Received Letter dtd. 3/9/93

YMP/92-24

U.S. DEPARTMENT OF ENERGY

OCRWM

YUCCA MOUNTAIN

YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT

SITE CHARACTERIZATION PARAMETER TABLES

REVISION 0

AUGUST 1992

UNITED STATES DEPARTMENT OF ENERGY

YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT

SITE CHARACTERIZATION PARAMETER TABLES

REVISION 0

AUGUST 1992

Prepared for

U.S. Department of Energy
Office of Civilian Radioactive Waste Management

Prepared for the Yucca Mountain Site Characterization Project as part of the Civilian Radioactive Waste Management Program. The Yucca Mountain Site Characterization Project is managed by the Yucca Mountain Site Characterization Project Office of the U.S. Department of Energy. The Yucca Mountain Site Characterization Project work is sponsored by the U.S. Department of Energy Office of Civilian Radioactive Waste Management.

YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT

SITE CHARACTERIZATION PARAMETER TABLES

Approved by:

Claudia M Newbury

Russell Dyer, Director
Regulatory & Site Evaluation Division
Yucca Mountain Site Characterization Project

9/10/92
Date

R. E. Spence

Richard E. Spence, Director
Yucca Mountain Quality Assurance Division
Yucca Mountain Site Characterization Project

9/10/92
Date

TABLE OF CONTENTS

LIST OF TABLES

LIST OF TABLES (continued)

LIST OF TABLES (continued)

1.0 SITE CHARACTERIZATION PARAMETERS

1.1 PURPOSE AND SCOPE

The information in the Site Characterization Parameter Tables document has been extracted from Sections 8.3.1 of the Yucca Mountain Site Characterization Program Baseline (SCPB), Revision 8 (YMP/CM-0011). This document includes site characterization activity parameter tables that support the performance allocation tables in the SCPB.

The activity parameter tables were developed in response to requests for site data from performance assessment and design programs. These requests for site data are documented in the performance allocation tables in the baselined SCPB. During site characterization, the SCPB performance allocation tables will be revised to reflect current planning as the site characterization program evolves and new or modified testing strategies are developed. When an approved change to a performance allocation table in the SCPB is baselined, the corresponding activity parameter tables in this document will be reviewed and revised for consistency with the technical baseline in the SCPB.

The Site Characterization Parameter Tables Document is a controlled document. Any revisions to this document will be reviewed, approved, and controlled in accordance with appropriate procedures.

1.2 GEOHYDROLOGY

Table 8.3.1.2-1 provides the initial framework for relating (1) the parameter requirements of the design and performance issues, and (2) the parameters that will be provided by the geohydrology program to satisfy those requirements. Table 8.3.1.2-1 lists in the two left-hand columns the issues and section numbers that call for information from the geohydrology program. In the two right-hand columns, the table lists the activity parameters that will be obtained in the program in response to those requirements, along with the section numbers where the activities are described that will obtain the parameters. The middle column (parameter category) provides the linkage between the performance and design and the characterization parts of the table; this column also provides the organizational structure upon which the listings of issues and activity parameters are based.

Activity parameters generally are those parameters that will be generated by the field and laboratory testing activities. They represent the most basic measurements that will be used in analyses to characterize the geohydrology of the site. Many of the activity parameters are building blocks to support various aspects of the project. Some, such as hydraulic conductivity, support design and performance issues directly; others, such as drainage-basin areas, primarily provide bases for analyses and evaluations to be conducted within the geohydrology program or within other characterization programs.

In Table 8.3.1.2-1, the activity parameters are grouped according to parameter categories. These categories, including major categories (such as "unsaturated-zone hydraulic and gaseous phase properties") and subcategories (such as unsaturated-zone transmissive properties) are topical categories that serve to group similar types of performance and design parameters and match them with groups of similar types of parameters to be obtained during site characterization. Generally, a one-to-one correspondence is not to be expected between a performance parameter and an activity parameter because of the great diversity, number, and highly specific nature of both types of parameters.

In addition to supporting design and performance analyses, the activity parameters included in Table 8.3.1.2-1 are needed (1) to test hypotheses that support conceptual models and (2) as input to hydrologic numerical models. A common requirement for all the parameters is that sufficient confidence can be placed in their values and in the understanding of their interrelationships that they can be used with confidence for the purpose intended. Therefore, a principal strategy of the geohydrology program is to use approaches that minimize uncertainty in the values of the parameters and in the understanding of their interrelationships, within the constraints of available resources. Some degree of uncertainty is inevitable because parameters vary in space and time, measurements contain errors, and hydrologic processes are slow and difficult to measure. But the strategy of the geohydrology program is to increase confidence by using multiple approaches to parameter determination, by testing hypotheses, and by developing valid models.

Table 8.3.1.2-1. Activity parameters provided by the geohydrology program that support performance and design issues (page 1 of 38)

Calls by performance and design issues		Parameter category	Response by geohydrology characterization program	
Issue	SCP section		Activity parameter	SCP activity
			METEOROLOGICAL CHARACTERISTICS	
1.12 2.1 2.2 2.3 2.7 4.4	8.3.3.2 8.3.5.3 8.3.5.4 8.3.5.5 8.3.2.3 8.3.2.5	Meteorological characteristics	Storm movement and intensity; meteorological input to unsaturated-zone infiltration and gas-phase circulation studies; (with integrated meteorological network)	8.3.1.2.1.1
			Atmospheric pressure and pressure variability	8.3.1.2.1.1.1
			Atmospheric stability; relations to storms	8.3.1.2.1.1.1
			Atmospheric temperature	8.3.1.2.1.1.1
			Humidity, relative; diurnal and seasonal variability	8.3.1.2.1.1.1
			Precipitation chemistry	8.3.1.2.1.1.1
			Precipitation, intensity and duration (monthly and seasonal variability)	8.3.1.2.1.1.1
			Radiation and irradiation, infrared (diurnal and seasonal variability)	8.3.1.2.1.1.1
			Wind, speed, and direction (diurnal, seasonal, and storm-specific variability)	8.3.1.2.1.1.1
			Air temperature	8.3.1.2.1.2.1
			Precipitation, quantity and timing	8.3.1.2.1.2.1
			Air temperature	8.3.1.2.1.3.3
			Precipitation, quantities and frequency	8.3.1.2.1.3.3
			Precipitation	8.3.1.2.2.1.2

Table 8.3.1.2-1. Activity parameters provided by the geohydrology program that support performance and design issues (page 2 of 38)

Calls by performance and design issues		Parameter category	Response by geohydrology characterization program	
			Activity parameter	SCP activity
Issue	SCP section			
		METEOROLOGICAL CHARACTERISTICS (continued)		
		Meteorological characteristics (continued)	Rainfall, experimentally induced	8.3.1.2.2.1.3
			Air temperature	8.3.1.2.2.6.1
			Barometric pressure	8.3.1.2.2.6.1
			Relative humidity	8.3.1.2.2.6.1
		SURFACE-WATER HYDRAULIC CHARACTERISTICS		
1.1	8.3.5.13	Surface-water flood and runoff characteristics	Runoff and streamflow, hydrologic characteristics	8.3.1.2.1.2
1.12	8.3.3.2		Durations of individual runoff events	8.3.1.2.1.2.1
2.1	8.3.5.3		Occurrences and geographics extent of runoff	8.3.1.2.1.2.1
2.3	8.3.5.5		Runoff quantities, at specific site for specific events	8.3.1.2.1.2.1
2.7	8.3.2.3		Runoff rates at specific sites	8.3.1.2.1.2.1
4.4	8.3.2.5		Runoff durations	8.3.1.2.1.3.3
			Runoff frequencies	8.3.1.2.1.3.3
			Runoff quantities	8.3.1.2.1.3.3
			Runoff rates	8.3.1.2.2.1.1
			Runoff	8.3.1.2.2.1.2
			Runoff; experimentally induced	8.3.1.2.2.1.3

Table 8.3.1.2-1. Activity parameters provided by the geohydrology program that support performance and design issues (page 3 of 38)

Calls by performance and design issues		Parameter category	Response by geohydrology characterization program	
Issue	SCP section		Activity parameter	SCP activity
		SURFACE-WATER HYDRAULIC CHARACTERISTICS (continued)		
1.1 1.12 2.7	8.3.5.13 8.3.3.2 8.3.2.3	Surface-water debris-transport characteristics	Sediment component of runoff	8.3.1.2.1.2.1
			Flood debris, physical characteristics	8.3.1.2.1.2.2
			Hillslope and channel erosion, location and areal extent	8.3.1.2.1.2.2
			Sediment deposits, location and areal extent	8.3.1.2.1.2.2
		SURFACE-WATER BOUNDARY CONDITIONS		
1.2 1.12	8.3.5.13 8.3.3.2	Surface-water drainage-basin and channel characteristics	Hillslope and channel erosion, timing	8.3.1.2.1.2.2
			Drainage-basin and channel geometry (aspect, area, configuration, slope, Manning coefficient)	8.3.1.2.1.3.3
			Surficial deposits, distribution, and characteristics	8.3.1.2.1.3.3
1.1 1.12	8.3.5.13 8.3.3.2	Surface-water chemistry and temperature	Hydrochemistry, surface water	8.3.1.2.1.3.3

Table 8.3.1.2-1. Activity parameters provided by the geohydrology program that support performance and design issues (page 4 of 38)

Calls by performance and design issues		Parameter category	Response by geohydrology characterization program	
Issue	SCP section		Activity parameter	SCP activity
		SURFACE-WATER HYDROLOGIC CONCEPTUAL/DESCRIPTIVE MODELS		
1.1 1.12 2.7	8.3.5.13 8.3.3.2 8.3.2.3	Surface-water hydrologic conceptual/descriptive models	Precipitation and its relation to surface runoff with particular emphasis on the Fortymile Wash drainage basin; rainfall-runoff model	8.3.1.2.1.1
			Flood and fluvial-debris hazards (8.3.1.16.1.1)	8.3.1.2.1.2
			Runoff and streamflow, relation to amounts and processes of groundwater recharge	8.3.1.2.1.2
			Runoff and streamflow, relation to precipitation	8.3.1.2.1.2
			Relations of runoff to weather conditions	8.3.1.2.1.2.1
			Runoff frequencies in specific and general areas	8.3.1.2.1.2.1
		UNSATURATED-ZONE HYDRAULIC AND GASEOUS-PHASE PROPERTIES		
1.1 1.6 1.10 1.12 4.4	8.3.5.13 8.3.5.12 8.3.4.2 8.3.3.2 8.3.2.5	Unsaturated-zone transmissive properties	Recharge locations, rates, and history	8.3.1.2.1.3.3
			Hydraulic conductivity	8.3.1.2.2.1.3
			Flux-related, matrix hydrologic properties (transmissive) of geologic samples	8.3.1.2.2.3
			Permeability, effective, hydraulic, matrix; subsurface geologic samples	8.3.1.2.2.3.1

Table 8.3.1.2-1. Activity parameters provided by the geohydrology program that support performance and design issues (page 5 of 38)

Calls by performance and design issues		Parameter category	Response by geohydrology characterization program	
Issue	SCP section		Activity parameter	SCP activity
UNSATURATED-ZONE HYDRAULIC AND GASEOUS-PHASE PROPERTIES (continued)				
		Unsaturated-zone transmissive properties	Permeability, relative, hydraulic, matrix, subsurface geologic samples	8.3.1.2.2.3.1
			Effective matrix porosity	8.3.1.2.2.3.2
			Hydraulic conductivity	8.3.1.2.2.3.2
			Permeability, in situ, hydraulic, bulk	8.3.1.2.2.3.2
			Permeability, in situ, pneumatic, bulk	8.3.1.2.2.3.2
			Permeability, matrix, as a function of saturation and matric potential, laboratory	8.3.1.2.2.3.2
			Effective porosity	8.3.1.2.2.3.3
			Fracture connectiveness	8.3.1.2.2.3.3
			Permeability, in situ, hydraulic, bulk	8.3.1.2.2.3.3
			Permeability, in situ, pneumatic, bulk	8.3.1.2.2.3.3
			Effective permeability to air as a function of saturation, water potential, and applied stress	8.3.1.2.2.4.1
			Effective permeability to water as a function of saturation, water potential, and applied stress	8.3.1.2.2.4.1

Table 8.3.1.2-1. Activity parameters provided by the geohydrology program that support performance and design issues (page 6 of 38)

Calls by performance and design issues		Parameter category	Response by geohydrology characterization program	
Issue	SCP section		Activity parameter	SCP activity
		UNSATURATED-ZONE HYDRAULIC AND GASEOUS-PHASE PROPERTIES		
1.1 1.6 1.10 1.12 4.4	8.3.5.13 8.3.5.12 8.3.4.2 8.3.3.2 8.3.2.5	Unsaturated-zone transmissive properties	Effective porosity for single fracture	8.3.1.2.2.4.1
			Permeability, effective, single fractures	8.3.1.2.2.4.1
			Effective porosities of the matrix and fractures	8.3.1.2.2.4.2
			Effective porosity, matrix and fractures	8.3.1.2.2.4.2
			Fracture connectiveness	8.3.1.2.2.4.2
			Hydraulic conductivity	8.3.1.2.2.4.2
			Hydraulic conductivity; unsaturated to air and water as functions of water saturation and matric potential	8.3.1.2.2.4.2
			Pneumatic conductivity, fracture networks	8.3.1.2.2.4.2
			Unsaturated hydraulic conductivity to air as a function of bulk water saturation and matric potential (including determination of critical saturation)	8.3.1.2.2.4.2
			Unsaturated hydraulic conductivity to water as a function of bulk water saturation and matric potential (including determination of critical saturation)	8.3.1.2.2.4.2
			Effective porosity of matrix and fractures (including pore-size distribution of matrix)	8.3.1.2.2.4.3

Table 8.3.1.2-1. Activity parameters provided by the geohydrology program that support performance and design issues (page 7 of 38)

Calls by performance and design issues		Parameter category	Response by geohydrology characterization program	
Issue	SCP section		Activity parameter	SCP activity
UNSATURATED-ZONE HYDRAULIC AND GASEOUS-PHASE PROPERTIES (continued)				
		Unsaturated-zone transmissive properties (continued)	Effective porosity, bulk; fracture-matrix networks	8.3.1.2.2.4.3
			Fracture and fracture-set spacing and density	8.3.1.2.2.4.3
			Hydraulic conductivity, unsaturated relative to air and water as a function of saturation and matric potential	8.3.1.2.2.4.3
			Permeability; (air) before and after excavation; hydraulic and pneumatic tests	8.3.1.2.2.4.3
			Permeability; (pneumatic) bulk, fracture/matrix networks; hydraulic and pneumatic tests	8.3.1.2.2.4.3
			Pneumatic conductivity; directional and saturation dependence; hydraulic and pneumatic tests	8.3.1.2.2.4.3
			Unsaturated hydraulic conductivities relative to air as a function of saturation and matric potential	8.3.1.2.2.4.3
			Bulk permeability	8.3.1.2.2.4.4
			Bulk permeability, pneumatic	8.3.1.2.2.4.4
			Bulk porosity	8.3.1.2.2.4.4
			Fracture permeability	8.3.1.2.2.4.4
			Gas permeability, excavation effects	8.3.1.2.2.4.4
			Permeability (pneumatic) bulk, fractured rock	8.3.1.2.2.4.4

Table 8.3.1.2-1. Activity parameters provided by the geohydrology program that support performance and design issues (page 8 of 38)

Calls by performance and design issues		Parameter category	Response by geohydrology characterization program	
Issue	SCP section		Activity parameter	SCP activity
UNSATURATED-ZONE HYDRAULIC AND GASEOUS-PHASE PROPERTIES (continued)				
		Unsaturated-zone transmissive properties (continued)	Permeability (relative), gas; rock matrix	8.3.1.2.2.4.4
			Permeability (relative), water; rock matrix	8.3.1.2.2.4.4
			Permeability (saturated), gas; rock matrix	8.3.1.2.2.4.4
			Air-permeability profiles	8.3.1.2.2.4.5
			Permeability profiles	8.3.1.2.2.4.5
			Hydraulic conductivity, perched-water zones	8.3.1.2.2.4.7
			Transmissivity, perched-water zones	8.3.1.2.2.4.7
			Bulk permeability (pneumatic)	8.3.1.2.2.4.9
			Effective porosity	8.3.1.2.2.4.9
			Hydraulic conductivity (perched-water zones)	8.3.1.2.2.4.9
			Transmissivity (perched-water zones)	8.3.1.2.2.4.9
			Air permeability, matrix	8.3.1.2.2.4.10
			Water permeability, matrix	8.3.1.2.2.4.10
			Conductive properties, gas flow	8.3.1.2.2.6
			Effective porosity	8.3.1.2.2.6.1
			Fracture connectivity	8.3.1.2.2.6.1
			Fracture permeability, anisotropic	8.3.1.2.2.6.1
			Permeability, pneumatic, bulk	8.3.1.2.2.6.1
			Porosity, fracture, effective	8.3.1.2.2.6.1

Table 8.3.1.2-1. Activity parameters provided by the geohydrology program that support performance and design issues (page 9 of 38)

Calls by performance and design issues		Parameter category	Response by geohydrology characterization program	
Issue	SCP section		Activity parameter	SCP activity
		UNSATURATED-ZONE HYDRAULIC AND GASEOUS-PHASE PROPERTIES (continued)		
1.1 1.6	8.3.5.13 8.3.5.12	Unsaturated-zone storage properties	Matrix porosity	8.3.1.2.2.1.1
			Moisture retention curves	8.3.1.2.2.1.1
			Flux-related, matrix hydrologic properties (storage) of geologic samples	8.3.1.2.2.3
			Matrix pore-size distribution, subsurface geologic samples	8.3.1.2.2.3.1
			Moisture retention curves, subsurface geologic samples	8.3.1.2.2.3.1
			Porosity; subsurface geologic samples	8.3.1.2.2.3.1
			Matrix pore-size distribution	8.3.1.2.2.3.2
			Porosity, total, laboratory	8.3.1.2.2.3.3
			Moisture retention, rock matrix	8.3.1.2.2.4.4
			Porosity pore-size distribution, matrix	8.3.1.2.2.4.4
			Porosity, bulk, fractured rock	8.3.1.2.2.4.4
			Porosity, matrix	8.3.1.2.2.4.4
			Storage coefficient, perched-water zones	8.3.1.2.2.4.7
			Storage coefficient (perched-water zones)	8.3.1.2.2.4.9
			Storage properties, gas phase	8.3.1.2.2.6
			Storativity, gas	8.3.1.2.2.6.1
1.1 1.10	8.3.5.13 8.3.4.2	Unsaturated-zone dispersive properties	Dispersivity, fractures	8.3.1.2.2.4.1
			Effective dispersivity for single fracture flow	8.3.1.2.2.4.1
			Flow-path tortuosity in single fractures	8.3.1.2.2.4.1

Table 8.3.1.2-1. Activity parameters provided by the geohydrology program that support performance and design issues (page 10 of 38)

Calls by performance and design issues		Parameter category	Response by geohydrology characterization program	
			Activity parameter	SCP activity
		UNSATURATED-ZONE HYDRAULIC AND GASEOUS-PHASE PROPERTIES (continued)		
		Unsaturated-zone dispersive properties (continued)	Tortuosity, fracture-flow paths	8.3.1.2.2.4.1
			Convective dispersivity, fracture networks	8.3.1.2.2.4.2
			Diffusive tortuosity, fractured rock and rock mass	8.3.1.2.2.4.4
			Dispersive properties, gas flow	8.3.1.2.2.6
			Convective dispersivity	8.3.1.2.2.6.1
			Fracture constrictivity	8.3.1.2.2.6.1
1.1	8.3.5.13	Unsaturated-zone diffusive properties	Matrix diffusion coefficient, fracture networks	8.3.1.2.2.4.2
			Gaseous diffusion coefficient, fractured rock units	8.3.1.2.2.4.4
			Diffusivity coefficient	8.3.1.2.2.5.1
1.1	8.3.5.13	Unsaturated-zone fault hydrologic characteristics	Air permeability, rock mass	8.3.1.2.2.4.10
1.6	8.3.5.12		Hydraulic potential, rock mass	8.3.1.2.2.4.10
1.11	8.3.2.2		Pneumatic potential, rock mass	8.3.1.2.2.4.10
1.12	8.3.3.2		Water content, rock mass	8.3.1.2.2.4.10
4.4	8.3.2.5		Water permeability, rock mass	8.3.1.2.2.4.10

Table 8.3.1.2-1. Activity parameters provided by the geohydrology program that support performance and design issues (page 11 of 38)

Calls by performance and design issues		Parameter category	Response by geohydrology characterization program	
Issue	SCP section		Activity parameter	SCP activity
		UNSATURATED-ZONE HYDRAULIC AND GASEOUS-PHASE INITIAL AND BOUNDARY CONDITIONS		
1.1	8.3.5.13	Unsaturated-zone fluid potential	Water potential	8.3.1.2.2.1.1
1.6	8.3.5.13		Flow paths, beneath experimental infiltration plots	8.3.1.2.2.1.3
			Matric potential, beneath experimental infiltration plots	8.3.1.2.2.1.3
			Flux-related, matrix hydrologic properties (fluid potential) of geologic samples	8.3.1.2.2.3
			Matric potential, subsurface geologic samples	8.3.1.2.2.3.1
			Water potential (total), subsurface geologic samples	8.3.1.2.2.3.1
			Matric potential	8.3.1.2.2.3.2
			Pneumatic potential	8.3.1.2.2.3.2
			Pressure head, profiles	8.3.1.2.2.3.2
			Water potential, total	8.3.1.2.2.3.2
			Matric potential	8.3.1.2.2.3.3
			Pneumatic potential	8.3.1.2.2.3.3
			Potential fields (ambient), lateral variation near Solitario Canyon fault zone	8.3.1.2.2.3.3
			Water potential, total	8.3.1.2.2.3.3
			Water potential (fracture), matrix networks	8.3.1.2.2.4.2
			Hydraulic potential of matrix and rock mass	8.3.1.2.2.4.3
			Water potential, matric and rock mass	8.3.1.2.2.4.3

Table 8.3.1.2-1. Activity parameters provided by the geohydrology program that support performance and design issues (page 12 of 38)

Calls by performance and design issues		Parameter category	Response by geohydrology characterization program	
Issue	SCP section		Activity parameter	SCP activity
		UNSATURATED-ZONE HYDRAULIC AND GASEOUS-PHASE INITIAL AND BOUNDARY CONDITIONS (continued)		
		Unsaturated-zone fluid potential (continued)	Water potential (total), hydraulic and pneumatic tests	8.3.1.2.2.4.3
			Matric potential, fractured rock and rock mass	8.3.1.2.2.4.4
			Pneumatic potential, distribution	8.3.1.2.2.4.4
			Water potential (rock matrix), total fractured rock	8.3.1.2.2.4.4
			Water potential (total), perched-water zones	8.3.1.2.2.4.7
			Hydraulic head (perched-water zones)	8.3.1.2.2.4.9
			Matric potential	8.3.1.2.2.4.9
			Water potential	8.3.1.2.2.4.9
			Pneumatic potential	8.3.1.2.2.6.1
			Vapor-pressure deficit (potential), relative, soil gas	8.3.1.2.2.6.1
1.1	8.3.5.13	Unsaturated-zone fluid chemistry, temperature, and age	Hydrochemistry, ground-water	8.3.1.2.1.3.3
1.6	8.3.5.12		Flow paths from tritium analysis	8.3.1.2.2.1.2
1.10	8.3.4.2		Tritium isotopic composition	8.3.1.2.2.1.2
1.12	8.3.3.2		Chloride; soil and tuff samples	8.3.1.2.2.2.1
4.4	8.3.2.5		Chlorine-35 to chlorine-37 ratios, soil and tuff samples	8.3.1.2.2.2.1
			Chlorine-36 to chlorine ratios, soil and tuff samples	8.3.1.2.2.2.1
			Pore gas, composition	8.3.1.2.2.4.4
			Radioactive isotopes	8.3.1.2.2.4.4
			Stable isotopes	8.3.1.2.2.4.4

Table 8.3.1.2-1. Activity parameters provided by the geohydrology program that support performance and design issues (page 13 of 38)

Calls by performance and design issues		Parameter category	Response by geohydrology characterization program	
Issue	SCP section		Activity parameter	SCP activity
UNSATURATED-ZONE HYDRAULIC AND GASEOUS-PHASE INITIAL AND BOUNDARY CONDITIONS (continued)				
		Unsaturated-zone fluid chemistry, temperature, and age (continued)	Temperature, fractured rock	8.3.1.2.2.4.4
			Hydrochemical properties, perched-water zones	8.3.1.2.2.4.7
			Radioactive isotopes	8.3.1.2.2.4.7
			Stable isotopes	8.3.1.2.2.4.7
			Water quality	8.3.1.2.2.4.7
			Hydrochemistry	8.3.1.2.2.4.8
			Moisture loss (water content O-18/O-16 and D/H ratios)	8.3.1.2.2.4.8
			Pore-gas composition	8.3.1.2.2.4.8
			Radioactive-isotope activity (C-14)	8.3.1.2.2.4.8
			Radioactive-isotope activity (Ar-39)	8.3.1.2.2.4.8
			Radioactive-isotope activity (Cl-36)	8.3.1.2.2.4.8
			Radioactive-isotope activity (tritium)	8.3.1.2.2.4.8
			Stable-isotope activity	8.3.1.2.2.4.8
			Stable-isotope ratio analyses	8.3.1.2.2.4.8
			Water quality, cations and anions	8.3.1.2.2.4.8
			Composition of formation gases	8.3.1.2.2.4.9
			Composition of formation water	8.3.1.2.2.4.9
			Radioactive and stable isotope composition	8.3.1.2.2.4.9
			Thermal potential	8.3.1.2.2.4.9
			Water chemistry (perched-water zones)	8.3.1.2.2.4.9
			Carbon-14 activity	8.3.1.2.2.4.10
			Composition of formation gases	8.3.1.2.2.4.10
			Composition of formation water	8.3.1.2.2.4.10
			Stable-isotope composition (oxygen-18, deuterium)	8.3.1.2.2.4.10

Table 8.3.1.2-1. Activity parameters provided by the geohydrology program that support performance and design issues (page 14 of 38)

Calls by performance and design issues		Parameter category	Response by geohydrology characterization program	
Issue	SCP section		Activity parameter	SCP activity
UNSATURATED-ZONE HYDRAULIC AND GASEOUS-PHASE INITIAL AND BOUNDARY CONDITIONS (continued)				
		Unsaturated-zone fluid chemistry, temperature, and age (continued)	Thermal potential, rock mass	8.3.1.2.2.4.10
			Tritium activity	8.3.1.2.2.4.10
			Gas composition	8.3.1.2.2.6.1
			Soil temperature	8.3.1.2.2.6.1
			Temperature profiles	8.3.1.2.2.6.1
			Gas chemistry and age	8.3.1.2.2.7
			Water chemistry and age	8.3.1.2.2.7
			Water-rock chemical interaction and geochemical evolution of water	8.3.1.2.2.7
			Pore-gas composition	8.3.1.2.2.7.1
			Radioactive-isotope activities in gas phase (tritium and C-14)	8.3.1.2.2.7.1
			Stable-isotope activities in gas phase (tritium and C-14)	8.3.1.2.2.7.1
			Pore water hydrochemical properties	8.3.1.2.2.7.2
			Radioactive-isotope activities in liquid phase	8.3.1.2.2.7.2
			Stable-isotope activities in liquid phase	8.3.1.2.2.7.2
			Water quality, cation and anions	8.3.1.2.2.7.2
1.1	8.3.5.13	Unsaturated-zone moisture conditions	Soil moisture content	8.3.1.2.1.3.3
1.6	8.3.5.12		Moisture content	8.3.1.2.2.1.1
1.10	8.3.4.2		Water content, gravimetric	8.3.1.2.2.1.1
1.11	8.3.2.2		Water content, saturation	8.3.1.2.2.1.2
1.12	8.3.3.2		Water content, volumetric	8.3.1.2.2.1.2

Table 8.3.1.2-1. Activity parameters provided by the geohydrology program that support performance and design issues (page 15 of 38)

Calls by performance and design issues		Parameter category	Response by geohydrology characterization program	
Issue	SCP section		Activity parameter	SCP activity
		UNSATURATED-ZONE HYDRAULIC AND GASEOUS-PHASE INITIAL AND BOUNDARY CONDITIONS (continued)		
2.7 4.4	8.3.2.3 8.3.2.5	Unsaturated-zone moisture conditions (continued)	Flux-related, matrix hydrologic properties (moisture conditions) of geologic samples	8.3.1.2.2.3
			Moisture content (volumetric), subsurface geologic samples	8.3.1.2.2.3.1
			Water content (gravimetric), subsurface geologic samples	8.3.1.2.2.3.1
			Moisture content, time dependence	8.3.1.2.2.3.2
			Water content	8.3.1.2.2.3.2
			Water content, gravimetric	8.3.1.2.2.3.2
			Water content, saturation profiles	8.3.1.2.2.3.2
			Moisture content, lateral variation	8.3.1.2.2.3.3
			Water content, gravimetric	8.3.1.2.2.3.3
			Water content, volumetric	8.3.1.2.2.3.3
			Water content	8.3.1.2.2.4.3
			Water content of matrix and rock mass	8.3.1.2.2.4.3
			Water content, matrix	8.3.1.2.2.4.3
			Water content (gravimetric), rock mass	8.3.1.2.2.4.4
			Water content (volumetric), rock mass	8.3.1.2.2.4.4
			Moisture content, in situ degree of saturation	8.3.1.2.2.4.5
			Gravimetric moisture content	8.3.1.2.2.4.9
			Volumetric moisture content	8.3.1.2.2.4.9
			Water-content profiles	8.3.1.2.2.4.9
			Water content, matrix	8.3.1.2.2.4.10
			Water-vapor content	8.3.1.2.2.6.1

