

**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**

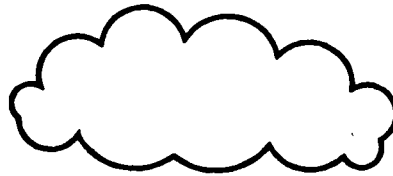
**DALLAS, TX
APRIL 7-8, 1992**

Overview

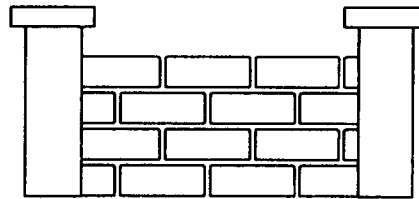
- **Goals and objectives of dry-drilling technology**
- **Review of large drill technology**
- **Lessons learned from Apache Leap experience**
- **Drilling schedule and cost**

Types of Data to Be Presented

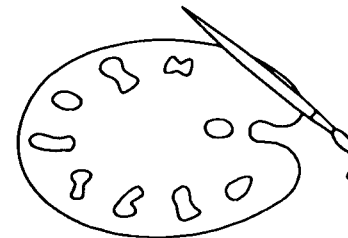
- **Soft**



- **Hard**

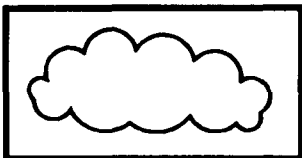


- **For illustration only**



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**

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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**

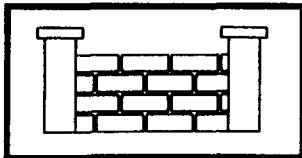
LM-300 Rig Specifications

Rig Dimensions:

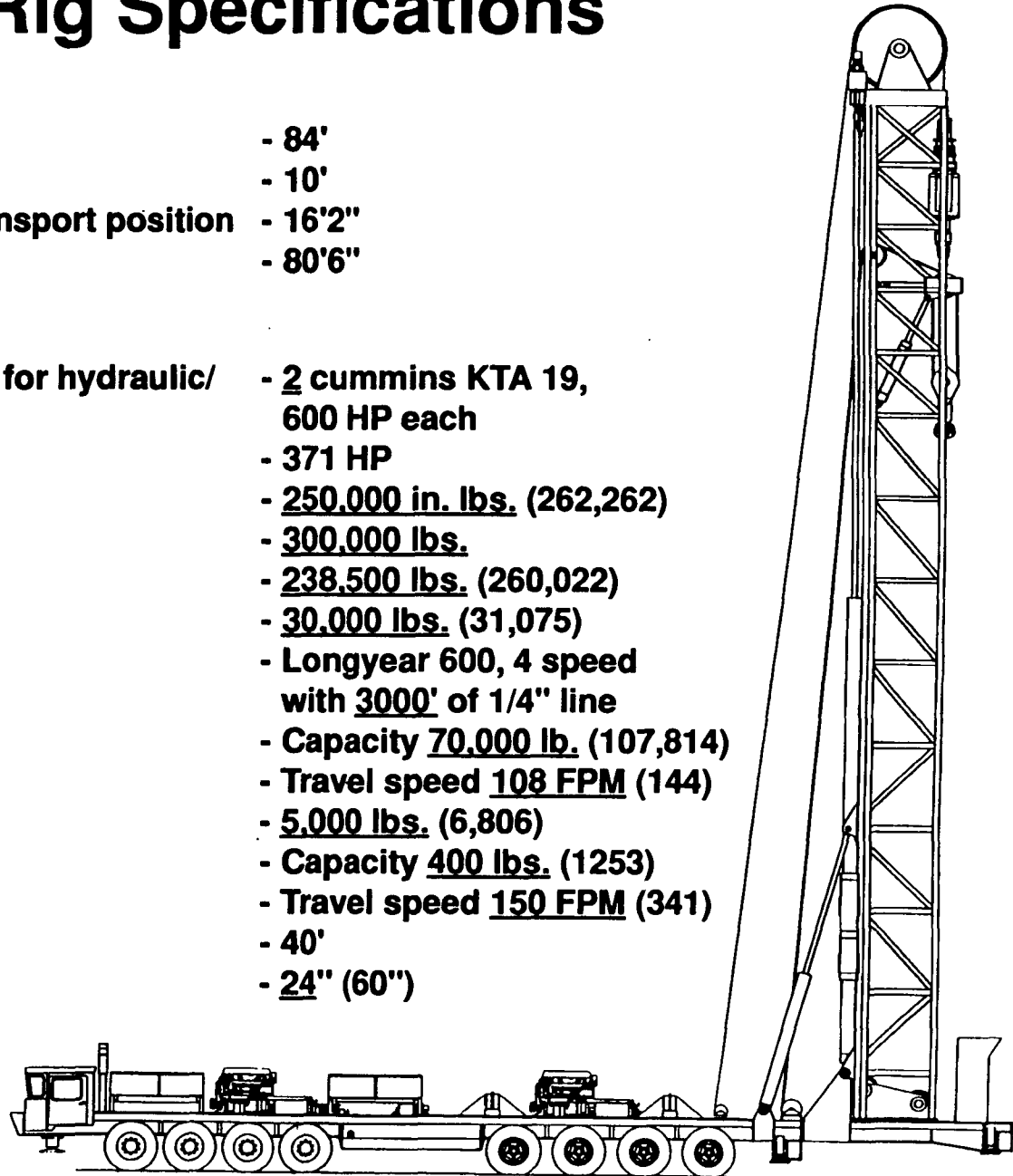
- Overall height with mast erect - 84'
- Overall width - 10'
- Overall height with mast in transport position - 16'2"
- Length of mast - 80'6"

