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

NUCLEAR WASTE TECHNICAL REVIEW BOARD
FULL BOARD MEETING

SUBJECT: DRILLING PROGRAM UPDATE

PRESENTER: DENNIS R. WILLIAMS

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

PRESENTER'S TELEPHONE NUMBER: (702) 794-7968

LAS VEGAS, NEVADA
OCTOBER 19-20, 1993

Drilling Program

More appropriately...

"Borehole Sampling, Testing, and Monitoring Program"

This Presentation is About Myths, Facts, and Data

We will

- Eliminate the myths
- State the facts
- Present and discuss the data

Myth

- **This is a drilling program**

Fact

- This is a testing-and-sampling program using a testing-and-sampling system
- We are not drilling Yucca Mountain; we are testing and sampling Yucca Mountain

Myth

- **The LM-300 is an inefficient drilling platform**

Myth

- **The LM-300 is an expensive drill rig to acquire and operate**

Fact

- **The LM-300 is an expensive testing-and-sampling system to acquire and operate**

  However, the LM-300 "rig" cost is commensurate with its size and complexity

Overview

- Sampling-and-testing objectives
- LM-300 as a sampling-and-testing system
- YMP drilling development history
- Drilling progress from recent experience
- Research and development emphasis in FY94
- System utilization
- Geophysical logging
- FY94 drill, test, complete and monitor schedule
- Long term
- Specific questions/comments

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Sampling and Testing Objectives

- Obtain core containing the *in situ* conditions of the mountain
- Provide boreholes without disturbing the *in situ* conditions of the mountain

Clean versus Dirty Borehole

- Testing cannot detect contamination in fractures
- No basis for evaluating the impact to the borehole wall for gas-phase testing, if the system functions improperly