Table 8.3.1.2-1. Activity parameters provided by the geohydrology program that support performance and design issues (page 16 of 38)

Calls by performance and design issues		Parameter category	Response by geohydrology characterization program	
Issue	SCP section		Activity parameter	SCP activity
	UNSATURATED-ZONE HYDRAULIC AND GASEOUS-PHASE INITIAL AND BOUNDARY CONDITIONS (continued)			
1.1	8.3.5.13	Unsaturated-zone fluid flux	Infiltration locations	8.3.1.2.1.3.3
1.6	8.3.5.12		Infiltration rates	8.3.1.2.1.3.3
1.10	8.3.4.2		Recharge locations, rates, and history	8.3.1.2.1.3.3
1.12	8.3.3.2		Infiltration rates	8.3.1.2.2.1.1
4.4	8.3.2.5		Vegetative cover, type and density	8.3.1.2.2.1.1
			Evapotranspiration rates	8.3.1.2.2.1.2
			Flow velocities	8.3.1.2.2.1.2
			Natural infiltration	8.3.1.2.2.1.2
			Net infiltration, beneath surficial evapotranspiration zone	8.3.1.2.2.1.2
			Water flux	8.3.1.2.2.1.2
			Evapotranspiration rates, experimental conditions	8.3.1.2.2.1.3
			Flow velocities beneath experimental infiltration plots	8.3.1.2.2.1.3
			Infiltration rates (saturated and unsaturated), experimentally induced	8.3.1.2.2.1.3
			Water flux beneath experimental infiltration plots	8.3.1.2.2.1.3
			Vapor flux	8.3.1.2.2.3.1
			Water flux	8.3.1.2.2.3.1
			Hydrogeologic unit definition	8.3.1.2.2.3.2
			Flux (volumetric) through fracture-matrix networks	8.3.1.2.2.4.2
			Volumetric flux and travel time through the rock mass	8.3.1.2.2.4.2
			Water velocity (directional distributions) fracture-matrix networks	8.3.1.2.2.4.2

Table 8.3.1.2-1. Activity parameters provided by the geohydrology program that support performance and design issues (page 17 of 38)

Calls by performance and design issues		Parameter category	Response by geohydrology characterization program	
Issue	SCP section		Activity parameter	SCP activity
UNSATURATED-ZONE HYDRAULIC AND GASEOUS-PHASE INITIAL AND BOUNDARY CONDITIONS (continued)				
		Unsaturated-zone fluid flux (continued)	Directional water velocity distributions	8.3.1.2.2.4.3
			Flux, volumetric	8.3.1.2.2.4.3
			Fracture and fracture-set densities and spacings	8.3.1.2.2.4.3
			Volumetric flux and travel time through the rock mass	8.3.1.2.2.4.3
			Water velocity (directional distributions), hydraulic and pneumatic tests	8.3.1.2.2.4.3
			Discharge, perched-water zones	8.3.1.2.2.4.7
			Flow rates, perched-water zones	8.3.1.2.2.4.7
			Flow paths, hydrochemical determination	8.3.1.2.2.4.8
			Travel times, hydrochemical determination	8.3.1.2.2.4.8
			Fluid flow, structural controls	8.3.1.2.2.6
			Gas-flow field, pre-waste emplacement	8.3.1.2.2.6
			Moisture flux, in gas phase	8.3.1.2.2.6
			Flow direction	8.3.1.2.2.6.1
			Flow velocities (air), in surface-based boreholes	8.3.1.2.2.6.1
			Flow velocity profiles	8.3.1.2.2.6.1
			Water-vapor flux	8.3.1.2.2.6.1
			Gas flow direction, flux, and travel time	8.3.1.2.2.7
			Gas transport mechanisms	8.3.1.2.2.7
			Water flow direction, flux, and travel time	8.3.1.2.2.7

Table 8.3.1.2-1. Activity parameters provided by the geohydrology program that support performance and design issues (page 18 of 38)

Calls by performance and design issues		Parameter category	Response by geohydrology characterization program	
Issue	SCP section		Activity parameter	SCP activity
		UNSATURATED-ZONE HYDRAULIC AND GASEOUS-PHASE INITIAL AND BOUNDARY CONDITIONS (continued)		
		Unsaturated-zone fluid flux (continued)	Gas flow paths, hydrochemical determination	8.3.1.2.2.7.1
			Gas flux, hydrochemical determination	8.3.1.2.2.7.1
			Gas travel times, chemical determination	8.3.1.2.2.7.1
			Water flow paths of (O^{18} to O^{16}, deuterium to hydrogen) pore waters	8.3.1.2.2.7.2
			Water travel times (C-14 and tritium)	8.3.1.2.2.7.2
		UNSATURATED-ZONE HYDROLOGIC CONCEPTUAL/DESCRIPTIVE MODELS		
1.1 1.6	8.3.5.13 8.3.5.12	Unsaturated-zone hydrologic conceptual/ descriptive models	Description of the scale dependence of pneumatic, hydrologic, and transport parameters	8.3.1.2.2.8.1
			Fluid and solute fluxes through variably saturated, fractured rock	8.3.1.2.2.8.1
			Liquid water matric potential; time-dependent spatial distribution (coupled heat and moisture-flow model)	8.3.1.2.2.8.2
			Validity of conceptual models describing flow and transport in variably saturated, fractured rock	8.3.1.2.2.8.2
			Boundary and initial conditions of the system	8.3.1.2.2.9.1
			Geologic framework of the system	8.3.1.2.2.9.1

Table 8.3.1.2-1. Activity parameters provided by the geohydrology program that support performance and design issues (page 19 of 38)

Calls by performance and design issues		Parameter category	Response by geohydrology characterization program	
Issue	SCP section		Activity parameter	SCP activity
		UNSATURATED-ZONE HYDROLOGIC CONCEPTUAL/DESCRIPTIVE MODELS (continued)		
		Unsaturated-zone hydrologic conceptual/ descriptive models (continued)	Hydrologic and other related physical processes that operate within the system under the constraints imposed by the geologic framework and the boundary and initial conditions	8.3.1.2.2.9.1
		UNSATURATED-ZONE FLOW AND SOLUTE-TRANSPORT NUMERICAL MODELS		
1.1	8.3.5.13	Unsaturated-zone flow and solute-transport numerical models	Ground-water travel time, fracture-matrix networks	8.3.1.2.2.4.2
1.6	8.3.5.12		Ground-water travel time, hydraulic and pneumatic tests	8.3.1.2.2.4.3
			Description of the scale dependence of pneumatic, hydrologic, and transport parameters	8.3.1.2.2.9.1
			Fluid and solute fluxes through variably saturated, fractured rock	8.3.1.2.2.9.1
			Validity of numerical models describing flow and transport in variably saturated, fractured rock	8.3.1.2.2.9.2
			Boundary conditions, hydrologic (Dirichlet, Neumann, mixed, evaporative, seepage-face, evapotranspiration, etc.)	8.3.1.2.2.9.2
			Code geometry (modeled parameters)	8.3.1.2.2.9.2

Table 8.3.1.2-1. Activity parameters provided by the geohydrology program that support performance and design issues (page 20 of 38)

Calls by performance and design issues		Parameter category	Response by geohydrology characterization program	
Issue	SCP section		Activity parameter	SCP activity
UNSATURATED-ZONE FLOW AND SOLUTE-TRANSPORT NUMERICAL MODELS (continued)				
		Unsaturated-zone flow and solute-transport numerical models (continued)	Discretization method (finite-difference, finite-element, or integrated finite-difference)	8.3.1.2.2.9.2
			Hydrologic and coupled processes (liquid-water flow, gas-phase flow, water-vapor, heat-flow, solute transport, chemical kinetics, stress-field dynamics, two-phase flow)	8.3.1.2.2.9.2
			Matrix solver (direct or iterative)	8.3.1.2.2.9.2
			Solution methodology (Picard iteration or Newton-Raphson linearization)	8.3.1.2.2.9.2
			Boundary fluxes, pressures, and potentials	8.3.1.2.2.9.3
			Hydrologic and thermomechanical properties for the component hydrogeologic units	8.3.1.2.2.9.3
			Time-dependent spatial distribution of matric potential, liquid water, saturation, pore-gas pressure, water-vapor concentration, moisture flux, and temperature	8.3.1.2.2.9.3
			Measurement errors	8.3.1.2.2.9.4
			Probable limits of uncertainty	8.3.1.2.2.9.4
			Statistical distribution functions	8.3.1.2.2.9.4
			Land-surface net infiltration to the unsaturated zone and its distribution in space and time	8.3.1.2.2.9.5

Table 8.3.1.2-1. Activity parameters provided by the geohydrology program that support performance and design issues (page 21 of 38)

Calls by performance and design issues		Parameter category	Response by geohydrology characterization program	
Issue	SCP section		Activity parameter	SCP activity
		UNSATURATED-ZONE FLOW AND SOLUTE-TRANSPORT NUMERICAL MODELS (continued)		
		Unsaturated-zone flow and solute-transport numerical models (continued)	Site geologic framework and its change with time	8.3.1.2.2.9.5
			Site water-table configuration and its change with time	8.3.1.2.2.9.5
			Spatial distribution of moisture flux within the unsaturated zone and its change with time	8.3.1.2.2.9.5
			Spatial distribution of temperature and stress within the unsaturated zone and their change with time	8.3.1.2.2.9.5
		SATURATED-ZONE HYDRAULIC PROPERTIES		
1.1	8.3.5.13	Saturated-zone transmissive properties	Hydraulic conductivity, assessment of data needs	8.3.1.2.1.3.1
1.6	8.3.5.12		Transmissivity, assessment of data needs	8.3.1.2.1.3.1
			Hydraulic conductivity	8.3.1.2.1.3.2
			Permeability	8.3.1.2.1.3.2
			Storativity	8.3.1.2.1.3.2
			Transmissivity	8.3.1.2.1.3.2
			Hydraulic conductivity, spatial distribution, concepts in regional flow model	8.3.1.2.1.4.1

Table 8.3.1.2-1. Activity parameters provided by the geohydrology program that support performance and design issues (page 22 of 38)

Calls by performance and design issues		Parameter category	Response by geohydrology characterization program	
Issue	SCP section		Activity parameter	SCP activity
		SATURATED-ZONE HYDRAULIC PROPERTIES		
		Saturated-zone transmissive properties (continued)	Hydraulic conductivity, spatial distribution, assumptions for subregional two-dimensional areal model	8.3.1.2.1.4.2
			Hydraulic conductivity, spatial distribution, subregional cross-sectional model	8.3.1.2.1.4.3
			Hydraulic conductivity, spatial distribution, assumptions for regional three-dimensional areal model	8.3.1.2.1.4.4
			Hydraulic conductivity, spatial distribution, regional three-dimensional model	8.3.1.2.1.4.4
			Hydraulic conductivity, saturated zone	8.3.1.2.3.1.2
			Effective porosity (bulk), estimate from earth-tide analysis of water levels	8.3.1.2.3.1.3
			Transmissivity (bulk) estimates at multiple-well test locations	8.3.1.2.3.1.3
			Hydraulic conductivity; tensor of equivalent porous media; multiple-well test locations	8.3.1.2.3.1.4
			Average linear velocity, pore water and tracers	8.3.1.2.3.1.5
			Effective porosities	8.3.1.2.3.1.5

Table 8.3.1.2-1. Activity parameters provided by the geohydrology program that support performance and design issues (page 23 of 38)

Calls by performance and design issues		Parameter category	Response by geohydrology characterization program	
Issue	SCP section		Activity parameter	SCP activity
		SATURATED-ZONE HYDRAULIC PROPERTIES (continued)		
		Saturated-zone transmissive properties (continued)	Effective porosity, single-well and multiple-well tracer test locations	8.3.1.2.3.1.5
			Fracture permeability	8.3.1.2.3.1.5
			Average linear velocity, pore water and tracers	8.3.1.2.3.1.6
			Effective porosities	8.3.1.2.3.1.6
			Effective porosity (well-test locations throughout the site) conservative tracers	8.3.1.2.3.1.6
			Hydraulic conductivity (well-test locations throughout the site) conservative tracers	8.3.1.2.3.1.6
			Sensitivity, transmissive properties	8.3.1.2.3.3.1
			Hydraulic conductivity, effective, variation with fracture geometry	8.3.1.2.3.3.2
			Hydraulic conductivity, spatial distribution	8.3.1.2.3.3.3
1.1	8.3.5.13	Saturated-zone storage properties	Storage coefficient, assessment of data needs	8.3.1.2.1.3.1
1.6	8.3.5.12		Porosity	8.3.1.2.1.3.2
			Storage coefficient	8.3.1.2.1.3.2
			Effective porosity, spatial distribution, concepts in regional flow model	8.3.1.2.1.4.1
			Storage coefficient, spatial distribution, concepts in regional flow model	8.3.1.2.1.4.1

Table 8.3.1.2-1. Activity parameters provided by the geohydrology program that support performance and design issues (page 24 of 38)

Calls by performance and design issues		Parameter category	Response by geohydrology characterization program	
Issue	SCP section		Activity parameter	SCP activity
		SATURATED-ZONE HYDRAULIC PROPERTIES (continued)		
		Saturated-zone storage properties (continued)	Effective porosity, spatial distribution, assumptions for subregional two-dimensional areal model	8.3.1.2.1.4.2
			Storage coefficient, assumptions for subregional two-dimensional areal model	8.3.1.2.1.4.2
			Effective porosity, assumptions for subregional cross-sectional model	8.3.1.2.1.4.3
			Storage coefficient, assumptions for subregional cross-sectional model	8.3.1.2.1.4.3
			Effective porosity, spatial distribution, assumptions for regional three-dimensional areal model	8.3.1.2.1.4.4
			Storage coefficient, assumptions for regional three-dimensional areal model	8.3.1.2.1.4.4
			Aquifer compressibility	8.3.1.2.3.1.2
			Storage coefficient, estimate from water-level fluctuations, well tests	8.3.1.2.3.1.2
			Barometric efficiency	8.3.1.2.3.1.3
			Dilatational efficiency	8.3.1.2.3.1.3
			Specific storage	8.3.1.2.3.1.3
			Storage coefficient, bulk estimates from well testing data	8.3.1.2.3.1.3
			Storage coefficient, stratigraphic variations at multiple-well locations	8.3.1.2.3.1.4
			Specific storage	8.3.1.2.3.1.6

Table 8.3.1.2-1. Activity parameters provided by the geohydrology program that support performance and design issues (page 25 of 38)

Calls by performance and design issues		Parameter category	Response by geohydrology characterization program	
Issue	SCP section		Activity parameter	SCP activity
		SATURATED-ZONE HYDRAULIC PROPERTIES (continued)		
		Saturated-zone storage properties (continued)	Effective porosity, spatial distribution, assumptions for site conceptual model	8.3.1.2.3.3.1
			Sensitivity, storage properties	8.3.1.2.3.3.1
			Storage coefficient, spatial distribution, assumptions for site conceptual model	8.3.1.2.3.3.1
			Effective porosity, spatial distribution	8.3.1.2.3.3.3
			Storage coefficient, spatial distribution	8.3.1.2.3.3.3
1.1	8.3.5.13	Saturated-zone dispersive properties	Dispersion coefficients	8.3.1.2.3.1.5
1.6	8.3.5.12		Dispersivity, conservative tracers	8.3.1.2.3.1.6
			Dispersion coefficients, single-well and multiple-well tracer test locations, reactive tracers	8.3.1.2.3.1.7
			Dispersion coefficients, well-test locations throughout the site	8.3.1.2.3.1.8
1.1	8.3.5.13	Saturated-zone diffusive properties	Hydraulic diffusivity	8.3.1.2.3.1.2
			Pneumatic diffusivity	8.3.1.2.3.1.3
			Vertical hydraulic diffusivity	8.3.1.2.3.1.3

Table 8.3.1.2-1. Activity parameters provided by the geohydrology program that support performance and design issues (page 26 of 38)

Calls by performance and design issues		Parameter category	Response by geohydrology characterization program	
Issue	SCP section		Activity parameter	SCP activity
			SATURATED-ZONE HYDRAULIC PROPERTIES (continued)	
1.1 1.6	8.3.5.13 8.3.5.12	Saturated-zone fault hydrologic characteristics	Fault zone, transmissive character	8.3.1.2.3.1.1
			Hydraulic gradient	8.3.1.2.3.1.1
			Saturated hydraulic conductivity, fault zone	8.3.1.2.3.1.1
			Storage coefficient, fault zone	8.3.1.2.3.1.1
			Storage coefficients, wall rocks	8.3.1.2.3.1.1
			SATURATED-ZONE HYDRAULIC INITIAL AND BOUNDARY CONDITIONS	
1.1 1.6	8.3.5.13 8.3.5.12	Saturated-zone water potential	Ground-water flow-path directions and gradients; assessment of data needs	8.3.1.2.1.3.1
			Hydrologic initial and boundary conditions; regional and subregional ground-water models; assessment of data needs	8.3.1.2.1.3.1
			Effective saturated thickness	8.3.1.2.1.3.2
			Ground-water flow directions, rates, and velocities	8.3.1.2.1.3.2
			Hydraulic gradient	8.3.1.2.1.3.2
			Hydraulic head	8.3.1.2.1.3.2
			Depth to saturation	8.3.1.2.1.3.4
			Hydraulic head, spatial distribution	8.3.1.2.1.3.4
			Hydraulic gradient, concepts in regional flow model	8.3.1.2.1.4.1
			Potentiometric surface, concepts in regional flow model	8.3.1.2.1.4.1

Table 8.3.1.2-1. Activity parameters provided by the geohydrology program that support performance and design issues (page 27 of 38)

Calls by performance and design issues		Parameter category	Response by geohydrology characterization program	
Issue	SCP section		Activity parameter	SCP activity
		SATURATED-ZONE HYDRAULIC INITIAL AND BOUNDARY CONDITIONS (continued)		
		Saturated-zone water potential (continued)	Hydraulic gradient, used in sub-regional two-dimensional areal model	8.3.1.2.1.4.2
			Potentiometric surface, assumptions for subregional two-dimensional areal model	8.3.1.2.1.4.2
			Saturated thickness distribution, effect on flux direction and magnitudes	8.3.1.2.1.4.2
			Hydraulic gradient, used in subregional cross-section model	8.3.1.2.1.4.3
			Hydraulic gradient, used in regional three-dimensional model	8.3.1.2.1.4.4
			Potentiometric surface, assumptions for regional three-dimensional areal model	8.3.1.2.1.4.4
			Hydraulic gradients	8.3.1.2.3.1.2
			Relative hydraulic gradients	8.3.1.2.3.1.3
			Potentiometric surface, assumptions for site conceptual model	8.3.1.2.3.3.1
			Sensitivity, potentiometric surface	8.3.1.2.3.3.1
1.1 1.6	8.3.5.13 8.3.5.12	Saturated-zone ground-water chemistry, temperature, and age	Hydrologic initial and boundary conditions (regional and subregional ground-water models), assessment of data needs	8.3.1.2.1.3.1
			Thermal conductivity, ambient heat flow	8.3.1.2.1.3.2

Table 8.3.1.2-1. Activity parameters provided by the geohydrology program that support performance and design issues (page 28 of 38)

Calls by performance and design issues		Parameter category	Response by geohydrology characterization program	
Issue	SCP section		Activity parameter	SCP activity
		SATURATED-ZONE HYDRAULIC INITIAL AND BOUNDARY CONDITIONS (continued)		
		Saturated-zone ground-water chemistry, temperature, and age (continued)	Water temperature	8.3.1.2.1.3.2
			Radioisotope activities, ground water	8.3.1.2.1.3.3
			Radiometric ages, ground water	8.3.1.2.1.3.3
			Hydrochemistry, ground-water assumptions for subregional two-dimensional area model	8.3.1.2.1.4.2
			Ground-water chemical concentration	8.3.1.2.3.2.1
			Radioisotope activity	8.3.1.2.3.2.1
			Stable-isotope ratios	8.3.1.2.3.2.1
			Ground-water chemical concentrations	8.3.1.2.3.2.2
			Radioisotope activity	8.3.1.2.3.2.2
			Stable-isotope ratios	8.3.1.2.3.2.2
			Chemical concentration	8.3.1.2.3.2.3
			Radioisotope activity	8.3.1.2.3.2.3
			Stable-isotope ratios	8.3.1.2.3.2.3
			Conservative-solute transport, scale of Yucca Mountain	8.3.1.2.3.3.3
1.1	8.3.5.13	Saturated-zone ground-water flux	Discharge locations and rates, assessment of data needs	8.3.1.2.1.3.1
1.6	8.3.5.12		Hydrologic initial and boundary conditions (regional and subregional ground-water models), assessment of data needs	8.3.1.2.1.3.1
			Recharge locations and rates, assessment of data needs	8.3.1.2.1.3.1

Table 8.3.1.2-1. Activity parameters provided by the geohydrology program that support performance and design issues (page 29 of 38)

Calls by performance and design issues		Parameter category	Response by geohydrology characterization program	
Issue	SCP section		Activity parameter	SCP activity
SATURATED-ZONE HYDRAULIC INITIAL AND BOUNDARY CONDITIONS (continued)				
		Saturated-zone ground-water flux (continued)	Evapotranspiration component of ground-water discharge	8.3.1.2.1.3.4
			Evapotranspiration rates and areal distribution	8.3.1.2.1.3.4
			Discharge, locations and rates, concepts in regional flow model	8.3.1.2.1.4.1
			Ground-water flux, concepts in regional flow models	8.3.1.2.1.4.1
			Recharge, locations and rates, concepts in regional flow model	8.3.1.2.1.4.1
			Discharge, locations and rates, assumptions for subregional two-dimensional areal model	8.3.1.2.1.4.2
			Evapotranspiration, assumptions for subregional two-dimensional areal model	8.3.1.2.1.4.2
			Ground-water flux, assumptions for subregional cross-sectional model	8.3.1.2.1.4.2
			Ground-water flux, assumptions for subregional two-dimensional areal model	8.3.1.2.1.4.2
			Hydrologic boundary conditions	8.3.1.2.1.4.2
			Recharge, locations and rates, assumptions for subregional two-dimensional areal model	8.3.1.2.1.4.2
			Discharge, locations and rates, assumptions for subregional cross-sectional model	8.3.1.2.1.4.3

Table 8.3.1.2-1. Activity parameters provided by the geohydrology program that support performance and design issues (page 30 of 38)

Calls by performance and design issues		Parameter category	Response by geohydrology characterization program	
Issue	SCP section		Activity parameter	SCP activity
		SATURATED-ZONE HYDRAULIC INITIAL AND BOUNDARY CONDITIONS (continued)		
		Saturated-zone ground-water flux (continued)	Recharge, locations and rates, assumptions for subregional cross-sectional model	8.3.1.2.1.4.3
			Discharge, locations and rates, assumptions for regional three-dimensional areal model	8.3.1.2.1.4.4
			Ground-water flux, regional three-dimensional model	8.3.1.2.1.4.4
			Recharge, locations and rates, assumptions for regional three-dimensional areal model	8.3.1.2.1.4.4
			Flow rates, interborehole and intraborehole	8.3.1.2.3.1.3
			Nature of hydraulic boundaries and conduits type of flow	8.3.1.2.3.1.3
			Average linear velocity, pore water and tracers	8.3.1.2.3.1.5
		SATURATED-ZONE HYDROLOGIC CONCEPTUAL/DESCRIPTIVE MODELS		
1.1 1.6	8.3.5.13 8.3.5.12	Saturated-zone hydrologic conceptual/descriptive models	Ground-water flow direction and magnitude based on regional hydrologic, hydrochemical, and heat-flow data	8.3.1.2.1.3

Table 8.3.1.2-1. Activity parameters provided by the geohydrology program that support performance and design issues (page 31 of 38)

Calls by performance and design issues		Parameter category	Response by geohydrology characterization program	
Issue	SCP section		Activity parameter	SCP activity
SATURATED-ZONE HYDROLOGIC CONCEPTUAL/DESCRIPTIVE MODELS (continued)				
		Saturated-zone hydrologic conceptual/descriptive models (continued)	Porosity type; matrix and fracture, regional geohydrologic units; assessment of data needs	8.3.1.2.1.3.1
			Hydraulic boundaries and conduits; scale of well tests and type of flow	8.3.1.2.3.1.3
			Aquifer heterogeneity and spatial distribution	8.3.1.2.3.1.4
			Effective porosity, spatial distribution, assumptions for site conceptual model	8.3.1.2.3.3.1
			Ground-water flux, assumptions for site conceptual model	8.3.1.2.3.3.1
			Hydraulic conductivity, spatial distribution, assumptions for site flow model	8.3.1.2.3.3.1
			Hydraulic gradient, concepts in site flow model	8.3.1.2.3.3.1
			Relations between fracture geometry characteristics and hydrologic response	8.3.1.2.3.3.2
			Relations between geophysical and hydrologic models	8.3.1.2.3.3.2

Table 8.3.1.2-1. Activity parameters provided by the geohydrology program that support performance and design issues (page 32 of 38)

Calls by performance and design issues		Parameter category	Response by geohydrology characterization program	
Issue	SCP section		Activity parameter	SCP activity
		SATURATED-ZONE SITE AND REGIONAL-FLOW AND SOLUTE-TRANSPORT NUMERICAL MODELS		
1.1 1.3 1.6	8.3.5.13 8.3.5.15 8.3.5.12	Saturated-zone site and regional flow and solute-transport numerical models	Effective porosity	8.3.1.2.1.4
			Ground-water flux	8.3.1.2.1.4
			Hydraulic conductivity	8.3.1.2.1.4
			Hydraulic gradient	8.3.1.2.1.4
			Storage coefficient	8.3.1.2.1.4
			Geochemical reaction (modeling)	8.3.1.2.3.2
			Conservative-solute transport	8.3.1.2.3.3
			Effective porosity	8.3.1.2.3.3
			Ground-water flux	8.3.1.2.3.3
			Hydraulic conductivity	8.3.1.2.3.3
			Hydraulic gradient	8.3.1.2.3.3
			Storage coefficient	8.3.1.2.3.3
			Conservative-solute transport, fracture networks, steady state and transient	8.3.1.2.3.3.2
			Effective porosity, fracture networks	8.3.1.2.3.3.2
			Ground-water flux, fracture networks, steady state and transient	8.3.1.2.3.3.2
			Hydraulic conductivity, fracture networks	8.3.1.2.3.3.2
			Hydrodynamic dispersion, fracture networks	8.3.1.2.3.3.2
			Storage coefficient, fracture networks	8.3.1.2.3.3.2
			Ground-water flow paths, scale of Yucca Mountain	8.3.1.2.3.3.3

Table 8.3.1.2-1. Activity parameters provided by the geohydrology program that support performance and design issues (page 33 of 38)

Calls by performance and design issues		Parameter category	Response by geohydrology characterization program	
Issue	SCP section		Activity parameter	SCP activity
		SATURATED-ZONE SITE AND REGIONAL-FLOW AND SOLUTE-TRANSPORT NUMERICAL MODELS (continued)		
		Saturated-zone and regional flow and solute-transport numerical models (continued)	Ground-water flow velocities, scale of Yucca Mountain	8.3.1.2.3.3.3
			Ground-water flux, scale of Yucca Mountain	8.3.1.2.3.3.3
		SATURATED-ZONE GEOCHEMICAL PROPERTIES		
1.1	8.3.5.13	Saturated-zone sorptive properties	Adsorption rate constants	8.3.1.2.3.1.7
			Sorption equilibrium constant	8.3.1.2.3.1.7
			Adsorption rate constants	8.3.1.2.3.1.8
			Sorption equilibrium constants	8.3.1.2.3.1.8
		ROCK-UNIT GEOMETRY AND PROPERTIES		
1.1	8.3.5.13	Rock-unit contact location and configuration	Hydrostratigraphic units	8.3.1.2.1.3.2
1.6	8.3.5.12		Stratigraphic contacts, hydrogeological units	8.3.1.2.1.3.2
1.11	8.3.2.2		Contact altitude, geohydrologic units	8.3.1.2.2.3.2
1.12	8.3.3.2		Lithology from geophysical logging	8.3.1.2.2.3.2
4.4	8.3.2.5		Depth to hydrogeologic contacts	8.3.1.2.2.4.9
			Geohydrologic units, physical properties	8.3.1.2.3.1.1
1.1	8.3.5.13	Rock-unit lateral and vertical variability	Alluvium thickness	8.3.1.2.2.1.1
1.6	8.3.5.12		Rock-unit surficial slope and aspect	8.3.1.2.2.1.1
1.11	8.3.2.2		Soil texture	8.3.1.2.2.1.1