Drilling Capabilities:

- Primary and secondary power for hydraulic/ drive systems - 2 cummins KTA 19, 600 HP each
- Power to tophead drive - 371 HP
- 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)
- Main hoist - Longyear 600, 4 speed 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")



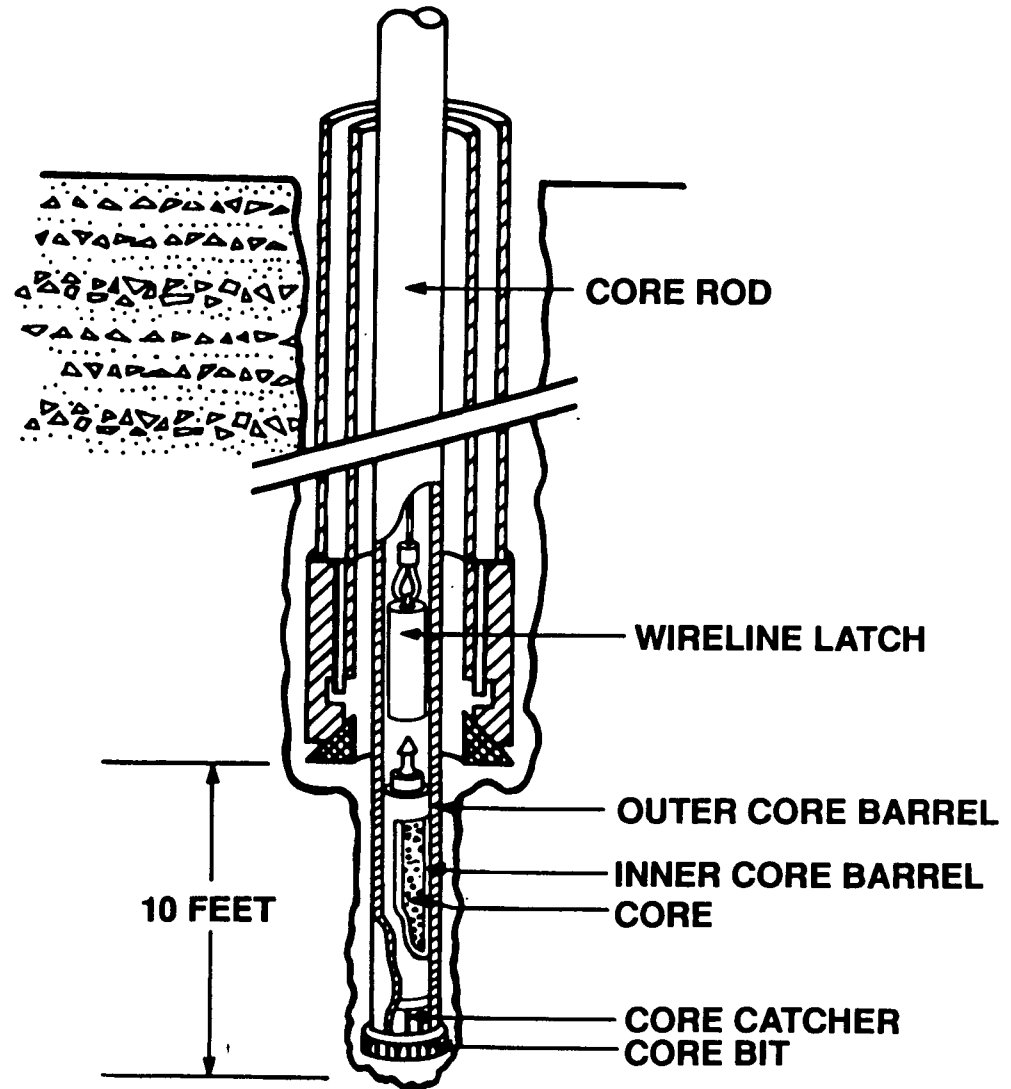
Parentheses = Actuals



Overall length with tag axles 99'9-1/2"