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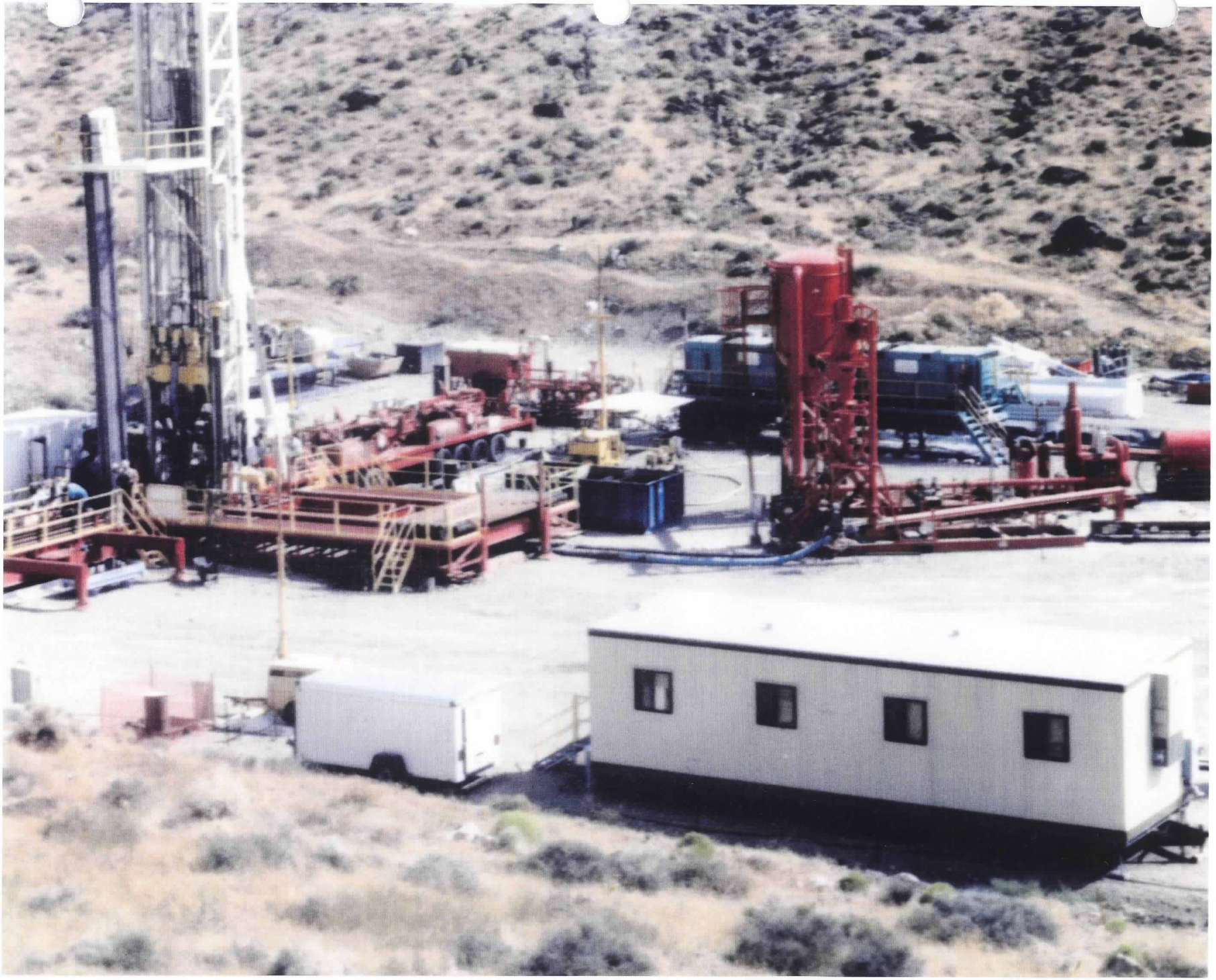