Table 8.3.1.2-1. Activity parameters provided by the geohydrology program that support performance and design issues (page 34 of 38)

Calls by performance and design issues		Parameter category	Response by geohydrology characterization program	
Issue	SCP section		Activity parameter	SCP activity
		ROCK-UNIT GEOMETRY AND PROPERTIES (continued)		
1.12	8.3.3.2	Rock-unit lateral and vertical variability	Thickness of soil and alluvium	8.3.1.2.2.1.1
4.4	8.3.2.5		Stratigraphic variation of hydraulic properties inferred from hydraulic tests	8.3.1.2.3.1.1
			Geohydrologic unit physical properties	8.3.1.2.3.1.2
			Geophysical properties, geohydrologic units, structural features	8.3.1.2.3.1.2
1.1	8.3.5.13	Rock-unit mineralogy/petrology and physical properties	Bulk density	8.3.1.2.1.3.2
1.6	8.3.5.12		Depositional environment	8.3.1.2.1.3.2
1.11	8.3.2.2		Grain size distribution	8.3.1.2.1.3.2
4.4	8.3.2.5		Lithologies, hydrogeologic units; drill cuttings, water-table holes	8.3.1.2.1.3.2
			Porosity	8.3.1.2.1.3.2
			Bulk density	8.3.1.2.2.1.1
			Clay mineralogy	8.3.1.2.2.1.1
			Grain density	8.3.1.2.2.1.1
			Porosity, subsurface geologic samples	8.3.1.2.2.3.1
			Bulk density, rock matrix	8.3.1.2.2.4.4
			Grain density, rock matrix	8.3.1.2.2.4.4
			In situ rock physical properties	8.3.1.2.2.4.5
			Porosity	8.3.1.2.2.4.5
			Porosity, perched-water zones	8.3.1.2.2.4.7
			Bulk density	8.3.1.2.2.4.9
			Fracture weathering	8.3.1.2.2.4.9
			Grain density	8.3.1.2.2.4.9
			Matrix pore-size distribution	8.3.1.2.2.4.9

Table 8.3.1.2-1. Activity parameters provided by the geohydrology program that support performance and design issues (page 35 of 38)

Calls by performance and design issues		Parameter category	Response by geohydrology characterization program	
Issue	SCP section		Activity parameter	SCP activity
			ROCK-UNIT GEOMETRY AND PROPERTIES (continued)	
		Rock-unit mineralogy/petrology and physical properties (continued)	Total density	8.3.1.2.2.4.9
			Pore-size distribution, matrix	8.3.1.2.2.4.10
			Porosity, matrix	8.3.1.2.2.4.10
			Matrix compressibility, inferred from barometric and earth-tide analysis	8.3.1.2.3.1.3
			FRACTURE GEOMETRY AND PROPERTIES	
1.1	8.3.5.13	Fracture distribution	Fractures	8.3.1.2.1.3.2
1.6	8.3.5.12		Lineaments	8.3.1.2.1.3.2
1.11	8.3.2.2		Fracture density	8.3.1.2.2.1.1
1.12	8.3.3.2		Fracture distribution	8.3.1.2.2.3.2
4.4	8.3.2.5		Fracture spacing	8.3.1.2.2.3.2
			Fracture distribution	8.3.1.2.2.3.3
			Fracture spacing	8.3.1.2.2.3.3
			Fracture distribution	8.3.1.2.2.4.4
			Fracture frequency, spacing, and distribution	8.3.1.2.2.4.9
			Fracture distribution and geometry from core and geophysical logs	8.3.1.2.3.1.1
			Fracture distribution, spacing and geometry from core and geophysical logs	8.3.1.2.3.1.2
			Fracture-system characteristics inferred from tracer tests, geophysical logs	8.3.1.2.3.1.5

Table 8.3.1.2-1. Activity parameters provided by the geohydrology program that support performance and design issues (page 36 of 38)

Calls by performance and design issues		Parameter category	Response by geohydrology characterization program	
Issue	SCP section		Activity parameter	SCP activity
			FRACTURE GEOMETRY AND PROPERTIES (continued)	
		Fracture distribution (continued)	Fracture-system characteristics inferred from hydraulic packer and tracer tests; conservative tracers	8.3.1.2.3.1.6
			Fracture location, orientation, and density in vertical planes between wells	
1.1	8.3.5.13	Fracture orientation	Fracture orientation	8.3.1.2.2.1.1
1.6	8.3.5.12		Fracture and fracture-set orientations	8.3.1.2.2.4.3
1.11	8.3.2.2		Fracture orientation	8.3.1.2.2.4.5
4.4	8.3.2.5		Fracture orientation from core and geophysical logs	8.3.1.2.3.1.1
			Fracture orientation inferred from core and geophysical logs	8.3.1.2.3.1.2
1.1	8.3.5.13	Fracture aperture	Fracture aperture geometry	8.3.1.2.2.4.1
1.6	8.3.5.12		Fracture aperture, roughness and contact area	8.3.1.2.2.4.1
			Fracture aperture	8.3.1.2.2.4.2
			Fracture and fracture-set apertures	8.3.1.2.2.4.3
			Fracture aperture	8.3.1.2.2.4.4
			Fracture aperture distributions inferred from hydraulic tests	8.3.1.2.3.1.1
			Fracture aperture inferred from hydraulic tests, matrix properties, geophysical logs	8.3.1.2.3.1.4

Table 8.3.1.2-1. Activity parameters provided by the geohydrology program that support performance and design issues (page 37 of 38)

Calls by performance and design issues		Parameter category	Response by geohydrology characterization program	
			Activity parameter	SCP activity
Issue	SCP section			
			FRACTURE GEOMETRY AND PROPERTIES (continued)	
		Fracture aperture (continued)	Fracture aperture distribution inferred from hydraulic packer and tracer tests, conservative tracers	8.3.1.2.3.1.6
1.1	8.3.5.13	Fracture length	Fracture connectivity	8.3.1.2.2.4.2
1.6	8.3.5.12		Fracture and fracture-set connectivities	8.3.1.2.2.4.3
1.11	8.3.2.2		Fracture and fracture-set length and connectiveness	8.3.1.2.2.4.3
4.4	8.3.2.5		Fracture and fracture-set lengths	
1.1	8.3.5.13	Fracture-filling mineralogy and physical properties	Fracture weathering	8.3.1.2.2.4.4
1.6	8.3.5.12		Fracture roughness	8.3.1.2.2.4.5
4.4	8.3.2.5			
			FAULT GEOMETRY AND PROPERTIES	
1.1	8.3.5.13	Fault location	Fault-zone location	8.3.1.2.2.3.3
1.6	8.3.5.12		Fault-zone location	8.3.1.2.3.1.1
1.11	8.3.2.2		Structural locations	8.3.1.2.3.1.2
1.12	8.3.3.2			
4.4	8.3.2.5			

Table 8.3.1.2-1. Activity parameters provided by the geohydrology program that support performance and design issues (page 38 of 38)

Calls by performance and design issues		Parameter category	Response by geohydrology characterization program	
			Activity parameter	SCP activity
Issue	SCP section			
		FRACTURE GEOMETRY AND PROPERTIES (continued)		
1.1 1.6 1.11 1.12 4.4	8.3.5.13 8.3.5.12 8.3.2.2 8.3.3.2 8.3.2.5	Fault geometry	Fault-zone effective width Fault-zone orientation, width Structural orientations and widths	8.3.1.2.2.3.3 8.3.1.2.3.1.1 8.3.1.2.3.1.2
1.1 1.6 1.11 1.12 4.4	8.3.5.13 8.3.5.12 8.3.2.2 8.3.3.2 8.3.2.5	Fault-zone mineralogy and physical properties, site area	Fault-zone mineralogy Fault-zone physical properties	8.3.1.2.2.3.3 8.3.1.2.2.3.3
		ROCK MECHANICAL PROPERTIES		
1.11 4.4	8.3.2.2 8.3.2.5	Rock-deformation	Fracture deformation	8.3.1.2.2.4.5
1.10 1.11 1.12 4.4	8.3.4.2 8.3.2.2 8.3.3.2 8.3.2.5	Rock in situ stress, repository area	In situ stress, magnitude and orientation	8.3.1.2.2.4.5

Table 8.3.1.4-1 Activity parameters provided by the rock characteristics program that support performance and design issues (page 3 of 12)

Calls by performance and design issues		Parameter category	Response by rock characteristics program	
Issue	SCP section		Activity parameter	SCP activity
		ROCK UNIT GEOMETRY AND PROPERTIES (continued)		
			Lateral continuity, repository host horizon	8.3.1.4.2.2.4
			Lateral extent, ash-flow zones	8.3.1.4.2.2.1
			Lateral extent, bedded-tuff zones	8.3.1.4.2.2.1
			Lateral variability, lithostratigraphic units, exploratory shaft facility drifts	8.3.1.4.2.2.4
			Lithic fragments, concentration variations, subunit contacts	8.3.1.4.2.1.5
			Lithic fragments, type and abundance, lithostratigraphic units	8.3.1.4.2.1.1
			Lithic-rich subzones, locations, flow units	8.3.1.4.2.1.5
			Lithologic uniformity, relations to density, seismic velocity, porosity, and resistivity	8.3.1.4.2.1.4
			Lithophysal zone characteristics, lithostratigraphic units	8.3.1.4.2.1.1
			Lithophysal zones, geophysical signatures	8.3.1.4.2.1.3
			Magnetic field intensity, total	8.3.1.4.2.1.2
			Magnetic field, variations	8.3.1.4.2.1.2
			Magnetic susceptibility	8.3.1.4.2.1.3, 8.3.1.4.2.1.5
			Porosity, core samples	8.3.1.4.2.1.4
			Porosity, variations	8.3.1.4.2.1.3

Table 8.3.1.4-1 Activity parameters provided by the rock characteristics program that support performance and design issues (page 4 of 12)

Calls by performance and design issues		Parameter category	Response by rock characteristics program	
Issue	SCP section		Activity parameter	SCP activity
		ROCK UNIT GEOMETRY AND PROPERTIES (continued)		
			Pumice characteristics, lithostratigraphic units	8.3.1.4.2.1.1
			Pumice clasts, concentration variations, subunit contacts	8.3.1.4.2.1.5
			Pumice clasts, concentrations, flow units	8.3.1.4.2.1.5
			Rock characteristics, changes, Topopah Spring Member	8.3.1.4.2.1.5
			Seismic velocity, contrasts	8.3.1.4.2.1.2
			Statistical analysis crossplots, geophysical measurements	8.3.1.4.2.1.3
			Thickness, ash-flow zones	8.3.1.4.2.2.1
			Thickness, bedded-tuff zones	8.3.1.4.2.2.1
			Thickness, volcanic section, from electromagnetic surveys	8.3.1.4.2.1.2
			Transport history, ash-flow tuffs	8.3.1.4.2.2.1
			Variability, lateral, lithostratigraphic units	8.3.1.4.2.1.1
1.1 4.4	8.3.5.13 8.3.2.5	Rock-unit mineralogy and petrology	Alteration history, ash-flow tuffs	8.3.1.4.2.2.1
			Alteration, degree and type, lithostratigraphic units	8.3.1.4.2.1.1
			Clay concentrations, from induced polarization data	8.3.1.4.2.1.4
			Compositional changes, anomalous, subunit contacts	8.3.1.4.2.1.5
			Cooling history, ash-flow tuffs	8.3.1.4.2.2.1

Table 8.3.1.4-1 Activity parameters provided by the rock characteristics program that support performance and design issues (page 5 of 12)

Calls by performance and design issues		Parameter category	Response by rock characteristics program	
Issue	SCP section		Activity parameter	SCP activity
		ROCK UNIT GEOMETRY AND PROPERTIES (continued)		
			Curie temperature	8.3.1.4.2.1.5
			Demagnetization, alternating field	8.3.1.4.2.1.5
			Demagnetization, thermal	8.3.1.4.2.1.5
			Depositional breaks, locations, flow units	8.3.1.4.2.1.5
			Essential minerals, abundance	8.3.1.4.2.1.1
			Gamma-radiation intensity temperature, relative	8.3.1.4.2.1.3
			Glassy intervals, lithostratigraphic units	8.3.1.4.2.1.1
			Grain size, bedded-tuff intervals, lithostratigraphic units	8.3.1.4.2.1.1
			Grain size, variations, flow units	8.3.1.4.2.1.5
			Induced polarization	8.3.1.4.2.1.3
			Isotopes, gamma-ray spectrometry	8.3.1.4.2.1.1
			Magnetic minerals, composition	8.3.1.4.2.1.5
			Magnetic minerals, grain size	8.3.1.4.2.1.5
			Magnetic minerals, grain size variation	8.3.1.4.2.1.5
			Magnetic minerals, relative abundance	8.3.1.4.2.1.5
			Magnetization, anhysteritic remanent	8.3.1.4.2.1.5
			Magnetization, isothermal remanent	8.3.1.4.2.1.5
			Magnetization, remanent, orientation and magnitude	8.3.1.4.2.1.5
			Magnetization, saturation	8.3.1.4.2.1.5
			Mineral phases, diagenetic, bedded tuffs	8.3.1.4.2.1.1

Table 8.3.1.4-1 Activity parameters provided by the rock characteristics program that support performance and design issues (page 6 of 12)

Calls by performance and design issues		Parameter category	Response by rock characteristics program	
Issue	SCP section		Activity parameter	SCP activity
		ROCK UNIT GEOMETRY AND PROPERTIES (continued)		
			Mineral phases, diagenetic, bedded tuffs	8.3.1.4.2.1.1
			Mineral phases, distinctive morphologies	8.3.1.4.2.1.1
			Mineralogy, bedded-tuff units	8.3.1.4.2.1.1
			Mineralogy, lithostratigraphic units	8.3.1.4.2.1.1
			Paleomagnetic directions, lithostratigraphic units	8.3.1.4.2.1.5
			Petrography, lithostratigraphic units	8.3.1.4.2.1.1
			Potassium, uranium, thorium content	8.3.1.4.2.1.3
			Primary crystallization, lithostratigraphic units	8.3.1.4.2.1.1
			Smectite-rich intervals, geophysical signatures	8.3.1.4.2.1.3
			Sorting, bedded-tuff units	8.3.1.4.2.1.1
			Sorting, lithostratigraphic units	8.3.1.4.2.1.1
			Spherulitic zones, lithostratigraphic units	8.3.1.4.2.1.1
			Textural variation, across flow-unit boundaries	8.3.1.4.2.1.5
			Texture, lithostratigraphic units	8.3.1.4.2.1.1
			Welding characteristics, anomalous, subunit contacts	8.3.1.4.2.1.5
			Welding, lithostratigraphic units	8.3.1.4.2.1.1
			Zeolite-rich intervals, geophysical signatures	8.3.1.4.2.1.3
			Zeolites, concentrations, from induced polarization	8.3.1.4.2.1.4

Table 8.3.1.4-1 Activity parameters provided by the rock characteristics program that support performance and design issues (page 7 of 12)

Calls by performance and design issues		Parameter category	Response by rock characteristics program	
Issue	SCP section		Activity parameter	SCP activity
			FRACTURE GEOMETRY AND PROPERTIES	
1.1 1.6 1.11 1.12 4.4	8.3.5.13 8.3.5.12 8.3.2.2 8.3.3.2 8.3.2.5	Fracture distribution	Fractal analysis	8.3.1.4.2.2.2
			Fracture characteristics, spatial variation	8.3.1.4.2.2.5
			Fracture distribution, spatial	8.3.1.4.2.2.2
			Fracture frequency, apparent, lateral variability	8.3.1.4.2.2.3
			Fracture frequency, variation with depth	8.3.1.4.2.2.3
			Fracture frequency, variation with lithostratigraphic unit	8.3.1.4.2.2.3
			Fracture location	8.3.1.4.2.2.3
			Fracture network geometry	8.3.1.4.2.2.2
			Fracture network, three-dimensional distribution, exploratory shaft facility	8.3.1.4.2.2.4
			Fracture networks	8.3.1.4.2.2.2
			Fracture patterns, local, variations	8.3.1.4.2.2.2
			Fracture, spatial distribution	8.3.1.4.2.2.4
			Fractures, subsurface, near fault zones, lateral variability	8.3.1.4.2.2.3
			Seismic properties, relation to fracture properties	8.3.1.4.2.2.5
			Seismic shear-wave amplitudes	8.3.1.4.2.2.5
			Seismic shear-wave polarizations	8.3.1.4.2.2.5
			Seismic shear-wave travel times	8.3.1.4.2.2.5
			Seismic-wave propagation characteristics	8.3.1.4.2.2.5

Table 8.3.1.4-1 Activity parameters provided by the rock characteristics program that support performance and design issues (page 8 of 12)

Calls by performance and design issues		Parameter category	Response by rock characteristics program	
Issue	SCP section		Activity parameter	SCP activity
		FRACTURE GEOMETRY AND PROPERTIES (continued)		
1.6 1.11 4.4	8.3.5.12 8.3.2.2 8.3.2.5	Fracture orientation	Fracture attitude, statistical distribution	8.3.1.4.2.2.3
			Fracture attitude, variation with depth	8.3.1.4.2.2.3
			Fracture attitude, variation with lithostratigraphic unit	8.3.1.4.2.2.3
			Fracture orientation	8.3.1.4.2.2.2
			Fracture orientation, statistical distribution	8.3.1.4.2.2.2
			Fracture strike direction, lateral variability	8.3.1.4.2.2.3
1.6 1.11 4.4	8.3.5.12 8.3.2.2 8.3.2.5	Fracture aperture	Fracture aperture	8.3.1.4.2.2.2, 8.3.1.4.2.2.3, 8.3.1.4.2.2.4
1.6 1.11 4.4	8.3.5.12 8.3.2.2 8.3.2.5	Fracture persistence	Fracture connectivity	8.3.1.4.2.2.2
			Fracture dimension	8.3.1.4.2.2.3
			Fracture intersections, distribution	8.3.1.4.2.2.2
			Fracture persistence	8.3.1.4.2.2.2
			Fracture persistence, statistical distribution	8.3.1.4.2.2.4
1.11 4.4	8.3.2.2 8.3.2.5	Fracture-filling mineralogy and physical properties	Fracture mineralization, degree	8.3.1.4.2.2.3
			Fracture roughness	8.3.1.4.2.2.2, 8.3.1.4.2.2.3
			Fracture surface profile	8.3.1.4.2.2.4

Table 8.3.1.4-1 Activity parameters provided by the rock characteristics program that support performance and design issues (page 9 of 12)

Calls by performance and design issues		Parameter category	Response by rock characteristics program	
Issue	SCP section		Activity parameter	SCP activity
		FRACTURE GEOMETRY AND PROPERTIES (continued)		
			Fracture surface profile	8.3.1.4.2.2.3
			Fracture types	8.3.1.4.2.2.3
			Fracture-filling mineralogy	8.3.1.4.2.2.2, 8.3.1.4.2.2.3, 8.3.1.4.2.2.4
		FAULT GEOMETRY AND PROPERTIES		
1.1 1.6 1.11 4.4	8.3.5.13 8.3.5.12 8.3.2.2 8.3.2.5	Fault location	Fault location	8.3.1.4.2.2.3
			Fault trends, from electromagnetic surveys	8.3.1.4.2.1.2
			Structural domains	8.3.1.4.2.2.4
			Structural rotations, magnitude from paleomagnetic directions	8.3.1.4.2.1.5
			Tectonic style, faults	8.3.1.4.2.2.4
			Tectonic style, faults, Ghost Dance fault	8.3.1.4.2.2.4
1.1 1.6 1.11 4.4	8.3.5.13 8.3.5.12 8.3.2.2 8.3.2.5	Fault orientation	Fault and fault-zone attitude	8.3.1.4.2.2.1
			Fault orientation	8.3.1.4.2.2.4
			Structural rotations, magnitude from paleomagnetic directions	8.3.1.4.2.1.5
1.1 1.6 1.11 4.4	8.3.5.13 8.3.5.12 8.3.2.2 8.3.2.5	Fault length and width	Fault and fault-zone length	8.3.1.4.2.2.1
			Fault-zone width	8.3.1.4.2.2.1, 8.3.1.4.2.2.3

Table 8.3.1.4-1 Activity parameters provided by the rock characteristics program that support performance and design issues (page 10 of 12)

Calls by performance and design issues		Parameter category	Response by rock characteristics program	
Issue	SCP section		Activity parameter	SCP activity
		FAULT GEOMETRY AND PROPERTIES (continued)		
1.11 2.3 4.4	8.3.2.2 8.3.5.5 8.3.2.5	Fault displacement	Fault displacement, deep-seated faults, indication from lateral discontinuities	8.3.1.4.2.1.2
			Fault displacement, faults and fault zones	8.3.1.4.2.2.1
			Strike-slip faults, indications from lateral discontinuities	8.3.1.4.2.1.2
			Structural domains	8.3.1.4.2.2.4
			Tectonic styles, faults	8.3.1.4.2.2.4
			Tectonic styles, faults, Ghost Dance fault	8.3.1.4.2.2.4
4.4	8.3.2.5	Fault-zone mineralogy and physical properties	Alteration characteristics, fault zones	8.3.1.4.2.1.2
			Fault and fault-zone characteristics, near-surface faults and zones	8.3.1.4.2.2.1
			Fault physical characteristics	8.3.1.4.2.2.4
		GEOLOGIC FRAMEWORK		
1.1 1.6 1.11 1.12 4.4	8.3.5.13 8.3.5.12 8.3.2.2 8.3.3.2 8.3.2.5	Geologic framework	Correlation diagrams, lithostratigraphic units	8.3.1.4.2.3.1
			Correlation of laboratory values and in situ values for rock properties	8.3.1.4.2.3.1

Table 8.3.1.4-1 Activity parameters provided by the rock characteristics program that support performance and design issues (page 11 of 12)

Calls by performance and design issues		Parameter category	Response by rock characteristics program	
Issue	SCP section		Activity parameter	SCP activity
		GEOLOGIC FRAMEWORK (continued)		
			Cross sections, lithostratigraphic units	8.3.1.4.2.3.1
			Fractures, spatial distribution	8.3.1.4.2.3.1
			Geologic model, three-dimensional	8.3.1.4.2.3.1
			Interpretation of depositional and and diagenetic history of rock units	8.3.1.4.2.3.1
			Interpretation of distribution of lithology, petrology, petrography, and mineralogy of rock units	8.3.1.4.2.3.1
			Isopach maps, lithostratigraphic units	8.3.1.4.2.3.1
			Isopleth maps, rock property values	8.3.1.4.2.3.1
			Relations between geologic and geophysical characteristics of rock units	8.3.1.4.2.3.1
			Rock properties, three-dimensional distribution	8.3.1.4.2.3.1
			Structure contour maps, lithostratigraphic units	8.3.1.4.2.3.1
			Surface geologic maps	8.3.1.4.2.3.1
		GEOLOGIC MODEL		
1.1	8.3.5.13	Geologic model synthesis	Age, fracturing	8.3.1.4.2.2.4
1.6	8.3.5.12		Chronology, faulting	8.3.1.4.2.2.1
1.11	8.3.2.2		Chronology, faulting, relative	8.3.1.4.2.2.3

Table 8.3.1.4-1 Activity parameters provided by the rock characteristics program that support performance and design issues (page 12 of 12)

Calls by performance and design issues		Parameter category	Response by rock characteristics program	
Issue	SCP section		Activity parameter	SCP activity
		GEOLOGIC MODEL (continued)		
1.12 4.4	8.3.3.2 8.3.2.5		Faulting chronology	8.3.1.4.2.1
			Fracture chronology, fracture development	8.3.1.4.2.2
			Fracture chronology, relative changes due to tectonism--see tectonism studies	8.3.1.4.2.3 8.3.1.8.2
			Fracture chronology, relative changes due to erosion--see erosion studies	8.3.1.6.4.1
			Saturation	8.3.1.4.2.1.3
			Water content	8.3.1.4.2.1.3
			Relationships among hydrologic test results, VSP fracture data and lithologic data	8.3.1.4.2.2.5
			Relationships among geochemical test results, VSP fracture data, and lithologic data	8.3.1.4.2.2.5
			Poisson's ratio	8.3.1.4.2.1.3
			Young's modulus	8.3.1.4.2.1.3
			Relationships among geomechanical test results, VSP fracture data, and lithologic data	8.3.1.4.2.2.5

1.5 CLIMATE

Table 8.3.1.5-1 lists the specific repository performance scenarios related to climatic change in the "initiating event or process" column. These scenarios have been identified as being of concern to Issues 1.1 and 1.9b. Each scenario has a related performance measure, as shown in column 2. Each performance measure has two performance parameters in the third column, related to either the 10,000-yr or 100,000-yr period. Each performance measure has an additional parameter assigned as the quantitative bound on the expected magnitude of the performance parameter. Following the performance parameters are the tentative goals and corresponding confidence levels needed to meet the total system performance objectives.

Table 8.3.1.5-2 provides a direct link between the climate-related performance parameters (Table 8.3.1.5-1) and the activities in the climate characterization program by using "parameter categories." Each parameter category represents a group of activities (and the parameters to be addressed by those activities) that will be used to evaluate the climate-related performance parameters. From Table 8.3.1.5-1, there are essentially four types of performance parameters relating to changes in ground-water flux, changes in the elevation of the water table, changes in the gradient of the water table, and the potential for surface discharge points for ground water in the controlled area. All the parameter categories represent activities that provide information, directly or indirectly, to each of these performance parameters. The most direct link is between the future climate and the paleohydrology-paleoclimate synthesis parameter categories; however, the other categories are linked indirectly to the performance parameters through these categories.

Table 8.3.1.5-1. Initiating events or processes and associated performance measures (for climate program) (page 1 of 2)

Initiating event or process	Intermediate performance measures	Performance parameters	Tentative goal	Needed confidence
Climatic changes cause increase in infiltration over C-area[a]	Radionuclide transport time through UZ[b], given fixed UZ thickness, rock hydrologic properties, and geochemical properties	Expected magnitude of flux change due to climatic changes over next 10,000 yr (to satisfy Issue 1.1)	Show expected flux change will be < 5 mm/yr	High
		Expected magnitude of flux change due to climatic changes over 100,000 yr (to satisfy Issue 1.9b)	Show expected flux change will be < 5 mm/yr	High
Climatic changes cause an increase in altitude of water table	Radionuclide transport time through UZ, given fixed UZ rock hydrologic and geochemical properties	Expected magnitude of change in water-table level due to climatic changes over next 10,000 yr (to satisfy Issue 1.1)	Show expected magnitude of change in water-table altitude will be <+100 m	High
		Expected magnitude of change in water-table level due to climatic changes over next 100,000 yr (to satisfy Issue 1.9b)	Show expected magnitude of change in water-table altitude will be <+100 m	Moderate
Climatic change causes an increase in the gradient of the water table within the C-area	Radionuclide transport time through SZ[c], given fixed distances to accessible environment boundary	Expected magnitude of change in water-table gradient due to climatic change over the next 10,000 yr (to satisfy Issue 1.1)	Show change will be < 2×10^{-3}	Moderate

Table 8.3.1.5-1. Initiating events or processes and associated performance measures (for climate program) (page 2 of 2)

Initiating event or process	Intermediate performance measures	Performance parameters	Tentative goal	Needed confidence
		Expected magnitude of change in water-table gradient due to climatic change over next 100,000 yr (to satisfy Issue 1.9b)	Show change will be $< 2 \times 10^{-3}$	Moderate
Climatic change causes appearance of surficial discharge points within C-area	Radionuclide transport time through SZ, given fixed SZ rock hydrologic and geochemical properties	Expected locations of surficial discharge points within C-zone over the next 10,000 yr; magnitudes of discharges at each location (to satisfy Issue 1.1)	Show that no significant surficial discharge points could appear within C-area, given a water-table rise <+160 m	Moderate
		Expected locations of surficial discharge points within the C-zone due to climatic change over the next 100,000 yr (to satisfy Issue 1.9b)	Show that no significant surficial discharge points could appear within C-area, given a water-table rise <+160 m	Moderate

[a]C-area = controlled area.
[b]UZ = unsaturated zone.
[c]SZ = saturated zone.