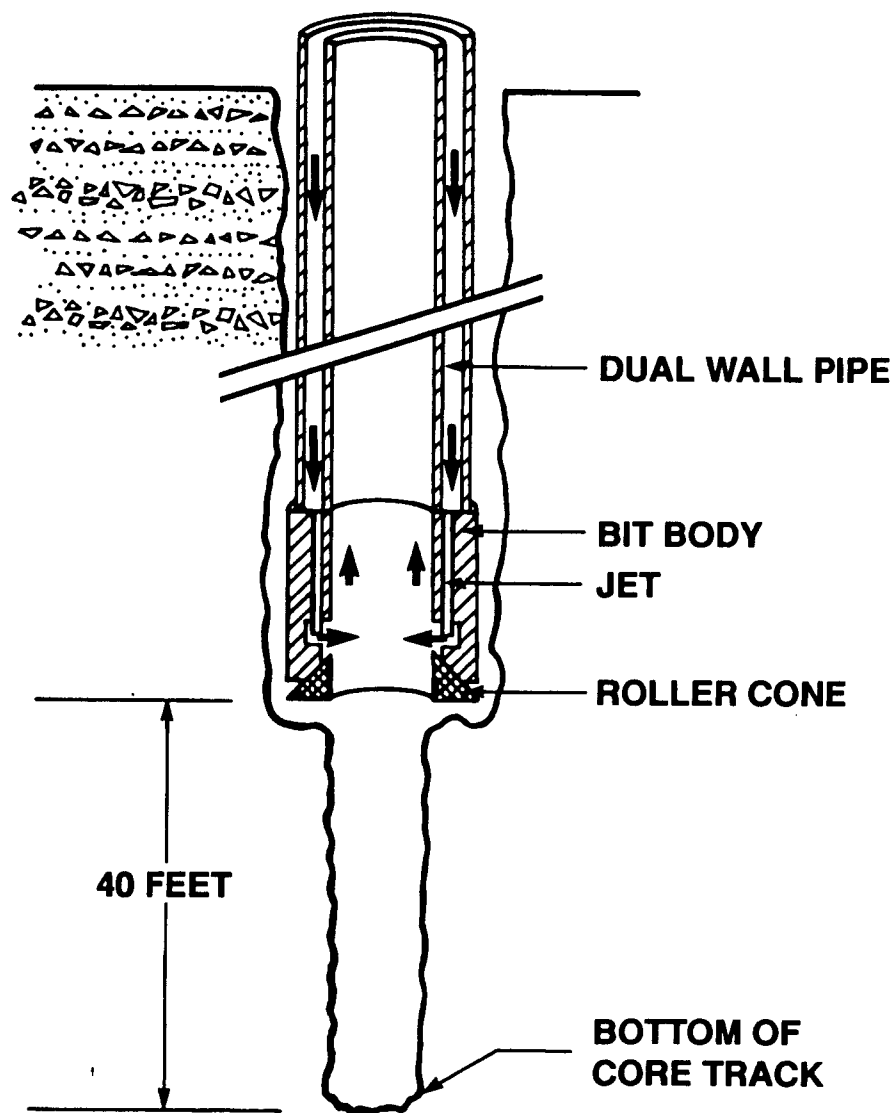
Dual Wall Drilling/Coring System

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.

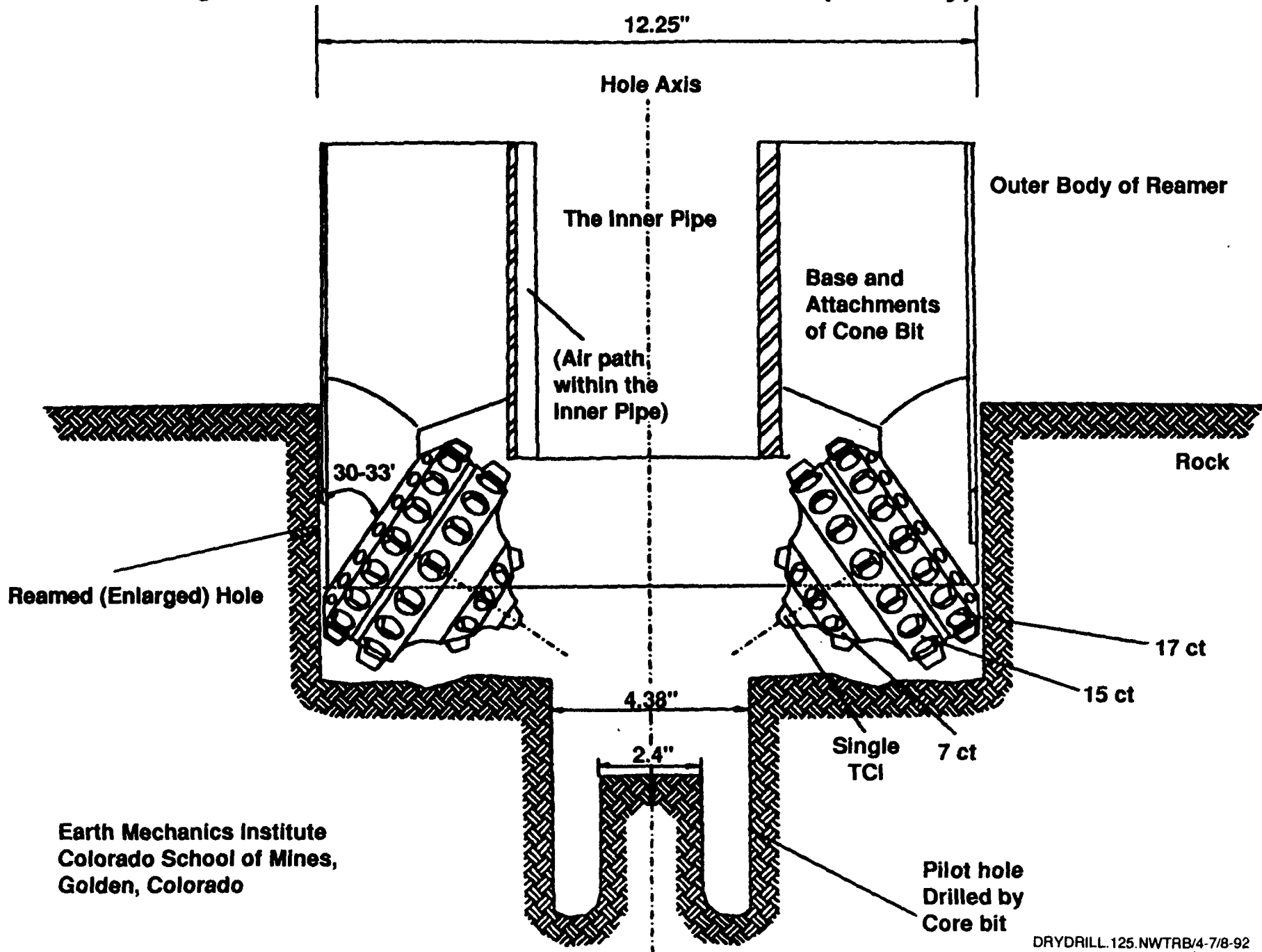


Dual Wall Drilling/Coring System

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.

