U.S. DEPARTMENT OF ENERGY
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT

NUCLEAR WASTE TECHNICAL REVIEW BOARD
FULL BOARD MEETING

SUBJECT: OVERVIEW OF SYSTEMATIC DRILLING PROGRAM

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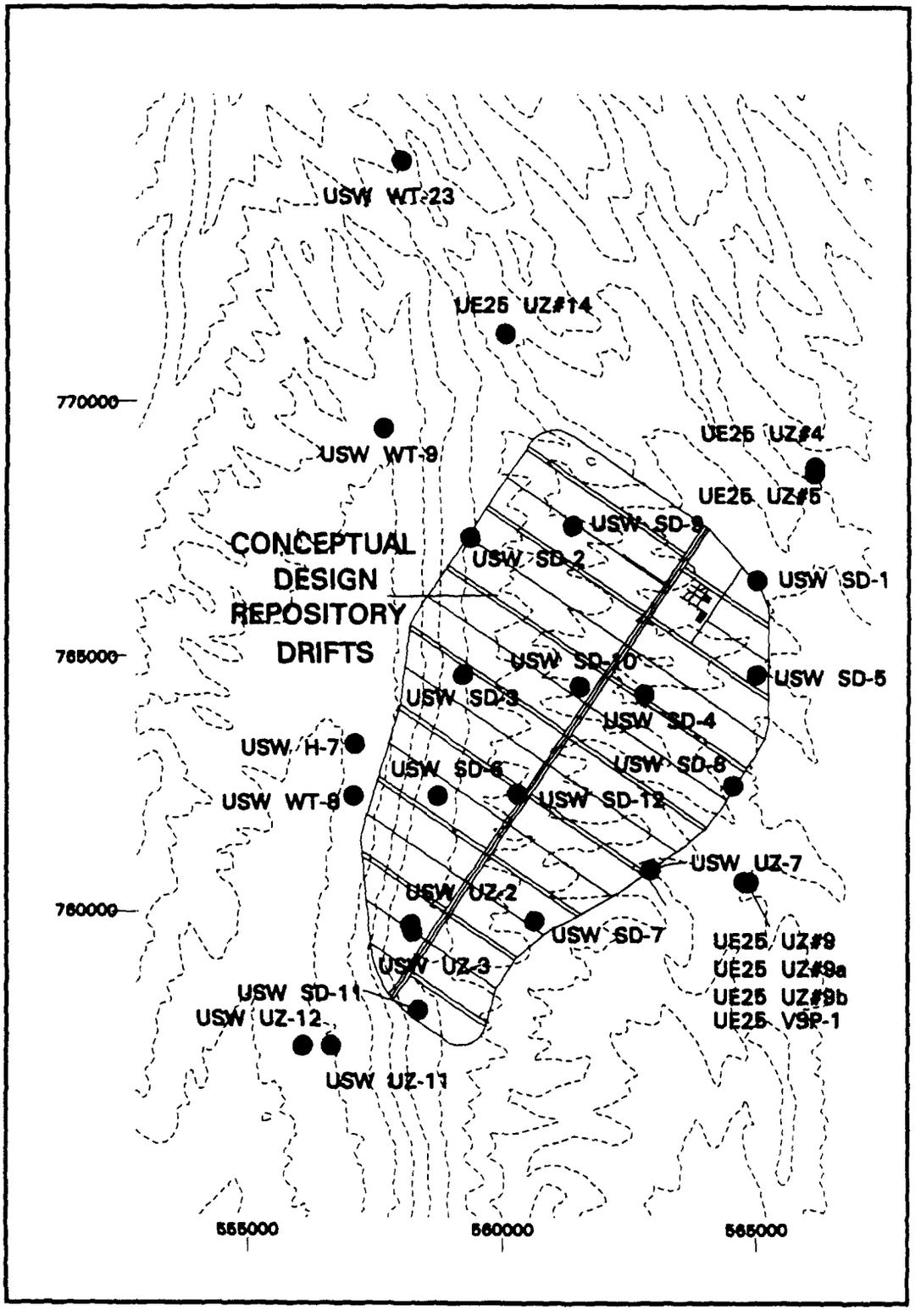
Purpose of the Systematic Drilling Program

- **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



NWSDPRTM2.125.NWTRB/10-19,20-93

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
- Laboratory thermal properties
- Laboratory thermal experiments
- Laboratory mechanical properties, intact
- Laboratory mechanical properties, frax.
- Geomechanical waste package