Table 8.3.1.5-2. Activity parameters provided by the climate program that support performance and design issues (page 1 of 6)

Calls by performance and design issues		Parameter category	Response by climate characterization program	
Issue	SCP section		Activity parameter	SCP activity
1.1, 1.9b	8.3.5.13, 8.3.5.18	Present regional climate	Monthly and annual values for temperature	8.3.1.5.1.1.1
			Monthly and annual values for precipitation	8.3.1.5.1.1.1
			Monthly and annual values for wind-velocity	8.3.1.5.1.1.1
			Spatial and temporal variation of precipitation	8.3.1.5.1.1.1
			Spatial and temporal variation of air temperature	8.3.1.5.1.1.1
1.1, 1.9b	8.3.5.13, 8.3.5.18	Quaternary regional paleoclimate	Paleontology (ostracodes, diatoms, aquatic palynomorphs, etc.) in marsh, lake, and playa deposits	8.3.1.5.1.2.1
			Lithostratigraphy of marsh, lake, and playa deposits	8.3.1.5.1.2.2
			Clastic sedimentology of marsh, lake, and playa deposits	8.3.1.5.1.2.2
			Chemical sedimentology of marsh, lake, and playa deposits	8.3.1.5.1.2.2
			Major element analyses of bulk sediments from marsh, lakes, and playas	8.3.1.5.1.2.2
			Carbonate mineralogy of bulk sediments from lakes, marshes, and playas	8.3.1.5.1.2.3

Table 8.3.1.5-2. Activity parameters provided by the climate program that support performance and design issues (page 2 of 6)

Calls by performance and design issues		Parameter category	Response by climate characterization program	
Issue	SCP section		Activity parameter	SCP activity
1.1, 1.9b (continued)	8.3.5.13, 8.3.5.18 (continued)	Quaternary regional paleoclimate (continued)	Non-carbonate mineralogy of bulk sediments from lakes, playas, and marshes	8.3.1.5.1.2.3
			Stable isotope analyses of bulk sediments from lakes, playas, and marshes	8.3.1.5.1.2.3
			Ages of playa, lake, and marsh deposits	8.3.1.5.1.2.4
			Pack-rat midden compositions	8.3.1.5.1.3.1
			Pack-rat midden distributions	8.3.1.5.1.3.1
			Pack-rat midden ages	8.3.1.5.1.3.1
			Pollen and spore compositions	8.3.1.5.1.3.2
			Pollen and spore distributions	8.3.1.5.1.3.2
			Pollen and spore ages	8.3.1.5.1.3.2
			Pollen-climate transfer functions	8.3.1.5.1.3.3
			Vegetation-climate and pollen-climate response surfaces	8.3.1.5.1.3.3
1.1, 1.9b	8.3.5.13, 8.3.5.18	Quaternary regional paleoenvironment	Soil morphology and distribution	8.3.1.5.1.4.1
			Soil physical properties	8.3.1.5.1.4.1
			Soil chemical properties	8.3.1.5.1.4.1

Table 8.3.1.5-2. Activity parameters provided by the climate program that support performance and design issues (page 3 of 6)

Calls by performance and design issues		Parameter category	Response by climate characterization program	
Issue	SCP section		Activity parameter	SCP activity
1.1, 1.9b (continued)	8.3.5.13, 8.3.5.18 (continued)	Quaternary regional paleoenvironment (continued)	Dust physical properties	8.3.1.5.1.4.1
			Dust chemical properties	8.3.1.5.1.4.1
			Soil water holding capacity	8.3.1.5.1.4.1
			Soil partial pressure of CO_2	8.3.1.5.1.4.1
			Movement of soil solutions	8.3.1.5.1.4.1
			Rates of carbonate translocation in soils	8.3.1.5.1.4.1
			Ages of soils	8.3.1.5.1.4.1
			Physical properties of surficial deposits	8.3.1.5.1.4.1, 8.3.1.5.1.4.2
			Soil mineralogical properties	8.3.1.5.1.4
			Ages of surficial deposits	8.3.1.5.1.4.1, 8.3.1.5.1.4.2
			Soil water chemistry	8.3.1.5.1.4.1
			Distribution of surficial deposits	8.3.1.5.1.4.2
			Thickness of surficial deposits	8.3.1.5.1.4.2
			Chemical properties of surficial deposits	8.3.1.5.1.4.2
			Mineralogical properties of surficial deposits	8.3.1.5.1.4.2
			Ages of eolian deposits	8.3.1.5.1.4.3
			Trace element geochemistry in eolian deposits	8.3.1.5.1.4.3
			Trace element geochemistry in alluvium	8.3.1.5.1.4.3
			Paleowind velocity	8.3.1.5.1.4.3

Table 8.3.1.5-2. Activity parameters provided by the climate program that support performance and design issues (page 4 of 6)

Calls by performance and design issues		Parameter category	Response by climate characterization program	
Issue	SCP section		Activity parameter	SCP activity
1.1, 1.9b	8.3.5.13, 8.3.5.18	Paleoclimate paleo-environmental synthesis	Paleoprecipitation distributions	8.3.1.5.1.5.1
			Paleoprecipitation intensities	8.3.1.5.1.5.1
			Paleotemperature patterns	8.3.1.5.1.5.1
			Paleoevaporation rates	8.3.1.5.1.5.1
			Time series of paleoprecipitation at key locations	8.3.1.5.1.5.1
			Time series of paleoevaporation rates at key locations	8.3.1.5.1.5.1
			Time series of paleotemperature at key locations	8.3.1.5.1.5.1
			Magnitude of high paleoprecipitation	8.3.1.5.1.5.1
			Duration of high paleoprecipitation periods	8.3.1.5.1.5.1
			Occurrence of high paleosnowmelt	8.3.1.5.1.5.1
			Magnitude of low paleotemperatures	8.3.1.5.1.5.1
			Magnitude of low paleoevaporation	8.3.1.5.1.5.1
1.1, 1.9b	8.3.5.13, 8.3.5.18	Future climate	Future seasonal distribution and average annual rainfall	8.3.1.5.1.6.3
			Future type and intensity of storms	8.3.1.5.1.6.3
			Future distribution and average annual snowfall and rapidity of snowmelt	8.3.1.5.1.6.3
			Future evapotranspiration	8.3.1.5.1.6.3
			Future cloud cover	8.3.1.5.1.6.3
			Future temperature	8.3.1.5.1.6.3
			Future wind speed and direction	8.3.1.5.1.6.3

Table 8.3.1.5-2. Activity parameters provided by the climate program that support performance and design issues (page 5 of 6)

Calls by performance and design issues		Parameter category	Response by climate characterization program	
Issue	SCP section		Activity parameter	SCP activity
1.1, 1.9b	8.3.5.13, 8.3.5.18	Quaternary regional paleohydrology	Paleoflood magnitudes	8.3.1.5.2.1.1
			Paleoflood frequencies	8.3.1.5.2.1.1
			Paleoflood hydraulic characteristics	8.3.1.5.2.1.1
			Paleoflood debris movement quantities	8.3.1.5.2.1.1
			Paleoflood debris movement characteristics	8.3.1.5.2.1.1
			Past evapotranspiration rate	8.3.1.5.2.1.3
			Past potentiometric head	8.3.1.5.2.1.3
			Location, type, and extent of hydrogeologic units	8.3.1.5.2.1.3
			Transmissivity	8.3.1.5.2.1.3
			Discharge of paleoseeps and paleosprings	8.3.1.5.2.1.3
			Locations of paleoseeps and paleosprings	8.3.1.5.2.1.3
			Analog infiltration rate	8.3.1.5.2.1.4
			Analog recharge rate	8.3.1.5.2.1.4
			Analog site effective moisture	8.3.1.5.2.1.4

Table 8.3.1.5-2. Activity parameters provided by the climate program that support performance and design issues (page 6 of 6)

Calls by performance and design issues		Parameter category	Response by climate characterization program	
Issue	SCP section		Activity parameter	SCP activity
1.1, 1.9b (continued)	8.3.5.13, 8.3.5.18 (continued)	Quaternary regional paleohydrology (continued)	Mineralogy of calcite-silica deposits	8.3.1.5.2.1.5
			Petrology of calcite-silica deposits	8.3.1.5.2.1.5
			Morphology of calcite-silica deposits	8.3.1.5.2.1.5
			Paleontology of calcite-silica deposits	8.3.1.5.2.1.5
			Chemistry of calcite-silica deposits	8.3.1.5.2.1.5
			Ages of calcite-silica deposits	8.3.1.5.2.1.5
			Isotopic concentrations of calcite-silica deposits	8.3.1.5.2.1.5
1.1, 1.9b	8.3.5.13, 8.3.5.18	Paleoclimate/ paleohydrology synthesis	Relationship between climate (e.g. precipitation, temperature, evapotranspiration) and infiltration and recharge	8.3.1.5.2.1.1, 8.3.1.5.2.1.2, 8.3.1.5.2.1.3, 8.3.1.5.2.1.4, 8.3.1.5.2.1.5

1.6 EROSION

Because erosion is not expected to pose a hazard to the isolation of waste at Yucca Mountain (Issue 1.1, Section 8.3.5.13), very few performance and design issues request information from the erosion program. Only Issue 1.12 (Section 8.3.3.2, seal characteristics), the surface characteristics program (Section 8.3.1.14), and the human interference program (Section 8.3.1.9), require input from the erosion program. In addition, the preliminary performance allocation for the surface system element (1.1.1) (Section 8.3.2.5) has established tentative goals for several parameters dealing with erosion at surface facilities. Table 8.3.1.6-1 lists the parameters requested by these issues and programs.

Table 8.3.1.6-1. Parameters provided by the erosion program that support performance and design issues

Issue requesting parameter	SCP section number	Performance or design parameter	Tentative goal	Desired confidence	Characterization parameter	Testing basis: Current estimate of parameter range	Testing basis: Current confidence	Testing basis: Needed confidence	Study number
1.12 (Seal characteristics)	8.3.3.2	Erosion potential at shafts.	< 1 m of preferential erosion of bedrock at shaft entry locations over 1,000 yr	Low	Long term erosion rates at shaft entry locations	40 cm/ 1,000 yr	Very low	Low	8.3.1.6.1.1 8.3.1.16.1.1
1.1 (Total system performance) through human interference program	8.3.5.13, 8.3.1.9	Locations of low erosion or deposition for surface markers	Identify geomorphologically stable areas along controlled-zone boundary	Low	Long term rates of erosion, deposition at proposed marker locations	40 cm/ 1,000 yr	Very low	Low	8.3.1.6.1.1 8.3.1.16.1.1
4.4 (Technical feasibility) through surface characteristics program	8.3.2.5, 8.3.1.14	Scour potential along Fortymile Wash at bridge locations; erosion potential along proposed roads	< 13 m of scour at bridge foundations over 100 yr; < 5 m of bed erosion in channel over 100 yr; < 1 m sheet erosion on roadways over 100 yr	Low	Rates of soil, bedrock erosion at bridge locations over 100 yr; erosion along roads and channel beds	40 cm/ 1,000 yr	Very low	Low	8.3.1.6.1.1 8.3.1.16.1.1

1.7 POSTCLOSURE TECTONICS

Tables 8.3.1.8-1 through 8.3.1.8-6 list the favorable and potentially adverse conditions on which data are required for the resolution of Issue 1.8 and the performance measures, intermediate performance measures and performance parameters on which data are required by Issue 1.1 and Issue 1.11. Each table is linked to a specific performance or intermediate performance measure identified by Issue 1.1 or 1.11 and a specific postclosure tectonics program investigation. The first column in Part A of the tables identifies the performance or design issue that has requested information from the postclosure tectonics program. The second and third columns identify the potentially adverse and favorable conditions from Issue 1.8 that will be addressed by each initiating event.

The fourth column lists the initiating events identified by Issues 1.1 or 1.11 that are related to the performance measure or intermediate performance measure. Initiating events are tectonic events or processes that, if they should occur during the period of interest, could directly or indirectly lead to releases or adversely affect estimates of release at the accessible environment boundary.

The fifth and sixth columns identify a performance measure and associated goal. Performance measures are high level measures of total system performance and are described in more detail in Section 8.3.5.13 (Issue 1.1) and Section 8.3.2.2 (Issue 1.11). The seventh and eighth columns describe an intermediate performance measure and associated goal that is related to a significant component of the radionuclide release calculation (e.g., average percolation flux rates) that could be altered by tectonic processes or events. The goal for the intermediate performance measure is not intended to indicate the expected value that will result from the analysis of the tectonics program or the value at which the site would fail to meet the system performance objective. Instead, the goal provides an estimate of when the initiating event may start to become significant in performance calculations and is intended to provide guidance to the tectonics program on the level of accuracy or precision required in the program's analyses. The intermediate performance measures and the scenario classes to which they belong are further described in Section 8.3.5.13 for Issue 1.1 or in Section 8.3.2.2 for Issue 1.11.

The final column describes the performance parameters that have been related by Issue 1.1 or Issue 1.11 to each initiating event. For each initiating event in the tectonics program there are usually two performance parameters. The first performance parameter provides the probability that the tectonic event described in the initiating event will occur during the period of interest. In many instances, estimating probabilities for a tectonic initiating event over 10,000 yr may be difficult. Evaluation of these probabilities are subject to considerable uncertainty, but these uncertainties are quantifiable using available data and judgment. The second performance parameter provides a description of the effects of the event on the concern described in the intermediate performance measure should such an event actually occur.

Table 8.3.1.8-1a. Investigation 8.3.1.8.1 - Studies to provide information required on direct releases resulting from volcanic activity

SCP section requesting parameter	Potentially adverse condition addressed (10 CFR 60.122(c)) (Section 8.3.5.17)	Favorable condition addressed (10 CFR 60.122(b)) (Section 8.3.5.17)	Initiating event	Performance measure	Tentative goal	Intermediate performance parameter	Goal	Performance parameter
8.3.5.13 (Issue 1.1, total system performance)	15	1	Volcanic eruption penetrates repository and causes direct releases to the accessible environment.	EPPM[a]	<<1	Not applicable	Not applicable	Annual probability of volcanic eruption that penetrates the repository
8.3.5.17 (Issue 1.8, NRC siting criteria)								Effects of volcanic eruption penetrating repository, including area of repository disrupted
8.3.5.18 (Issue 1.9, higher level findings-postclosure)								

[a]EPPM = expected partial performance measure (Section 8.3.5.13).

Table 8.3.1.8-1b. Investigation 8.3.1.8.1 - Studies to provide information required on direct releases resulting from volcanic activity (page 1 of 2)

Performance parameter	Tentative parameter goal	Needed confidence	Characterization parameter	Testing basis: Current estimate (range or bound)	Testing basis: Confidence in current estimate	Testing basis: Needed confidence in final values	Investigations supplying data	Key studies or activities supplying data
Annual probability of volcanic eruption that penetrates the repository	$< 10^{-6}$ per yr	High	Location and timing of volcanic events	See Section 1.3.2.1.2	Moderate	High	8.3.1.8.5	8.3.1.8.5.1.1 - Volcanism drill-holes 8.3.1.8.5.1.2 - Geochronology studies 8.3.1.8.5.1.3 - Field geologic studies 8.3.1.8.5.1.4 - Geochemistry of scoria sequences
			Evaluation of structural controls on volcanism	See Section 1.3.2.1	Low	Moderate	8.3.1.8.1	8.3.1.8.1.1.1 - Location and timing of volcanic events
							8.3.1.8.5	8.3.1.8.5.1.3 - Field geologic studies 8.3.1.8.5.1.5 - Geochemical cycles of basaltic volcanic fields
							8.3.1.17.4	8.3.1.17.4.12.1 - Evaluate tectonic processes and tectonic stability at the site
			Presence of magma bodies in the vicinity of the site	See Section 1.3.2.1	Low	Moderate	8.3.1.17.4	8.3.1.17.4.7 - Subsurface geometry of Quaternary faults at Yucca Mountain
							8.3.1.8.5	8.3.1.8.5.2.1 - Evaluation of depth of curie temperature isotherm 8.3.1.8.5.2.3 - Heat flow at Yucca Mountain
							8.3.1.17.4	8.3.1.17.4.1.2 - Monitor current seismicity 8.3.1.17.4.3.1 - Evaluate crustal structure and subsurface expression of Quaternary faults

Table 8.3.1.8-1b. Investigation 8.3.1.8.1 - Studies to provide information required on direct releases resulting from volcanic activity (page 2 of 2)

Performance parameter	Tentative parameter goal	Needed confidence	Characterization parameter	Testing basis: Current estimate (range or bound)	Testing basis: Confidence in current estimate	Testing basis: Needed confidence in final values	Investigations supplying data	Key studies or activities supplying data
Effects of volcanic eruption penetrating repository, including area of repository disrupted, and confidence bounds of estimate	Show that < 0.1% of repository area is disrupted with a conditional probability of <0.1 of being exceeded in 10,000 yr, should such an intrusion occur	Moderate	Effects of Strombolian eruptions	< 0.05% of repository area disrupted	Moderate	Moderate	None planned (See Sections 1.3.2.1 and 1.5.1)	
			Effects of hydrovolcanic eruptions	Data not available	Low	Moderate	8.3.1.8.5	8.3.1.8.5.1.3 - Field geologic studies

Table 8.3.1.8-2a. Investigation 8.3.1.8.2 - Studies to provide information required on rupture of waste packages due to tectonic events

SCP section requesting parameter	Potentially adverse condition addressed (10 CFR 60.122(c)) (Section 8.3.5.17)	Favorable condition addressed (10 CFR 60.122(b)) (Section 8.3.5.17)	Initiating event	Performance measure	Tentative goal	Intermediate performance parameter	Performance parameter
8.3.5.17 (Issue 1.8, NRC siting criteria) 8.3.2.2 (Issue 1.11, configuration of underground facilities-postclosure)	15	1	Igneous intrusion penetrating repository resulting in failure of waste packages	Usable area: is usable area adequate for 70,000 MTU of waste?	Probability < 0.1 in 1,000 yr that > 0.5% of waste packages will be ruptured by tectonic processes or events	Not applicable	Probability of igneous intrusion penetrating repository Effects of igneous intrusion penetrating repository
8.3.5.18 (Issue 1.9, higher level findings-postclosure)	11	1	Offset of one or more faults intersect waste packages and cause failure	Usable area: is usable area adequate for 70,000 MTU of waste?	Probability < 0.1 in 1,000 yr that > 0.5% of waste packages will be ruptured by tectonic processes or events	Not applicable	Number of waste packages affected by fault penetrating repository Probability of faulting with displacement over 5 cm in repository
	12 13 14	1	Ground motion causes spalling or failure and closes air gap around waste package	Usable area: is usable area adequate for 70,000 MTU of waste?	Placement of waste packages in zones with rock properties that will not lead to failure during expected ground motions	Not applicable	Expected ground motion at emplacement boreholes in 1,000-yr period
	11	1	Folding or distributed shear causes waste emplacement borehole deformation and results in waste package failure	Usable area: is usable area adequate for 70,000 MTU of waste?	Probability < 0.1 in 1,000 yr that >0.5% of waste packages will be ruptured by tectonic processes or events	Not applicable	Rate of deformation due to folding or distributed shearing in repository horizon

Table 8.3.1.8-2b. Investigation 8.3.1.8.2 - Studies to provide information required on rupture of waste packages due to tectonic events (page 1 of 2)

Performance parameter	Tentative parameter goal	Needed confidence	Characterization parameter	Testing basis: Current estimate (range or bound)	Testing basis: Confidence in current estimate	Testing basis: Needed confidence in final values	Investigations supplying data	Key studies or activities supplying data
Probability of igneous intrusion penetrating repository	Annual probability less than 10^{-5}	High	Characterization parameters identical to Investigation 1.19.1	10^{-8} to 10^{-10}	Moderate	High	8.3.1.8.1	8.3.1.8.1.1.14 - Probability calculations and assessment
Effects of igneous intrusion penetrating repository	Less than 0.5% of waste packages disrupted	Low	Number of waste packages disrupted by intrusion	1 to 10	Moderate	Moderate	8.3.1.8.1	8.3.1.8.1.2.1 - Effects of Strombolian eruptions
							8.3.2.2.3	8.3.2.2.3 - Design concepts for the underground facility
Number of waste packages affected by fault penetrating repository	Less than 0.5% of waste packages intersected by a single fault with a 95% level of confidence	High	Width of Quaternary fault zones in and near site in which faulting exceeds 5 cm in a single event	< 5 m	Low	Moderate	8.3.1.17.4	8.3.1.17.4.2.2 - Conduct exploratory trenching in Midway Valley 8.3.1.17.4.6.2 - Evaluate age and recurrence of movement on suspected and known Quaternary faults
			Orientation of faults in and near the repository block	N.25.W-N.25.E	Moderate	Moderate	8.3.1.4.2	8.3.1.4.2.2.1 - Geologic mapping of zonal features of Paintbrush Tuff
							8.3.1.4	8.3.1.4.2.3.1 - Development of 3-D geologic model of the site area
							8.3.1.17.4	8.3.1.17.4.6.1 - Evaluate Quaternary geology and potential Quaternary faults at Yucca Mountain
			Repository layout of waste packages and fault slip rates	See Section 6.2.6; < 0.01 mm/yr	Moderate	High	8.3.2.2.3	8.3.2.2.3 - Design concepts for the underground facility
							8.3.1.17.4	8.3.1.17.4.2.2 - Conduct exploratory trenching in Midway Valley 8.3.1.17.4.6.1 - Evaluate Quaternary geology and potential Quaternary faults at Yucca Mountain 8.3.1.17.4.6.2 - Evaluate age and recurrence of movement on suspected and known Quaternary faults

Table 8.3.1.8-2b. Investigation 8.3.1.8.2 - Studies to provide information required on rupture of waste packages due to tectonic events (page 2 of 2)

Performance parameter	Tentative parameter goal	Needed confidence	Characterization parameter	Testing basis: Current estimate (range or bound)	Testing basis: Confidence in current estimate	Testing basis: Needed confidence in final values	Investigations supplying data	Key studies or activities supplying data
Probability of faulting with displacement over 5 cm in repository	Annual probability less than 10^{-4} of faulting with displacement over 5 cm	Moderate	Characteristics of faults that penetrate the repository with total offset > 10 m				8.3.1.17.4	8.3.1.4.2.2.1 - Geologic mapping of zonal features of Paintbrush Tuff 8.3.1.2.3.1 - Development of 3-D geologic model of the site area
			Density	See Section 1.3.2.2.2	Low	Moderate	8.3.1.4.2	8.3.1.17.4.6.1 - Evaluate Quaternary geology and potential Quaternary faults at Yucca Mountain 8.3.1.17.4.6.2 - Age and recurrence of movement on suspected and known Quaternary faults
			Length	< 3000 m	Moderate	High		
			Total Offset	10-50 m	Moderate	High		
			Characteristics of Quaternary faults in and near site with slip rates > 0.001 mm/yr				8.3.1.17.4	8.3.1.17.4.6.1 - Evaluate Quaternary geology and potential Quaternary faults at Yucca Mountain 8.3.1.17.4.6.2 - Age and recurrence of movement on suspected and known Quaternary faults 8.3.1.17.4.12.1 - Evaluate tectonic processes and tectonic stability at the site
			Location	See Figure 1-36	Moderate	High		
			Slip rate	< 0.01 mm/yr	Moderate	High		
			Length	< 35 km	Low	Moderate		
			Total offset	200-500 m	Low	High		
Expected ground motion at emplacement boreholes in 1,000-yr period	Probability of exceeding ground motion values < 0.1 in 1,000-yr	Moderate	Characterization parameters identical to Investigation 8.3.1.17.3	Expected PGA[a] (10,000 yr return period) 0.5-0.7g	Low-moderate	Moderate	8.3.1.17.3	8.3.1.17.3.5.2 - Characterize ground motion from the controlling seismic events 8.3.1.17.3.6.2 - Evaluate ground motion probabilities
Rate of deformation due to folding or distributed shearing in repository horizon	Waste emplacement boreholes will be subject to < 0.005 shear strain in 1,000 yrs as a result of folding or deformation	Low	Nature and age of folding in the repository horizon	No detectable folding in 10 million yr	Moderate	High	8.3.1.4.2 8.3.1.4.3 8.3.1.17.4 8.3.1.8.2	8.3.1.4.2.2.1 - Geologic mapping of zonal features of Paintbrush Tuff 8.3.1.4.2.3.1 - Development of 3-D geologic model of the site area 8.3.1.17.4.12.1 - Evaluate tectonic processes and tectonic stability at the site 8.3.1.8.2.1.2 - Calculation of the number of waste packages intersected by a fault

[a]PGA = Peak Ground Acceleration.

Table 8.3.1.8-3a. Investigation 8.3.1.8.3 - Studies to provide information required on changes in unsaturated and saturated zone hydrology due to tectonic events (Study 1; alteration of average percolation flux) (page 1 of 2)

SCP section requesting parameter	Potentially adverse condition addressed (10 CFR 60.122(c)) (Section 8.3.5.17)	Favorable condition addressed (10 CFR 60.122(b)) (Section 8.3.5.17)	Initiating event	Performance measure	Goal	Intermediate performance measure	Goal	Performance parameter
8.3.5.13 (Issue 1.1, total system performance) 8.3.5.17 (Issue 1.8, NRC siting criteria) 8.3.5.18 (Issue 1.9, higher level findings-postclosure)	3, 15	1, 8(i)	Volcanic eruption causes flows or other changes in topography that result in impoundment or diversion of drainage	EPPM[a]	<< 1	Radionuclide transport time through UZ[b], given fixed UZ thickness, rock hydrologic properties and geochemical properties	Tectonic processes and events will not adversely alter the average percolation flux at the top of the Topopah Spring welded unit by more than a factor of 2. The probability of exceeding the goal will be <0.1 in 10,000 yr	Annual probability of volcanic events within the controlled area Effects of a volcanic event on topography and flux rates
			Igneous intrusion, such as a sill, that could result in a significant change in average flux	Same as above	Same as above	Same as above	Same as above	Annual probability of significant igneous intrusion in the controlled area Effects of an igneous intrusion on flux rates
	3, 4, 11	1, 8(i)	Offset on fault creates surface impoundments, alters drainage, creates perched aquifers, or changes dip of tuff beds, thereby significantly changing average flux	Same as above	Same as above	Same as above	Same as above	Probability of offset > 2 m on a fault in the controlled area in 10,000 yr Probability of changing dip by > 2° in 10,000 yr by faulting Effect of faulting flux rates

Table 8.3.1.8-3a. Investigation 8.3.1.8.3 - Studies to provide information required on changes in unsaturated and saturated zone hydrology due to tectonic events (Study 1; alteration of average percolation flux) (page 2 of 2)

SCP section requesting parameter	Potentially adverse condition addressed (10 CFR 60.122(c)) (Section 8.3.5.17)	Favorable condition addressed (10 CFR 60.122(b)) (Section 8.3.5.17)	Initiating event	Performance measure	Goal	Intermediate performance measure	Goal	Performance parameter
	3, 4, 11	1, 8(i)	Folding changes dip of tuff beds controlled area thereby significantly changing average flux	EPPM	<< 1	Same as above	Same as above	Probability of changing dip by > 2° in 10,000 yr by folding
	3, 4, 11, 16	1, 8(i)	Uplift or subsidence changes topography or drainage thereby significantly changing average flux	Same as above	Same as above	Same as above	Same as above	Probability of exceeding 30 m elevation change in 10,000 yr

[a]EPPM = expected partial performance measure (see Section 8.3.5.13).
[b]UZ = unsaturated zone.