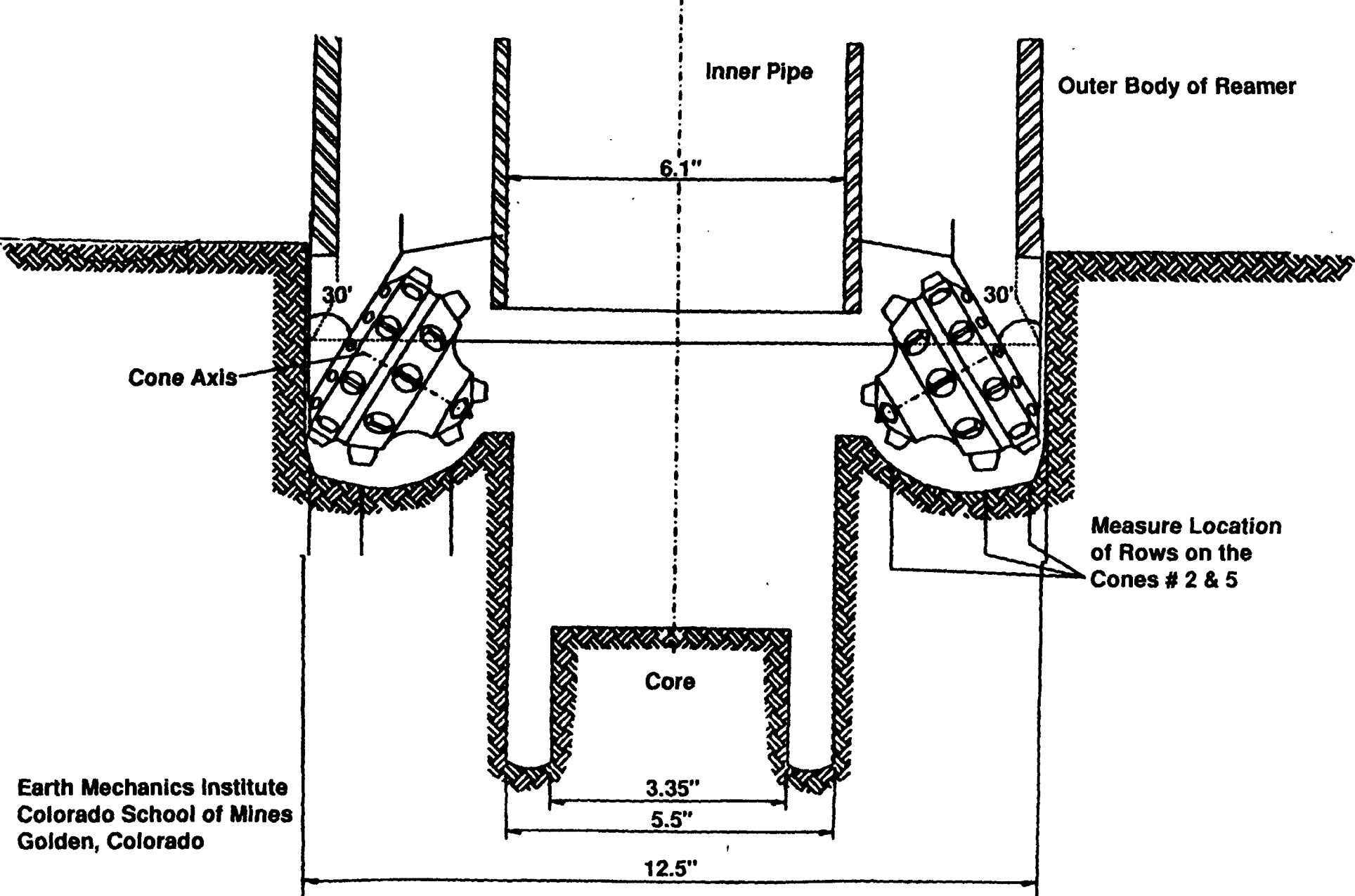


Configuration of Cones 1 & 4 for the Dresser (Security) Cone Reamer



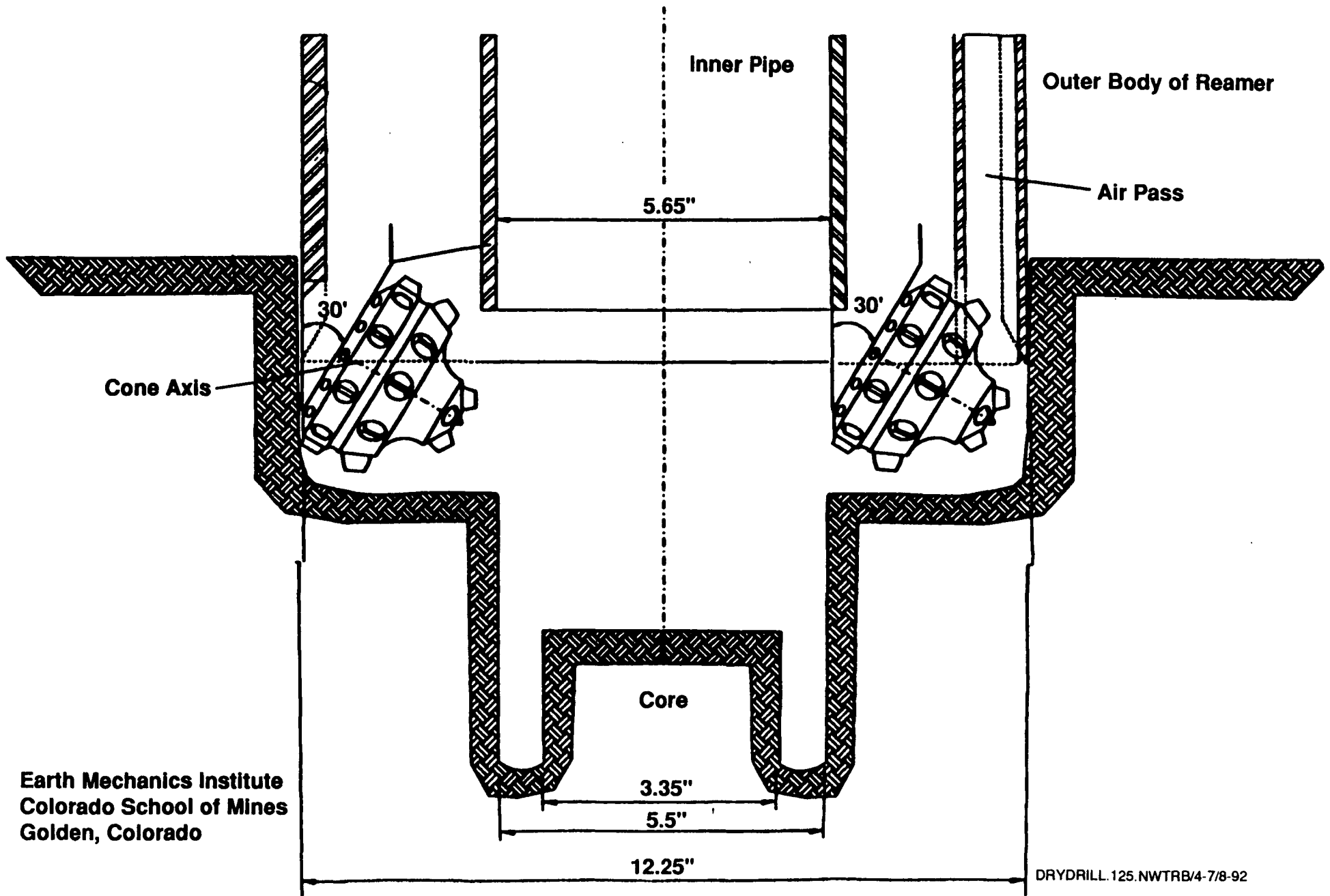
Earth Mechanics Institute
 Colorado School of Mines,
 Golden, Colorado

