtration (3)		
8.3.1.3.6.2	Diffusion		
8.3.1.3.6.2.1	Uptake of Radionuclides on Rock Beakers in a Saturated System		1/88
8.3.1.3.6.2.2	Diffusion Through a Saturated Tuff Slab		
8.3.1.3.6.2.3	Diffusion in an Unsaturated Tuff Block		
8.3.1.3.7.1	Retardation Sensitivity Analysis		1/88
8.3.1.3.7.1.1	Analysis of Physical/Chemical Processes Affecting Transport		
8.3.1.3.7.1.2	Geochemical/Geophysical Model of Yucca Mountain and Integrated Geochemical Transport Calculations		
8.3.1.3.7.1.3	Transport Models and Related Support		TBD
8.3.1.3.7.2	Demonstration of Applicability of Laboratory Data to Repository Transport Calculations		
8.3.1.3.8.1	Gaseous Radionuclide Transport Calculations and Measurements		TBD
8.3.1.3.8.1.1	Physical Transport Mechanisms and Rates—Retardation Mechanisms and Transport with Retardation		
8.3.1.3.8.1.2	Gas Transport Measurements		
8.3.1.4.2.1	Characterization of the Vertical and Lateral Distribution of Stratigraphic Units Within the Site Area		
8.3.1.4.2.1.1	Surface and Subsurface Stratigraphic Studies of the Host Rock and Surrounding Units		7/88
8.3.1.4.2.1.2	Surface-Based Geophysical Surveys		
8.3.1.4.2.1.3	Borehole Geophysical Surveys		
8.3.1.4.2.1.4	Petrophysical Properties Testing		
8.3.1.4.2.1.5	Magnetic Properties and Stratigraphic Correlations		
8.3.1.4.2.2	Characterization of the Structural Features Within the Site Area		
8.3.1.4.2.2.1	Geologic Mapping of Zonal Features in the Paintbrush Tuff at a Scale of 1:12,000		10/88
8.3.1.4.2.2.2	Surface-Fracture Network Studies		
8.3.1.4.2.2.3	Borehole Evaluation of Faults and Fractures		
8.3.1.4.2.2.4	Geologic Mapping of the Exploratory Shaft and Drifts		
8.3.1.4.2.2.5	Seismic Tomography and Vertical Seismic Profiling		
8.3.1.4.2.3	Three-Dimensional Geologic Model		
8.3.1.4.2.3.1	Development of a Three-Dimensional Geologic Model of the Site Area		10/89
8.3.1.4.3.1	Systematic Acquisition of Site-Specific Subsurface Information		
8.3.1.4.3.1.1	Systematic drilling program		TBD
8.3.1.4.3.2	Three-Dimensional Rock Characteristics Models		2/89
8.3.1.4.3.2.1	Development of Three-Dimensional Models of Rock Characteristics at the Repository Site		
8.3.1.5.1.1	Characterization of Modern Regional Climate		
8.3.1.5.1.1.1	Synoptic Characterization of Regional Climate		8/88

<u>NNWSI STUDY PLANS (SCP SECTION; TITLE; ACTIVITIES)</u>		<u>Tent. DATE</u>
8.3.1.5.1.2	Paleoclimate Study: Lake, Playa, Marsh Deposits	
8.3.1.5.1.2.1	Paleontologic Analyses	
8.3.1.5.1.2.2	Analysis of the Stratigraphy-Sedimentology of Marsh, Lacustrine, and Playa Deposits	1/88
8.3.1.5.1.2.3	Geochemical Analyses of Lake, Marsh, and Playa Deposits	
8.3.1.5.1.2.4	Chronologic Analyses of Lake, Playa, and Marsh Deposits	
8.3.1.5.1.3	Climatic Implications of Terrestrial Paleocology	2/88
8.3.1.5.1.3.1	Analysis of Pack Rat Middens	
8.3.1.5.1.3.2	Analysis of Pollen Samples	
8.3.1.5.1.3.3	Determination of Vegetation-Climate Relationships	
8.3.1.5.1.4	Analysis of the Paleoenvironmental History of the Yucca Mountain Region	3/88
8.3.1.5.1.4.1	Modeling of Soil Properties in the Yucca Mountain Region	
8.3.1.5.1.4.2	Soil Moisture Analog Study	
8.3.1.5.1.4.3	Surficial Deposits Mapping of the Yucca Mountain Area	
8.3.1.5.1.4.4	Eolian History of the Yucca Mountain Region	
8.3.1.5.1.5	Paleoclimate-Paleoenvironment Synthesis	9/88
8.3.1.5.1.5.1	Paleoclimate-Paleoenvironment Sythesis	
8.3.1.5.1.6	Characterization of the Future Regional Climate and Environments	11/89
8.3.1.5.1.6.1	Global Climate Modeling	
8.3.1.5.1.6.2	Regional Climate Modeling	
8.3.1.5.1.6.3	Linked Global-Regional Climate Modeling	
8.3.1.5.1.6.4	Empirical Climate Modeling	
8.3.1.5.2.1	Characterization of the Quaternary Regional Hydrology	9/88
8.3.1.5.2.1.1	Regional Paleoflood Evaluation	
8.3.1.5.2.1.2	Quaternary Unsaturated Zone Hydrochemical Analysis	
8.3.1.5.2.1.3	Evaluation of Past Discharge Areas	
8.3.1.5.2.1.4	Analog Recharge Studies	
8.3.1.5.2.1.5	Studies of Calcite and Opaline Silica Vein Deposits	
8.3.1.5.2.2	Characterization of the Future Regional Hydrology Due to Climate Changes	1/90
8.3.1.5.2.2.1	Analysis of Future Surface Hydrology due to Climate Changes	
8.3.1.5.2.2.2	Analysis of Future Unsaturated Zone Hydrology due to Climate Changes	
8.3.1.5.2.2.3	Synthesis of the Effects of Possible Future Recharge Due to Climate Changes on Hydrologic Characteristics of the Yucca Mountain Saturated Zone	
8.3.1.6.1.1	Distribution and Characteristics of Present and Past Erosion	12/89
8.3.1.6.1.1.1	Development of Geomorphic Map of Yucca Mountain	
8.3.1.6.1.1.2	Analysis of Downcutting History of Fortymile Wash and its Tributaries	
8.3.1.6.1.1.3	An Analysis of Hillslope Erosion at Yucca Mountain	
8.3.1.6.2.1	Influence of Future Climatic Conditions on Locations and Rates of Erosion	-
8.3.1.6.2.1.1	Evaluation of Impact of Future Climatic Conditions on Locations and Rates of Erosion	12/89
8.3.1.6.3.1	Evaluation of the Effects of Future Tectonic Activity on Erosion at Yucca Mountain	
8.3.1.6.3.1.1	Evaluation of Impact of Future Uplift or Subsidence and Faulting on Erosion at Yucca Mountain and Vicinity	1/90
8.3.1.6.4.1	Development of a Topical Report to Address the Effects of Erosion on the Hydrologic, Geochemical, and Rock Characteristics at Yucca Mt.	2/90
8.3.1.8.1.1	Probability of a Volcanic Eruption Penetrating the Repository	
8.3.1.8.1.1.1	Location and Timing of Volcanic Events	
8.3.1.8.1.1.2	Evaluation of the Structural Controls of Basaltic Volcanic Activity	2/88
8.3.1.8.1.1.3	Presence of Magma Bodies in the Vicinity of the Site	
8.3.1.8.1.1.4	Probability Calculations and Assessment	