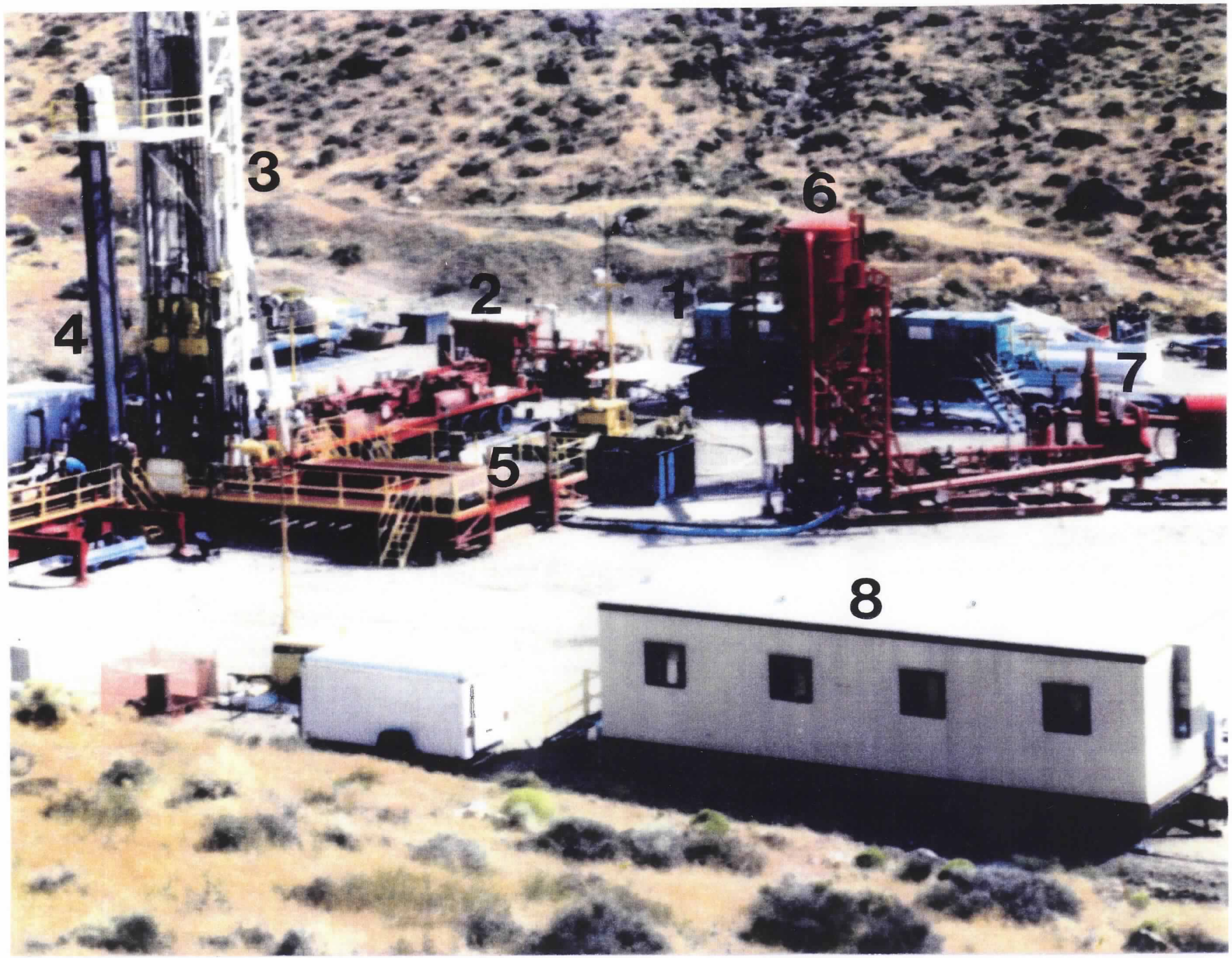
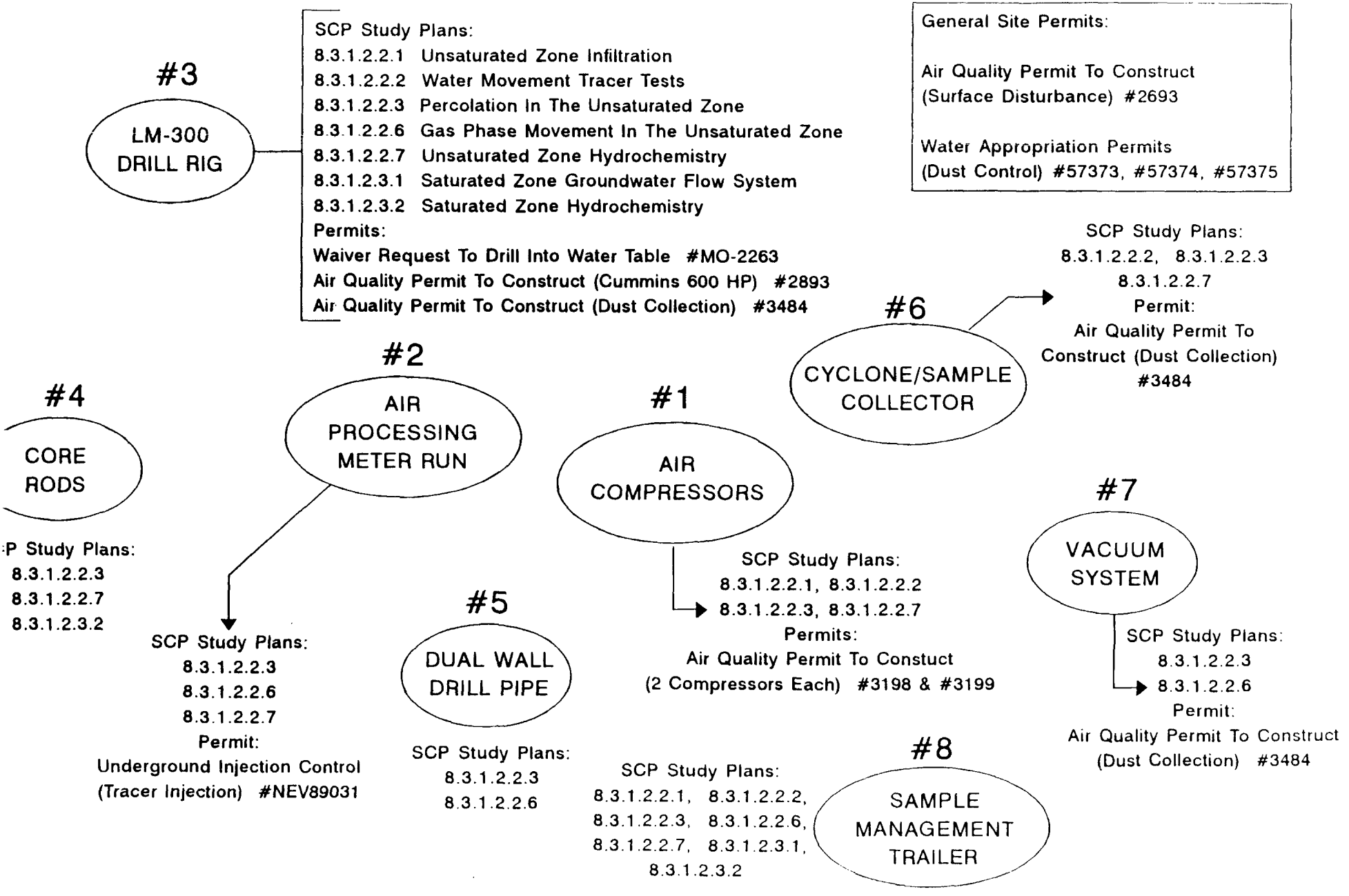