Configuration of Cones 2 & 5 for the Standard Cone Reamer



Earth Mechanics Institute
Colorado School of Mines
Golden, Colorado

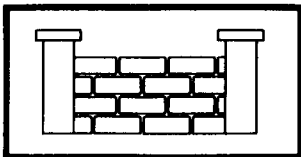
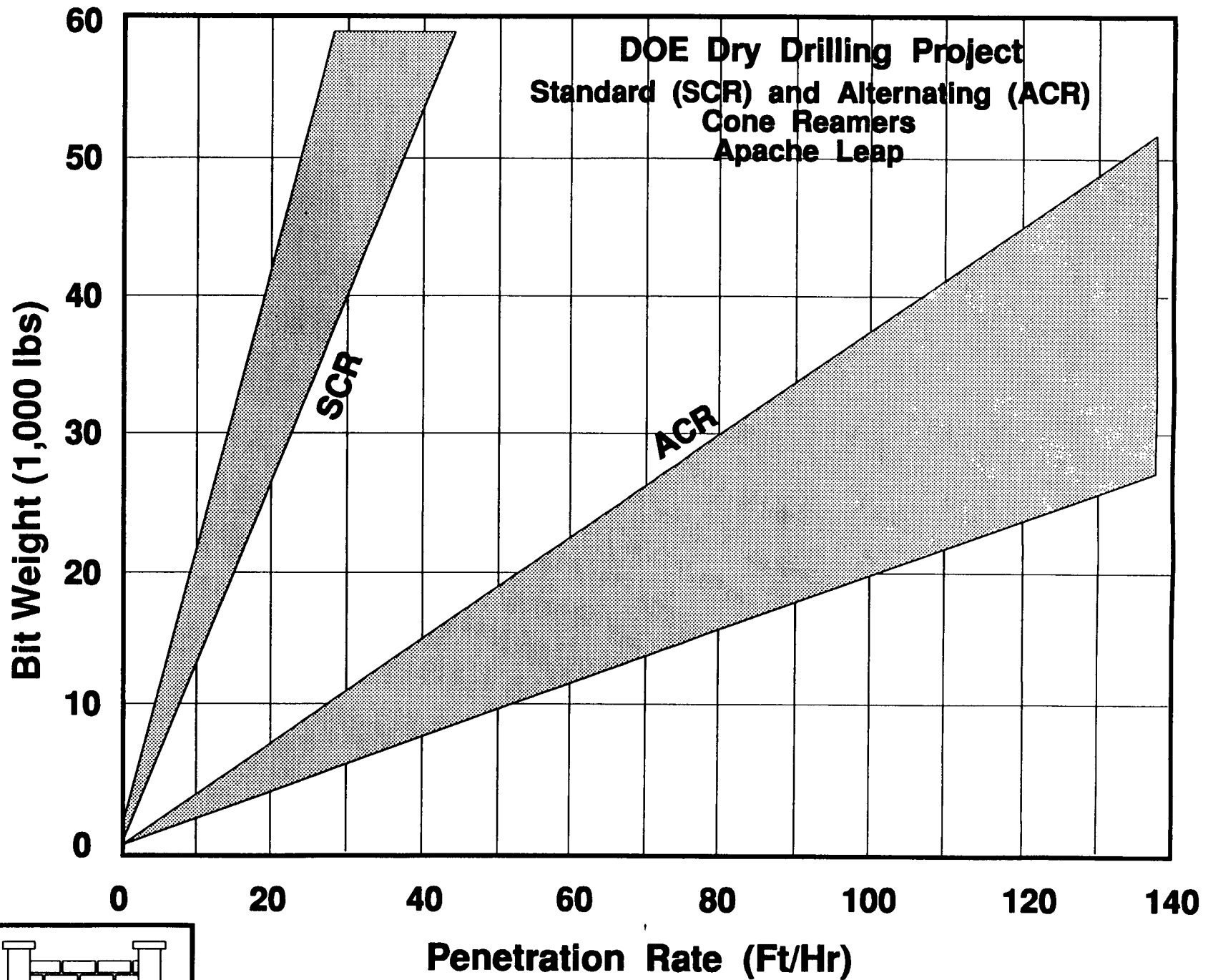
Configuration of Cones 2 & 5 for the Alternating Cone Reamer