**NNWSI STUDY PLANS [SCP SECTION; TITLE; ACTIVITIES]****Tent. DATE**  
2/88

8.3.1.8.1.2	Effects of Volcanic Eruption Penetrating the Repository	
8.3.1.8.1.2.1	Effects of Strombolian Eruptions	
8.3.1.8.1.2.2	Effects of Hydravolcanic Eruptions	
8.3.1.8.2.1	Analysis of Waste Package Rupture due to Tectonic Processes and Events	TBD
8.3.1.8.2.1.1	Assessment of Waste Package Rupture due to Igneous Intrusion	
8.3.1.8.2.1.2	Calculation of the Number of Waste Packages Intersected by a Fault	
8.3.1.8.2.1.3	Probability and Rate of Faulting	
8.3.1.8.2.1.4	Assessment of Waste Package Rupture due to Faulting	
8.3.1.8.2.1.5	Assessment of Postclosure Ground Motion in the Subsurface	
8.3.1.8.2.1.6	Nature, Age, and Rate of Folding and Deformation in the Repository Horizon	
8.3.1.8.2.1.7	Assessment of Waste Package Rupture due to Folding and Deformation	
8.3.1.8.3.1	Analysis of the Effects of Tectonic Process Events on Average Percolation Flux Rates Over the Repository	
8.3.1.8.3.1.1	Annual Probability of Volcanic or Igneous Events in the Controlled Area	
8.3.1.8.3.1.2	Assessment of the Effects of Igneous Intrusions and Volcanic Events on Flux Rates	TBD
8.3.1.8.3.1.3	Faulting Rates, Recurrence Intervals, and Probable Cumulative Offset in 10,000 years	
8.3.1.8.3.1.4	Effects of Faulting on Average Flux Rates	
8.3.1.8.3.1.5	Assessment of the Effects of Faulting on Flux Rates	
8.3.1.8.3.1.6	Uplift Rates in the Controlled Area	
8.3.1.8.3.1.7	Assessment of the Effects of Folding, Uplift, and Subsidence on Flux Rates	
8.3.1.8.3.2	Analysis of the Effect of Tectonic Processes and Events on Changes in Water Table Altitude	TBD
8.3.1.8.3.2.1	Thermal and Barrier-to-Flow Effects of Igneous Intrusions on Water-Table Altitudes	
8.3.1.8.3.2.2	Assessment of the Effects of Igneous Intrusions on Water-Table Levels	
8.3.1.8.3.2.3	Assessment of the Effect of Strain Changes on Water-Table Altitude	
8.3.1.8.3.2.4	Assessment of the Effect of Folding, Uplift, or Subsidence on Water-Table Altitude	
8.3.1.8.3.2.5	Effects of Faulting on Water-Table Altitudes	
8.3.1.8.3.2.6	Assessment of the Effect of Faulting on Water-Table Altitude	
8.3.1.8.3.3	Analysis of the Effects of Tectonic Processes and Events on Local Fracture Permeability and Effective Porosity	TBD
8.3.1.8.3.3.1	Assessment of the Effects of Igneous Intrusions on Local Fracture Permeability and Effective Porosities	
8.3.1.8.3.3.2	Assessment of the Effects of Faulting on Local Fracture Permeability and Effective Porosities	
8.3.1.8.3.3.3	Assessment of the Effects of Stress or Strain on Hydrologic Properties of the Rock Mass	
8.3.1.8.4.1	Analysis of the Effects of Tectonic Processes and Events on Rock Geochemical Properties	
8.3.1.8.4.1.1	Assessment of the Change in Rock Geochemical Properties due to Igneous Intrusions	TBD
8.3.1.8.4.1.2	Assessment of the Degree of Mineralogic Change Along Fault Zones in 10,000 Years	
8.3.1.8.4.1.3	Assessment of the Effects of Fault Offset on Travel Pathway	
8.3.1.8.4.1.4	Assessment of the Degree of Mineralogic Change in the Controlled Area Resulting From Tectonic Change in Water-Table Levels	
8.3.1.8.5.1	Characterization of Volcanic Features	
8.3.1.8.5.1.1	Volcanism Drillholes	
8.3.1.8.5.1.2	Geochronology Studies	
8.3.1.8.5.1.3	Field Geologic Studies	12/87
8.3.1.8.5.1.4	Geochemistry of Scoria Sequences	
8.3.1.8.5.1.5	Geochemical Cycles of Basaltic Volcanic Fields	

**NNWSI STUDY PLANS (SCP SECTION; TITLE; ACTIVITIES)****Tent. DATE**

8.3.1.8.5.2	Characterization of Igneous Intrusive Features	
8.3.1.8.5.2.1	Evaluation of Depth of Curie Temperature Isotherm	
8.3.1.8.5.2.2	Chemical and Physical Changes Around Dikes	
8.3.1.8.5.2.3	Heat Flow at Yucca Mt. & Evaluation of Regional Ambient Heat Flow and Local Heat Flow Anomalies	10/88
8.3.1.8.5.3	Investigation of Folds in Miocene and Younger Rocks of the Region	3/90
8.3.1.8.5.3.1	Evaluation of Folds in Neogene Rocks of the Region	
8.3.1.9.1.1	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	Synthesis of Tectonic, Seismic, and Volcanic Hazards Data from Other Site Characterization Activities	12/87
8.3.1.9.1.1.2	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	Natural Resource Assessment of Yucca Mountain, Nye County, Nevada	
8.3.1.9.2.1.1	Geochemical Assessment of Yucca Mountain in Relation to the Potential for Mineralization	
8.3.1.9.2.1.2	Geophysical/Geological Appraisal of the Site Relative to Mineral Resources	3/88
8.3.1.9.2.1.3	Assessment of the Potential for Geothermal Energy at Yucca Mountain, Nevada	
8.3.1.9.2.1.4	Assessment of Hydrocarbon Resources At and Near the Site	
8.3.1.9.2.1.5	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	Water Resource Assessment of Yucca Mountain, Nevada	
8.3.1.9.2.2.1	Projected Trends in Local and Regional Ground-Water Development and Estimated Withdrawal Rates in Southern Nevada, Proximal to Yucca Mountain	12/87
8.3.1.9.3.1	Compilation 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	3/88
8.3.1.9.3.1.1	Compilation of Data to Support the Assessment Calculation of the Potential for Future Inadvertent Human Intrusion	
8.3.1.9.3.2	An Evaluation of the Potential Effects of Exploiting Natural Resources on the Hydrologic Characteristics at Yucca Mountain	
8.3.1.9.3.2.1	An Analysis of the Potential Effects of Future Ground-Water Withdrawals on the Hydrologic System in the Vicinity of Yucca Mountain, Nevada	3/88
8.3.1.9.3.2.2	Assessment of Initiating Events Related to Human Interference That are Considered not to be Sufficiently Creative or Significant to Warrant Further Investigation	
8.3.1.12.2.1	Meteorological Data Collection at the Yucca Mountain Site	12/87
8.3.1.12.2.1.1	Site Meteorological Monitoring Program	
8.3.1.12.2.1.2	Data Summary for Input to Dose Assessments	
8.3.1.14.2.1	Exploration Program	
8.3.1.14.2.1.1	Site Reconnaissance	9/88
8.3.1.14.2.1.2	Preliminary Exploration	
8.3.1.14.2.1.3	Detailed Exploration	
8.3.1.14.2.2	Laboratory Tests and Material Property Measurements	
8.3.1.14.2.2.1	Physical Property and Index Laboratory Tests	9/88
8.3.1.14.2.2.2	Mechanical and Dynamic Laboratory Property Tests	
8.3.1.14.2.3	Field Tests and Characterization Measurements	9/88
8.3.1.14.2.3.1	Physical Property Field Tests and Characterization Measurements	
8.3.1.14.2.3.2	Mechanical Property Field Tests	
8.3.1.14.2.3.3	Geophysical Field Measurements	