DRILPROG13.125.NWTRB/10-19/20-93

LM-300 SAMPLING SYSTEM AT UZ-14



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YMP Drilling Development History

Development

- **Prototype development of dual-wall system**
  - **1989-1991; $6 MM**
  - **Established feasibility of dual-wall system for unsaturated zone**
- **LM-300 system acquisition and shakedown**
  - **1992; $6 MM**
  - **Established dual-wall (unsaturated zone sampling) capability at YMP**

Enhancement

- **Bit-testing program (ongoing)**

YMP Drilling Studies History

- **Bit-testing program**
  - **1991; $221K**
    - -- Compared Apache Leap with Yucca Mountain tuff
    - -- Initiated bit development program (BDP)
  - **1992; $397K**
    - -- BDP resulted in improved PDC bits and increased drill-bit industry interest in YMP (e.g., Hughes Tool Co.)
    - -- Initiated Vibratory Core Rod Simulation (VCRS) Study
  - **1993; $500K**
    - -- VCRS defined critical rotary speeds for core rods
    - -- Developed VCRS program for field use
    - -- Continued BDP with adaptation of INTEQ Data Acquisition system to improve VCRS model

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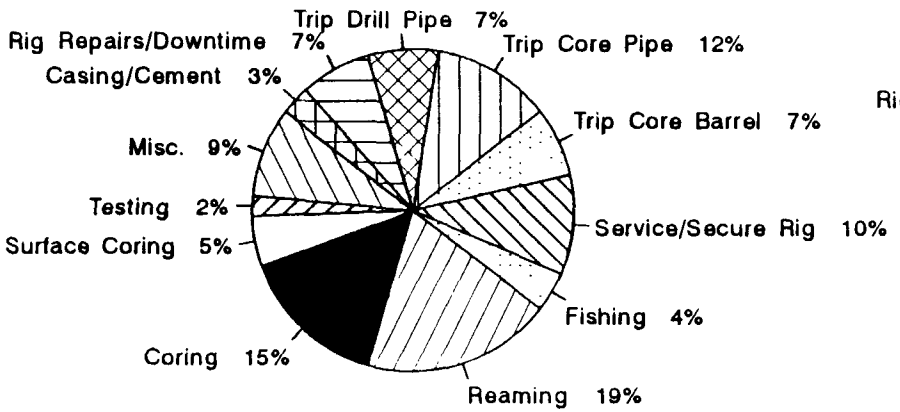
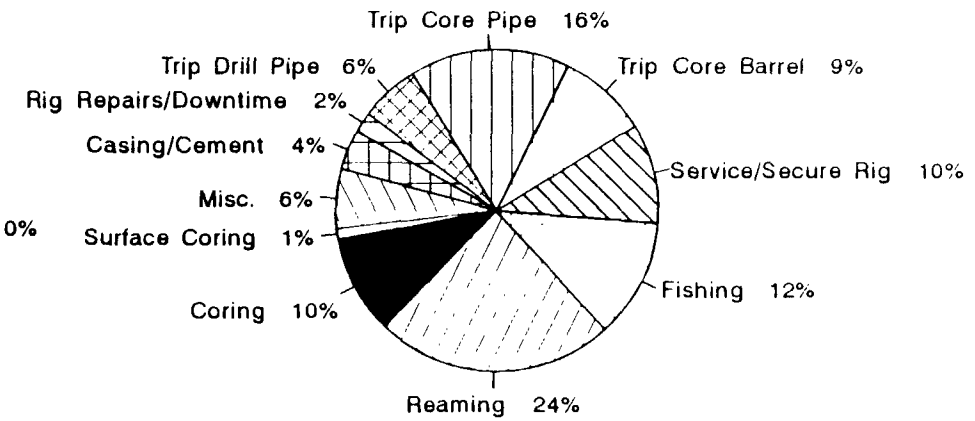
UE-25 UZ-16 Versus USW UZ-14
Drill Rig = LM-300



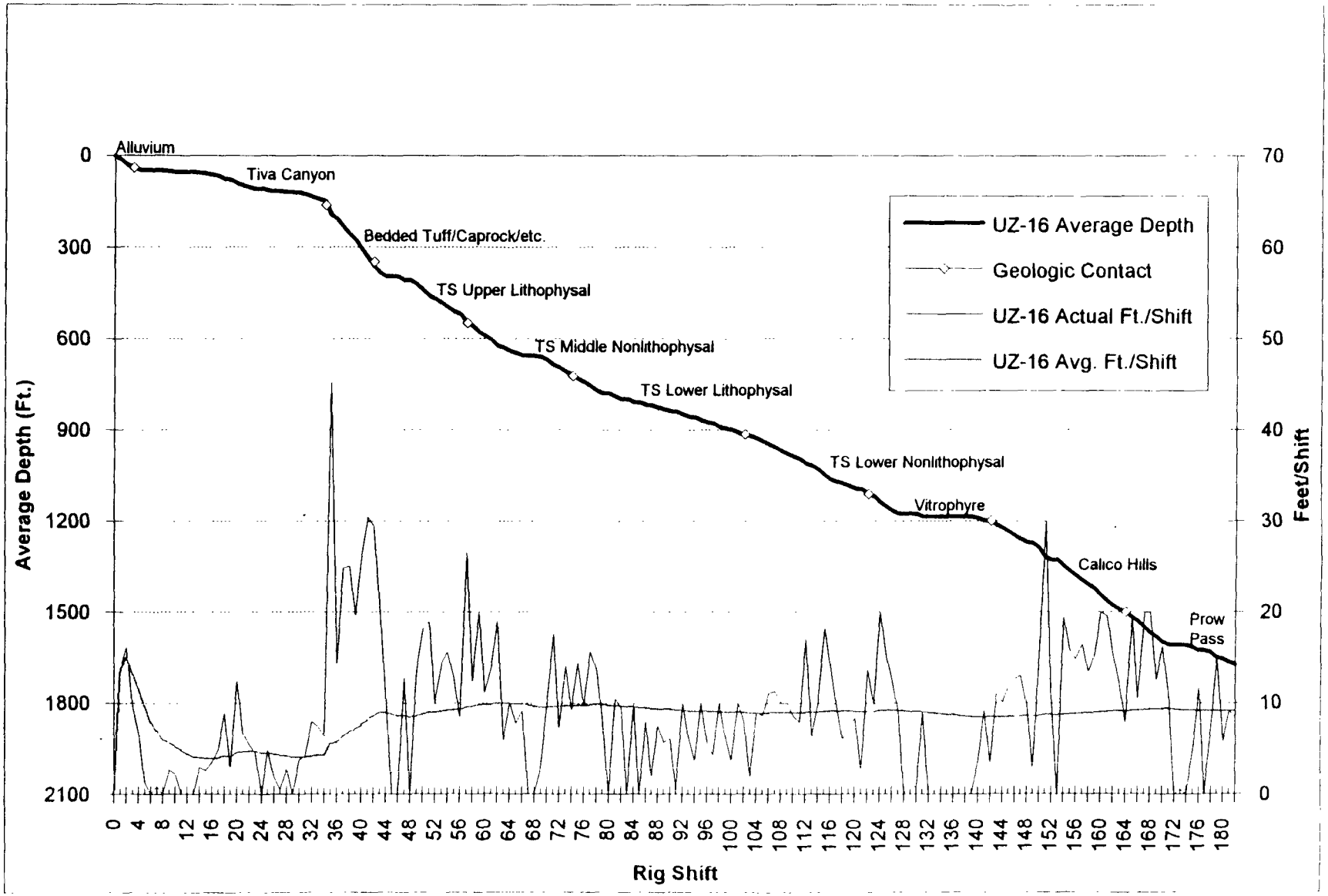
UE-25 UZ-16
186 Shifts Total Rig Time
Total Footage = 1,686 Ft
Ft/8 Hr Shift = 9.1 Ft/Shift
Ft/Hr = 1.13 Ft/Hr