Table 8.3.1.8-3b. Investigation 8.3.1.8.3 - Studies to provide information required on changes in unsaturated and saturated zone hydrology due to tectonic events (Study 1; alteration of average percolation flux) (page 1 of 2)

Performance parameter	Tentative parameter goal	Needed confidence	Characterization parameter	Testing basis: Current estimate (range or bound)	Testing basis: Confidence in current estimate	Testing basis: Needed confidence in final values	Investigations supplying data	Key studies or activities supplying data
Annual probability of volcanic events within the controlled area	$< 10^{-5}$ per yr	High	Probability calculation for volcanic events	10^{-7} to 10^{-9} per yr	Moderate	High	8.3.1.8.1	8.3.1.8.1.1.4 - Probability calculations and assessment
Effects of a volcanic event on topography and flux rates	Show topographic changes are not great enough to significantly affect flux	Low	Data on topographic changes caused by an eruption	See Section 1.5.1.2.2	Moderate	Moderate	8.3.1.8.1	8.3.1.8.1.2.1 - Effects of Strombolian eruptions 8.3.1.8.1.2.2 - Effects of hydrovolcanic eruptions
			Hydrologic model of flow in the unsaturated zone	See Section 3.9.3.2.1	Moderate	High	8.3.1.2.2	8.3.1.2.2.8 - Flow in unsaturated, fractured rock 8.3.1.2.2.9 - Site unsaturated zone modeling, synthesis, and integration
Annual probability of significant igneous intrusion in the controlled area	$< 10^{-5}$ per yr	High	Probability calculation for igneous events	10^{-7} to 10^{-9} per yr	Moderate	High	8.3.1.8.1	8.3.1.8.1.1.4 - Probability calulations and assessment
Effects of an igneous intrusion on flux rates	Show igneous intrusion will not significantly affect flux because of depth, location, and extent of intrusion	Low	Orientation and dimensions of possible intrusions at the site	= N.30.E; < 4 km x 0.3-4 m	Moderate	Moderate	No new activities planned	None
			Hydrologic model of flow in the unsaturated zone	See Section 3.9.3.2.1	Moderate	High	8.3.1.2.2	8.3.1.2.2.8 - Flow in unsaturated, fractured rock 8.3.1.2.2.9 - Site unsaturated zone modeling, synthesis, and integration
Probability of offset > 2 m on a fault in the controlled area in 10,000 yr	$< 10^{-1}$ per 10,000 yr	Moderate	Vertical slip rate and recurrence interval on Quaternary faults in and near the site	Slip rate < 0.01 mm per yr	Moderate	High	8.3.1.17.4	8.3.1.17.4.4.3 - Evaluate Stagecoach Road fault zone
							8.3.1.17.4	8.3.1.17.4.6.2 - Evaluate age and recurrence of movement on suspected and known Quaternary faults

Table 8.3.1.8-3b. Investigation 8.3.1.8.3 - Studies to provide information required on changes in unsaturated and saturated zone hydrology due to tectonic events (Study 1; alteration of average percolation flux) (page 2 of 2)

Performance parameter	Tentative parameter goal	Needed confidence	Characterization parameter	Testing basis: Current estimate (range or bound)	Testing basis: Confidence in current estimate	Testing basis: Needed confidence in final values	Investigations supplying data	Key studies or activities supplying data
Probability of changing dip by >2° in 10,000 yr by faulting	< 10^{-4} per 10,000 yr	Low	Vertical slip rate on Quaternary faults in and near the site and rate of tilting	< 0.01 mm per yr	Moderate	High	8.3.1.17.4	8.3.1.17.4.6.1 - Evaluate Quaternary geology and potential Quaternary faults at Yucca Mountain 8.3.1.17.4.6.2 - Evaluate age and recurrence of movement on suspected and known Quaternary faults
							8.3.1.4.2	8.3.1.4.2.2.1 - Geologic mapping of zonal features of Paintbrush Tuff
							8.3.1.4.3	8.3.1.4.2.3.1 - Development of a 3-D geologic model of the site area
Effect of faulting on flux rates	Show faulting will not significantly affect flux because of low slip rate	Moderate	Hydrologic model of flow in the unsaturated zone	See Section 3.9.3.2.1	Moderate	High	8.3.1.2.2	8.3.1.2.2.8 - Flow in unsaturated, fractured rock 8.3.1.2.2.9 - Site unsaturated zone modeling, synthesis, and integration
Probability of changing dip by >2° in 10,000 yr by folding	< 10^{-4} per 10,000 yr	Low	Rate of folding in the unsaturated zone section	No detectable folding in 10 million yr	Moderate	High	8.3.1.4.2	8.3.1.4.2.2.1 - Geologic mapping of the exploratory shaft and drifts
							8.3.1.4.3	8.3.1.4.2.2.4 - Geologic mapping of the exploratory shaft and drifts
Probability of exceeding 30 m elevation change in 10,000 yr	< 10^{-4} per 10,000 yr	Low	Rate of uplift or subsidence at site	< 3×10^{-2} mm per yr	Moderate	Moderate	8.3.1.17.4	8.3.1.4.2.3.1 - Development of a 3-D geologic model of the site area 8.3.1.17.4.9.2 - Evaluate extent of Quaternary uplift and subsidence at and near Yucca Mountain 8.3.1.17.4.1.10 - Geodetic leveling

Table 8.3.1.8-4a. Investigation 8.3.1.8.3 - Studies to provide information required on changes in unsaturated and saturated zone hydrology due to tectonic events (Study 2; changes in water table elevation) (page 1 of 2)

SCP section requesting parameter	Potentially adverse condition addressed (10 CFR 60.122(c)) (Section 8.3.5.17)	Favorable condition addressed (10 CFR 60.122(b)) (Section 8.3.5.17)	Initiating event	Performance measure	Goal	Intermediate performance measure	Goal	Performance parameter
8.3.5.13 (Issue 1.1, total system performance) 8.3.5.17 (Issue 1.8, NRC siting criteria) 8.3.5.18 (Issue 1.9, higher level findings - postclosure)	5, 15, 22, 23	1, 8(ii)	Igneous intrusion causes barrier to flow or thermal effects that alter water-table level	EPPM[a]	<< 1	Radionuclide transport time through UZ[b], given fixed UZ rock hydrologic and geochemical properties	Water table will not rise to within 100 m of emplaced waste in 10,000 yr	Annual probability of a significant igneous intrusion within 0.5 km of controlled area boundary
							No discharge points created in the controlled area	Barrier-to-flow effects of igneous intrusions on water-table levels
							Perched aquifers will not be created within 100 m of emplaced waste	Thermal effects of igneous intrusions on water-table levels
							The probability of exceeding the goals will be < 0.1 in 10,000 yr	
	4, 5, 11, 22, 23	1, 8(ii)	Episodic changes in strain in the rock mass due to faulting causes changes in water-table level	Same as above	Same as above	Same as above	Same as above strain-induced	Probability that changes increased to potentiometric level to > 850 m mean sea level

Table 8.3.1.8-4a. Investigation 8.3.1.8.3 - Studies to provide information required on changes in unsaturated and saturated zone hydrology due to tectonic events (Study 2; changes in water table elevation) (page 2 of 2)

SCP section requesting parameter	Potentially adverse condition addressed (10 CFR 60.122(c)) (Section 8.3.5.17)	Favorable condition addressed (10 CFR 60.122(b)) (Section 8.3.5.17)	Initiating event	Performance measure	Goal	Intermediate performance measure	Goal	Performance parameter
	4, 5, 11, 22, 23	1, 8(ii)	Folding, uplift, or subsidence lowers repository with respect to water table	Same as above	Same as above	Same as above	Same as above	Probability that repository will be lowered by 100 m through action of folding, uplift, or subsidence in 10,000 yr
	4, 5, 11, 22, 23	1, 8(ii)	Offset on fault juxtaposes transmissive and nontransmissive units resulting in either the creation of a perched aquifer or a rise in the water table	Same as above	Same as above	Same as above	Same as above	Probability of total offsets > 2.0 m in 10,000 yr on a fault within controlled area boundary Effects of fault offset on water-table levels

[a]EPPM = expected partial performance measure (see Section 8.3.5.13).
[b]UZ = unsaturated zone.

Table 8.3.1.8-4b. Investigation 8.3.1.8.3 - Studies to provide information required on changes in unsaturated and saturated zone hydrology due to tectonic events (Study 2; changes in water-table elevation) (page 1 of 2)

Performance parameter	Tentative parameter goal	Needed confidence	Characterization parameter	Testing basis: Current estimate (range or bound)	Testing basis: Confidence in current estimate	Testing basis: Needed confidence in final values	Investigations supplying data	Key studies or activities supplying data
Annual probability of a significant igneous intrusion within 0.5 km of controlled area boundary	$< 10^{-5}$ per yr	Moderate	Probability calculation for volcanic events	10^{-7} to 10^{-9} per yr	Moderate	High	8.3.1.8.1	8.3.1.8.1.1.4 - Probability calculations and assessment
Barrier-to-flow effects of igneous intrusions on water-table levels	Show water table will not rise to within 100 m of repository horizon in 10,000 yr	Low	Orientation and dimensions of possible intrusions at the site	Orientation: N.20°-40°E. Length: 400-4000 m	Moderate	Moderate	8.3.1.17.4	8.3.1.17.4.12.1 - Evaluate tectonic processes and tectonic stability at the site
			Hydrologic model of saturated zone flow system	See Section 3.9.3.2.2	Moderate	High	8.3.1.2.3	8.3.1.2.3.3.1 - Conceptualization of saturated zone flow models
Thermal effects of igneous intrusions on water-table levels	Show water table will not rise to within 100 m of repository horizon in 10,0000 yr	Low	Model thermal effects around a dike	400°C at 2 m distance after 40 days	Moderate	Moderate	8.3.1.8.1	8.3.1.8.1.2.1 - Effects of Strombolian eruptions 8.3.1.8.1.1.3 - Presence of magma bodies in vicinity of site
			Hydrologic model of saturated zone flow system	See Section 3.9.3.2.2	Moderate	High	8.3.1.2.3	8.3.1.2.3.3.1 - Conceptualization of saturated zone flow models
Probability that strain-induced changes increase potentiometric level to > 850 m MSL[a]	$< 10^{-5}$ per yr	Low	Strain rates and strain changes due to faulting	See Section 1.3.2.3	Low	Moderate	8.3.1.17.4	8.3.1.17.4.12.1 - Evaluate tectonic processes and tectonic stability at the site
			Hydrologic model of saturated zone flow system	See Section 3.9.3.2.2	Moderate	High	8.3.1.2.3	8.3.1.2.3.3.1 - Conceptualization of saturated zone flow models
Probability that repository will be lowered by 100 m through action of folding, uplift, or subsidence in 10,000 yr	$< 10^{-4}$ per 10,000 yr	Low	Folding, uplift, and subsidence rates in site area	$< 3 \times 10^{-2}$ mm per yr	Moderate	Moderate	8.3.1.17.4	8.3.1.17.4.9.2 - Evaluate extent of Quaternary uplift and subsidence at and near Yucca Mountain 8.3.1.17.4.10 - Geodetic leveling
							8.3.1.4.2	8.3.1.4.2.2.1 - Geologic mapping of zonal features of Paintbrush Tuff 8.3.1.4.2.2.4 - Geologic mapping of exploratory shaft and drifts
							8.3.1.4.3	8.3.1.4.2.3.1 - Development of a 3-D geologic model of the site area

Table 8.3.1.8-4b. Investigation 8.3.1.8.3 - Studies to provide information required on changes in unsaturated and saturated zone hydrology due to tectonic events (Study 2; changes in water-table elevation) (page 2 of 2)

Performance parameter	Tentative parameter goal	Needed confidence	Characterization parameter	Testing basis: Current estimate (range or bound)	Testing basis: Confidence in current estimate	Testing basis: Needed confidence in final values	Investigations supplying data	Key studies or activities supplying data
Probability of total offsets > 2.0 m in 10,000 yr on a fault within controlled area boundary	< 10^{-1} per 10,000 yr	Low	Slip rates on Quaternary faults in and near site	< 0.01 mm/yr	Moderate	High	8.3.1.17.4	8.3.1.17.4.4.3 - Evaluate Stagecoach Road fault zone 8.3.1.17.4.6.1 - Evaluate Quaternary geology and potential Quaternary faults at Yucca Mountain 8.3.1.17.4.6.2 - Evaluate age and recurrence of movement on suspected and known Quaternary faults
Effects of fault offset on water-table levels	Show water table will not rise to within 100 m of repository horizon in 10,000 yr	High	Orientation and length of faulting	N.25°E. - N.25°W. 10-20 km	Moderate	Moderate	8.3.1.17.3	8.3.1.17.3.1 - Relevant earthquake sources
			Hydrologic model of saturated zone flow system	See Section 3.9.3.2.1	Moderate	High	8.3.1.2.3	8.3.1.2.3.3.1 - Conceptualization of saturated zone flow models
			Hydrologic model of unsaturated flow system	See Section 3.9.3.2.1	Moderate	High	8.3.1.2.2	8.3.1.2.2.8 - Flow in unsaturated, fractured rock 8.3.1.2.2.9 - Site unsaturated zone modeling, synthesis, and integration
			Evidence of higher water levels in Quaternary due to faulting	See Section 1.2.2.2.10	Low	Moderate	8.3.1.5.2	8.3.1.5.2.1.5 - Studies of calcite and opaline silica vein deposits

*MSL = mean sea level.

Table 8.3.1.8-5a. Investigation 8.3.1.8.3 - Studies to provide information required on changes in unsaturated and saturated zone hydrology due to tectonic events (Study 3; alteration of rock properties along significant travel paths)

SCP section requesting parameter	Potentially adverse condition addressed (10 CFR 60.122(c)) (Section 8.3.5.17)	Favorable condition addressed (10 CFR 60.122(b)) (Section 8.3.5.17)	Initiating event	Performance measure	Goal	Intermediate performance measure	Goal	Performance parameter
8.3.5.13 (Issue 1.1, total system performance) 8.3.5.17 (Issue 1.8, NRC siting criteria) 8.3.5.18 (Issue 1.9, higher level findings-postclosure)	5, 15, 24	1, 8(i)	Igneous intrusion causes changes in hydrologic properties	EPPM[a]	<< 1	Radionuclide transport time through UZ[b], given fixed thickness of UZ	The localized flux along travel paths from the repository to the accessible environment will not be significantly increased for distances that are a signifi-part of the the travel path over 10,000 yr	Annual probability of significant igneous intrusions within 0.5 km of controlled area boundary Effects of igneous intrusions on local fracture permeabilities and effective porosities
	4, 5, 11, 24	1, 8(i)	Episodic offset on faulting causes local changes in rock hydrologic properties, thereby destroying existing barriers to flow, creating barriers to flow, or creating new conduits for drainage	Same as above	Same as above	Same as above	Same as above	Annual probability of faulting events on Quaternary faults within 0.5 km of controlled area boundary Effects of fault motion on local fracture permeabilities and effective porosities
	4, 5, 11, 24	1, 8(i)	Changes in stress or strain in the controlled area resulting from episodic faulting, folding, or uplift causes changes in the hydrologic properties of the rock mass	Same as above	Same as above	Same as above	Same as above	Effects of changes of stress or strain on hydrologic properties of the rock mass

[a]EPPM = expected partial performance measure (Section 8.3.5.13).
[b]UZ = unsaturated zone.

Table 8.3.1.8-5b. Investigation 8.3.1.8.3 - Studies to provide information required on changes in unsaturated and saturated zone hydrology due to tectonic events (Study 3; alteration of rock properties along significant travel paths)

Performance parameter	Tentative parameter goal	Needed confidence	Characterization parameter	Testing basis: Current estimate (range or bound)	Testing basis: Confidence in current estimate	Testing basis: Needed confidence in final values	Investigations supplying data	Key studies or activities supplying data
Annual probability of significant igneous intrusions within 0.5 km of controlled area boundary	$< 10^{-5}$ per yr	Moderate	Probability calculation for volcanic events	10^{-7} to 10^{-9} per yr	Moderate	High	8.3.1.8.1	8.3.1.8.1.1.4 - Probability calculations and assessment
Effects of igneous intrusions on local fracture permeabilities and effective porosities	Show no significant changes in rock hydrologic properties	Low	Evidence of change in rock properties around dikes in the region	No data available	Low	Moderate	8.3.1.8.5	8.3.1.8.5.2.2 - Chemical and physical changes around dikes
Annual probability of faulting events on Quaternary faults within 0.5 km of controlled area boundary	Show $< 10^{-4}$ per yr for each fault	High	Location of Quaternary faults in and near site	See Figure 1-36	Moderate	High	8.3.1.17.4	8.3.1.17.4.6.1 - Evaluate Quaternary geology and potential Quaternary faults at Yucca Mountain
			Slip rate and recurrence interval for Quaternary faults in and near site	Slip rate < 0.01 mm per yr	Moderate	High	8.3.1.17.4	8.3.1.17.4.6.2 - Evaluate age and recurrence of movement on suspected and known Quaternary faults
Effects of fault motion on local fracture permeabilities and effective porosities	Show change in fracture permeability is < a factor of 2, and that fracture porosity increases	High	Evidence of episodic rock property changes along faults	See Section 1.3.2.2.2	Low	Moderate	8.3.1.4.2	8.3.1.4.2.2.3 - Borehole evaluation of faults and fractures 8.3.1.4.2.2.4 - Geologic mapping of exploratory shaft and drifts 8.3.1.3.2.1.3 - Fracture mineralogy
Effects of changes of stress or strain on hydrologic properties of the rock mass	Show changes in conductivity and porosity of rock mass are < a factor of 2	Low	Potential stress and strain changes in the rock mass due to faulting or other tectonic processes	See Section 1.3.2.3	Low	Moderate	8.3.1.17.4	8.3.1.17.4.12.1 - Evaluate tectonic processes and tectonic stability at the site
			Hydrologic models of flow in the saturated and unsaturated zone	See Sections 3.9.2.1 and 3.9.3.2.2	Low	Moderate	8.3.1.2.2	8.3.1.2.2.8 - Flow in unsaturated, fractured rock 8.3.1.2.2.9 - Site unsaturated zone modeling, synthesis, and integration
							8.3.1.2.3	8.3.1.2.3.3.1 - Conceptualization of saturated zone flow models

Table 8.3.1.8-6a. Investigation 8.3.1.8.4 - Studies to provide information required on changes in rock geochemical properties resulting from tectonic processes

SCP section requesting parameter	Potentially adverse condition addressed (10 CFR 60.122(c)) (Section 8.3.5.17)	Favorable condition addressed (10 CFR 60.122(b)) (Section 8.3.5.17)	Initiating event	Performance measure	Goal	Intermediate performance measure	Goal	Performance parameter
8.3.5.13 (Issue 1.1, total system performance) 8.3.5.17 (Issue 1.8, NRC siting criteria)	8, 15, 24	1, 3	Igneous intrusion causes changes in rock geochemical properties	EPPM[a]	<< 1	Radionuclide transport time through UZ[b], given fixed thickness of UZ	For radionuclides with travel times less than 10,000 yr, the change in K_ds[c] will not be more than a factor of 2 in 10,000 yr with a high level of confidence	Annual probability of igneous intrusions within 0.5 km of the controlled area boundary Effects of intrusions on local rock geochemical properties
8.3.5.18 (Issue 1.9, higher level findings-postclosure)	8, 11, 24	1, 3	Offset on a fault causes changes in movement of ground water that results in mineralogical changes along fault zone	Same as above	Same as above	Same as above	Same as above	Probabilty of movement and location of Quaternary faults in controlled area Degree of mineral changes in fault zone in 10,000 yr
	8, 11, 24	1, 3	Offset on a fault changes travel pathway to one with different geochemical properties	Same as above	Same as above	Same as above	Same as above	Probability of total offsets > 2.0 m in 10,000 yr on a fault within 0.5 km of controlled area boundary Effects of fault offset on travel pathway
	8, 11, 24	1, 3	Tectonic processes cause changes in ground-water table or movement that results in mineral changes in controlled area	Same as above	Same as above	Same as above	Same as above	Degree of mineral change in the controlled are resulting from changes in water-table level or flow paths in 10,000 yr

[a]EPPM = expected partial performance measure (Section 8.3.5.13).
[b]UZ = unsaturated zone.
[c]K_d = distribution coefficient.

Table 8.3.1.8-6b. Investigation 8.3.1.8.4 - Studies to provide information required on changes in rock geochemical properties resulting from tectonic processes (page 1 of 2)

Performance parameter	Tentative parameter goal	Needed confidence	Characterization parameter	Testing basis: Current estimate (range or bound)	Testing basis: Confidence in current estimate	Testing basis: Needed confidence in final values	Investigations supplying data	Key studies or activities supplying data
Annual probability of significant igneous intrusions within 0.5 km of the controlled area boundary	$< 10^{-5}$ per yr	Moderate	Probability calculations for volcanic events	10^{-7} to 10^{-9} per yr	Moderate	High	8.3.1.8.1	8.3.1.8.1.1.4 - Probability calulations and assessment
Effects of intrusions on local rock geochemical properties	Show potential changes in mineralogy will not be extensive	Low	Evidence of change in geochemical properties around dikes in the region	Data not available	Low	Moderate	8.3.1.8.5	8.3.1.8.5.2.2 - Chemical and physical changes around dikes
Probability of movement within 2 km of surface and location of Quaternary faults in controlled area	$< 10^{-4}$ per yr for each fault	Moderate	Location of Quaternary faults in controlled area	See Figure 1-36	Moderate	High	8.3.1.17.4	8.3.1.17.4.6.1 - Evaluate Quaternary geology and potential Quaternary faults at Yucca Mountain
			Slip rate and recurrence intervals for Quaternary faults in the controlled area	< 0.01 mm per yr	Moderate	High	8.3.1.17.4	8.3.1.17.4.6.2 - Evaluate age and recurrence of movement on suspected and known Quaternary faults
Degree of mineralogic change in fault zone in 10,000 yr	Show adverse changes in mineralogy will not occur	Moderate	Nature and age of mineralogic changes on faults in the controlled area	See Section 1.3.2.3	Low	Moderate	8.3.1.4.2	8.3.1.4.2.2.3 - Borehole evaluation of faults and fractures 8.3.1.4.2.2.4 - Geologic mapping of shafts and drifts 8.3.1.3.2.1.3 - Fracture mineralogy 8.3.1.3.2.2 - History of mineralogic and geochemical alteration of Yucca Mountain
Probability of total offsets > 2.0 m in 10,000 yr on a fault within controlled area boundary	$< 10^{-1}$ per 10,000 yr	Moderate	Slip rates on Quaternary faults in and near site	< 0.01 mm per yr	Moderate	High	8.3.1.17.4	8.3.1.17.4.4.3 - Evaluate Stagecoach Road fault zone 8.3.1.17.4.6.2 - Evaluate age and recurrence of movement on suspected and known Quaternary faults

Table 8.3.1.8-6b. Investigation 8.3.1.8.4 - Studies to provide information required on changes in rock geochemical properties resulting from tectonic processes (page 2 of 2)

Performance parameter	Tentative parameter goal	Needed confidence	Characterization parameter	Testing basis: Current estimate (range or bound)	Testing basis: Confidence in current estimate	Testing basis: Needed confidence in final values	Investigations supplying data	Key studies or activities supplying data
Effects of fault offset on travel pathway	Show significant changes will not occur	Moderate	Hydrologic models of unsaturated and saturated zone flow	See Sections 3.9.3.2.1 and 3.9.3.2.2	Moderate	High	8.3.1.2.2 8.3.1.2.3	8.3.1.2.2.8 - Flow in unsaturated, fractured rock 8.3.1.2.2.9 - Site unsaturated zone modeling, synthesis, and integration 8.3.1.8.3.3.1 - Conceptualization of saturated zone flow models
Degree of mineralogic change in the controlled area resulting from changes in water-table level or flow paths in 10,000 yr	Show adverse changes in mineralogy will not occur	Low	Probability and magnitude of hydrologic changes	Data not available	Low	Moderate	8.3.1.8.3	8.3.1.8.3.2.2 - Assessment of the effects of igneous intrusion on water-table elevations 8.3.1.8.3.2.3 - Assessment of the effect of strain changes on water-table elevation 8.3.1.8.3.2.4 - Assessment of the effect of folding, uplift, or subsidence on water-table elevation 8.3.1.8.3.2.6 - Assessment of the effect of faulting on water-table elevation

1.8 HUMAN INTERFERENCE

The general approach to obtaining the required parameters from the human interference program is to identify the natural and anthropogenic parameters that are required by the design and performance issues. Table 8.3.1.9-1 lists the performance issue that requests data from this program, along with the performance and characterization parameters required by the issue.

The data requirements of Issue 1.1 primarily involve quantifying, in probabilistic terms, the site-specific factors that could contribute to unanticipated natural phenomena or anthropogenic events at or in the vicinity of Yucca Mountain. Design of the marker system (Issue 4.4) requires site-specific data to ensure strategic placement of the monuments in locations having low risk associated with the consequences of natural phenomena or human activities. Archaeological studies of ancient monuments and structures (Kaplan, 1982; Berry et al., 1984) have been used to address identifiable and potentially disruptive and destructive anthropogenic factors that could affect marker survivability. The remaining parameters, the consequences of natural phenomena, will be obtained through other site activities and evaluated in Study 8.3.1.9.1.1 as listed in Table 8.3.1.9-1.

Table 8.3.1.9-1. Initiating events, associated performance parameters, and activity parameters for the human interference program (page 1 of 7)

Issue requesting parameter	SCP section	Initiating event	Performance parameter	Activity parameter	SCP section
1.1 Total system releases	8.3.5.13	Exploratory drilling intercepts a waste package and brings up waste with core or cuttings	Presence and readability of C-area[a] markers over 10,000 yr (long-term survivability of markers)	Rates of Erosion Weathering Deposition Igneous activity Seismic activity at marker locations	8.3.1.9.1
			Expected drilling rate (no. of boreholes/km^2/yr) in R-area[b] over the next 10,000 yr	Quantities, tonnages, and grades of known or inferred resources at Yucca Mountain	8.3.1.9.2.1
			Distribution of diameters of exploratory drilling	Types of known or inferred resources at Yucca Mountain	8.3.1.9.2 and 8.3.1.9.3
			Distribution of depths of exploratory drilling	Types of known or inferred resources at Yucca Mountain	8.3.1.9.2 and 8.3.1.9.3
		Extensive groundwater withdrawal occurs near C-area	Expected magnitude of change in water-table level in the C-area due to extensive groundwater withdrawal in next 10,000 yr	Quantity, rates, well locations, and hydrostratigraphic unit sources of groundwater withdrawals	8.3.1.9.2.2 and 8.3.1.16.2.1

Table 8.3.1.9-1. Initiating events, associated performance parameters, and activity parameters for the human interference program (page 2 of 7)

Issue requesting parameter	SCP section	Initiating event	Performance parameter	Activity parameter	SCP section
1.1 Total system releases (continued)	8.3.5.13 (continued)		Expected magnitude in changes in gradient of water table under C-area due to ground-water withdrawal near C-area in next 10,000 yr	Quantity, rates, well locations, and hydrostratigraphic source of ground-water withdrawals	8.3.1.9.2.2 and 8.3.1.16.2.1
			Presence and readability of C-area markers over 10,000 yr	See the activity parameter for the exploratory drillers intercept under the initiating event column of this table	8.3.1.9.1.1
		Extensive surface or subsurface mining occurs near the C-area	Expected magnitude of change in water-table level due to mine-water use or mine dewatering near C-area over next 10,000 yr	Estimated depth of mine, cross-sectional area of mines or shafts	8.3.1.9.3.2

Table 8.3.1.9-1. Initiating events, associated performance parameters, and activity parameters for the human interference program (page 3 of 7)

Issue requesting parameter	SCP section	Initiating event	Performance parameter	Activity parameter	SCP section
1.1 Total system releases (continued)	8.3.5.13 (continued)		Expected magnitude of change in gradient under C-area due to mine-water usage or mine dewatering	Estimated water usage based on quantity of water-available, depth of mine	8.3.1.9.3.2
			Expected magnitude of changes in distribution coefficient (K_ds) of unsaturated zone (UZ) and saturated zone (SZ) due to mining activities near the C-area	No changes expected	8.3.1.9.3.2
			Presence and readability of C-area markers over next 10,000 yr	See the activity parameter for the exploratory drillers intercept under the initiating event column of this table	8.3.1.9.1.1

Table 8.3.1.9-1. Initiating events, associated performance parameters, and activity parameters for the human interference program (page 4 of 7)

Issue requesting parameter	SCP section	Initiating event	Performance parameter	Activity parameter	SCP section
1.1 Total system releases (continued)	8.3.5.13 (continued)	Large-scale surface-water impoundments are constructed near the C-area	Expected magnitude of change in water-table level due to presence of artificial lake near C-area	Area, depth, volume of surface-water impoundment; seepage rates, percolation rates and transmissivity of near-surface and subsurface materials	8.3.1.9.3.2
			Expected magnitude of changes in K_ds for UZ and SZ units due to presence of an artificial lake near C-area	No changes expected	
			Expected magnitude of changes in head gradients of the SZ in C-area due to the presence of an artificial lake near C-area	Area, depth, volume of surface-water impoundments	8.3.1.9.3.2

Table 8.3.1.9-1. Initiating events, associated performance parameters, and activity parameters for the human interference program (page 5 of 7)

Issue requesting parameter	SCP section	Initiating event	Performance parameter	Activity parameter	SCP section
1.1 Total system releases (continued)	8.3.5.13 (continued)		Expected magnitude of flux change due to presence of an artificial lake near the C-area in next 10,000 yr	Area, depth, and volume of surface water impoundment; seepage rates, percolation rates, and transmissivity of near-surface and subsurface materials	8.3.1.9.3.2
			Presence and readability of C-area markers over 10,000 yr	See the activity parameter for the exploratory drilling intercept under the initiating event column of this table	8.3.1.9.1.1
		Extensive irrigation is conducted near the C-area	Expected magnitude of change in altitude of water-table under C-area due to extensive irrigation near C-area over next 10,000 yr	Area of irrigation, crop cultivation, quantity of water used for irrigation based on quantity of water available	8.3.1.9.3.2

Table 8.3.1.9-1. Initiating events, associated performance parameters, and activity parameters for the human interference program (page 6 of 7)

Issue requesting parameter	SCP section	Initiating event	Performance parameter	Activity parameter	SCP section
1.1 Total system releases (continued)	8.3.5.13 (continued)		Expected magnitude of flux change due to extensive irrigation near the C-area over next 10,000 yr	Area of irrigation, crop cultivation, quantity of water applied, infiltration, and percolation rate	
			Expected magnitude of change in read gradients below C-area due to extensive irrigation over next 10,000 yr	Quantity of irrigation withdrawals	8.3.1.9.3.2
			Expected magnitude of changes in K_ds of UZ and SZ	No change expected	8.3.1.9.3.2
			Presence and readability of surface markers over 10,000 yr	See the activity parameter for the exploratory drilling intercept under the initiating event column of this table	8.3.1.9.1.1

Table 8.3.1.9-1. Initiating events, associated performance parameters, and activity parameters for the human interference program (page 7 of 7)

Issue requesting parameter	SCP section	Initiating event	Performance parameter	Activity parameter	SCP section
4.4 Technical feasibility	8.3.2.5	NA[c]	Surface markers located in geomorphically stable locations	Rates of deposition, igneous activity and seismic activity near C-area boundary	

[a]C-area = controlled area (i.e., the actual area chosen according to the 40 CFR 191.12 definition of controlled area).
[b]R-area = restricted area (i.e., the projection of the primary area and extensions onto the surface).
[c]NA = not applicable).

1.9 METEOROLOGY

Table 8.3.1.12-1 shows the link between the design and performance parameters (information needed) and the meteorology program parameters that satisfy those needs, respectively.