**NNWSI STUDY PLANS [SCP SECTION; TITLE; ACTIVITIES]****Tent. DATE**

8.3.1.15.1.1	Laboratory Thermal Properties	2/88
8.3.1.15.1.1.1	Density and Porosity Characterization	
8.3.1.15.1.1.2	Volumetric Heat Capacity Characterization	
8.3.1.15.1.1.3	Thermal Conductivity Characterization	
8.3.1.15.1.2	Laboratory Thermal Expansion Testing	3/88
8.3.1.15.1.2.1	Thermal Expansion Characterization	11/87
8.3.1.15.1.3	Laboratory Determination of Mechanical Properties of Intact Rock	
8.3.1.15.1.3.1	Compressive Mechanical Properties of Intact Rock at Baseline Experiment Conditions	
8.3.1.15.1.3.2	Effects of Variable Environmental Conditions on Compressive Mechanical Properties	
8.3.1.15.1.3.3	Tensile Strength of Unit TSw2	
8.3.1.15.1.4	Laboratory Determination of the Mechanical Properties of Fractures	1/88
8.3.1.15.1.4.1	Mechanical Properties of Fractures at Baseline Experiment Conditions	
8.3.1.15.1.4.2	Effects of Variable Environmental Conditions on Mechanical Properties of Fractures	
8.3.1.15.1.5	Excavation Investigations	
8.3.1.15.1.5.1	Shaft Convergence	
8.3.1.15.1.5.2	Demonstration Breakout Room Testing	10/87
8.3.1.15.1.5.3	Sequential Drift Mining	
8.3.1.15.1.6	In Situ Thermomechanical Properties	
8.3.1.15.1.6.1	Heater Experiment in Unit TSw1	8/88
8.3.1.15.1.6.2	Canister-Scale Heater Experiment	
8.3.1.15.1.6.3	Yucca Mountain Heated Block	
8.3.1.15.1.6.4	Thermal Stress Measurements	
8.3.1.15.1.6.5	Heated Room Experiment	8/88
8.3.1.15.1.7	In Situ Mechanical Properties	
8.3.1.15.1.7.1	Plate Loading Tests	
8.3.1.15.1.7.2	Rock-Mass Strength Experiment	
8.3.1.15.1.8	In Situ Design Verification	
8.3.1.15.1.8.1	Evaluation of Mining Methods	5/88
8.3.1.15.1.8.2	Monitoring of Ground-Support Systems	
8.3.1.15.1.8.3	Monitoring of Drift Stability	
8.3.1.15.1.8.4	Air Quality and Ventilation Experiment	
8.3.1.15.2.1	Characterization of the Site Ambient Stress Conditions	
8.3.1.15.2.1.1	Anelastic Strain Recovery Experiments in Core Holes (S)	10/87
8.3.1.15.2.1.2	Overcore Stress Tests in the Exploratory Shaft Facility	
8.3.1.15.2.2	Exploratory Shaft Facility Rock Ambient Thermal Conditions Study	
8.3.1.15.2.2.1	Surface-Based Evaluation of Ambient Thermal Conditions	11/88
8.3.1.16.1.1	Characterization of Flood Potential of the Yucca Mountain Site	10/88
8.3.1.16.2.1	Location of Adequate Water Supply for Construction, Operation, Closure, and Decommissioning of a Mined Geologic Disposal System at Yucca Mountain, Nevada	12/87
8.3.1.16.2.1.1	Assessment of the Cost, Feasibility, and Adequacy of Wells J-12 and J-13 for Use as the Alternate Water Supply for a Mined Geologic Disposal System at Yucca Mountain, Nevada	
8.3.1.16.2.1.2	Location of a Primary Water Supply for a Mined Geologic Disposal System at Yucca Mountain, Nevada	
8.3.1.16.2.1.3	Location of Alternative Water Supplies for a Mined Geologic Disposal System at Yucca Mountain, Nevada	
8.3.1.16.2.1.4	Identification and Evaluation of Potential Effects of Repository Related Water Withdrawals on the Local Flow System at Yucca Mountain, Nevada	
8.3.1.16.3.1	Determination of Preclosure Hydrologic Conditions of the Unsaturated Zone at Yucca Mountain, Nevada	
8.3.1.16.3.1.1	Synthesis of Data from Issue 8.3.1.2 to Determine the Preclosure Hydrologic Characteristics of the Unsaturated Zone at Yucca Mountain, Nevada	3/90