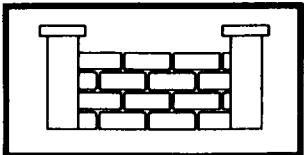
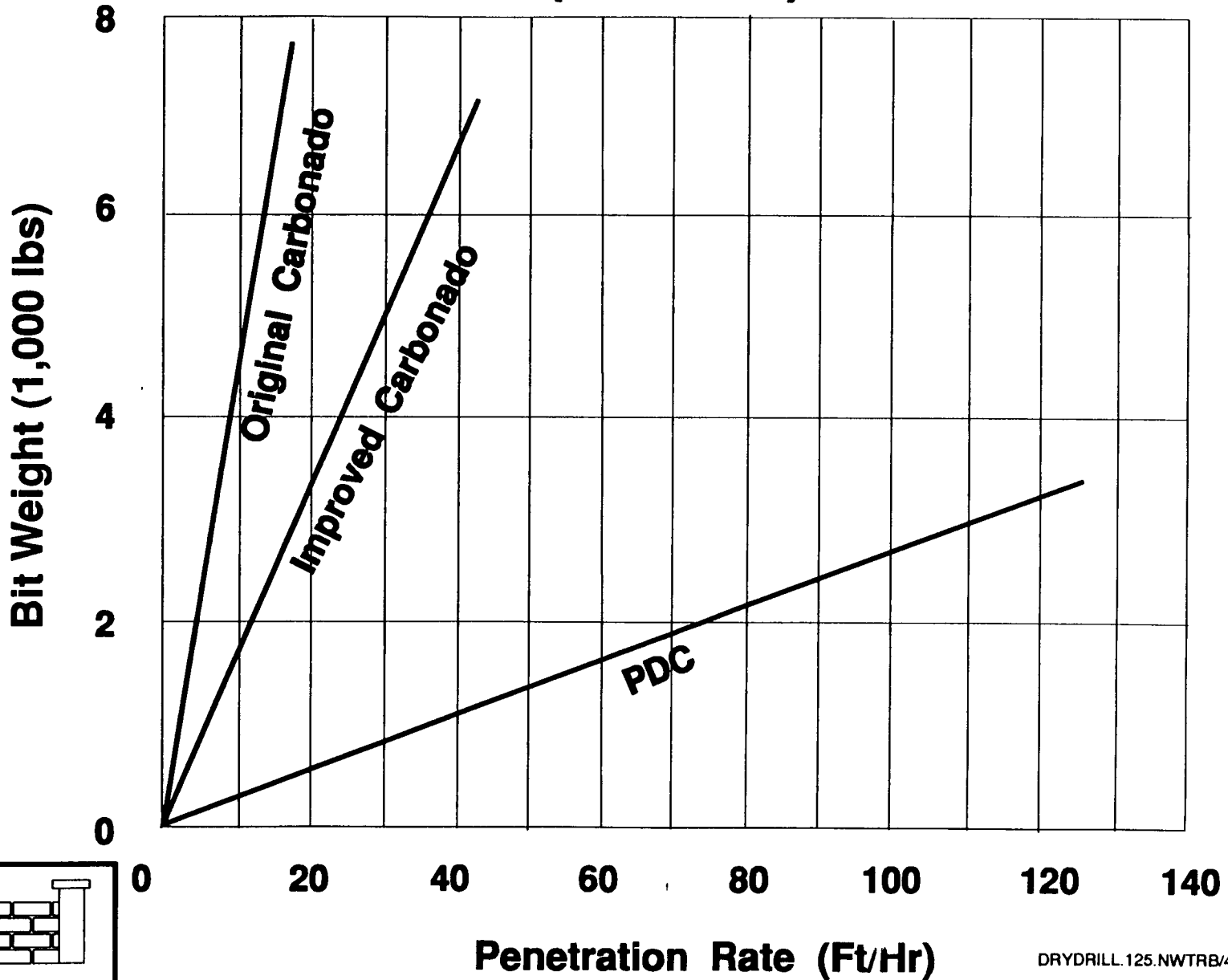
Earth Mechanics Institute
Colorado School of Mines
Golden, Colorado

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Core Bit Performance Comparison (60 RPM)