Table 8.3.1.12-1. Performance allocation table for meteorology program

Issue	SCP section	Performance or design parameter	Characterization parameter	Testing basis: Current estimate	Testing basis: Current confidence	Testing basis: Needed confidence	SCP study (or activity)[a]
2.1, 2.2, 2.3, 4.2, and 4.4	8.3.5.3, 8.3.5.4, 8.3.5.5, 8.3.2.3, 8.3.2.4, and 8.3.2.5	x/Q	Wind speed	Figures 5-3 to 5-7	Low	High	8.3.1.12.1.1--Regional meteorological conditions
			Wind direction	Tables 5-6 and 5-7	Low	High	
				Figures 5-3 to 5-7	Low	High	8.3.1.12.2.1.1--Site meteorological monitoring program
				Tables 5-6 and 5-7	Low	High	
			Temperature	Tables 5-2 and 5-3	Low	High	
			Mixing layer depth	Quiring (1968)	Low	High	
			Atmospheric stability	Table 5-11	Low	High	
			Atmospheric moisture	Tables 5-2 and 5-5	Low	High	
			Precipitation (type, amount, intensity)	Tables 5-2 and 5-4	Low	High	
2.2	8.3.5.4	Radon emanation rate from tuff	Temperature	Tables 5-2 and 5-3	Low	High	8.3.1.12.2.1.2--Data summary for input to dose assessments
			Barometric pressure	Table 5-2	Low	High	
2.3 and 4.4	8.3.5.5 and 8.3.2.5	Accident initiating events	Extreme winds and frequency of occurrence	Tables 5-2 and 5-8	Medium	High	8.3.1.12.4.1--Potential extreme weather phenomena and their reoccurrence
			Lightning strikes and frequency	Section 5.1.1.6	Medium	High	
			Precipitation extremes (snow, rain, ice, and amounts and frequency)	Tables 5-2, 5-4, and 5-10	Medium	High	
			Temperature extremes	Tables 5-2, 5-3, and 5-9	Medium	High	

[a]Studies and activities listed apply to all parameters associated with the issue.

1.10 SURFACE CHARACTERISTICS

The design- and performance-issue parameters in Table 8.3.1.14-1 are determined by the site surface system element (1.1.1) requirements described in Section 8.3.2 (Table 8.3.2.5-1). These design and performance parameters determine what characterization parameters will be needed. The characterization parameters with their expected ranges, confidence levels, and required activities are also presented in Table 8.3.1.14-1.

Table 8.3.1.14-1. Performance allocation for site surface and subsurface access characterization parameters and the corresponding performance or design parameters and issues they support[a] (page 1 of 12)

Issue or program	SCP section	Performance or design parameters[b]	Characterization parameters (key column)	Current estimate	Current confidence	Needed confidence	Study or activity providing data
			GEOMETRICAL PARAMETERS				
1.11 4.4 8.3.1.4 8.3.1.15 8.3.1.16	8.3.2.2.1 8.3.2.2.3 8.3.2.5.1 8.3.2.5.5 8.3.2.5.7 8.3.1.4.3 8.3.1.15.3 8.3.1.16.1	Surface topography at facility locations (1-m contour interval)	Surface topography at facility locations (1-m contour interval)	20-ft contour interval topographic map (see Figure 4-3 of the SCP-CDR (SNL, 1987))	Medium	Medium	No further studies are planned. Topographical measurements have been made and topographic maps are forthcoming.
4.4	8.3.2.5.1 8.3.2.5.5 8.3.2.5.7	Allowable foundation bearing capacity in soil					
		Allowable foundation bearing capacity in rock					
		Active and passive soil pressures on a wall					
		Active and passive rock pressures on a wall					
		Factor of safety of slope (soil)					
		Factor of safety of slope (rock)					
		Ramp or shaft in situ stress					
4.4 8.3.1.16	8.3.2.5.1 8.3.2.5.5 8.3.2.5.7 8.3.1.16.1	Surface topography of access routes (2-m contour intervals)	Surface topography of access routes (2-m contour intervals)	20-ft contour interval topographic map (see Figures 4-2 and 4-3 of the SCP-CDR (SNL, 1987))	Medium	Medium	No further studies are planned. Topographical measurements have been made and topographic maps are forthcoming.
4.4	8.3.2.5.1 8.3.2.5.5 8.3.2.5.7	Factor of safety of slope (soil)					
		Factor of safety of slope (rock)					

Table 8.3.1.14-1. Performance allocation for site surface and subsurface access characterization parameters and the corresponding performance or design parameters and issues they support[a] (page 2 of 12)

Issue or program	SCP section	Performance or design parameters[b]	Characterization parameters (key column)	Current estimate	Current confidence	Needed confidence	Study or activity providing data
			SOIL PARAMETERS				
		Allowable foundation bearing capacity in soil Active and passive soil pressure on a wall Factor of safety of slope (soil)	Alluvial stratigraphy Layering Thickness Geometry	General stratigraphic description. Top 0.3 to 0.7 m is loose fine-grained sandy soil overlying approximately 2 m of material that is partly to wholly cemented with calcite (caliche). Below the caliche layer is an 10 to 50 m thick layer of dense sandy gravel alluvial material which overlies the ashflow tuff bedrock (Section 6.1.2.1.2)	Low	Medium	8.3.1.14.2.1.1, 8.3.1.14.2.1.2, 8.3.1.14.2.3
4.4 8.3.1.17	8.3.2.5.1 8.3.2.5.5 8.3.2.5.7 8.3.1.17.3	Soil-structure interaction for foundation[c] Soil-structure interaction for retaining wall[c]					
4.4	8.3.2.5.1 8.3.2.5.5 8.3.2.5.7	Magnitude of time dependent settlement in soils below earthfills[d] Magnitude of swell in subgrade soils[d] Magnitude of soil collapse[d] Soil liquefaction potential[d]					
		Identification of any fault within 100 m of facilities important to safety (FITS) with greater than 1 chance in 100 of producing more than 5 cm of surface displacement in 100 yr	Alluvial faulting (the study for this characterization parameter is developed in Section 8.3.1.17.4.2 (preclosure tectonics) location orientation	See Section 8.3.1.17.4.2 in preclosure tectonics	Low	High	See Study 8.3.1.17.4.2, (location and recency of faulting near prospective surface facilities)
		Allowable foundation bearing capacity in soil Active and passive soil pressure on a wall Factor of safety of slope (soil)	Soil classification vs. depth Soil gradation Atterberg limits[d]	GP-GM[e] From preliminary investigations, no cohesive soils have been found	Low Low	Medium Medium	8.3.1.14.2.2.1

Table 8.3.1.14-1. Performance allocation for site surface and subsurface access characterization parameters and the corresponding performance or design parameters and issues they support[a] (page 3 of 12)

Issue or program	SCP section	Performance or design parameters[b]	Characterization parameters (key column)	Current estimate	Current confidence	Needed confidence	Study or activity providing data
			SOIL PARAMETERS (continued)				
		Soil-structure interaction for foundation[b]					
		Soil-structure interaction for retaining wall[b]					
		Magnitude of time dependent settlement in soils below earthfills[d]					
		Magnitude of swell in subgrade soils[d]					
		Magnitude of soil collapse[d]					
		Soil liquefaction potential[d]					
		Allowable foundation bearing in soil	Physical properties vs. capacity depth				8.3.1.14.2.2.1, 8.3.1.14.2.3.1
			In situ density	101-112 pcf	Low	Medium	
			Relative density	Not available	Low	Medium	
			Moisture content	7.2%	Low	Medium	
			Percent saturation	47.3%	Low	Medium	
			Specific gravity	2.43	Low	Medium	
		Active and passive soil pressure on a wall					
		Factor of safety of slope (soil)					
		Soil-structure interaction for foundation[c]					
		Soil-structure interaction for retaining wall[c]					
		Magnitude of time dependent settlement in soils below earthfills[d]					
		Magnitude of swell in subgrade soils[d]					
		Magnitude of soil collapse[d]					
		Soil liquefaction potential[d]					

Table 8.3.1.14-1. Performance allocation for site surface and subsurface access characterization parameters and the corresponding performance or design parameters and issues they support[a] (page 4 of 12)

Issue or program	SCP section	Performance or design parameters[b]	Characterization parameters (key column)	Current estimate	Current confidence	Needed confidence	Study or activity providing data
			SOIL PARAMETERS (continued)				
		Allowable foundation bearing capacity in soil	Compaction characteristics				
		Active and passive soil pressure on a wall	Compaction curves for potential fill material including maximum dry density (γ_d) and optimum water content	γ_d (max) = 108-114 pcf Optimum water content = 12-15%	Low Low	Medium Medium	8.3.1.14.2.2.1
		Magnitude of soil collapse[d]					
			Mechanical and dynamic properties vs. depth for undisturbed and recompacted soils				
4.4	8.3.2.5.1 8.3.2.5.5 8.3.2.5.7	Allowable foundation bearing capacity in soil	Young's modulus (static and dynamic)	10,000-20,000 psi (static) (Ho et al., (1986) 192,000 psi (dynamic calculated from Vp)	Low	Medium	8.3.1.14.2.2.2, 8.3.1.14.3.2, 8.3.1.14.2.3.2
8.3.1.17	8.3.1.17.3	Soil structure interaction for foundation[c]					
		Soil structure interaction for retaining wall[c]	Poisson's ratio (static and dynamic)	0.3-0.35 (static) (Ho et al., 1986) 0.286 (dynamic) (Neal, 1986)	Low	Medium	8.3.1.14.2.2.2, 8.3.1.14.2.3.3
		Soil liquefaction potential[d]					
		Soil structure interaction for foundation[c]	Compressive wave velocity (Vp) and shear wave velocity (Vs) (these parameters will be used to calculate the dynamic elastic characterization parameters: Young's modulus, shear modulus, and Poisson's ratio).	Vp = 3,300 ft/sec (Neal, 1986) Vs = 1,800 ft/sec (Neal, 1986)	Medium	High	8.3.1.14.2.3.3
		Soil-structure interaction for retaining wall[c]					
		Soil liquefaction potential[d]					

Table 8.3.1.14-1. Performance allocation for site surface and subsurface access characterization parameters and the corresponding performance or design parameters and issues they support[a] (page 5 of 12)

Issue or program	SCP section	Performance or design parameters[b]	Characterization parameters (key column)	Current estimate	Current confidence	Needed confidence	Study or activity providing data
			SOIL PARAMETERS (continued)				
			Shear modulus (static and dynamic)	3,700-7,700 psi (static-calculated) 74,100 psi (dynamic-calculated from Vs)	Low	Medium	8.3.1.14.2.3.3
			Damping	Not available	Low	Medium	8.3.1.14.2.3.3
4.4	8.3.2.5.1 8.3.2.5.5 8.3.2.5.7	Allowable foundation bearing capacity in soil Active and passive soil pressure on a wall Factor of safety of slope (soil) Soil-structure interaction for foundation[c] Soil-structure interaction for retaining wall[c]	Mohr-Coulomb strength parameters in terms of cohesion (c) and angle of friction (ϕ)	c = 500 psf (cemented) ϕ = 33 to 37°	Low	High	8.3.1.14.2.2.2
		Allowable foundation bearing capacity in soil	Plate load bearing pressure vs. settlement	Not available	Low	Medium	
			CONTINGENT SOIL PARAMETERS				
			The following characterization parameters are contingent parameters (see footnote d)				
4.4	8.3.2.5.1 8.3.2.5.5 8.3.2.5.7	Soil-structure interaction for foundation[c]	Other strength parameters such as Drucker-Prager, etc. (if required)[d]	Not available	Low	Medium	8.3.1.14.2.2.2
8.3.1.17	8.3.1.17.3	Soil-structure interaction	Bulk modulus and constrained modulus[d]	Not available	Low	Medium	8.3.1.14.2.2.2

Table 8.3.1.14-1. Performance allocation for site surface and subsurface access characterization parameters and the corresponding performance or design parameters and issues they support[a] (page 6 of 12)

Issue or program	SCP section	Performance or design parameters[b]	Characterization parameters (key column)	Current estimate	Current confidence	Needed confidence	Study or activity providing data
			CONTINGENT SOIL PARAMETERS (continued)				
		Soil liquefaction potential[d]	Strength and stress-deformation characteristics under dynamic load conditions evaluated as a function of stress rate, confinement stress, initial static stress level, magnitude of pulsating stress, number of stress cycles, and frequency of loading[d]	Not available	Low	Medium	8.3.1.14.2.2.2
			Dynamic shear modulus as a function of strain and confinement stress[d]	Not available	Low	High	8.3.1.14.2.2.2, 8.3.1.14.2.3.3
			Damping as a function of strain[d]	Not available	Low	High	8.3.1.14.2.2.2, 8.3.1.14.2.3.3
			Shear wave velocities as a function of strain[d]	Not available	Low	High	8.3.1.14.2.2.2, 8.3.1.14.2.3.3
			Deformation modulus in terms of stress-strain characteristics and confinement stress conditions[d]	Not available	Low	High	8.3.1.14.2.2.2
4.4	8.3.2.5.1 8.3.2.5.5 8.3.2.5.7	Soil liquefaction potential[d]	Liquefaction parameters: cyclic shearing stress ratio, cyclic deformation, and porepressure response (this information will not be needed if there are no perched water bodies near the ground surface)[d]	Not available	Low	Medium	8.3.1.14.2.2.2

Table 8.3.1.14-1. Performance allocation for site surface and subsurface access characterization parameters and the corresponding performance or design parameters and issues they support[a] (page 7 of 12)

Issue or program	SCP section	Performance or design parameters[b]	Characterization parameters (key column)	Current estimate	Current confidence	Needed confidence	Study or activity providing data
			CONTINGENT SOIL PARAMETERS (continued)				
		Allowable foundation bearing capacity in soil Soil-structure interaction for foundation[c] Soil-structure interaction for retaining wall[c]	Modulus of subgrade reaction from plate load test (static and dynamic)[d]	200-300 pci	Low	Medium	8.3.1.14.2.3.2
		Allowable foundation bearing capacity in soil Magnitude and rate of time dependent settlement below earthfills[d]	Compression and swell index (for saturated clayey soils if they are encountered)	Not available	Low	Medium	8.3.1.14.2.2.2
		Magnitude of swell in subgrade soils below roads[d]	Coefficient of consolidation (for saturated clayey soils if they are encountered)[d]	Not available	Low	Medium	8.3.1.14.2.2.2
		Allowable foundation bearing capacity in soil Magnitude of soil collapse below surface facilities (foundations, earthfills, and roads) due to saturation and/or loading[d]	Collapse potential (for relative dry low density soils)[d]	Not available	Low	Medium	8.3.1.14.2.2.2
			OTHER SOIL PARAMETERS				
		Favorable hydraulic induced soil erosion characteristics	Erosion potential	<13 m/100 yr of scour around bridge piers <5 m/100 yr of bed erosion <1 m/100 yr of sheet erosion	Low	Medium	8.3.1.6.1.1.2, 8.3.1.6.1.1.3
		Favorable infiltration/runoff ratio	Infiltration/runoff ratio	See Section 8.3.1.12 (meteorology) and 8.3.1.2 (geohydrology)	Low	Medium to high	See Section 8.3.1.12 (meteorology) and 8.3.1.2 (geohydrology)

Table 8.3.1.14-1. Performance allocation for site surface and subsurface access characterization parameters and the corresponding performance or design parameters and issues they support[a] (page 8 of 12)

Issue or program	SCP section	Performance or design parameters[b]	Characterization parameters (key column)	Current estimate	Current confidence	Needed confidence	Study or activity providing data
			ROCK PARAMETERS				
4.4 8.3.1.17	8.3.2.5.1 8.3.2.5.5 8.3.2.5.7 8.3.1.17.3	Allowable foundation bearing capacity in rock Active and passive rock pressure on a wall Factor of safety of slope (rock) Rock-structure interaction for foundation[c] Rock-structure interaction for retaining wall[c] Siting and configuration of ramps and shafts Stability of ramps and shafts Support or reinforcement requirements for ramps and shafts	Rock stratigraphy Rock type Layering Thickness Geometry	See Figure 6-6 in the SCP and Figures 5 and 7 in Neal (1986)	Low	Medium	8.3.1.4.2.2, 8.3.1.14.2.1.1, 8.3.1.14.2.1.2, 8.3.1.14.2.1.3, 8.3.1.14.2.3.3
4.4	8.3.2.5.1 8.3.2.5.5 8.3.2.5.7	Allowable foundation bearing capacity in rock Active and passive rock pressure on a wall Factor of safety of slope (rock) Siting and configuration of ramps and shafts Stability of ramps and shafts Support or reinforcement requirements for ramps and shafts	Rock structure Quantitative description of faults Location Orientation Aperture Type of infilling Moisture and/or seepage conditions Waviness and roughness	Not available	Low	High	8.3.1.4.2.2, 8.3.1.14.2.1.1, 8.3.1.14.2.1.2, 8.3.1.14.2.1.3, 8.3.1.14.2.3.1
			Quantitative description of joints Number of joint sets Spacing of joints for each set Orientation of each joint set Type of infilling if any Moisture and/or seepage conditions Waviness and roughness Persistence	Not available			

Table 8.3.1.14-1. Performance allocation for site surface and subsurface access characterization parameters and the corresponding performance or design parameters and issues they support[a] (page 9 of 12)

Issue or program	SCP section	Performance or design parameters[b]	Characterization parameters (key column)	Current estimate	Current confidence	Needed confidence	Study or activity providing data
			ROCK PARAMETERS (continued)				
			Drill core (total core recovery, discontinuity, frequency, and rock quality designation (RQD))				
		Allowable foundation bearing capacity in rock Active and passive rock pressure on a wall Rock-structure interaction for foundation[c] Rock-structure interaction for retaining wall[c] Siting and configuration of ramps and shafts Stability of ramps and shafts Support or reinforcement requirements for ramps and shafts	Rock mass classification Rock mass rating (RMR)[f] Tunneling quality index (Q)[f]	Not available	Low	Medium	8.3.1.14.2.3.1
		Allowable foundation bearing capacity in rock Active and passive rock pressure on a wall Factor of safety of slope (rock) Rock-structure interaction for foundation[c] Rock-structure interaction for retaining wall[c] Siting and configuration of ramps and shafts Stability of ramps and shafts Support or reinforcement requirements for ramps and shafts	Physical properties vs. depth Density (dry) Percent saturation Porosity Specific gravity	2.23 gm/cc or 139 lb/ft^3 67% < 23% 11% < 4% 2.51 < 0.04	Low Low Low Low	Medium Medium Medium Medium	8.3.1.14.2.2.1
			Mechanical and dynamic properties				

Table 8.3.1.14-1. Performance allocation for site surface and subsurface access characterization parameters and the corresponding performance or design parameters and issues they support[a] (page 10 of 12)

Issue or program	SCP section	Performance or design parameters[b]	Characterization parameters (key column)	Current estimate	Current confidence	Needed confidence	Study or activity providing data
			ROCK PARAMETERS (continued)				
		Allowable foundation bearing capacity in rock Rock-structure interaction for foundation[c]	Plate load bearing pressure vs. settlement	Not available	Low	Medium	8.3.1.14.2.3.2
		Magnitude of soil collapse below surface facilities[d]					
		Allowable foundation bearing capacity in rock Factor of safety of slope (rock) Rock-structure interaction for foundation[c] Rock-structure interaction for retaining wall[c] Siting and configuration of ramps and shafts Stability of ramps and shafts Support or reinforcement requirements for ramps and shafts	Peak and residual failure envelopes derived from uniaxial and triaxial compression tests	c (peak) = 26.0 ±10.13 MPa (range) ϕ (peak) = 44.7° ±0.20° (range) Tensile strength = 9.3 MPa Unconfined compressive strength = 120 ± 82 MPa (range)	Low	High	8.3.1.14.2.2.2
		Allowable foundation bearing capacity in rock Active and passive rock pressure on a wall Factor of safety of slope (rock) Siting and configuration of ramps and shafts Stability of ramps and shafts Support or reinforcement requirements for ramps and shafts	Discontinuity shear strength in terms of c and ϕ	c = 0.1 MPa < 0.1 (range) ϕ = 28.4 (range: 11.3° - 38.7°	Medium	High	8.3.1.14.2.2.2
4.4	8.3.2.5.1 8.3.2.5.5 8.3.2.5.7	Allowable foundation bearing capacity in rock Siting and configuration of ramps and shafts Stability of ramps and shafts Support or reinforcement requirements for ramps and shafts	Young's modulus (static and dynamic	20.0 GPa ± 5.55 (range) - static rock mass (SCP, Chapter 6)	Low	Medium	8.3.1.14.2.2.2, 8.3.1.14.2.3.2, 8.3.1.14.2.3.3

Table 8.3.1.14-1. Performance allocation for site surface and subsurface access characterization parameters and the corresponding performance or design parameters and issues they support[a] (page 11 of 12)

Issue or program	SCP section	Performance or design parameters[b]	Characterization parameters (key column)	Current estimate	Current confidence	Needed confidence	Study or activity providing data
			ROCK PARAMETERS (continued)				
8.3.1.17	8.3.1.17.3	Rock-structure interaction for foundation[c] Rock-structure interaction for retaining wall[c] Siting and configuration of ramps and shafts Stability of ramps and shafts Support or reinforcement requirements for ramps and shafts	Poisson's ratio	2.94 GPa (calculated from in situ Vp) 0.24 (laboratory-static) (SCP, Chapter 6) 0.319 (in situ calculated from Vp and Vs) (Neal, 1986)	Low	Medium	8.3.1.14.2.2.2, 8.3.1.14.2.3.3
		Rock-structure interaction for foundation[c] Rock-structure interaction for retaining wall[c] Siting and configuration of ramps and shafts Stability of ramps and shafts Support or reinforcement requirements for ramps and shafts	Shear modulus (static and dynamic)	8.1 GPa ± 2.2 (range) - static rock mass 1.1 GPa (calculated from in situ Vs)	Low	Medium	8.3.1.14.2.2.2, 8.3.1.14.2.3.3
		Rock-structure interaction for foundation[c] Rock-structure interaction for retaining wall[c] Siting and configuration of ramps and shafts Stability of ramps and shafts Support or reinforcement requirements for ramps and shafts	Compressive wave velocities vs. depth	Vp = 7,500 - 9,000 ft/sec (laboratory) (Neal, 1986) Vp = 4,500 ft/sec (in situ) (Neal, 1986)	Low Low	High High	8.3.1.14.2.2.2, 8.3.1.14.2.3.3
		Rock-structure interaction for foundation[c] Rock-structure interaction for retaining wall[c] Siting and configuration of ramps and shafts Stability of ramps and shafts Support or reinforcement requirements for ramps and shafts	Shear wave velocities vs. depth (the compressive and shear wave velocities will be used to calculate the dynamic elastic characterization parameters: Young's modulus, shear modulus, and Poisson's ratio)	Vs = 4,390 - 5,790 ft/sec (laboratory-calculated) Vs = 2,320 ft/sec (in situ-calculated)	Low Low	High High	8.3.1.14.2.2.2, 8.3.1.14.2.3.3
			Damping vs. depth	Not available	Low	High	8.3.1.14.2.2.2, 8.3.1.14.2.3.3

Table 8.3.1.14-1. Performance allocation for site surface and subsurface access characterization parameters and the corresponding performance or design parameters and issues they support[a] (page 12 of 12)

Issue or program	SCP section	Performance or design parameters[b]	Characterization parameters (key column)	Current estimate	Current confidence	Needed confidence	Study or activity providing data
			CONTINGENT ROCK PARAMETERS				
			The following characterization parameters are contingent parameters (see footnote(d))				
		Rock-structure interaction for foundation[c]	Shear wave velocities as a function of strain[d]	Not available	Low	High	8.3.1.14.2.2.2, 8.3.1.14.2.3.3
		Rock-structure interaction for retaining wall[c]	Dynamic shear modulus as a function of strain[d]	Not available	Low	High	8.3.1.14.2.2.2, 8.3.1.14.2.3.3
		Siting and configuration of ramps and shafts					
		Stability of ramps and shafts	Damping as a function of strain[d]	Not available	Low	High	8.3.1.14.2.2.2, 8.3.1.14.2.3.3
		Support or reinforcement requirements for ramps and shafts					

[a]This table is organized around column 4, characterization parameters, as the "key" column. The parameter listed in this column "feeds" characterization data to the design and performance parameters listed in column 3, performance or design parameters. Conversely, the resolution of the performance or design issues listed in column 3 requires data input from the characterization parameter specified in column 4 (key column).

[b]See Table 8.3.2.5-1 for complete description of performance and design parameter.

[c]If the alluvium or rock adjacent to the foundation has shear velocities greater than 3,500 ft/sec, then a soil structure interaction analysis will probably not be necessary.

[d]The need for these design and performance parameters or characterization parameters are contingent on the soil and rock conditions encountered, function or design requirements of the surface facilities, types of foundations selected, and the sophistication or type of analyses used in the design or performance studies. However, based on the sites preliminary surface soil and rock data and the type of foundations which are recommended in the SCP-CDR (SNL, 1987), the parameters are currently not needed.

[e]GP = poorly graded gravel; GM = silty gravel.

[f]RMR = rock mass rating from CSIR (South African Council for Scientific and Industrial Research) Geomechanics Classification; Q = NGI (Norwegian Geotechnical Institute) tunneling quality index.

1.11 THERMAL MECHANICAL ROCK PROPERTIES

Table 8.3.1.15-1 summarizes the required thermal mechanical rock properties and outlines the tie to this section's site characterization activities, which describe how the data will be obtained. The parameters to be measured may be different from those requested in the table. The reasons for the differences and the techniques to be used to produce required data from measured data are described in later portions of Section 8.3.1.15. In addition, amplified discussions of the reasons for the selection of testing techniques are provided in a number of study plans to be written in support of the SCP. In some instances, a preferred test technique is to be prototyped before use in site characterization. If prototyping indicates that a preferred technique will not produce satisfactory results, an alternative technique will be selected.

The stratigraphic locations in Table 8.3.1.15-1 are thermal/mechanical units rather than formal stratigraphic units. This approach has been taken because the repository design process uses the thermal/mechanical units as the stratigraphic framework for analysis.