# NNWSI STUDY PLANS [SCP SECTION; TITLE; ACTIVITIES]

Tent. DATE

8.3.1.17.1.1	Potential for Ash Fall at the Site	TBD
8.3.1.17.1.1.1	Survey Literature Regarding Quaternary Silicic Volcanic Centers in the Western Great Basin	
8.3.1.17.1.1.2	Assess Potential Ash-Fall Thickness at the Site	
8.3.1.17.1.1.3	Assess Potential Particle Density and Size Distribution of Ash Flow at the Site	
8.3.1.17.2.1	Faulting Potential at the Repository	TBD
8.3.1.17.2.1.1	Assess the Potential for Surface Faulting at Prospective Sites of Surface Facilities that Are Important to Safety (S)	
8.3.1.17.2.1.2	Assess the Potential for Displacement on Faults that Intersect Underground Facilities (C)	
8.3.1.17.3.1	Relevant Earthquake Sources	TBD
8.3.1.17.3.1.1	Identify Relevant Earthquake Sources	
8.3.1.17.3.1.2	Characterize Exceptional Earthquakes for Relevant Seismogenic Sources	
8.3.1.17.3.2	Underground Nuclear Explosion (UNE) Sources	10/87
8.3.1.17.3.2.1	Determine the Range of UNE Sources	
8.3.1.17.3.2.2	Determine Maximum UNE Source (s)	
8.3.1.17.3.3	Ground Motion from Regional Earthquakes and UNEs	2/89
8.3.1.17.3.3.1	Select or Develop Empirical Models for Earthquake Ground Motions	
8.3.1.17.3.3.2	Select or Develop Empirical Models for UNEs	
8.3.1.17.3.4	Effects of Local Site Geology on Surface and Subsurface Motions	3/89
8.3.1.17.3.4.1	Determine Site Effects from Ground Motion Recordings	
8.3.1.17.3.4.2	Model Site Effects Using the Wave Properties of the Local Geology	
8.3.1.17.3.5	Ground Motion at the Site from Controlling Seismic Events	4/89
8.3.1.17.3.5.1	Identify Controlling Seismic Events	
8.3.1.17.3.5.2	Characterize Ground Motion from the Controlling Seismic Events	
8.3.1.17.3.6	Probabilistic Seismic Hazards Analyses	2/89
8.3.1.17.3.6.1	Evaluate Earthquake Sources	
8.3.1.17.3.6.2	Evaluate Ground Motion Probabilities	
8.3.1.17.4.1	Historic and Current Seismicity	12/87
8.3.1.17.4.1.1	Compile Historical Earthquake Record	
8.3.1.17.4.1.2	Monitor Current Seismicity	
8.3.1.17.4.1.3	Evaluate Potential for Induced Seismicity at the Site	
8.3.1.17.4.2	Location and Recency of Faulting near Prospective Surface Facilities	10/88
8.3.1.17.4.2.1	Identify Appropriate Trench Locations in Midway Valley	
8.3.1.17.4.2.2	Conduct Exploratory Trenching in Midway Valley	
8.3.1.17.4.3	Quaternary Faulting Within 100km of Yucca Mountain, Including the Walker Zone	4/88
8.3.1.17.4.3.1	Evaluate Crustal Structure and Subsurface Expression of Quaternary Faults in an East-West Transect Crossing the Furnace Creek Fault Zone, Yucca Mountain, and the Walker Lane	
8.3.1.17.4.3.2	Evaluate Quaternary Faults Within 100km of Yucca Mountain	
8.3.1.17.4.3.3	Evaluate the Cedar Mountain Earthquake of 1933 and Its Bearing on Wrench Tectonics of the Walker Lane Within 100km of the Site	
8.3.1.17.4.3.4	Evaluate the Bare Mountain Fault Zone	
8.3.1.17.4.3.5	Evaluate Structural Domains and Characterize the Yucca Mountain Region With Respect to Regional Patterns of Faults and Fractures	
8.3.1.17.4.4	Quaternary Faulting Proximal to the Site Within Northeast-Trending Fault Zones	6/89
8.3.1.17.4.4.1	Evaluate the Rock Valley Fault System	
8.3.1.17.4.4.2	Evaluate the Mine Mountain Fault System	
8.3.1.17.4.4.3	Evaluate the Stagecoach Road Fault Zone	
8.3.1.17.4.4.4	Evaluate the Cone Springs Fault System	

**NNWSI STUDY PLANS [SCP SECTION; TITLE; ACTIVITIES]****Tent. DATE**

<b>8.3.1.17.4.5</b>	<b>Detachment Faults at or Proximal to Yucca Mountain</b>	
<b>8.3.1.17.4.5.1</b>	<b>Evaluate the Significance of the Miocene-Paleozoic Contact in the Calico Hills Area to Detachment Faulting Within the Site Area</b>	<b>7/89</b>
<b>8.3.1.17.4.5.2</b>	<b>Evaluate Postulated Detachment Faults in the Beatty-Bare Mountain Area</b>	
<b>8.3.1.17.4.5.3</b>	<b>Evaluate the Potential Relationship of Megabreccia Within and South of Crater Flat to Detachment Faulting</b>	
<b>8.3.1.17.4.5.4</b>	<b>Evaluate Postulated Detachment Faults in the Specter Range and Camp Desert Rock Areas</b>	
<b>8.3.1.17.4.5.5</b>	<b>Evaluate the Age of Detachment Faults Using Radiometric Ages</b>	
<b>8.3.1.17.4.6</b>	<b>Quaternary Faulting Within the Site Area</b>	
<b>8.3.1.17.4.6.1</b>	<b>Evaluate Quaternary Geology and Potential Quaternary Faults at Yucca Mountain</b>	<b>9/89</b>
<b>8.3.1.17.4.6.2</b>	<b>Evaluate Age and Recurrence of Movement on Suspected and Known Quaternary Faults</b>	
<b>8.3.1.17.4.7</b>	<b>Subsurface Geometry and Concealed Extensions of Quaternary Faults at Yucca Mountain</b>	
<b>8.3.1.17.4.7.1</b>	<b>Evaluate Intermediate Depth (to 2-3km) Reflection and Refraction Methods and Plan Potential Application of These Methods Within the Site Area</b>	<b>10/89</b>
<b>8.3.1.17.4.7.2</b>	<b>Detailed Gravity Survey of the Site Area</b>	
<b>8.3.1.17.4.7.3</b>	<b>Detailed Aeromagnetic Survey of the Site Area</b>	
<b>8.3.1.17.4.7.4</b>	<b>Detailed Ground Magnetic Survey of Specific Features Within the Site Area</b>	
<b>8.3.1.17.4.7.5</b>	<b>Evaluate Surface Geoelectric Methods and Plan Potential Applications of These Methods Within the Site Area</b>	
<b>8.3.1.17.4.7.6</b>	<b>Evaluate Methods to Detect Buried Faults Using Gamma Ray Measurements, and Plan Potential Applications of These Methods Within the Site Area</b>	
<b>8.3.1.17.4.7.7</b>	<b>Evaluate Thermal Infrared Methods and Plan Potential Applications of These Methods Within the Site Area</b>	
<b>8.3.1.17.4.7.8</b>	<b>Evaluate Shallow Seismic Reflection (Mini-Sosie) Methods and If Appropriate Conduct Surveys of Selected Structures at and Proximal to the Site Area</b>	
<b>8.3.1.17.4.8</b>	<b>Stress Field Within and Proximal to the Site Area</b>	
<b>8.3.1.17.4.8.1</b>	<b>Evaluate Present Stress Field Within the Site Area</b>	<b>11/89</b>
<b>8.3.1.17.4.8.2</b>	<b>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</b>	
<b>8.3.1.17.4.8.3</b>	<b>Evaluate Published and Unpublished Data on Paleostress Orientation at and Proximal to the Site and Assess the Relevance of These Data to Quaternary Tectonics</b>	
<b>8.3.1.17.4.8.4</b>	<b>Evaluate Theoretical Stress Distributions Associated With Potential Tectonic Settings (Wrench Fault, Normal Fault, Detachment Fault Setting, etc.) of the Site</b>	
<b>8.3.1.17.4.9</b>	<b>Tectonic Geomorphology of the Yucca Mountain Region</b>	
<b>8.3.1.17.4.9.1</b>	<b>Evaluate Age and Extent of Tectonically Stable Areas at and Near Yucca Mountain</b>	<b>12/89</b>
<b>8.3.1.17.4.9.2</b>	<b>Evaluate Extent of Areas of Quaternary Uplift and Subsidence at and Near Yucca Mountain</b>	
<b>8.3.1.17.4.9.3</b>	<b>Evaluate Variations in the Nature and Intensity of Quaternary Faulting Within 100km of Yucca Mountain through Morphotectonic and Morphologic Analysis</b>	
<b>8.3.1.17.4.10</b>	<b>Geodetic Leveling</b>	
<b>8.3.1.17.4.10.1</b>	<b>Relevel Base-Station Network, Yucca Mountain and Vicinity</b>	
<b>8.3.1.17.4.10.2</b>	<b>GPS Survey Selected Base Stations, Yucca Mountain and Vicinity</b>	<b>5/88</b>
<b>8.3.1.17.4.10.3</b>	<b>Analyze Existing Releveling Data, Yucca Mountain and Vicinity</b>	
<b>8.3.1.17.4.11</b>	<b>Characterization of Regional Lateral Crustal Movement</b>	
<b>8.3.1.17.4.11.1</b>	<b>Analyze Lateral Component of Crustal Movement Based on Historic Faulting, Seismicity, and Trilateration Surveys</b>	<b>12/89</b>

