OVERVIEW OF SYSTEMATIC DRILLING PROGRAM

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Purpose of the Systematic Drilling Program

- A primary source of subsurface data within the repository block
  - Engineering information: ESF and repository
  - Geometry of stratigraphic units
  - Lithology
  - Rock characteristics via sampling and lab testing
  - In situ test facilities

- Closely integrated with PA and design analyses through 3-D models of the site
  - Evaluation of data adequacy/geologic uncertainty
  - Quantitative numerical models of material properties to support performance and design analyses
Systematic Drilling Program
Proposed Hole Locations
Ties to Other Surface-Based Testing Programs

- **Site** focus versus process focus
- "Systematic" complement to feature-of-interest-based drilling programs (UZ, H, WT, Ramp)
  - Drillhole pattern optimized to provide coherent areal coverage and statistically valid (unbiased) sample
- Revised several times to adjust to design changes
  - Soil and Rock Properties Study (ramp drillholes)
  - Realignment of ESF main test level drift
  - NRC request for *in situ* monitoring/mine-by data
- Window-of-opportunity for other studies
Other SCP Studies Depending Upon SDP for Samples and Information

- UZ percolation
- UZ hydrochemistry
- Mineralology, petrology, and chemistry of transport pathways
- Site ambient stress
- Seal material properties
- 3-D geologic model

- Laboratory thermal properties
- Laboratory thermal experiments
- Laboratory mechanical properties, intact
- Laboratory mechanical properties, frax.
- Geomechanical waste package
- 3-D rock characteristics models

Evaluation of Data Adequacy/Uncertainty
Ties to Underground Exploration Program

• Necessary precursor to location of ESF workings
• Areal coverage versus intensive detail
• Vertical coverage versus repository-horizon detail
• Exploration of deeper units and transport pathways
  – Tuffs of Calico Hills: “primary barrier” to waste migration
  – Crater Flat Tuff units in saturated zone
• SDP study plan contains plans for closely spaced sampling in ESF main test level and Calico Hills test level
  – Issue of range of spatial correlation and drillhole spacings
  – Required input for 3-D material properties models for design and PA analyses
Systematic Drilling Program Addresses Issues/Problems not Addressed Separately

- **Site-specific** engineering orientation
- **Calico Hills** vitric-to-zeolitic transition
  - Location, nature, properties
  - “Primary barrier” to waste migration
- **Characterization of deep transport pathways** (LANL)
- **Spatial variability of material properties**
- **Concept of data adequacy and geologic uncertainty**
Stochastic Images and Evaluation of Uncertainty

after Journel, 1989
Current Status and Short-Term Planning

- Study plan approved by NRC
- TPs approved and in process
- MOU for joint hydrologic properties testing in place with USGS (Alan Flint)
- Hole SD-12 scheduled 1st quarter FY94
  - TPP in final review
  - Job package in preparation
- Hole SD-9 scheduled 2nd quarter FY94
  - WSC in process
- Schedule for information release
  - Tied to ESF design needs
Summary

• Focused on site-specific issues

• Broad, integrated viewpoint
  – Multiple users for site characterization
  – Feedback tie with design analyses and PA

• Engineering orientation
  – Site-specific data
  – Sample/material-properties focus
  – Timing of data availability
  – Issue of data adequacy
Issues Related to Core Requirements

- Microstratigraphic zonation of thick welded intervals is context-sensitive
  - Zonation is believed important to 3-D model of Yucca Mountain
  - Zonal control of hydrologic properties
  - Surface transect studies: vertical versus horizontal data
  - Critical features for identification require core

- Laboratory testing programs
  - Information cannot be gathered indirectly (unless zonal control can be confirmed and documented)
    - Hydraulic properties and state variables require core samples
    - Mechanical and thermal properties require core samples

- Raax camera versus geophysical logs versus core
Zonal Control of Hydrologic Properties

by zone

by location
Issues Related to Requirements for Core

(Continued)

• Lack of dollar/time savings from partial core due to cost of tripping tools

• Issue of preciseness/accuracy versus quantity of information
  – Are we asking the right questions? “Indicator” techniques
  – Less precise information --> more data points and more holes
  – Flow through to design and PA analyses; feedback