Table 8.3.1.15-1. Performance and design parameters, tentative goals, and characterization parameters for thermal and mechanical properties program[a] (page 1 of 12)

Issue requesting parameter (SCP section)	Performance or design parameter	Material type and spatial location[b]	Stratigraphic location[c] (request)	Tentative goal[d,e]	Needed confidence[d]	Current estimate	Current confidence[d]	Parameter to be measured	Material type tested	SCP activity numbers	Spatial location	Stratigraphic location[c]
1.6 (8.3.5.12)	Bulk density	Rock mass; primary area	NS	NS	NS	NS	NS	Grain density, porosity	Intact rock	8.3.1.15.1.1.1	(g)	NS
1.10 (8.3.4.2)	Bulk density	Rock mass; primary area	TSw2	$\bar{x} \pm 0.1\ \bar{x}$	Medium	2.26 - 2.33 g/cm^3	Low to medium	Grain density, porosity	Intact rock	8.3.1.15.1.1.1	(g)	TSw2
2.2 (8.3.5.4)	Bulk density	Rock mass; primary area	TSw2	NS	High	2.26 - 2.33 g/cm^3	Low to medium	Grain density, porosity	Intact rock	8.3.1.15.1.1.1	(g)	TSw2
2.7 (8.3.2.3)	Bulk density	Rock mass; primary area	TSw2	(f)	Medium to high	2.26 - 2.33 g/cm^3	Low to medium	Grain density, porosity	Intact rock	8.3.1.15.1.1.1	(g)	TSw2
1.6 (8.3.5.12)	Thermal conductivity	Rock mass; primary area	NS	NS	NS	NS	NS	Thermal conductivity of solids, porosity	Intact rock	8.3.1.15.1.1.1	(g)	NS
								Thermal conductivity	Rock mass	8.3.1.15.1.6.2 8.3.1.15.1.6.3 8.3.1.15.1.6.5	ESF	TSw2
1.10 (8.3.4.2)	Thermal conductivity	Intact rock; primary area	TSw2	$\bar{x} \pm 0.1\bar{x}$	Medium	NS	Low to medium	Thermal conductivity of solids, porosity	Intact rock	8.3.1.15.1.1.1 8.3.1.15.1.1.3	(g)	TSw2
	Thermal conductivity	Rock mass; primary area	TSw2	$\bar{x} \pm 0.1\bar{x}$	Medium	NS	Low to medium	Thermal conductivity	Rock mass	8.3.1.15.1.7.2 8.3.1.15.1.6.3 8.3.1.15.1.6.5	ESF	TSw2
1.11 (8.3.2.2)	Thermal conductivity	Rock mass; primary area and extensions	TSw2	$\bar{x} \pm 0.2\bar{x}$	High	See Table 6-16	Low to medium	Thermal conductivity of solids, porosity	Intact rock	8.3.1.15.1.1.1 8.3.1.15.1.1.3	(g)	TSw2
								Thermal conductivity	Rock mass	8.3.1.15.1.6.2 8.3.1.15.1.6.3 8.3.1.15.1.6.5	ESF	TSw2
			TSw1	$\bar{x} \pm 0.2\bar{x}$	Medium	See Table 6-16	Low to medium	Thermal conductivity of solids, porosity	Intact rock	8.3.1.15.1.1.1 8.3.1.15.1.1.3	(g)	TSw1
								Thermal conductivity	Rock mass	8.3.1.15.1.6.1	ESF	TSw1

Table 8.3.1.15-1. Performance and design parameters, tentative goals, and characterization parameters for thermal and mechanical properties program[a] (page 2 of 12)

Issue requesting parameter (SCP section)	Performance or design parameter	Material type and spatial location[b]	Stratigraphic location[c] (request)	Tentative goal[d,e]	Needed confidence[d]	Current estimate	Current confidence[d]	Parameter to be measured	Material type tested	SCP activity numbers	Spatial location	Stratigraphic location[c]
1.11 (8.3.2.2) (continued)			TSw3, CHn1	$\bar{x} \pm 0.2\bar{x}$	Medium	See Table 6-16	Low to medium	Thermal conductivity of solids, porosity	Intact rock	8.3.1.15.1.1.1 8.3.1.15.1.1.3	(g)	TSw3, CHn1
			Units above TSw1, CHn2	$\bar{x} \pm 0.2\bar{x}$	Low	See Table 6-16	Low to medium	Thermal conductivity of solids, porosity	Intact rock	8.3.1.15.1.1.1 8.3.1.15.1.1.3	(g)	(h)
1.12 (8.3.3.2)	Thermal conductivity	Rock mass; primary area	TSw2, CHn1	NS	Medium	NS	Low to medium	Thermal conductivity of solids, porosity	Intact rock	8.3.1.15.1.1.1 8.3.1.15.1.1.3	(g)	TSw2, CHn1
								Thermal conductivity	Rock mass	8.3.1.15.1.6.2 8.3.1.15.1.6.3 8.3.1.15.1.6.5	ESF	TSw2
4.4 (8.3.2.5)	Thermal conductivity	Rock mass; primary area	TSw2	$\bar{x} \pm 0.2\bar{x}$	Medium	$\bar{x}$	Low to medium	Thermal conductivity of solids, porosity	Intact rock	8.3.1.15.1.1.1 8.3.1.15.1.1.3	(g)	TSw2
								Thermal conductivity	Rock mass	8.3.1.15.1.6.2 8.3.1.15.1.6.3 8.3.1.15.1.6.5	ESF	TSw2
			TSw1	$\bar{x} \pm 0.2\bar{x}$	Medium	$\bar{x}$	Low to medium	Thermal conductivity of solids, porosity	Intact rock	8.3.1.15.1.1.1 8.3.1.15.1.1.3	(g)	TSw1
								Thermal conductivity	Rock mass	8.3.1.15.1.6.1	ESF	TSw1
	Thermal conductivity	Rock mass; primary area	Ground surface to base of TSw2	$\bar{x} \pm 0.2\bar{x}$	Low	$\bar{x}$	Low to medium	Thermal conductivity of solids, porosity	Intact rock	8.3.1.15.1.1.1 8.3.1.15.1.1.3	(g)	Alluvium, TCw, PTn, TSw1, TSw2
								Thermal conductivity	Rock mass	8.3.1.15.1.6.1 8.3.1.15.1.6.2 8.3.1.15.1.6.3 8.3.1.15.1.6.5	ESF	TSw1, TSw2

Table 8.3.1.15-1. Performance and design parameters, tentative goals, and characterization parameters for thermal and mechanical properties program[a] (page 3 of 12)

Issue requesting parameter (SCP section)	Performance or design parameter	Material type and spatial location[b]	Stratigraphic location[c] (request)	Tentative goal[d,e]	Needed confidence[d]	Current estimate	Current confidence[d]	Parameter to be measured	Material type tested	SCP activity numbers	Spatial location	Stratigraphic location[c]
1.6 (8.3.5.12)	Heat capacity	Rock mass; primary area	NS	NS	NS	NS	NS	Heat capacity of solids, grain density, porosity	Intact rock	8.3.1.15.1.1.1 8.3.1.15.1.1.2	(g)	NS
								Heat capacity	Rock mass	8.3.1.15.1.6.2 8.3.1.15.1.6.3 8.3.1.15.1.6.5	ESF	TSw2
1.10 (8.3.4.2)	Heat capacity	Intact rock; primary area	TSw2	$\bar{x} \pm 0.2\,\bar{x}$	Medium	$\bar{x}$	Low to Medium	Heat capacity of solids, grain density, porosity	Intact rock	8.3.1.15.1.1.1 8.3.1.15.1.1.2	(g)	TSw2
								Heat capacity	Rock mass	8.3.1.15.1.6.2 8.3.1.15.1.6.3 8.3.1.15.1.6.5	(g)	TSw2
1.11 (8.3.2.2)	Heat capacity	Rock mass; primary area and extensions	TSw2	$\bar{x} \pm 0.1\bar{x}$	High	See Table 6-16	Low to medium	Heat capacity of solids, grain density, porosity	Intact rock	8.3.1.15.1.1.1 8.3.1.15.1.1.2	(g)	TSw2
								Heat capacity	Rock mass	8.3.1.15.1.6.2 8.3.1.15.1.6.3 8.3.1.15.1.6.5	(g)	TSw2
			TSw1	$\bar{x} \pm 0.1\bar{x}$	Medium	See Table 6-16	Low to medium	Heat capacity of solids, grain density, porosity	Intact rock	8.3.1.15.1.1.1 8.3.1.15.1.1.2	(g)	TSw1
								Heat capacity	Rock mass	8.3.1.15.1.6.1	ESF	TSw1
			TSw3, CHn1	$\bar{x} \pm 0.1\bar{x}$	Medium	See Table 6-16	Low to medium	Heat capacity of solids, grain density, porosity	Intact rock	8.3.1.15.1.1.1 8.3.1.15.1.1.2	(g)	TSw3 CHn1
			All units above TSw1, CHn2	$\bar{x} \pm 0.1\bar{x}$	Low	See Table 6-16	Low	Heat capacity of solids, grain density, porosity	Intact Rock	8.3.1.15.1.1.1 8.3.1.15.1.1.2	(g)	(f)

Table 8.3.1.15-1. Performance and design parameters, tentative goals, and characterization parameters for thermal and mechanical properties program[a] (page 4 of 12)

Issue requesting parameter (SCP section)	Performance or design parameter	Material type and spatial location[b]	Stratigraphic location[c] (request)	Tentative goal[d,e]	Needed confidence[d]	Current estimate	Current confidence[d]	Parameter to be measured	Material type tested	SCP activity numbers	Spatial location	Stratigraphic location[c]
1.12 (8.3.3.2)	Heat capacity	Rock mass; primary area	TSw2, CHnl	NS	Medium	NS	Low to medium	Heat capacity of solids, grain density, porosity	Intact rock	8.3.1.15.1.1.1 8.3.1.15.1.1.2	(g)	TSw2, CHnl
								Heat capacity	Rock mass	8.3.1.15.1.6.2 8.3.1.15.1.6.3 8.3.1.15.1.6.5	ESF	TSw2
4.4 (8.3.2.5)	Heat capacity	Rock mass; primary area	TSw2	$\bar{x} \pm 0.1\bar{x}$	Medium	$\bar{x}$	Low to medium	Heat capacity of solids, grain density, porosity	Intact rock	8.3.1.15.1.1.1 8.3.1.15.1.1.2	(g)	TSw2
								Heat capacity	Rock mass	8.3.1.15.1.6.2 8.3.1.15.1.6.3 8.3.1.15.1.6.5	ESF	TSw2
			TSw1	$\bar{x} \pm 0.1\bar{x}$	Medium	$\bar{x}$	Low to medium	Heat capacity of solids, grain density, porosity	Intact rock	8.3.1.15.1.1.1 8.3.1.15.1.1.2	(g)	TSw1
								Heat capacity	Rock mass	8.3.1.15.1.6.1	ESF	TSw1
	Heat capacity	Rock mass; primary area	Ground surface to base of TSw2	$\bar{x} \pm 0.1\bar{x}$	Low	$\bar{x}$	Low to medium	Heat capacity of solids, grain density, porosity	Intact rock	8.3.1.15.1.1.1 8.3.1.15.1.1.2	(g)	Alluvium, TCw, PTn, TSw1, TSw2
								Heat capacity	Rock mass	8.3.1.15.1.6.1 8.3.1.15.1.6.2 8.3.1.15.1.6.3 8.3.1.15.1.6.5		TSw1, TSw2
1.6 (8.3.5.12)	Coefficient of thermal expansion	Rock mass; primary area	NS	NS	NS	NS	NS	Coefficient of thermal expansion	Intact rock	8.3.1.15.1.2.1	(g)	NS
								Coefficient of thermal expansion	Rock mass	8.3.1.15.1.6.2 8.3.1.15.1.6.3 8.3.1.15.1.6.4 8.3.1.15.1.6.5	ESF	TSw2

Table 8.3.1.15-1. Performance and design parameters, tentative goals, and characterization parameters for thermal and mechanical properties program[a] (page 5 of 12)

Issue requesting parameter (SCP section)	Performance or design parameter	Material type and spatial location[b]	Stratigraphic location[c] (request)	Tentative goal[d,e]	Needed confidence[d]	Current estimate	Current confidence[d]	Parameter to be measured	Material type tested	SCP activity numbers	Spatial location	Stratigraphic location[c]
1.11 (8.3.2.2)	Coefficient of thermal expansion	Rock mass; primary area and extensions	TSw2	$\bar{x} \pm 0.15\bar{x}$	High	See Table 6-16	Medium	Coefficient of thermal expansion	Intact rock	8.3.1.15.1.2.1	(g)	TSw2
								Coefficient of thermal expansion	Rock mass	8.3.1.15.1.6.2 8.3.1.15.1.6.3 8.3.1.15.1.6.4 8.3.1.15.1.6.5	ESF	TSw2
			TSw1	$\bar{x} \pm 0.15\bar{x}$	Medium	See Table 6-16	Low to medium	Coefficient of thermal expansion	Intact rock	8.3.1.15.1.2.1	(g)	TSw1
								Coefficient of thermal expansion	Rock mass	8.3.1.15.1.6.1	ESF	TSw1
			TSw3, CHn1	$\bar{x} \pm 0.15\bar{x}$	Medium	See Table 6-16	Low to medium	Coefficient of thermal expansion	Intact rock	8.3.1.15.1.2.1	(g)	TSw3, CHn1
			All units above TSw1, CHn2	$\bar{x} \pm 0.15\bar{x}$	Low	See Table 6-16	Low to medium	Coefficient of thermal expansion	Intact rock	8.3.1.15.1.2.1	(g)	(h)
1.12 (8.3.3.2)	Coefficient of thermal expansion	Rock mass; primary area	TSw2, CHn1	NS	Medium	NS	Low to medium	Coefficient of thermal expansion	Intact rock	8.3.1.15.1.2.1	(g)	TSw2, CHn1
								Coefficient of thermal expansion	Rock mass	8.3.1.15.1.6.2 8.3.1.15.1.6.3 8.3.1.15.1.6.4 8.3.1.15.1.6.5	ESF	TSw2
4.4 (8.3.2.5)	Coefficient of thermal expansion	Rock mass; primary area	TSw2	$\bar{x} \pm 0.15\bar{x}$	Medium	$\bar{x}$	Medium	Coefficient of thermal expansion	Intact rock	8.3.1.15.1.2.1	(g)	TSw2
								Coefficient of thermal expansion	Rock mass	8.3.1.15.1.6.2 8.3.1.15.1.6.3 8.3.1.15.1.6.4 8.3.1.15.1.6.5	ESF	TSw2
			TSw1	$\bar{x} \pm 0.15\bar{x}$	Medium	$\bar{x}$	Low to medium	Coefficient of thermal expansion	Intact rock	8.3.1.15.1.2.1	(g)	TSw1
								Coefficient of thermal expansion	Rock mass	8.3.1.15.1.6.1	ESF	TSw1

Table 8.3.1.15-1. Performance and design parameters, tentative goals, and characterization parameters for thermal and mechanical properties program[a] (page 6 of 12)

Issue requesting parameter (SCP section)	Performance or design parameter	Material type and spatial location[b]	Stratigraphic location[c] (request)	Tentative goal[d,e]	Needed confidence[d]	Current estimate	Current confidence[d]	Parameter to be measured	Material type tested	SCP activity numbers	Spatial location	Stratigraphic location[c]
1.11 (8.3.2.2)	Elastic properties											
	Young's modulus	Intact rock; primary area and extensions	TSw2	$\bar{x} \pm 0.15\bar{x}$	High	See Table 6-12	Medium	Young's modulus	Intact rock	8.3.1.15.1.3.1 8.3.1.15.1.3.2	(g)	TSw2
			TSw1	$\bar{x} \pm 0.15\bar{x}$	Medium	See Table 6-12	Medium	Young's modulus	Intact rock	8.3.1.15.1.3.1 8.3.1.15.1.3.2	(g)	TSw1
			TSw3, CHn1	$\bar{x} \pm 0.15\bar{x}$	Medium	See Table 6-12	Low	Young's modulus	Intact rock	8.3.1.15.1.3.1 8.3.1.15.1.3.2	(g)	TSw3, CHn1
			All units above TSw1, CHn2	$\bar{x} \pm 0.15\bar{x}$	Low	See Table 6-12	Low to medium	Young's modulus	Intact rock	8.3.1.15.1.3.1 8.3.1.15.1.3.2	(g)	(h)
	Deformation modulus	Rock mass; primary area and extensions	TSw2	$\bar{x} \pm 0.15\bar{x}$	High	See Table 6-14	Low	Young's modulus, fracture stiffness	Intact rock and fractures	8.3.1.15.1.3.1 8.3.1.15.1.3.2 8.3.1.15.1.4.1 8.3.1.15.1.4.2 8.3.1.15.1.3.2	(g)	TSw2
								Deformation modulus	Rock mass	8.3.1.15.1.6.3 8.3.1.15.1.7.1	ESF	TSw2
			TSw1	$\bar{x} \pm 0.15\bar{x}$	Medium	See Table 6-14	Low	Young's modulus, fracture stiffnesses	Intact rock and fractures	8.3.1.15.1.3.1 8.3.1.15.1.3.2 8.3.1.15.1.4.1 8.3.1.15.1.4.2	(g)	TSw1
								Deformation modulus	Rock mass	8.3.1.15.1.7.1	ESF	TSw1
			TSw3, CHn1	$\bar{x} \pm 0.15\bar{x}$	Medium	See Table 6-14	Low	Young's modulus, fracture stiffness	Intact rock and fractures	8.3.1.15.1.3.1 8.3.1.15.1.3.2 8.3.1.15.1.4.1 8.3.1.15.1.4.2	(g)	TSw3, CHn1
			All units above TSw1, CHn2	$\bar{x} \pm 0.15\bar{x}$	Low	See Table 6-14	Low	Young's modulus, fracture stiffness	Intact rock and fractures	8.3.1.15.1.3.1 8.3.1.15.1.3.2 8.3.1.15.1.4.1 8.3.1.15.1.4.2	(g)	(h)

Table 8.3.1.15-1. Performance and design parameters, tentative goals, and characterization parameters for thermal and mechanical properties program[a] (page 7 of 12)

Issue requesting parameter (SCP section)	Performance or design parameter	Material type and spatial location[b]	Stratigraphic location[c] (request)	Tentative goal[d,e]	Needed confidence[d]	Current estimate	Current confidence[d]	Parameter to be measured	Material type tested	SCP activity numbers	Spatial location	Stratigraphic location[c]
1.11 (8.3.2.2) (continued)	Poisson's ratio	Intact rock; primary area and extensions	TSw2	$\bar{x} \pm 0.2\bar{x}$	Medium	See Table 6-12	Medium	Poisson's ratio	Intact rock	8.3.1.15.1.3.1 8.3.1.15.1.3.2	(g)	TSw2
			All units other than TSw2	$\bar{x} \pm 0.2\bar{x}$	Low	See Table 6-12	Low to medium	Poisson's ratio	Intact rock	8.3.1.15.1.3.1 8.3.1.15.1.3.2	(g)	(h)
4.4 (8.3.2.5)	Elastic properties											
	Young's modulus	Intact rock; primary area	TSw2	29-33 GPa	Medium	31 GPa	Medium	Young's modulus	Intact rock	8.3.1.15.1.3.1 8.3.1.15.1.3.2	(g)	TSw2
			TSw1	Nonlithophysal: 12-54 GPa	Medium	Nonlithophysal: 19-44 GPa	Medium	Young's modulus	Intact rock	8.3.1.15.1.3.1 8.3.1.15.1.3.2	(g)	TSw1
				Lithophysal: 14-17 GPa	Medium	Lithophysal: 15.5 GPa	Low	Young's modulus				
	Deformation modulus	Rock mass; primary area	TSw2	11-19 GPa	Medium	11-19 GPa	Low	Young's modulus, fracture stiffnesses	Intact rock and fractures	8.3.1.15.1.3.1 8.3.1.15.1.3.2 8.3.1.15.1.4.1 8.3.1.15.1.4.2	(g)	TSw2
								Deformation modulus	Rock mass	8.3.1.15.1.6.3 8.3.1.15.1.7.1 8.3.1.15.2.1.2	ESF	TSw2
			TSw1	Nonlithophysal: 12-20 GPa	Medium	Nonlithophysal: 12-20 GPa	Low	Young's modulus, fracture stiffnesses	Intact rock and fractures	8.3.1.15.1.3.1 8.3.1.15.1.3.2 8.3.1.15.1.4.1 8.3.1.15.1.4.2	(g)	TSw1
				Lithophysal: 4-11 GPa	Medium	Lithophysal: 4-11 GPa	Low	Deformation modulus	Rock mass	8.3.1.15.1.3.1	ESF	TSw1

Table 8.3.1.15-1. Performance and design parameters, tentative goals, and characterization parameters for thermal and mechanical properties program[a] (page 8 of 12)

Issue requesting parameter (SCP section)	Performance or design parameter	Material type and spatial location[b]	Stratigraphic location[c] (request)	Tentative goal[d,e]	Needed confidence[d]	Current estimate	Current confidence[d]	Parameter to be measured	Material type tested	SCP activity numbers	Spatial location	Stratigraphic location[c]
4.4 (8.3.2.5) (continued)	Poisson's ratio	Intact rock; primary area	TSw2	0.19-0.29	Medium	0.19-0.29	Medium	Poisson's ratio	Intact rock	8.3.1.15.1.3.1 8.3.1.15.1.3.2	(g)	TSw1
			TSw1	Nonlithophysal: 0.20-0.30 GPa	Low	Nonlithophysal: 0.20-0.30 GPa	Low to medium	Poisson's ratio	Intact rock	8.3.1.15.1.3.1 8.3.1.15.1.3.2	(g)	TSw1
				Lithophysal: 0.13-0.19	Low	Lithophysal: 0.13-0.19	Low					
1.11 (8.3.2.2)	Compressive strength	Intact rock; primary area and extensions	TSw2	$\bar{x} \pm 0.2\bar{x}$	High	See Table 6-12	Medium	Compressive strength	Intact rock	8.3.1.15.1.3.1 8.3.1.15.1.3.2	(g)	TSw2
	Compressive strength	Intact rock; primary area and extensions	TSw1	$\bar{x} \pm 0.2\bar{x}$	High	See Table 6-12	Medium	Compressive strength	Intact rock	8.3.1.15.1.3.1 8.3.1.15.1.3.2	(g)	TSw1
	Cohesion and angle of internal friction	Intact rock; primary area and extensions	Units above TSw1 and below TSw2	$\bar{x} \pm 0.2\bar{x}$	Medium	See Table 6-12	Low to medium	Compressive strength	Intact rock	8.3.1.15.1.3.1 8.3.1.15.1.3.2	(g)	(h)
	Unconfined compressive strength	Intact rock; primary area and extensions	Units above TSw1 and below TSw2	$\bar{x} \pm 0.15\bar{x}$	Low	See Table 6-12	Low to medium	Unconfined compressive strength	Intact rock	8.3.1.15.1.3.1	(g)	(f)
1.12 (8.3.3.2)	Unconfined compressive strength	Rock mass; shaft and ramp locations	TCw	$\bar{x} \pm 0.2\bar{x}$	Medium	See Table 6-12	Low	Compressive strength	Intact rock	8.3.1.15.1.3.1 8.3.1.15.1.3.2	(g)	TCw
	Unconfined compressive strength	Rock mass; primary area	CHn1	$\bar{x} \pm 0.2\bar{x}$	Medium	See Table 6-12	Low	Compressive strength	Intact rock	8.3.1.15.1.3.1 8.3.1.15.1.3.2	(g)	CHn1
	Unconfined compressive strength	Rock mass; primary area	TSw2	$\bar{x} \pm 0.2\bar{x}$	Medium	See Table 6-12	Low	Unconfined compressive strength	Intact rock	8.3.1.15.1.3.1 8.3.1.15.1.3.2	(g)	TSw2
4.4 (8.3.2.5)	Compressive strength	Intact rock; primary area	TSw1, TSw2	TSw1, nonlithophysal: 54-207 MPa	Medium	67-172 MPa	Medium	Unconfined compressive strength	Intact rock	8.3.1.15.1.3.1 8.3.1.15.1.3.2	(g)	TSw1, TSw2

Table 8.3.1.15-1. Performance and design parameters, tentative goals, and characterization parameters for thermal and mechanical properties program[a] (page 9 of 12)

Issue requesting parameter (SCP section)	Performance or design parameter	Material type and spatial location[b]	Stratigraphic location[c] (request)	Tentative goal[d,e]	Needed confidence[d]	Current estimate	Current confidence[d]	Parameter to be measured	Material type tested	SCP activity numbers	Spatial location	Stratigraphic location[c]
4.4 (8.3.2.5) (continued)				TSw1, lithophysal: 13-19 MPa	Medium	16 MPa	Medium	Compressive strength				
				TSw2: 121-175 MPa	Medium	148 MPa	Medium	Unconfined compressive strength				
	Unconfined compressive strength	Intact rock; primary area	TCw, PTn	$\bar{x} \pm 0.2\bar{x}$	Medium	$\bar{x}$	Low to medium	Unconfined compressive strength	Intact rock	8.3.1.15.1.3.1 (g) 8.3.1.15.1.3.2		TCw, PTn
	Cohesion and angle of internal friction	Intact rock; primary area	TCw, PTn	$\bar{x} \pm 0.2\bar{x}$	Medium	$\bar{x}$	Low to medium	Compressive strength	Intact rock	8.3.1.15.1.13.1 (g) 8.3.1.15.1.3.2		TCw, PTn, TSw1, TSw2
1.11 (8.3.2.2)	Mechanical properties of fractures											
	Cohesion and coefficient of friction	Fractures; primary area and extensions	Units above TSw1 and below TSw2	$\bar{x} \pm 0.15\bar{x}$	Medium	See Table 6-13	Low	Shear stress at onset of slip	Fractures	8.3.1.15.1.4.1 (g) 8.3.1.15.1.4.2		(h)
	Large-scale joint strength	Fractures; primary area	TSw1, TSw2	$\bar{x} \pm 0.2\bar{x}$	High	NS	Low	Shear stress at onset of slip	Fractures	8.3.1.15.1.4.1 (g) 8.3.1.15.1.4.2		TSw1, TSw2
	Normal and shear stiffnesses	Fractures; primary area and extensions	TSw2	See Table 6-13	Medium	NS	Low	Normal and shear stiffnesses	Fractures	8.3.1.15.1.4.1 (g) 8.3.1.15.1.4.2		TSw2
			TSw1, TSw3, CHn1	See Table 6-13	Low	NS	Low	Normal and shear stiffnesses	Fractures	8.3.1.15.1.4.1 (g) 8.3.1.15.1.4.2		(h)
4.4 (8.3.2.5)	Mechanical properties of fractures											
	Cohesion and coefficient of friction	Fractures; primary area	TSw2	$\bar{x} \pm 0.2\bar{x}$	Medium	$\bar{x}$	Low	Shear stress at onset of slip	Fractures	8.3.1.15.1.4.1 (g) 8.3.1.15.1.4.2		TSw2
	Normal and shear stiffnesses	Fractures; primary area	TSw2	NS	Medium	NS	Low	Normal and shear stiffnesses	Fractures	8.3.1.15.1.4.1 (g) 8.3.1.15.1.4.2		TSw2

Table 8.3.1.15-1. Performance and design parameters, tentative goals, and characterization parameters for thermal and mechanical properties program[a] (page 10 of 12)

Issue requesting parameter (SCP section)	Performance or design parameter	Material type and spatial location[b]	Stratigraphic location[c] (request)	Tentative goal[d,e]	Needed confidence[d]	Current estimate	Current confidence[d]	Parameter to be measured	Material type tested	SCP activity numbers	Spatial location	Stratigraphic location[c]
2.2 (8.3.5.4)	Radon emanation rate	Rock mass; primary area	TSw2	NS	High	0.48 pCi/m^{2}s	Low	Radon emanation rate	Rock mass	8.3.1.15.1.6.2	ESF	TSw2
2.7 (8.3.2.3)	Radon emanation rate	Rock mass; primary area	TSw2	(f)	High	0.48 pCi/m^{2}s	Low	Radon emanation rate	Rock mass	8.3.1.15.1.6.2 8.3.1.15.1.8.4	ESF	TSw2
4.4 (8.3.2.5)	Radon emanation rate	Rock mass; primary area	TSw2	(f)	Medium	NS	Low	Radon emanation rate	Rock mass	8.3.1.15.1.6.2 8.3.1.15.1.8.4	ESF	TSw2
1.11 (8.3.2.2)	Empirical design parameters											
	Joint wall compressive strength	Fracture surfaces; primary area	TSw2	See Table 6-15	Medium	NS	Low	Joint wall compressive strength	Fracture surfaces	8.3.1.15.1.6.3 8.3.1.15.1.7.1	ESF	TSw2
			TSw1, TSw3, CHn1	See Table 6-15	Low	NS	Low	Joint wall compressive strength	Fracture surfaces	NS	(g)	(h)
	Joint roughness coefficient	Fracture surfaces; primary area	TSw2	See Table 6-15	Medium	NS	Low	Joint roughness coefficient	Fracture surfaces	8.3.1.15.1.6.3 8.3.1.15.1.7.1	ESF	TSw2
			TSw1, TSw3, CHn1	See Table 6-15	Low	NS	Low	Joint wall compressive strength	Fracture surfaces	NS	(g)	(h)
4.4 (8.3.2.5)	Empirical design parameters											
	Joint wall compressive strength	Fracture surfaces; primary area	TSw2	See Table 6-15	Medium	NS	Low	Joint wall compressive strength	Fracture surfaces	8.3.1.15.1.6.3 8.3.1.15.1.7.1	ESF	TSw2
	Joint roughness coefficient	Fracture surfaces; primary area	TSw2	See Table 6-15	Medium	NS	Low	Joint roughness coefficient	Fracture surfaces	8.3.1.15.1.6.3 8.3.1.15.1.7.1	ESF	TSw2
1.11 (8.3.2.2)	In situ stress state[i]											
	σ_v	Rock mass; primary area and extensions	Ground surface to water table	±1 MPa	Medium	(ρgh)[j]	Low to medium	Grain density, porosity	Intact rock	8.3.1.15.1.1.1	(g)	Alluvium, TCw, PTn, TSw1, TSw2, TSw3, CHn1, CHn2

Table 8.3.1.15-1. Performance and design parameters, tentative goals, and characterization parameters for thermal and mechanical properties program[a] (page 11 of 12)

Issue requesting parameter (SCP section)	Performance or design parameter	Material type and spatial location[b]	Stratigraphic location[c] (request)	Tentative goal[d,e]	Needed confidence[d]	Current estimate	Current confidence[d]	Parameter to be measured	Material type tested	SCP activity numbers	Spatial location	Stratigraphic location[c]
1.11 (8.3.2.2) (continued)	σ_h, σ_H	Rock mass; primary area and extensions	Ground surface to water table	±2 MPa	Medium	NS	Low	Deformation, elastic properties	Intact rock	8.3.1.15.2.1.1	(g)	TSw2
1.12 (8.3.3.2)	In situ stress state											
	σ_v	Rock mass; primary area	TCw, TSw2, CHn1	±MPa	Low	4-10 MPa	Low to medium	Grain density, porosity	Intact rock	8.3.1.15.1.1.1	(g)	Alluvium, TC2, PTn, TSw1, TSw2, TSw3, CHn1
	σ_h, σ_H	Rock mass; primary area	TCw, TSw2, CHn1	±2 MPa	Low	σ_h/σ_v, σ_H/σ_v = 0.3-1.0	Low	Deformation, elastic properties	Intact rock	8.3.1.15.2.1.1 8.3.1.15.2.1.2	(g)	TCw, TSw2, CHn1
4.4 (8.3.2.5)	In situ stress state											
	σ_v	Rock mass; primary area	TSw2	300 m depth: 6.3-7.7 MPa	Medium	(6.3-7.7 MPa)	Low to medium	Grain density, porosity	Intact rock	8.3.1.15.1.1.1	(g)	Alluvium, TCw, PTn, TSw1, TSw2,
	σ_h/σ_v	Rock mass; primary area	TSw2	0.3-0.8	Medium	0.3-0.8	Low	Deformation, elastic properties	Intact rock	8.3.1.15.2.1.1 8.3.1.15.2.1.2	(g)	TSw2
	σ_H/σ_v	Rock mass; primary area	TSw2	0.3-1.0	Medium	0.3-1.0	Low	Deformation, elastic properties	Intact rock	8.3.1.15.2.1.1 8.3.1.15.2.1.2	(g)	TSw2
	Bearing of σ_h	Rock mass; primary area	TSw2	N.45°W-N.65°W	Medium	N.45°W-N.65°W	Medium	Deformation, elastic properties	Intact rock	8.3.1.15.2.1.1 8.3.1.15.2.1.2	(g)	TSw2
	Bearing of σ_H	Rock mass; primary area	TSw2	N.75°E-N.40°E	Medium	N.25°E-N.40°E	Medium	Deformation, elastic properties	Intact rock	8.3.1.15.2.1.1 8.3.1.15.2.1.2	(g)	TSw2
1.6 (8.3.5.12)	Initial temperatures	Rock mass; primary area	TSw2	NS	NS	NS	NS	Initial temperatures	Rock mass	8.3.1.15.2.2.1	(g)	TSw2
1.10 (8.3.4.2)	Initial temperatures	Rock mass; primary area	TSw2	±3°C	Medium	23-25°C	Medium	Initial temperatures	Rock mass	8.3.1.15.2.2.1	(g)	TSw2

Table 8.3.1.15-1. Performance and design parameters, tentative goals, and characterization parameters for thermal and mechanical properties program[a] (page 12 of 12)

Issue requesting parameter (SCP section)	Performance or design parameter	Material type and spatial location[b]	Stratigraphic location[c] (request)	Tentative goal[d,e]	Needed confidence[d]	Current estimate	Current confidence[d]	Parameter to be measured	Material type tested	SCP activity numbers	Spatial location	Stratigraphic location[c]
1.11 (8.3.2.2)	Initial temperatures	Rock mass; primary area and extensions	TSw2	±3°C	Medium	23-26°C	Medium	Initial temperatures	Rock mass	8.3.1.15.2.2.1	(g)	TSw2 and above
4.4 (8.3.2.5)	Initial temperatures	Rock mass; primary area	TSw2	23-25°C	Medium	23-25°C	Medium	Initial temperatures	Rock mass	8.3.1.15.2.2.1	(g)	TSw2
	Initial temperatures	Rock mass; primary area	TSw2	±2C	Medium	Present values ±2C	Medium	Initial temperatures	Rock mass	8.3.1.15.2.2.1	(g)	TSw2
	Initial temperatures	Rock mass; primary area	Ground surface to base of TSw2	±2C	Medium	Present values ±2C		Initial temperatures	Rock mass	8.3.1.15.2.2.1	(g)	Alluvium TCw, PTn, TSw1, TSw2

[a]This table summarizes requirements of both preclosure and postclosure issues.
[b]Definitions of the primary area and extensions are provided in Chapter 6, Figure 6-87.
[c]The thermal/mechanical stratigraphy at Yucca Mountain is shown in Figure 2-5 of Chapter 2. CHn = Calico Hills nonwelded unit; PTn = Paintbrush nonwelded unit; TCw = Tiva Canyon welded unit; TSw = Topopah Spring welded unit; and NS = not specified.
[d]The manner in which tentative goals and levels of confidence are used in planning the characterization program is discussed in the investigation for Section 8.3.1.15.1.
[e]$\bar{x}$ = mean value of existing sample group.
[f]Tentative goal is that a prescribed percentage (related to the needed confidence) of the data falls within the given interval. Failure to meet the goal will result in a need to reevaluate the existing design.
[g]Spatial locations will be a combination of new boreholes (location to be determined; see Investigation 8.3.1.4.1 for discussion) and the exploratory shaft and associated underground excavations; ESF = exploratory studies facility.
[h]Stratigraphic locations will be in the units specified as required by pertinent issues if measurements need to be made. For many parameters for which the required confidence level is low, existing data will be sufficient to satisfy the requirements.
[i]σ_v = vertical in situ stress; σ_h = minimum horizontal in situ stress; σ_H = maximum horizontal in situ stress.
[j]ρgh indicates the product of density (ρ), gravitational acceleration (g), and height of overlying column of rock (h).