**NNWSI STUDY PLANS [SCP SECTION; TITLE; ACTIVITIES]****Tent. DATE**

<b>8.3.1.17.4.12</b>	<b>Tectonic Models and Synthesis</b>	
<b>8.3.1.17.4.12.1</b>	<b>Evaluate Tectonic Processes and Tectonic Stability at the Site</b>	<b>3/90</b>
<b>8.3.1.17.4.12.2</b>	<b>Evaluate Tectonic Models</b>	
<b>8.3.1.17.4.12.3</b>	<b>Evaluate Tectonic Disruption Sequences</b>	
<b>8.3.3.2.2.1</b>	<b>Seal Material Properties Development</b>	<b>5/88</b>
<b>8.3.3.2.2.1.1</b>	<b>Detailed Property Determination of Cementitious-Based and Earthen Materials</b>	
<b>8.3.3.2.2.1.2</b>	<b>Hydraulic Conductivity and Consolidation Testing of Crushed Tuff</b>	
<b>8.3.4.2.4.1</b>	<b>Characterize Chemical and Mineralogical Changes in the Postemplacement Environment</b>	<b>12/87</b>
<b>8.3.4.2.4.1.1</b>	<b>Rock-Water Interactions at Elevated Temperatures</b>	
<b>8.3.4.2.4.1.2</b>	<b>Effect of Grout, Concrete and Other Repository Materials on Water Composition</b>	
<b>8.3.4.2.4.1.3</b>	<b>Composition of Vadose Water from the Waste Package Environment</b>	
<b>8.3.4.2.4.1.4</b>	<b>Dissolution of Phases in the Waste Package Environment</b>	
<b>8.3.4.2.4.1.5</b>	<b>Effects of Radiation on Water Chemistry</b>	
<b>8.3.4.2.4.1.6</b>	<b>Effects of Container and Borehole Liner Corrosion Products on Water Chemistry</b>	
<b>8.3.4.2.4.1.7</b>	<b>Numerical Analysis and Modeling of Rock-Water Interaction</b>	
<b>8.3.4.2.4.2</b>	<b>Hydrologic Properties of Waste Package Environment</b>	<b>2/88</b>
<b>8.3.4.2.4.2.1</b>	<b>Single Fluid Phase System Properties</b>	
<b>8.3.4.2.4.2.2</b>	<b>Two-Phase Fluid System Properties</b>	
<b>8.3.4.2.4.2.3</b>	<b>Numerical Analysis of Flow and Transport in Laboratory Systems</b>	
<b>8.3.4.2.4.3</b>	<b>Thermal and Mechanical Attributes of the Waste Package Environment</b>	<b>2/88</b>
<b>8.3.4.2.4.3.1</b>	<b>Waste Package Environment Temperature Field Analysis</b>	
<b>8.3.4.2.4.3.2</b>	<b>Waste Package Environment Stress Field Analysis</b>	
<b>8.3.4.2.4.4</b>	<b>Engineered Barrier System Field Tests</b>	<b>TBD</b>
<b>8.3.4.2.4.4.1</b>	<b>Repository Horizon Near-Field Hydrologic Properties</b>	
<b>8.3.4.2.4.4.2</b>	<b>Repository Horizon Rock-Water Interactions</b>	
<b>8.3.4.2.4.4.3</b>	<b>Numerical Analysis of Fluid Flow and Transport in the Repository Horizon Near-Field Environment</b>	

BWIP STUDY PLANS [SUBJECT; TITLE; (SD-BWI-XXX)(Est. Pages)]	Tent. DATE
Materials Characterization Container Materials Testing: General Corrosion Study Plan (-020) (20)	3/88
Waste Form/Filler Materials Interactions Study Plan (-009) (21)	3/88
Container Mtls Testing: Environmentally Assisted Cracking Study Plan (-023) (21)	3/88
Container Materials Testing: Mechanical and Physical Properties SP (-024) (15)	TBD
Container Materials Testing: Pitting Corrosion Study Plan (-022) (22)	4/88
Container Materials Testing: Crevice Corrosion Study Plan (-022) (25)	4/88
Waste Package Environment: Basalt/Groundwater Interactions SP (-042) (50)	2/88
Waste Package Environment: Geochemical Environment Analysis SP (-003) (29)	3/88
Waste/Barrier/Rock Interactions: Spent Fuel Release Testing SP (-040) (75)	3/88
Waste/Barrier/Rock Interactions: Borosilicate Glass RIs Testing SP (-041) (50)	TBD
Waste Form Test Materials Study Plan (-008) (21)	5/88
Waste Package Natural Analogs Study Plan (-002) (25)	3/88
Waste Package Metallic Artifacts Study Plan (-025) (6)	TBD
Waste/Barrier/Rock Interactions: Other Waste Forms Testing ( ) ( )	TBD
Packing Materials Testing: Chemical Stability Study Plan (-037) (75)	2/88
Packing Materials Testing: Physical Properties and Processes SP (-038) (75)	2/88
Radionuclide Solubility/Sorption and Specification Behavior Study Plan (-039) (60)	3/88

**BWIP STUDY PLANS [SUBJECT: TITLE: (SD-BWI-XXX)(Est. Pages)]**

**Tent. DATE**

<b>Repository D&amp;D</b>	<b>Study Plan for In Situ Stress Determination (-005) (100)</b>	<b>1/88 -</b>
	<b>Study Plan for Evaluation of Opening Performance (-004) (140)</b>	<b>1/88 -</b>
	<b>Study Plan for Thermal Properties Determination (-006) (80)</b>	<b>1/88 -</b>
	<b>Study Plan for Mechanical Properties Determination (-007) (83)</b>	<b>1/88</b>
<b>Repository Seals D&amp;D</b>	<b>Laboratory Testing for Selection of Seals Materials Study Plan (-026) (38)</b>	<b>3/88</b>
	<b>Effects of Elevated Temps on Physical Props of Ref. Seals Mtls SP (-027) (30)</b>	<b>3/88 -</b>
	<b>Characterization of Reference Seals Materials Study Plan (-045)</b>	<b>TBD</b>
	<b>Interface Properties of Reference Seals Materials Study Plan (-046)</b>	<b>TBD</b>
	<b>Exploratory Shaft Grout Development Study Plan (-056) (50)</b>	<b>1/88</b>
	<b>Long-Term Stability of Reference Seals Materials Study Plan (-028)</b>	<b>TBD</b>
	<b>Demonstration of Subsurface Borehole Seals Performance</b>	<b>TBD</b>
	<b>Demonstration of Surface Borehole Seals Installation and Performance</b>	<b>TBD</b>
	<b>Demonstration of Drift Seals Performance</b>	<b>TBD</b>
	<b>Demonstration of Shaft Seals Installation and Performance</b>	<b>TBD</b>
	<b>Characterization of Damaged Rock Zone Sealing</b>	<b>TBD</b>
	<b>Development of Subsurface Borehole Seals Installation Methods</b>	<b>TBD</b>
	<b>Development of Drift Seals Installation Methods</b>	<b>TBD</b>