- 3-D geologic model
- 3-D rock characteristics models

Evaluation of Data Adequacy/Uncertainty

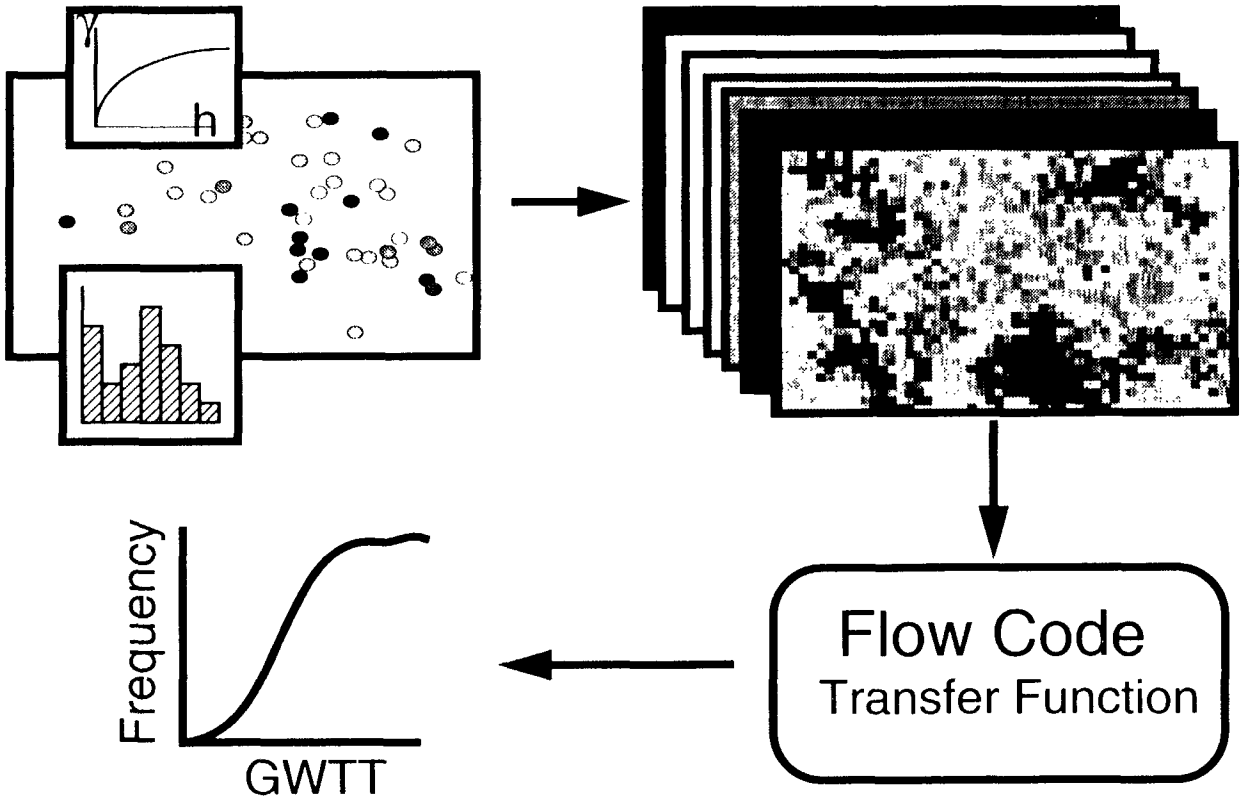
Ties to Underground Exploration Program

- 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

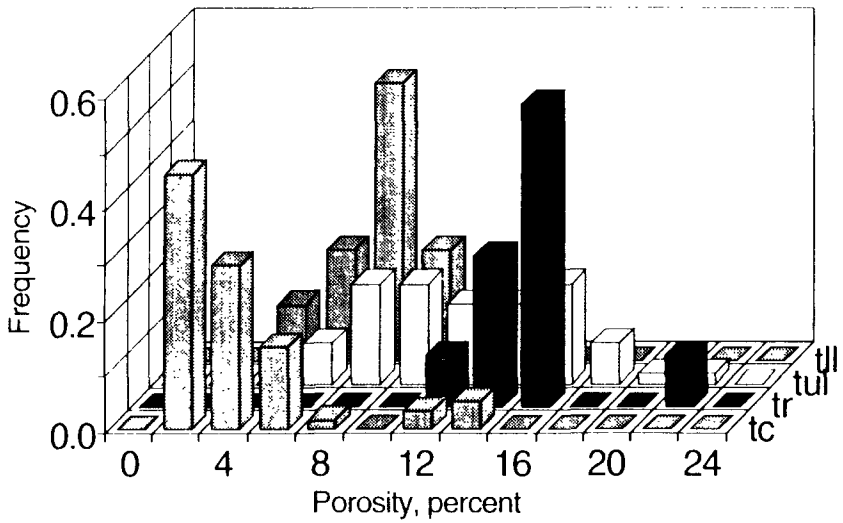
- Focused on site-specific issues
- Broad, integrated viewpoint
  - Multiple users for site characterization
  - Feedback tie with design analyses and PA
- Engineering orientation
  - Site-specific data
  - Sample/material-properties focus
  - Timing of data availability
  - Issue of data adequacy

Issues Related to Core Requirements

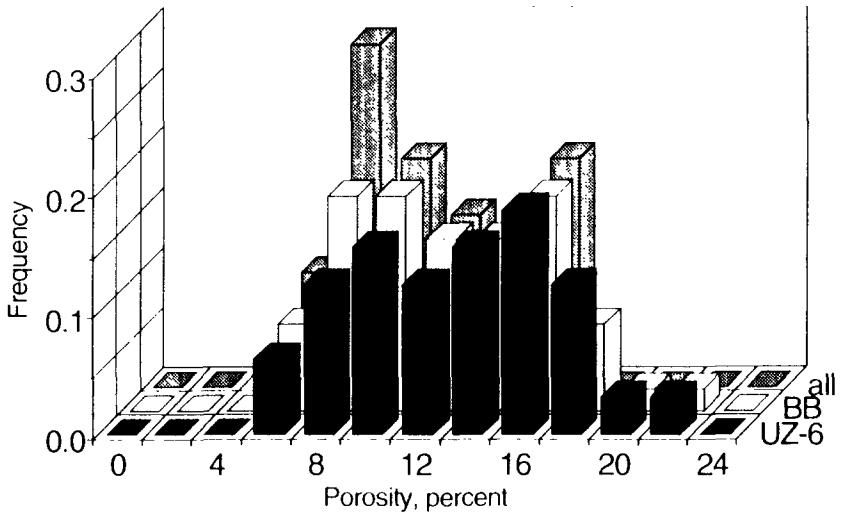
- **Microstratigraphic zonation of thick welded intervals is context-sensitive**
  - Zonation is believed important to 3-D model of Yucca Mountain
  - Zonal control of hydrologic properties
  - Surface transect studies: vertical versus horizontal data
  - Critical features for identification require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