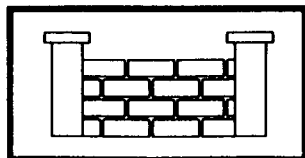


Overview

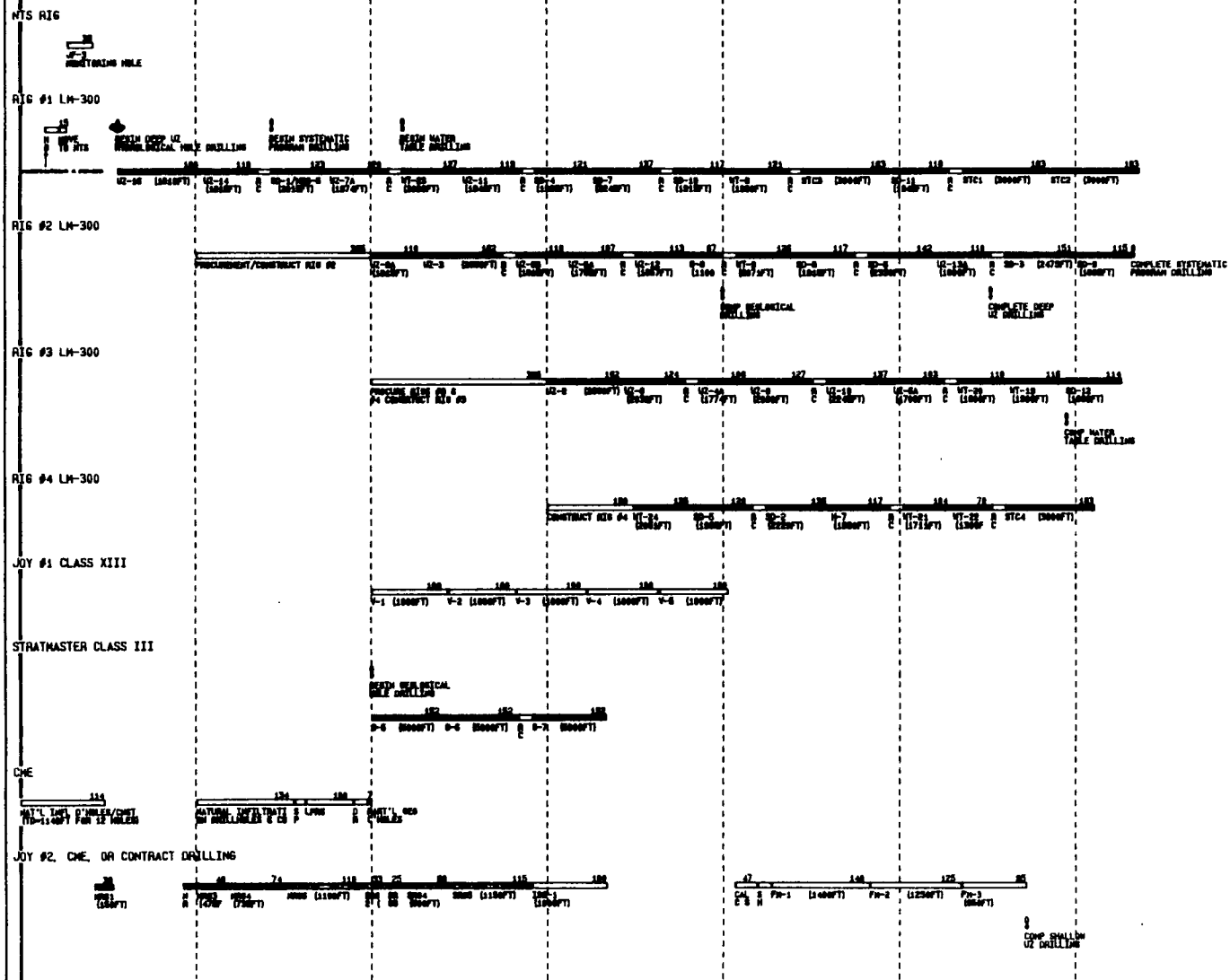
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Rig Staffing (LM-300, Stratmaster)

	Men/Shift	Men/Day
REECo		
Rig Super	1	3
Driller	1	3
Derrickman	1	3
Motorman	1	3
Drill Helper	1	3
Compressor Operator	1	3
Electrician	1	3
Mechanic/Welder	1	3
Teamster	1	3
Forklift Operator	1	3
Ironworker	1	3
Laborer	<u>2</u>	<u>6</u>
Subtotal	<u>13</u>	<u>39</u>
 RSN		
Drilling Engineer	1	3
Drilling Inspector	<u>1</u>	<u>3</u>
Subtotal	<u>2</u>	<u>6</u>
 SMF Drilling Support Divison		
Senior Geologist	1	3
Geologist	3	9
Shift Supervisor	<u>1</u>	<u>3</u>
Subtotal	<u>5</u>	<u>15</u>
 TOTAL	 <u><u>20</u></u>	 <u><u>60</u></u>



1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001



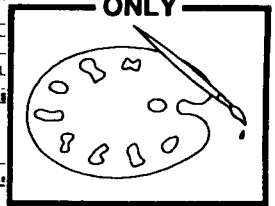
ASSUMPTIONS

- Note for dry drilling is estimated at 500ft/month here and here
- U2-10 is scheduled to start April 1, 1998 and complete six months later.
- Rigs L.L.B.R. 4 to operate 24 hours/day 7 days/week except for drilling of U2-10.
- Note for drilling with the Microtaper on U-2, U-3, and U-7 is estimated to be 1000ft/month. 24 hrs/day, 7 days/week.
- Joy 1, Joy 2, and CHE-200 to operate 8 days per week, 8 hours per day.