<u>BWIP STUDY PLANS [SUBJECT; TITLE; (SD-BWI-XXX)(Est. Pages)]</u>		<u>Tent. DATE</u>
Waste Package D&D	Container Corrosion Qualification Testing Study Plan (-017) (16)	TBD
	Packing Saturation Qualification Study Plan (-018) (32)	TBD
	Waste Package In-Situ Testing	TBD
	Monolith Container Development Study Plan (-012) (29)	3/88
	Pressure Vessel Container Development Study Plan (-011) (32)	4/88
	Container Handling and Safety Testing Study Plan (-013) (10)	TBD
	Waste Acceptance Specifications Study Plan (-010) (32)	4/88
	Nonmetallic Container Development	TBD
	Packing Fabrication Study Plan (-014) (37)	3/88
	Packing Nondestructive Examination Study Plan (-015) (26)	3/88
	Packing Handling and Emplacement Study Plan (-016) (24)	3/88
	Container Settlement Study Plan (-019) (29)	3/88

**BWIP STUDY PLANS [SUBJECT; TITLE; (SD-BWI-XXX)(Est. Pages)]****Tent. DATE**

<b>Site Department</b>		<b>Tent. DATE</b>
	<b>Mineral, Hydrocarbon, and Geothermal Resource Potential Study Plan (-044) (35)</b>	<b>3/88</b>
	<b>Tectonic Model Development Study Plan (-052) (11)</b>	<b>4/88</b>
	<b>Intraflow Structures Study Plan (-036) (60)</b>	<b>2/88</b>
	<b>Constitutive Model Development Study Plan (-047) (60)</b>	<b>1/88</b>
	<b>Groundwater Flow System Hydrochemistry Study Plan (-032) (50)</b>	<b>4/88</b>
	<b>Site Groundwater Study Plan (057) (150)</b>	<b>4/88</b>
	<b>Minerologic and Petrologic Characterization Study Plan (-030) (50)</b>	<b>2/88</b>
	<b>Surface Water System Study Plan (-034) (101)</b>	<b>2/88</b>
	<b>Site Flooding Study Plan (-033) (28)</b>	<b>2/88</b>
	<b>Physical Rock Properties Characterization Study Plan (-059) ( )</b>	<b>3/88</b>
	<b>Stratigraphy Study Plan (-035) (75)</b>	<b>2/88</b>
	<b>Cooling Joint Characteristics Study Plan (-043) (55)</b>	<b>3/88</b>
	<b>Structural Geology and Geophysics Study Plan (-054) (105)</b>	<b>3/88</b>
	<b>Past Climatic Change Study Plan (-050) (68)</b>	<b>4/88</b>
	<b>Site Meteorology Study Plan</b>	<b>5/88</b>
	<b>Deformation Study Plan (-055) (35)</b>	<b>3/88</b>
	<b>Earthquake Seismology Study Plan (-031) (150)</b>	<b>3/88</b>
	<b>Regional Groundwater Study Plan (-053) (150)</b>	<b>4/88</b>
	<b>Water Resource Potential Study Plan (-051) (19)</b>	<b>3/88</b>
	<b>Future Climatic Change Study Plan (-049) (50)</b>	<b>4/88</b>
	<b>Groundwater Redox (-001) (43)</b>	<b>4/88</b>
	<b>Radionuclide Reactivity Study Plan (-029) (140)</b>	<b>4/88</b>



SRPD STUDY PLANS [Approx. Sequential No.: TITLE]TENT. DATE

- ( 1) Meteorology/Air Quality SSP
- ( 2) Land Use SSP
- ( 3) Background Environmental Radioactivity SSP
- ( 4) Socioeconomics SSP
- ( 5) Water Resources SSP
- ( 6) Surface Geologic Mapping
- ( 7) Exploratory Shaft Facilities Design Foundation Borings
- ( 8) 3-D Seismic Reflection Survey
- ( 9) EDBH 1 and 2
- (10) EDBH Seismic Reflection Survey
- (11) Borehole Search
- (12) Potential Field Surveys
- (13) Micro Seismic Monitoring
- (14) Intermediate (Shallow) Aquifer Hydro Clusters
- (15) Exploratory Shaft Monitoring Wells
- (16) Geochemistry Sampling Plan
- (17) Geochemistry Analytical Requirements and Methodologies
- (18) Playa Studies
- (19) Regional Geologic Studies
- (20) Stratigraphic Boreholes
- (21) Topographic and Leveling Surveys
- (22) Regional Hydrologic Studies
- (23) Upper Hydro Clusters
- (24) Lower Aquifer (Deep) Hydro Clusters
- (25) Transportation/Utility Foundation Borings

Soon  
After  
SCP

Y  
FY-88

SRPD STUDY PLANS [Approx. Sequential No.; TITLE]

TENT. DATE

- (26) Regional Seismic Surveys
- (27) Laboratory Soil Testing
- (28) Routine Rock Mechanics Properties
- (29) Geohydrologic System Analysis Plan
- (30) Special Rock Mechanics Properties
- (31) Shaft Surface Facility Monitoring Wells
- (32) Geochemical Characteristics of HSU A
- (33) Geochemical Characteristics of HSU B
- (34) Geochemical Characteristics of HSU C
- (35) Repository Surface Facilities Foundation Borings
- (36) Repository Surface Facility Monitoring Wells
- (37) Water Supply Wells
- (38) Brine Origin and Evolution
- (39) Host Rock Isolation Characteristics
- (40) Radionuclide Solubility
- (41) Radionuclide Retardation
- (42) Repository Geochemical Environment
- (43) Seal System Geochemical Environment
- (44) Performance Assessment Overview
- (45) Postclosure Waste Package Performance Assessment
- (46) Postclosure Site Performance Assessment
- (47) Postclosure Total System Performance Assessment
- (48) Postclosure Shafts and Seals Performance Assessment
- (49) Postclosure Repository Performance Assessment
- (50) Preclosure Performance Assessment

FY-88

Beyond  
FY-88

SRPD STUDY PLANS [Approx. Sequential No.; TITLE]

TENT. DATE

Beyond  
FY-88'

- (51) Shaft SSP
- (52) At-Depth SSP
- (53) Detailed Salt Stratigraphy
- (54) Room Heater
- (55) Brine Migration Test
- (56) Room Backfill Test
- (57) Underground Environmental Monitoring
- (58) Waste Package Heater Test
- (59) Room Heater
- (60) Mine-By
- (61) Borehole Seal
- (62) Compatibility between Components of the Seal system and  
their Geochemical Environments
- (63) Effects of the Seal System on the Geochemical  
Environment of the Host Rock and Surrounding Units
- (64) Thermal Analysis Validation (Waste Package)
- (65) Study of Emplacement Hole Closure and Waste Package  
Pressure
- (66) Laboratory Study of Brine Mobilization and Movement  
(Waste Package)
- (67) In Site Study of Brine Migration (Waste Package)
- (68) Waste Selection and Characterization Study
- (69) Radionuclide Solubility and Specification Behavior Study

SRPD STUDY PLANS [Approx. Sequential No.; TITLE]