USW UZ-14
69 Shifts Total Rig Time
Total Footage = 1,182 Ft
Ft/8 Hr Shift = 17.1 Ft/Shift
Ft/Hr = 2.14 Ft/Hr

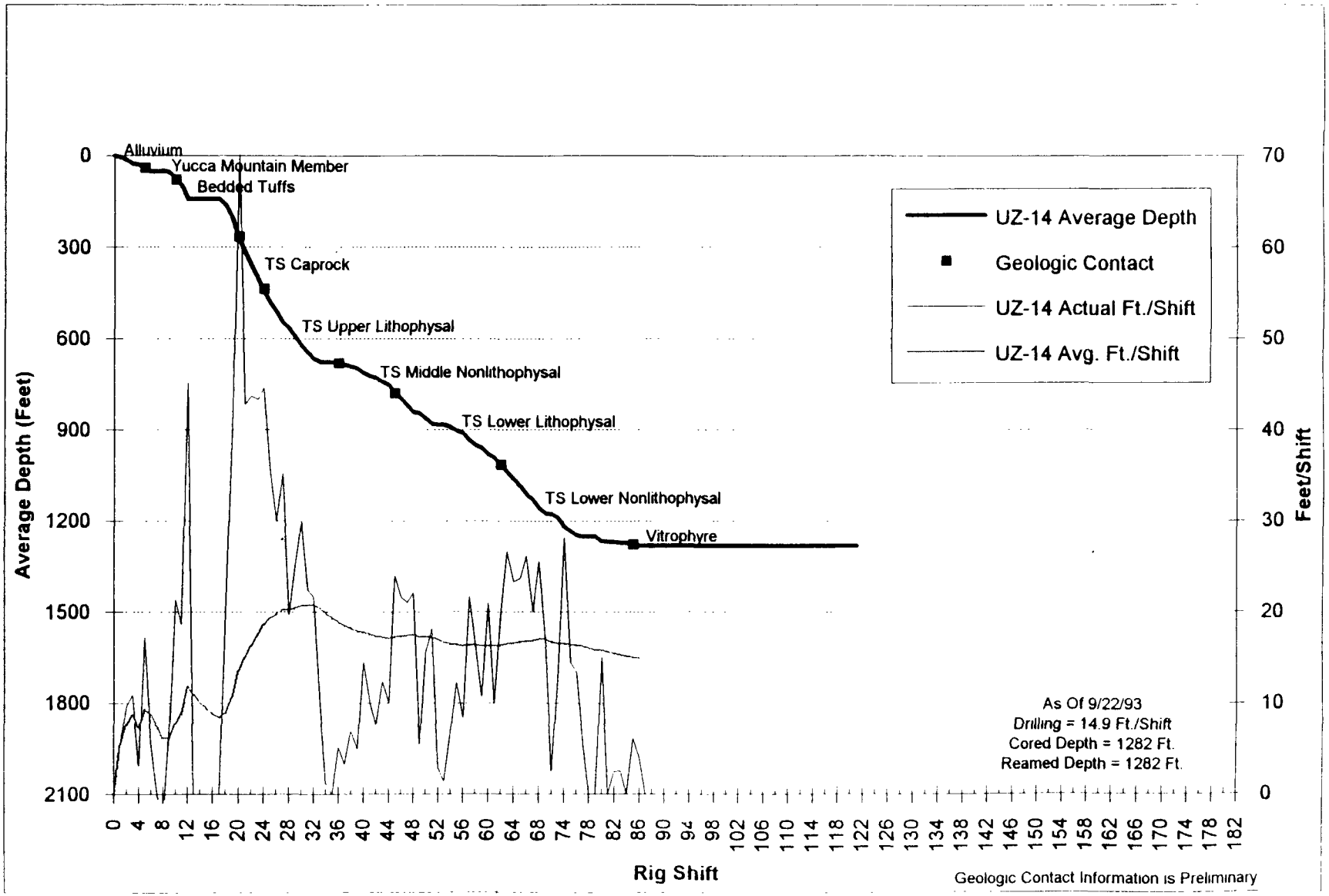
UZ-16 includes drilling through March 16, 1993 (Total Depth)
UZ-14 includes drilling through July 26, 1993 (1,182 Ft.)