Drillhole Designations	Title	SCP Reference
CA, C 2	Celeste Well Drilling	0.2.1.2.2.1
CR	Drillhole for water	0.2.1.2.2.2
	Supply and Tests	
FM	Fertile Well Drilling	0.2.1.2.2.3
	Includes SM - Shallow Monitor	
G	Geologic Drilling	0.2.1.4.2.1
H	Hollister Canyon Fault	0.2.1.2.2.1
ISB	In Situ Stress Drilling	0.2.1.17.4.2
LPM/SPM	Rainfall Simulation	0.2.1.2.2.2
	/Artificial Infiltration	
NM/SM	Surface Facilities Drilling	0.2.1.14.2.1
SD	Geostatistical Drilling	0.2.1.4.2.1
STC	Southern Tracer Complex	0.2.1.2.2.1
U2	Unsatrated Ion. Vertical	0.2.1.2.2.2
	Seismic Profile and Prototype	
V	Volcanic Drilling	0.2.1.2.2.1
WT	Water Table Drilling	0.2.1.2.2.1

Note: NC indicates Rig Certified

FOR ILLUSTRATION ONLY



Activity Bar/Early Dates
Critical Activity
Progress Bar

DRILLHOLE TYPES
 ■■ BEHMOIC DRILLHOLES
 ■■ GEOSTATISTICAL DRILLHOLES
 ■■ WATER TABLE DRILLHOLES
 ■■ UZ HOLES/POP PROTOTYPE/DRILLING AND TESTS
 ■■ SAS-PHASE CHEM/CINC UZ & SOL. CANYON FAULT D'HOLES
 ■■ SURFACE FACILITIES DRILLHOLES
 ■■ SOUTHERN TRACER COMPLEX DRILLHOLES

Primavera Systems, Inc. 1986-1991

REYNOLDS ELECTRICAL & ENGINEERING CO
 123 YUCCA MOUNTAIN PROJECT (4RIGS)
 1.2.3 DRILLING SCHEDULE

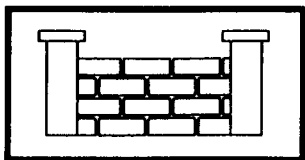
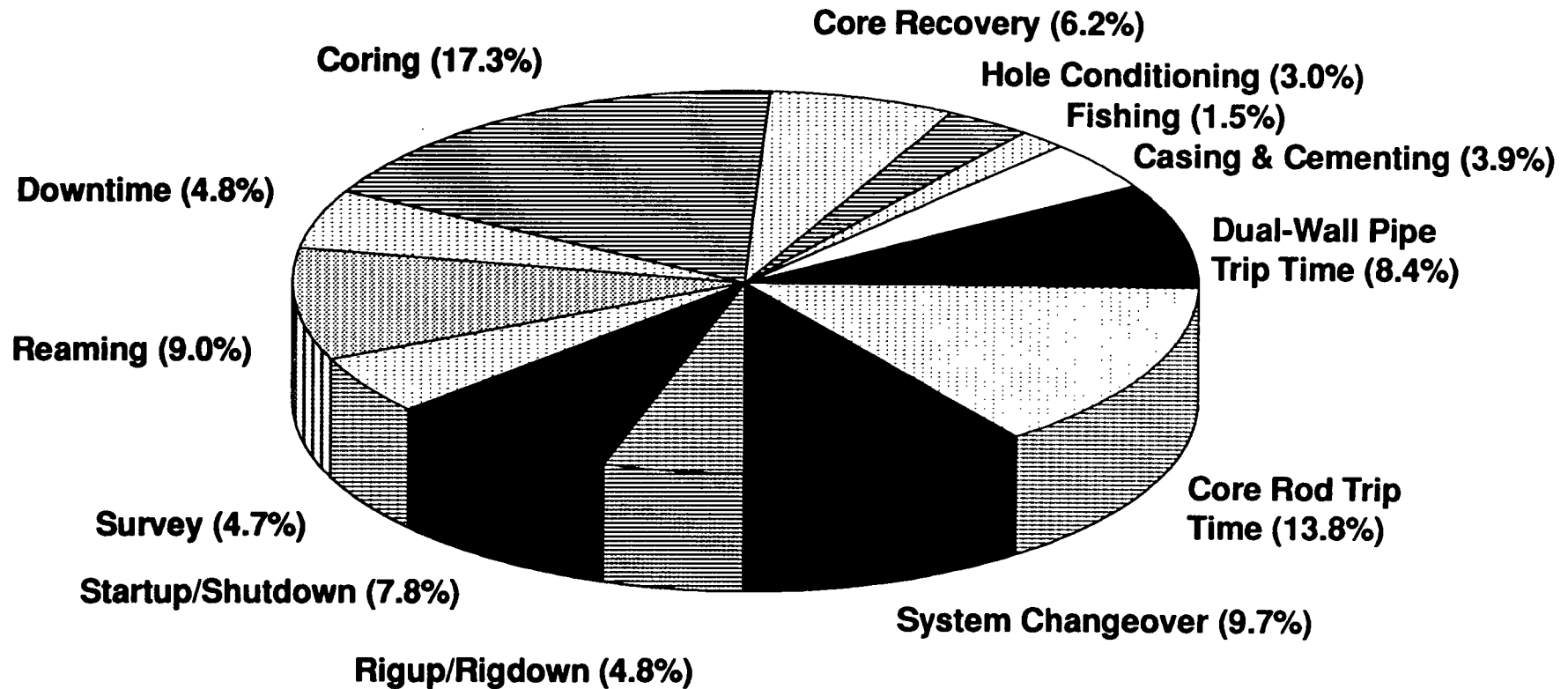
Planning Unit Day Sheet 1 of 1

Project Start: 10CT91
 Project Finish: 10DEC98
 Data Date: 10CT91
 Plot Date: 16MAR92

Y M P DRILL
 Date: 16MAR92
 Prepared by: MLC

Apache Leap Drilling

Time Breakdown (898 Hours Total)



Potential Time Savings

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