TENT. DATE

- (70) Spent Fuel Leach Study
- (71) Borosilicate Glass Leach Study
- (72) General Corrosion Study
- (73) Electrochemical Study
- (74) Localized Corrosion Study
- (75) Stress Corrosion Cracking Study
- (76) Hydrogen Effect Study
- (77) Chemical Properties Study
- (78) Physical Properties Study
- (79) Thermal Properties Study
- (80) Packing Materials Consolidation Study
- (81) Compatibility Study
- (82) Laboratory Analog Study
- (83) In Situ Interaction Study
- (84) Fabrication Study
- (85) Advanced Conceptual Design Study
- (86) License Application Design Study
- (87) Waste Package Development Models Study
- (88) Waste Package Standard Models Study
- (89) Waste Package Systems Performance Study

Beyond  
FY-88



TO: Distribution shown on attached "Checklist"

DATE: \_\_\_\_\_

FROM: D.E. Alexander

SUBJECT: HQ Review of SCP Study Plan: \_\_\_\_\_

The attached SCP Study Plan has been received and found acceptable for technical review. The responsible Lead Review Branch is indicated on the attached checklist as well as the HQ organizations requested to participate in the technical review. The technical reviews should focus on the content of the study plan and especially whether that content meets the requirements laid out in the May 7-8, 1986 DOE-NRC agreement. All review comments should be made on the standard (white) study plan review comment sheets.

A comment consolidation meeting under the chairmanship of the head Review Branch will be held:

Date \_\_\_\_\_

Time \_\_\_\_\_

Location \_\_\_\_\_

The comment resolution workshop on this study plan will be held with project office personnel:

Date \_\_\_\_\_

Time \_\_\_\_\_

Location \_\_\_\_\_

If you have any questions or problems related to this matter, please call me (1238) or Carol Hanlon (1224).

cc: J. Bresee	w/ enclosures
T. Isaacs	" "
J. Nelson	" "
D. Fenster	" "
E. Taylor	" "
W. McClain	" "
R. Stein	" "
J. Knight	" "
Submitting Project Office	w/o enclosures

**STUDY PLAN CHECKLIST**

Project Office \_\_\_\_\_

Study Plan Number & Title \_\_\_\_\_

Other Identifiers, if any \_\_\_\_\_

Date of Study Plan \_\_\_\_\_

Acceptability Reviewer \_\_\_\_\_

Date of Review \_\_\_\_\_

Acceptable for Technical Review \_\_\_\_\_

Lead Review Branch \_\_\_\_\_

**Technical Reviews (distribution):**

Technology Br.      Engineering Br.      GeoSciences Br.      Proj. Mgt. Br.

☐

C. Hanlon  
S. Singal

☐

M. Frei

☐☐

R. Blaney

Siting, Licenses  
& QA Div.

☐

C. Head  
C. Newton  
G. Parker

Econ. & Int'l  
Analysis Br.

☐

B. Gale

O. Environment  
Safety & Health

☐

C. Borgstrom  
C. Bradley

O. General  
Counsel

☐

R. Mussler  
S. Echols

Approved \_\_\_\_\_ Date \_\_\_\_\_  
(Chief, Technology Branch)

	<u>YES</u>	<u>NO</u>
1. Is the study identified in the SCP with the same title and numbers?	_____	_____
2. Is the study described in the study plan consistent with the study description presented in the SCP?	_____	_____
3. Is there an explicit link between the tests and analyses in the study and the relevant issue resolution strategies (including relevant performance goals or parameter goals) set forth in the SCP?	_____	_____
4. Is the overall schedule for the study in the study plan consistent with the schedule presented in the SCP Section 8.5?	_____	_____
5. Does the study plan contain the material called for in the May 7-8, 1986 DOE-NRC agreement on content requirements? Specifically, does it contain:	_____	_____
I. Purpose and Objective of Study	_____	_____
II. Rationale for Selected Study	_____	_____
III. Description of Tests and Analysis	_____	_____
IV. Application of Results	_____	_____
V. Schedule and Milestones	_____	_____

**CHECKLIST FOR TECHNICAL REVIEW**  
**OF STUDY PLAN**

Project Office \_\_\_\_\_

Study Plan Number & Title \_\_\_\_\_

Other Identifiers, if any \_\_\_\_\_

Date of Study Plan \_\_\_\_\_

Reviewer/Compiler \_\_\_\_\_

One of the primary purposes of the technical reviews of the study plans is to judge the adequacy and acceptability of the material against the requirements in the May 7-8, 1986 DOE-NRC agreement on content. This checklist is intended to focus and summarize that aspect of the review. The checklist therefore constitutes a general comment on the study plan. Because of that, any item checked "No" should also have a written-in comment. Supplemental comment sheets (white) can and should be filled out for any item the reviewer feels strongly about, whether or not it is indicated on the checklist.

The following checklist gives the responses to the question: Does the study plan provide adequate, appropriate and acceptable material meeting the requirements of the May 7-8 DOE-NRC agreement with regard to . . .

	<u>YES</u>	<u>NO</u>	<u>N/A</u>
<b>I. Purpose and Objective of Study</b>			
o Information to be obtained by the study and its use?	_____	_____	_____
o Rationale/justification for information to be obtained?	_____	_____	_____
<b>II. Rationale for Selected Study</b>			
o Rationale for selected tests and analyses?	_____	_____	_____
o Rationale for selected number, location, duration, timing of tests, considering uncertainty and alternatives?	_____	_____	_____
o Constraints for the study?	_____	_____	_____



	<u>YES</u>	<u>NO</u>	<u>N/A</u>
<b>III. Description of Tests and Analyses</b>			
o For each type of test:			
- Approach, parameters, conditions, number, locations?	_____	_____	_____
- Test methods, procedures, QA requirements?	_____	_____	_____
- Tolerance, accuracy, precision?	_____	_____	_____
- Expected results?	_____	_____	_____
- Test Equipment?	_____	_____	_____
- Data reduction and analysis?	_____	_____	_____
- Representativeness of test, limitations, uncertainties?	_____	_____	_____
- Locations, layout of test?	_____	_____	_____
- Relationship of tests to performance/parameter goals?	_____	_____	_____
o For each type of analysis:			
- Purpose, including test or design activity being supported?	_____	_____	_____
- Methods of analysis?	_____	_____	_____
- Reference to procedures, QA requirements?	_____	_____	_____
- Data input to analysis?	_____	_____	_____
- Expected output of analysis and accuracy?	_____	_____	_____
- Representativeness of analytical approach, limitations, and uncertainties?	_____	_____	_____

YES    NO    N/A

**IV. Application of Results**

- |  |       |       |       |
|--|-------|-------|-------|
| o Where results of study will be used?                     | _____ | _____ | _____ |
| o Reference to performance assessment analyses?            | _____ | _____ | _____ |
| o Reference to design and development?                     | _____ | _____ | _____ |
| o Reference to planning other characterization activities? | _____ | _____ | _____ |

**V. Schedule and Milestones**

- |  |       |       |       |
|--|-------|-------|-------|
| o Durations and interrelationships of activities in study? | _____ | _____ | _____ |
| o Timing of study relative to other studies?               | _____ | _____ | _____ |
| o Dates for activities and milestones?                     | _____ | _____ | _____ |

**DOE CONTENT REQUIREMENTS FOR DESCRIPTIONS OF STUDIES  
IN STUDY PLANS**

The test program presented in Chapter 8 of the SCP will be subdivided into a hierarchy of increasing detail. The SCP test program hierarchy will include (in increasing detail): generic program; specific program; investigation; study; tests and analyses; and test procedures. Details for studies and tests and analyses, listed in Chapter 8 of the SCP, will be presented in study plans. Study plans will be separate from the SCP proper and will be issued periodically throughout site characterization. Individual test procedures will be referenced in the study plans.