UE-25 UZ-16 Performance



DRILPROG19 125 NWTRB/10-16-93

USW UZ-14 Performance



UZ-14 Cementing Perched Water Zone (Phase 1, 1255-1271 ft)

- Open-hole cementing reduced water inflow from 60+ gallons/hour to "0" gallon/hour on first attempt
- Halliburton "Micro Matrix" slurry found to be effective for small fracture cementing
- Cementing design effective for satisfying test interference controls

UZ-14 Cementing Perched Water Zone (Phase 2, 1275-1276 ft)

- Open-hole cementing reduced water inflow from 3+ gallons/hour to "0" gallon/hour on first attempt
- Halliburton "Micro Matrix" slurry found to be effective for extremely small perched-water inflow
- Cementing design even more simplified than Phase 1

FY92-94 Programs

	FY92		FY93		FY94	
Program	Ft.(Holes)	Direct $	Ft.(Holes)	Direct $	Ft.(Holes)	Direct $
UZ	800 (1)	$635K	2170 (2)	$1591K	1718 (2)	$750K
SD					3800 (2)	$1500K
UZN	2242 (16)	$621K	980 (8)	$247K		
RAMP	150 (1)	$36K	4398 (7)	$1060K	2425 (5)	$450K
Total =	3,192 Ft.	$1,292K	7,548 Ft.	$2,898K	7,943 Ft.	$2,700K

Drill Rigs
CME 550
CME 850
Joy-1
Failing 1500
LM-300

Testing, completion, and monitoring, FY94:
Rig months=5.4; direct=$500K

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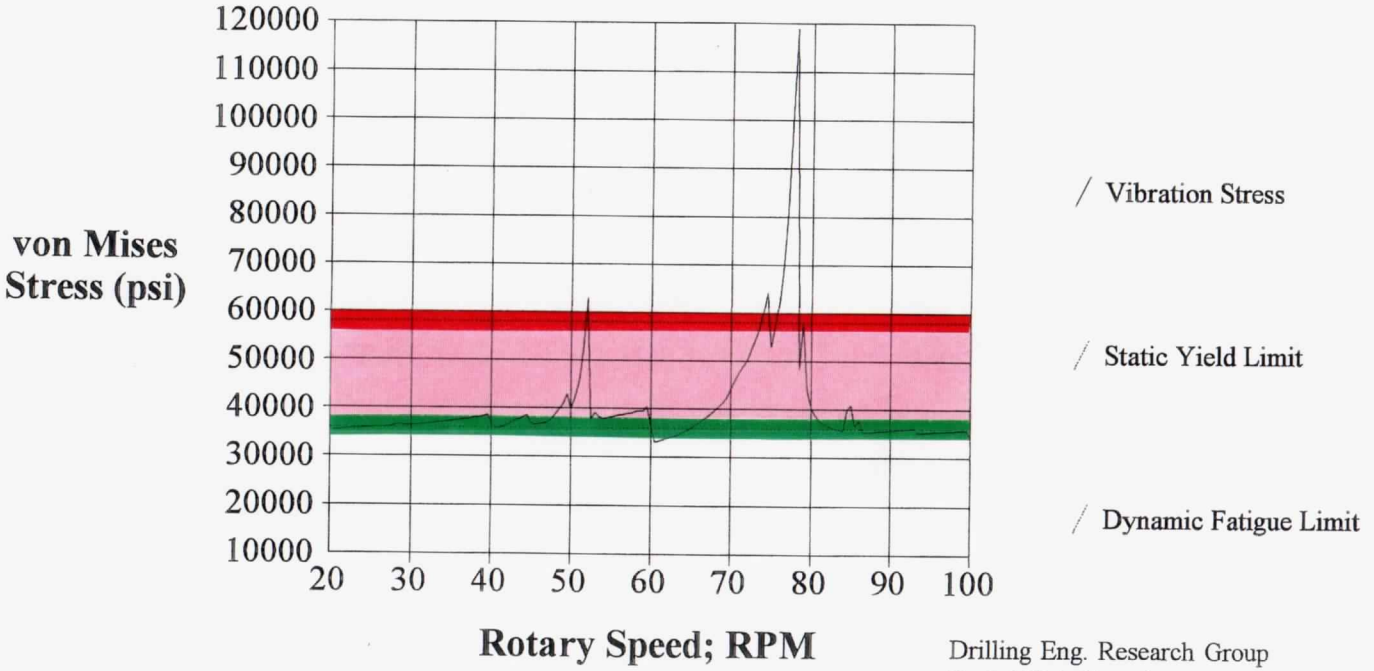
Technology Studies Emphasis FY94

1. Venturi Feasibility
2. Vibration Analysis Program
3. Deviation Control Simulator
4. Finish Core-Bit Testing Report

Venturi Feasibility

- Determine feasibility of generating vacuum downhole at reaming bit
- Rough prototype worked with limited success in early prototype drilling program
- Could be essential to provide "balanced air" drilling beyond 2000 ft.
- Not readily available, if needed

CSM Core Rod Vibration Study (VCRS Program)