1.12 PRECLOSURE HYDROLOGY

Tables 8.3.1.16-1 and 8.3.1.16-2 list the parameters to be collected by this program, identify the issues that will use each parameter, and define the activities under which each parameter is to be collected.

Table 8.3.1.16-1. Data requirements of the design and performance issues satisfied by the preclosure hydrology program for System Element 1.1.1 (surface)

SCP Issue requesting parameters	Design parameters	Goal	Confidence	Characterization parameters	Testing basis: Current estimate	Testing basis: Present confidence[a]	Testing basis: Confidence needed[b]	Studies/activities
4.4 Technical feasibility (Section 8.3.2.5) 4.2 Nonradiological health and safety (Section 8.3.2.4)	Surface hydrology at all surface facility locations Magnitude of 10, 25, 50, 100, 500 yr, and probable maximum floods Area and depth of inundation for facilities and access portals	Determine parameter values using ANSI and other standard applicable methods Define elevation of flood levels to ±2 m	High	Precipiation quantities and rates (from regional data)	Refer to Section 5.1	Low to moderate	High	8.3.1.16.1.1 (flood potential of Yucca Mountain)
				Streamflow rates, quantities, and durations (clear water	Refer to Bullard (1986)	Low	High	8.3.1.2.1.1 (regional meteorology) and 8.3.1.2.1.2 (runoff streamflow)
				Peak flow discharge for 10, 25, 50, 100, 500 yr, and probable maximum floods	Refer to Bullard (1986) and Squires and Young (1984)	Low to moderate	High	
				Channel morphology and surface topography	Refer to Squires and Young (1984) and Waddell et al. (1984)	Low to moderate	Moderate	
	Flow velocities Debris load of flows	Calculate maximum tractive force of channel flow and sheet flow in area of inundation	High	Quantity and character of debris moved during flooding	Refer to Costa (1983)	Very low	High	8.3.1.16.1.1 (flood potential of Yucca Mountain)
				Define water to sediment ratio	Refer to Costa (1983)	Very low	High	8.3.1.2.1.2 (runoff and streamflow)
				Characterize sediments within watershed	Refer to Costa (1983)	Very low	High	8.3.1.2.2 (unsaturated-zone hydrologic system)

[a]Present confidence ratings of high, moderate, and low are based on the quality of data and the number of site-specific measurements currently available.
[b]Confidence needed is an indication of the level of certainty that will be necessary to demonstrate that a goal is met.

Table 8.3.1.16-2. Data requirements of the design and performance issues satisfied by the preclosure hydrology program for System Element 1.1.2 (subsurface)

SCP Issue requesting parameters	Design parameters	Goal	Confidence	Characterization parameters	Testing basis: Current estimate	Testing basis: Present confidence[a]	Testing basis: Confidence needed[b]	Studies/activities
4.4 Technical feasibility (Section 8.3.2.5)	Sustained yield of wells	864,000 m^3/yr	Moderate	Aquifer transmissivity and storage coefficient	To be determined from well testing	Medium	Moderate	8.3.1.16.2.1 (location of adequate water supply) and 8.3.1.2.3 (regional ground-water flow system)
1.11 Configuration of underground facilities (Section 8.3.2.2) 1.12 Seal characteristics (Section 8.3.3.2)	Water inflow to underground facility (including seasonal variation)	Quantify potential inflow rate (total into mine). Expected 0-20 gpm accuracy ±10	Moderate	Fracture flow into exploratory studies facility	≤100 gpd	Low	Moderate	8.3.1.2.2.3 (surface based exploratory shaft testing), 8.3.1.2.2.4 (unsaturated-zone percolation), and 8.3.1.16.1.1 (flood potential of Yucca Mountain)

[a]Present confidence ratings of high, moderate, and low are based on the quality of data and the number of site-specific measurements currently available.
[b]Confidence needed is an indication of the level of certainty that will be necessary to demonstrate that a goal has been met.

1.13 PRECLOSURE TECTONICS

The required characterization data are summarized in part a of Tables 8.3.1.17-1 through 8.3.1.17-6; part b of these tables provides summary information on the characterization program designed to provide the required data. The data requirements are organized by the type of potential tectonic event: volcanic, including eruption and ashfall; faulting; and vibratory ground motion from natural earthquakes and underground nuclear explosions. Two tables are presented for each type of event, one for considerations of surface facilities and one for underground facilities.

8.3.1.17-1a. Design and performance parameters related to surface facilities and preclosure volcanic activity

Design or performance parameter[a]	Goal	Needed confidence	Characterization parameters
Probability of volcanic eruption that would disrupt surface facilities	Less than 1 chance in 10,000 in 100 yr	High	Annual probability of volcanic disruption at the site
Design-basis ash-fall thickness for facilities important to safety (FITS) ventilation systems	Less than 1 chance in 10 of exceeding design-basis ash-fall thickness in 100 yr	Low to medium	Probability of ash fall at the site as a function of ash-fall thickness 1,000-yr(+) ash-fall thickness at the site
Ash-fall particle density and size distribution	TBD[b]	Low to medium	Potential density and distribution of ash-fall particles

[a]These parameters are from Issue 4.4 (technical feasibility, Section 8.3.2.5), and corresponding performance measures are given in that issue.
[b]TBD = to be determined.

Table 8.3.1.17-1b. Characterization parameters related to surface facilities and preclosure volcanic activity

Characterization parameters	Testing basis			Key studies/activities supplying parameters
	Current estimate (range)	Confidence in current estimate	Needed confidence in final values	
Annual probability of volcanic disruption at the site	10^{-7} to 10^{-9} per yr	Moderate	Medium to high	8.3.1.8.1.1.4--Probability calculations (of volcanic disruption) and assessment
Probability of ash fall at the site as a function of ash-fall thickness	TBD[a]	TBD	Low to medium	8.3.1.17.1.1.2--Assess potential ash-fall thickness at the site
1,000-yr(+) ash-fall thickness at the site	0.1-2.0 cm	Low	Low to medium	8.3.1.17.1.1.2--Assess potential ash-fall thickness at the site
Potential density and distribution of ash-fall particles	TBD	TBD	Low to medium	8.3.1.17.1.1.3--Assess potential density and size distribution of ash fall at the site

[a]TBD = to be determined.

Table 8.3.1.17-2a. Design and performance parameters related to underground facilities and preclosure volcanic activity

Design or performance parameter[a]	Goal	Needed confidence	Characterization parameters
Probability of volcanic eruption through the underground facilities	Less than 1 chance in 10,000 in 100 yr	High	Annual probability of volcanic disruption of the underground facilities
Design-basis ash-fall thickness (at ventilation shaft locations)	Less than 1 chance in 10 of exceeding design-basis ash-fall thickness in 100 yr	Low to medium	Probability of ash fall at the site as a function of ash-fall thickness 1,000-yr(+) ash-fall thickness at the site
Ash-fall particle density and size distribution	TBD[b]	Low to medium	Potential density and size distribution of ash-fall particles

[a]These parameters are from Issue 4.4 (technical feasibility, Section 8.3.2.5), and corresponding performance measures are given in that issue.

[b]TBD = to be determined.

Table 8.3.1.17-2b. Characterization parameters related to underground facilities and preclosure volcanic activity

Characterization parameters	Testing basis			Key studies/activities supplying parameters
	Current estimate (range)	Confidence in current estimate	Needed confidence in final values	
Annual probability of volcanic disruption of the underground facilities	4.7×10^{-8} to 3.3×10^{-10} per yr	Medium	Medium to high	8.3.1.8.1.1.4--Probability calculations (of volcanic disruption) and assessment
Probability of ash fall at the site as a function of ash-fall thickness	TBD[a]	TBD	Low to medium	8.3.1.17.1.1.2--Assess potential ash-fall thickness at the site
1,000-yr(+) ash-fall thickness	0.1-2.0 cm	Low	Low to medium	8.3.1.17.1.1.2--Assess potential ash-fall thickness at the site
Potential density and size distribution of ash-fall particles	TBD	TBD	Low to medium	8.3.1.8.1.1.3--Assess potential particulate size distribution of ash fall at the site

[a]TBD = to be determined.

Table 8.3.1.17-3a. Design and performance parameters related to surface facilities and preclosure fault displacement (page 1 of 2)

Design or performance parameter[a]	Goal	Needed confidence	Characterization parameters
Identification of any fault within 100 m of facilities important to safety (FITS) with greater than 1 chance in 100 of producing more than 5 cm of surface offset during the preclosure period (approximately 100 yr)	Determine existence	High	Identification and characterization of potentially significant Quaternary faults within 5 km of FITS
If existence is determined, establish			
Classification	Standard practice	High	Identification and characterization of faults within 100 m of FITS that have apparent Quaternary slip rates >0.001 mm/yr or that measurably offset materials less than 100,000 yr old
Location at surface	±5 m	High	
Orientation at surface	±10°	High	

Table 8.3.1.17-3a. Design and performance parameters related to surface facilities and preclosure fault displacement (page 2 of 2)

Design or performance parameter[a]	Goal	Needed confidence	Characterization parameters
Total probability of exceeding 5 cm fault displacement at locations proposed for FITS	Less than 1 chance in 100 of exceeding 5 cm displacement beneath surface FITS in 100 yr	High	Estimate of total probability for >5 cm displacement beneath FITS, considering known and possibly concealed faults and tectonic interrelationships among local faults

[a]These parameters are from Issue 4.4 (technical feasibility, Section 8.3.2.5), and corresponding performance measures are given in that issue.

Table 8.3.1.17-3b. Characterization parameters related to surface facilities and preclosure fault displacement

Characterization parameters	Testing basis: Current estimate (range)	Testing basis: Confidence in current estimate	Testing basis: Needed confidence in final values	Key studies/activities supplying parameters
Identification and characterization of potentially significant Quaternary faults within 5 km of facilities important to safety (FITS)	4 such faults	Low	Medium to high	8.3.1.17.4.6.1--Evaluate Quaternary geology and potential Quaternary faults at Yucca Mountain
Identification and characterization of faults within 100 m of FITS that have apparent Quaternary slip rates > 0.001 mm/yr or that measurably offset materials less than 100,000 yr old	No such faults	Low	High	8.3.1.17.4.2.2--Conduct exploratory trenching in in Midway Valley
Estimate of total probability for >5 cm displacement beneath FITS, considering known and possibly concealed faults and tectonic interrelationships among local faults	Less than 1 chance in 100 of exceeding 5 cm displacement beneath FITS in 100 yr	Low	High	8.3.1.17.2.1.1--Assess the potential for surface faulting at prospective sites of surface FITS

Table 8.3.1.17-4a. Design and performance parameters related to underground facilities and preclosure fault displacement (page 1 of 2)

Design or performance parameter[a]	Goal	Needed confidence	Characterization parameters
Identification and characterization of significant Quaternary faults in the repository block:			Surface locations of faults in the repository with > 1 m offset of Quarternary materials or with > 100 m offset of Tertiary rocks
Classification	Standard practice	High	
Location at surface	±5 m	High	
Orientation at surface	±10°	High	
Identification and characterization of any fault within the waste emplacement area with greater than 1 chance in 100 of producing more than 7 cm (waste-package air-gap distance) of subsurface offset during the preclosure period (approximately 100 yr)	Determine existence; for any such faults (none are now known to exist), determine location within the waste emplacement area	High	Surface and subsurface locations of faults with Quaternary slip rates > 0.005 mm/yr that intersect underground facilities

Table 8.3.1.17-4a. Design and performance parameters related to underground facilities and preclosure fault displacement (page 2 of 2)

Design or performance parameter[a]	Goal	Needed confidence	Characterization parameters
Total probability of exceeding 7 cm fault displacement on any fault that intersects areas of waste emplacement	Less than 1 chance in 10 in 100 yr of exceeding 7 cm displacement on any fault that intersects areas of waste emplacement	Medium	Estimated total probability of fault displacement exceeding 7 cm in areas of emplaced waste, considering known and possibly concealed faults and tectonic interrelationships among local faults

[a]These parameters are from Issue 4.4 (technical feasibility, Section 8.3.2.5), and corresponding performance measures are given in that issue.

Table 8.3.1.17-4b. Characterization parameters related to the underground facilities and preclosure fault displacement

Characterization parameters	Testing basis: Current estimate (range)	Testing basis: Confidence in current estimate	Testing basis: Needed confidence in final values	Key studies/activities supplying parameters
Surface locations of faults in the repository block with >1 m offset of Quaternary materials or with >100 m offset of Tertiary rocks	2 such faults exist	Low to medium	Medium	8.3.1.17.4.6.1--Evaluate Quaternary geology and potential Quaternary faults at Yucca Mountain
Surface and subsurface locations of faults with Quaternary slip rates >0.005 mm/yr that intersect underground facilities	No such faults exist	Medium	Medium to high	8.3.1.17.4.6.1--Evaluate Quaternary geology and potential Quaternary faults at Yucca Mountain 8.3.1.17.4.6.2--Evaluate age and recurrence of movement on suspected and known Quaternary faults within the site area 8.3.1.17.4.7--Subsurface geometry and concealed extensions of Quaternary faults at Yucca Mountain
Estimated total probability of fault displacement exceeding 7 cm in areas of emplaced waste, considering known and possibly concealed faults and tectonic interrelationships among local faults	Less than 1 chance in 100 in 100 yr of exceeding 7 cm displacement in areas of emplaced waste	Medium	Medium	8.3.1.17.2.1.2--Assess the potential for rupture on faults that intersect underground facilities

Table 8.3.1.17-5a. Design and performance parameters related to surface facilities and preclosure vibratory ground motion (page 1 of 3)

Design or performance parameter[a]	Goal	Needed confidence	Characterization parameters
Design-basis ground motion time histories (minimum band width = 0.5 to 33 Hz) and corresponding response spectra (at 1 Hz intervals) for surface facilities important to safety (FITS)	Representative of 10,000-yr cumulative slip earthquakes on nearby faults, or maximum potential underground nuclear explosions (UNEs) that would control site ground motion at any frequency between 0.5 and 33 Hz (including any effect of local geology or building embedment)	Medium to high	Identification of potential earthquake sources in the controlled area Potentially relevant earthquake sources in the region (≤100 km) Magnitude of 10,000-yr cumulative slip earthquakes on local sources Magnitude of 10,000-yr cumulative slip earthquakes on regional sources Maximum future underground nuclear explosion Closest distance of future UNEs Ground motion attenuation with distance Spectral modification due to local geology Controlling ground motion event(s) Time histories and reponse spectra representative of controlling event(s)

Table 8.3.1.17-5a. Design and performance parameters related to surface facilities and preclosure vibratory ground motion (page 2 of 3)

Design or performance parameter[a]	Goal	Needed confidence	Characterization parameters
Combined potential for vibratory ground motion at FITS, considering all faults	Less than 1 chance in 10 of exceeding design-basis ground motion in 100 yr	Medium to high	Identification of potential earthquake sources in the controlled area Potentially relevant earthquake sources in the region (≤100 km) Earthquake recurrence relationships for local and regional sources Ground motion attenuation with distance Spectral modification due to local geology Ground motion exceedance probabilities
Probability versus peak acceleration, peak velocity, and peak velocity response at selected frequencies, at surface locations of FITS	Values estimated for annual probabilities ranging from 10^{-2} to 10^{-6} per yr	Medium	Identification of potential earthquake sources in the controlled area Potentially relevant earthquake sources in the region (≤100 km) Earthquake recurrence relationships for local and regional sources

Table 8.3.1.17-5a. Design and performance parameters related to surface facilities and preclosure vibratory ground motion (page 3 of 3)

Design or performance parameter[a]	Goal	Needed confidence	Characterization parameters
Probability versus peak acceleration, peak velocity, and peak velocity response at selected frequencies, at surface locations of FITS (continued)			Ground motion attenuation with distance Spectral modification due to local geology Ground motion exceedance probabilities

[a]These parameters come from Issues 4.4 (technical feasibility, Section 8.3.2.5) and 1.12 (seal characteristics, Section 8.3.3.2), and corresponding performance measures are given in those issues.

Table 8.3.1.17-5b. Characterization parameters related to surface facilities and preclosure vibratory ground motion (page 1 of 3)

Characterization parameters	Testing basis: Current estimate (range)	Testing basis: Confidence in current estimate	Testing basis: Needed confidence in final values	Key studies/activities supplying parameters
Identification of potential earthquake sources in the controlled area	See Chapter 1	Medium	Medium to high	8.3.1.17.3.1.1--Identify relevant earthquake sources
Potentially relevant earthquake sources in the region (≤100 km)	See Chapter 1	Low to medium	Medium	8.3.1.17.3.1.1--Identify relevant earthquake sources
Magnitude of 10,000-yr cumulative slip earthquakes on local sources	≈6.5	Low to medium	Medium to high	8.3.1.17.3.1.2--Characterize 10,000-yr cumulative slip earthquakes for relevant seismogenic sources
Magnitude of 10,000-yr cumulative slip earthquakes on regional sources	6.5 - 8.5	Low	Medium	8.3.1.17.3.1.2--Characterize 10,000-yr cumulative slip earthquakes for relevant seismogenic sources
Maximum future underground nuclear explosion (UNE)	150-750 kt	Medium	Medium	8.3.1.17.3.2.2--Determine maximum UNE source(s)
Closest distance of future future UNEs	23 km (Buckboard Mesa area)	Medium	Medium	8.3.1.17.3.2.2--Determine maximum UNE source(s)

Table 8.3.1.17-5b. Characterization parameters related to surface facilities and preclosure vibratory ground motion (page 2 of 3)

Characterization parameters	Testing basis: Current estimate (range)	Testing basis: Confidence in current estimate	Testing basis: Needed confidence in final values	Key studies/activities supplying parameters
Ground motion attenuation with distance	Published models for California and western U.S.	Low to medium	Medium	8.3.1.17.3.3--Ground motion from earthquakes and UNEs
Spectral modification at facilities important to safety due to local geology	0.5 - 4	Low	Medium	8.3.1.17.3.4--Effects of local site geology on surface and subsurface motions
Controlling ground motion event(s)	≈6.5 M earthquake on Paintbrush Canyon	Low to medium	Medium to high	8.3.1.17.3.5.1--Identify controlling seismic events
Time histories and response spectra representative of controlling event(s)	TBD[a] (0.4-0.6g peak acceleration)	Low to medium	Medium to high	8.3.1.17.3.5.2--Characterize ground motion from controlling seismic events
Earthquake recurrence relationships for local and regional sources	See Section 1.4.2	Low to medium	Medium	8.3.1.17.3.6.1--Evaluate earthquake sources

Table 8.3.1.17-5b. Characterization parameters related to surface facilities and preclosure vibratory ground motion (page 3 of 3)

Characterization parameters	Testing basis			Key studies/activities supplying parameters
	Current estimate (range)	Confidence in current estimate	Needed confidence in final values	
Ground motion exceedance probabilities	1-5 x 10^{-4}/yr for 0.5g	Low to medium	Medium	8.3.1.17.3.6.2--Evaluate ground motion probabilities

[a]TBD = to be determined.

Table 8.3.1.17-6a. Design and performance parameters related to underground facilities and preclosure vibratory ground motion (page 1 of 4)

Design or performance parameter[a]	Goal	Needed confidence	Characterization parameters
Design-basis ground motion time histories and corresponding response spectra for underground facilities (at various depths) (minimum band width = 0.5 to 33 Hz; 1 Hz interval for response spectra)	Representative of 10,000-yr cumulative slip earthquakes or nearby faults, or maximum potential underground nuclear explosions (UNEs) that would control site ground motion at any frequency between 0.5 and 33 Hz (including any effects of local geology or depth of burial)	Medium	Identification of potential earthquake sources in the controlled area Potentially relevant earthquake sources in the region (≤100 km) Magnitude of 10,000-yr cumulative slip earthquakes on local sources Magnitude of 10,000-yr cumulative slip earthquakes on regional sources Future maximum UNE Closest distance of future UNEs Ground motion attenuation with distance

Table 8.3.1.17-6a. Design and performance parameters related to underground facilities and preclosure vibratory ground motion (page 2 of 4)

Design or performance parameter[a]	Goal	Needed confidence	Characterization parameters
Design-basis ground motion time histories and corresponding response spectra for underground facilities (at various depths) (minimum band width = 0.5 to 33 Hz; 1 Hz interval for response spectra) (continued)			Spectral modification due to local geology and depth of burial Controlling ground motion event(s) Time histories and response spectra representative of of controlling event(s)
Combined potential for vibratory ground motion at underground facility locations, considering all faults	Less than 1 chance in 10 of exceeding design-basis ground motion in 100 yr	Medium	Identification of potential earthquake sources in the controlled area Potentially relevant earthquake sources in the region (≤100 km) Earthquake recurrence relationships for local and regional sources

Table 8.3.1.17-6a. Design and performance parameters related to underground facilities and preclosure vibratory ground motion (page 3 of 4)

Design or performance parameter[a]	Goal	Needed confidence	Characterization parameters
Combined potential for vibratory ground motion at underground facility locations, considering all faults (continued)			Ground motion attenuation with distance Spectral modification due to local geology and depth of burial Ground motion exceedance probabilities
Probability versus peak acceleration, peak velocity, and peak velocity response at selected frequencies at underground facility locations	Values estimated for annual probabilities ranging from 10^{-2} to 10^{-6} per yr	Low to medium	Identification of potential earthquake sources in the controlled area Potentially relevant earthquake sources in the region (≤100 km) Earthquake recurrence relationships for local and regional sources

Table 8.3.1.17-6a. Design and performance parameters related to underground facilities and preclosure vibratory ground motion (page 4 of 4)

Design or performance parameter[a]	Goal	Needed confidence	Characterization parameters
Probability versus peak acceleration, peak velocity, and peak velocity response at selected frequencies at underground facility locations (continued)			Ground motion attenuation with distance Spectral modification due to local geology and depth of burial Ground motion exceedance probabilities

[a]These parameters are from Issues 4.4 (technical feasibility, Section 8.3.2.5) and 1.12 (seal characteristics, Section 8.3.3.2), and corresponding performance measures are given in those issues.

Table 8.3.1.17-6b. Characterization parameters related to underground facilities and preclosure vibratory ground motion (page 1 of 3)

Characterization parameters	Testing basis: Current estimate (range)	Testing basis: Confidence in current estimate	Testing basis: Needed confidence in final values	Key studies/activities supplying parameters
Identification of potential earthquake sources in the controlled area	See Chapter 1	Medium	Medium	8.3.1.17.3.1.1--Identify relevant earthquake sources
Potentially relevant earthquake sources in the region (≤100 km)	See Chapter 1	Low to medium	Medium	8.3.1.17.3.1.1--Identify relevant earthquake sources
Magnitude of 10,000-yr cumulative slip earthquakes on local sources	≈6.5	Low to medium	Medium to high	8.3.1.17.3.1.2--Characterize 10,000-yr cumulative slip earthquakes for relevant seismogenic sources
Magnitude of 10,000-yr cumulative slip earthquakes on regional sources	6.5-8.5	Low	Medium	8.3.1.17.3.1.2--Characterize 10,000-yr cumulative slip earthquakes for relevant seismogenic sources
Maximum future underground nuclear explosion (UNE)	150-750 kt	Medium	Medium	8.3.1.17.3.2.2--Determine maximum UNE source(s)
Closest distance of future future UNEs	23 km (Buckboard Mesa area)	Medium	Medium	8.3.1.17.3.2.2--Determine maximum UNE source(s)

Table 8.3.1.17-6b. Characterization parameters related to underground facilities and preclosure vibratory ground motion (page 2 of 3)

Characterization parameters	Testing basis: Current estimate (range)	Testing basis: Confidence in current estimate	Testing basis: Needed confidence in final values	Key studies/activities supplying parameters
Ground motion attenuation with distance	Published models for California and western U.S.	Low to medium	Medium	8.3.1.17.3.3--Ground motion from regional earthquakes and UNEs
Spectral modification due to local geology and depth of burial	.25-1	Low	Medium	8.3.1.17.3.4--Effects of local site geology on surface and subsurface motions
Controlling ground motion event(s)	~6.5 M earthquake on Paintbrush Canyon fault	Low to medium	Medium	8.3.1.17.3.5.1--Identify controlling seismic events
Time-histories and response spectra representative of controlling event(s)	TBD[a]	Low to medium	Medium	8.3.1.17.3.5.2--Characterize ground motion from controlling seismic events
Earthquake recurrence relationships for local and regional sources	See Section 1.4.2	Low to medium	Medium	8.3.1.17.3.6.1--Evaluate earthquake sources

Table 8.3.1.17-6b. Characterization parameters related to underground facilities and preclosure vibratory ground motion (page 3 of 3)

Characterization parameters	Testing basis			Key studies/activities supplying parameters
	Current estimate (range)	Confidence in current estimate	Needed confidence in final values	
Ground motion exceedance probabilities	10^{-4}/yr for 0.5g	Low	Low to medium	8.3.1.17.3.6.2--Evaluate ground motion probabilities

[a]TBD = to be determined.