The following outline describes the information on studies, tests and analyses that will be presented in the study plans. A study may involve a single test or a set of tests and analyses, as appropriate. The tests include those measurements of physical parameters, or observations of physical phenomena, that are performed in the field or in the laboratory. Test activities include preparation of procedures, test set-up, conduct of the test, data acquisition, and data reduction. The analyses include those calculations or other evaluations needed to assess site characteristics and support design activities.

The items listed in the outline will be addressed for studies and tests and analyses to the extent that each item applies. Not all items will be applicable in all studies.

In some cases, tests and analyses may be planned for later stages in the study for which the detailed plans depend on the results of earlier tests and analyses. Under these circumstances, it will not be possible to provide the same level of detail for all tests and analyses at the time the study plan is first issued. In such cases, the initial study plans will present complete descriptions of the tests and analyses that occur early in the study and less detailed information for tests and analyses that occur later.

**I. Purpose and Objectives of Studies:**

- o Describe the information that will be obtained in this study. Briefly discuss how this information will be used; and
- o Provide the rationale and justification for the information to be obtained by the study. It can be justified by: 1.) a performance goal and a confidence level in that goal (developed via the performance allocation process and results that will be described elsewhere in the SCP); 2.) a design goal and a confidence level in that goal (design goals beyond those related to performance issues); 3.) a direct Federal, State, and other regulatory requirements for specific studies. Where relevant

performance or design goals actually apply at a higher level than the study (e.g. where the goals apply to a group of studies), describe the relationship between this study and that higher level goal.

## **II. Rationale for Selected Study:**

- o Provide the rationale and justification for the selected tests and analyses (including standard tests). Indicate the alternative test and analytical methods from which they were selected, including options for type of test, instrumentation, data collection and recording, and alternative analytical approaches. Describe the advantages and limitations of the various options; and
- o Provide the rationale for the selected number, location, duration, and timing of tests with consideration to various sources of uncertainty (e.g. test method, interference with other tests, and estimated parameter variability). This rationale should also identify reasonable alternatives, summarize reasons for not selecting these alternatives and reference, if available, reports which evaluate alternatives considered (refer to NRC Observation 8).
- o Describe the constraints that exist for the study, and explain how these constraints affect selection of test methods and analytical approaches. Factors to be considered include:
  - Potential impacts on the site from testing;
  - Whether the study needs to simulate repository conditions;
  - Required accuracy and precision of parameters to be measured with test instrumentation;
  - Limits of analytical methods that will use the information from the tests;
  - Capability of analytical methods to support the study; and
  - Time required versus time available to complete the study.
  - The scale of the phenomena, especially the limitations of the equipment relative to the scale of the phenomena to be measured and the applicability of studies conducted in the laboratory to the scale of the phenomena in the field.
  - Interrelationships of tests involving significant interference with other tests and how plans have been designed or sequenced to address such interference.
  - Interrelationships involving significant interference

among tests and exploratory shaft facility design and construction (as appropriate, refer to Section 8.4 of the SCP or its references for specific exploratory shaft facility design information such as design drawings or specifications) (refer to NRC Observation 4).

### **III. Description of Tests and Analyses:**

- o Since studies are comprised of tests and analyses, provide for each type of test:**
  - Describe the general approach that will be used in the test. Describe key parameters that will be measured in the test and the experimental conditions under which the test will be conducted. Indicate the number of tests and their locations (e.g. spatial location relative to the site, exploratory shaft facility elements, repository layout, stratigraphic units, depth, and test location);**
  - Summarize the test methods. Reference any standard procedures (e.g., ASTM, API) to be used. If any of the procedures to be used are not standard, or if a standard procedure will be modified, summarize the steps of the test, how it will be modified, and reference the technical procedures that will be followed during the test. If procedures are not yet available, indicate when they will be available. Indicate the level of quality assurance and provide a rationale for any tests which are not judged to be QA level 1. Reference the applicable specific QA requirements that will be applied to the test;**
  - Specify the tolerance, accuracy, and precision required in the test, where appropriate;**
  - Indicate the range of expected results of the test and the basis for those expected results;**
  - List the equipment required for the test and describe briefly any such equipment that is special;**
  - Describe techniques to be used for data reduction and analysis of the results;**
  - Discuss the representativeness of the test including why the test results are considered representative of future conditions or the spatial variability of existing conditions. Also indicate limitations and uncertainties that will apply to the use of the results; and**
  - Provide illustrations such as maps, cross sections, and facility design drawings to show the locations of tests and schematic layouts of tests.**

- Relationship of the test to the set performance goals and confidence levels.

o For each type of analysis:

- State the purpose of the analysis, indicating the testing or design activity being supported. Indicate what conditions or environments will be evaluated and any sensitivity or uncertainty analyses that will be performed. Discuss the relationship of the analysis to the set performance goals and confidence levels;
- Describe the methods of analysis, including any analytical expressions and numerical models that will be employed;
- Reference the technical procedures document that will be followed during the analysis. If procedures are not yet available, indicate when they will be available. Indicate the level of quality assurance that will be applied to the analysis and provide a rationale for any analyses which are not judged to be QA level 1. Reference the applicable QA requirements;
- Identify the data input requirements of the analysis;
- Describe the expected output and accuracy of the analysis; and
- Describe the representativeness of the analytical approach (e.g., with respect to spatial variability of existing conditions and future conditions) and indicate limitations and uncertainties that will apply to the results.

IV. Application of Results:

- o Briefly discuss where the results from the study will be used for the support of other studies (performance assessment, design, and characterization studies);
- o For performance assessment uses, refer to specific performance assessment analyses (described in Section 8.3.5 of the SCP) which will use the information produced from the studies described above, and refer to any use of the results for model validation;
- o For design uses, refer to, or describe, where the information from the study described above will be used in construction equipment design and development and engineering system design and development (e.g., waste package, repository engineered barriers, and shafts and borehole seals); and
- o For characterization uses, refer to, or describe, where the

information from the study described above will be used in planning other characterization activities.

V. Schedule and Milestones:

- o Provide the durations of and interrelationships among the principal activities associated with conducting the study (e.g., preparation of test procedures, test set-ups, testing, data analyses, preparation of reports), and indicate the key milestones including decision points associated with the study activities;
- o Describe the timing of this study relative to other studies and other program activities that will affect, or will be affected by, the schedule for completion of the subject study; and
- o Dates for activities or milestones, including durations and interrelationships, for the study plans will be provided. These should reference the master schedules provided in Section 8.5. of the SCP.

WM DOCKET CONTROL  
WM DOCKET CONTROL  
CENTER

'87 DEC -2 AM 1:33

WM Record File

109

WM Project 1

Docket No. \_\_\_\_\_

PDR ☒

LPDR \_\_\_\_\_

Distribution:

REB  
SOP

MRB

FTana

Youngblood

(WM, 623-SS)

Young