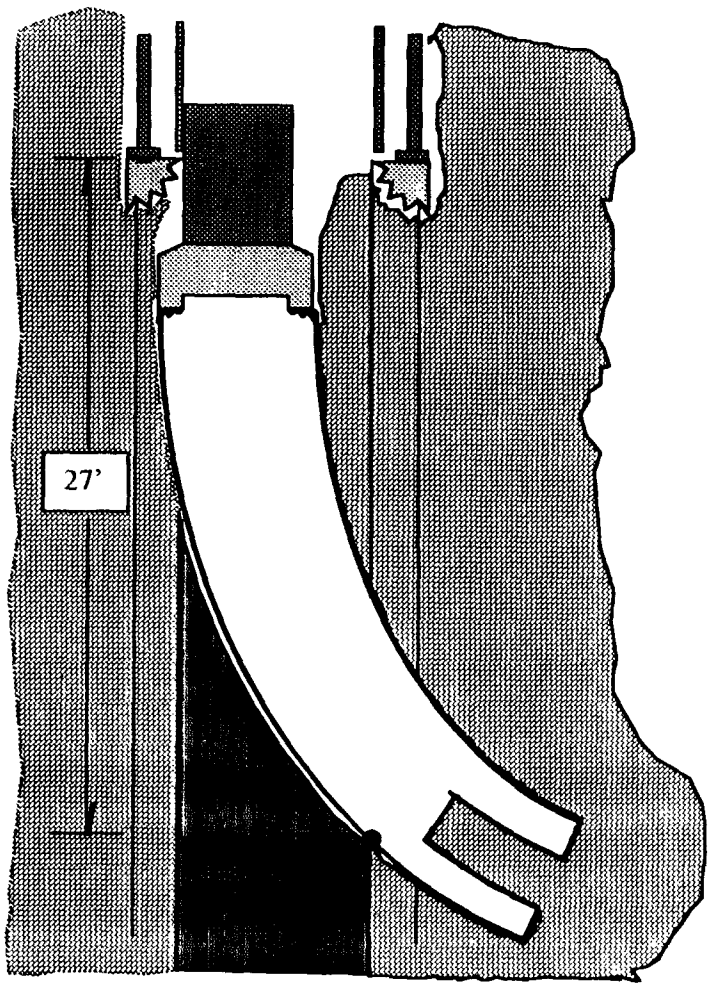


Drilling Eng. Research Group
Prof. Mitchell et.al.

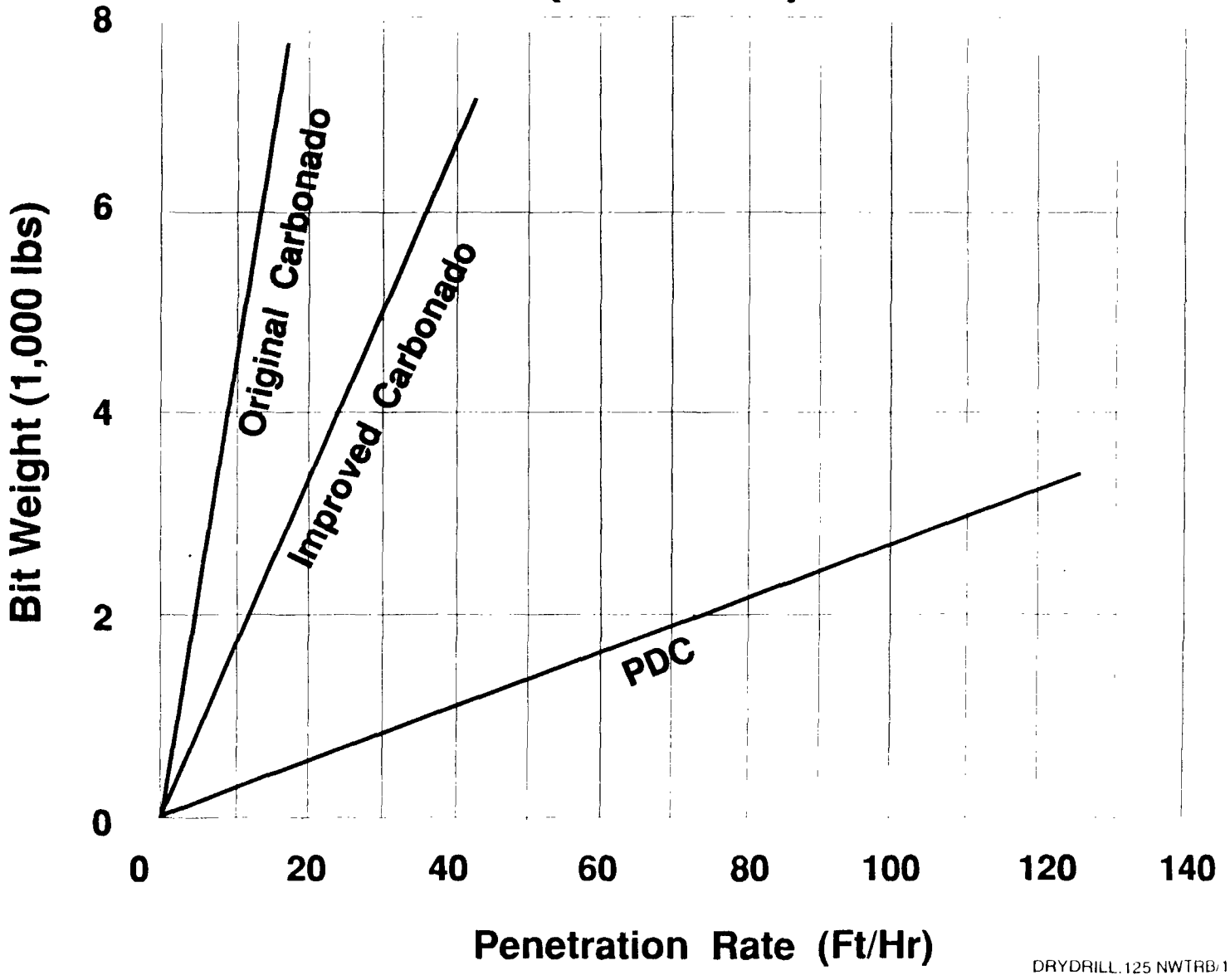
- Shows critical rotary speeds for core rod
- Graphical presentation of "high risk" rotary speeds
- Provides previously unavailable analysis of CHD-101 coring system in dry coring environment

