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

PRESENTATION TO THE
NUCLEAR WASTE TECHNICAL REVIEW BOARD
FULL BOARD MEETING

SUBJECT:  DRY DRILLING TECHNOLOGY

PRESENTER:  DR. UEL S. CLANTON

PRESENTER'S TITLE
AND ORGANIZATION:  CHIEF, SITE CHARACTERIZATION BRANCH
YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT
LAS VEGAS, NEVADA

PRESENTER'S
TELEPHONE NUMBER:  (702) 794-7934

DALLAS, TX
APRIL 7-8, 1992
Overview

- Goals and objectives of dry-drilling technology
- Review of large drill technology
- Lessons learned from Apache Leap experience
- Drilling schedule and cost
Types of Data to Be Presented

- Soft

- Hard

- For illustration only
Drilling Objectives

- Obtain core containing the in situ conditions of the mountain
- Provide boreholes without disturbing the in situ conditions of the mountain
Requirements to Achieve Objectives

- Design and construct an advanced drill rig
- Design and construct an efficient reaming bit
- Design and construct an efficient coring bit
- Develop a drilling and coring technique to characterize the mountain
Overview

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Drilling Technique

- Top-head drive, push-pull and rotate capability
- Dual wall, reverse circulation
- Conditioned air as a drilling medium
- Core through the reaming bit with the drill string in the borehole
- Wireline core retrieval
- Polycrystalline diamond composite (PDC) core bits
- Alternate cone-reaming bits
LM-300 Rig Specifications

Rig Dimensions:
- Overall height with mast erect: 84'
- Overall width: 10'
- Overall height with mast in transport position: 16'2"
- Length of mast: 80'6"

Drilling Capabilities:
- Primary and secondary power for hydraulic/drive systems
- Power to tophead drive
- Torque: 250,000 in. lbs. (262,262)
- Max. mast load: 300,000 lbs.
- Pullback capability: 238,500 lbs. (260,022)
- Pulldown capability: 30,000 lbs. (31,075)
- Longyear 600, 4 speed main hoist with 3000' of 1/4" line
- Capacity 70,000 lb. (107,814)
- Travel speed 108 FPM (144)
- Pipe handling winch rating: 5,000 lbs. (6,806)
- Wireline winch capacity 400 lbs. (1253)
- Travel speed 150 FPM (341)
- Max. tubular length: 40'
- Max. tubular diameter: 24" (60")

Parentheses = Actuals

Overall length with tag axles 99'9-1/2"
Coring operations are commenced and the core rod is advanced 40 feet ahead of the dual wall pipe in 10 foot increments (10 foot cores). The cores are retrieved by conventional wireline while the core rod is left in the hole for the duration of the 40 foot core run. The 40 foot limit is used to prevent the more flexible core rod from initiating a deviation in the borehole and causing the drillpipe to follow a deviated path resulting in binding of the dual wall pipe.
Once the coring assembly is out of the borehole, it is drilled/reamed with the dual wall drill string to the bottom of the core track. The formation is protected from contamination normally associated with drilling by circulating the cuttings up the center of the dual wall pipe. Contaminated formation caused by the coring operation is removed when the core track is reamed down. The bold arrows indicate the direction of air flow during reaming.
Configuration of Cones 1 & 4 for the Dresser (Security) Cone Reamer

Hole Axis

The Inner Pipe

(Air path, within the Inner Pipe)

The Inner Pipe

Base and Attachments of Cone Bit

Outer Body of Reamer

Reamed (Enlarged) Hole

30-33'

Rock

17 ct

15 ct

7 ct

Single TCI

Pilot hole Drilled by Core bit

Earth Mechanics Institute
Colorado School of Mines,
Golden, Colorado

DRYDRILL 125 NWTRB/4-7/8-92
Configuration of Cones 2 & 5 for the Standard Cone Reamer

Earth Mechanics Institute
Colorado School of Mines
Golden, Colorado
Configuration of Cones 2 & 5 for the Alternating Cone Reamer

Inner Pipe

Outer Body of Reamer

Air Pass

Cone Axis

Core

Earth Mechanics Institute
Colorado School of Mines
Golden, Colorado

12.25" DRYDRILL 125.NWTRB/4-7/8-92
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DOE Dry Drilling Project
Standard (SCR) and Alternating (ACR)
Cone Reamers
Apache Leap

Penetration Rate (Ft/Hr)

Bit Weight (1,000 lbs)
Core Bit Performance Comparison
(60 RPM)

Bit Weight (1,000 lbs)

Penetration Rate (Ft/Hr)

0 20 40 60 80 100 120 140

0 2 4 6 8

Original Carbonado
Improved Carbonado
PDC
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# Rig Staffing (LM-300, Stratmaster)

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<tr>
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<td>Forklift Operator</td>
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**TOTAL**                     | **20**    | **60**  |
Apache Leap Drilling
Time Breakdown (898 Hours Total)

- Core Recovery (6.2%)
- Reaming (9.0%)
- Downtime (4.8%)
- Coring (17.3%)
- Startup/Shutdown (7.8%)
- Core Rod Trip Time (13.8%)
- System Changeover (9.7%)
- Dual-Wall Pipe Trip Time (8.4%)
- Hole Conditioning (3.0%)
- Fishing (1.5%)
- Casing & Cementing (3.9%)
- Rigup/Rigdown (4.8%)
- Survey (4.7%)

Potential Time Savings
- Coring = 60%
- Core Rod Trip Time = 50%
- DWDP Trip Time = 10%
- Net Total Potential Savings = 15.3%

DRYDRILL. 125.NWTRB/4-78-92