Coring Deviation Control

THE PROBLEM



Core Bit Performance Comparison (60 RPM)



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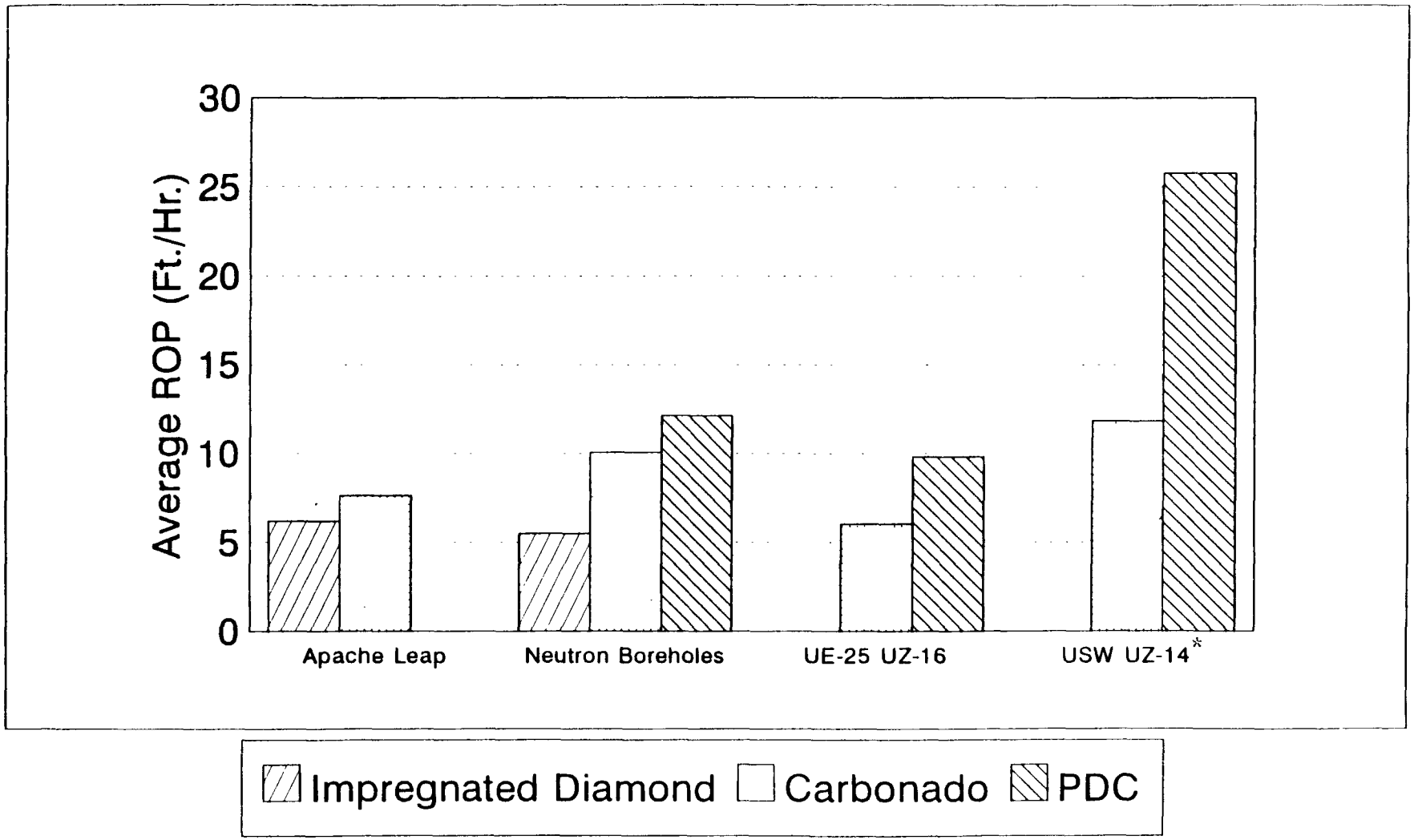
Core Bit Performance

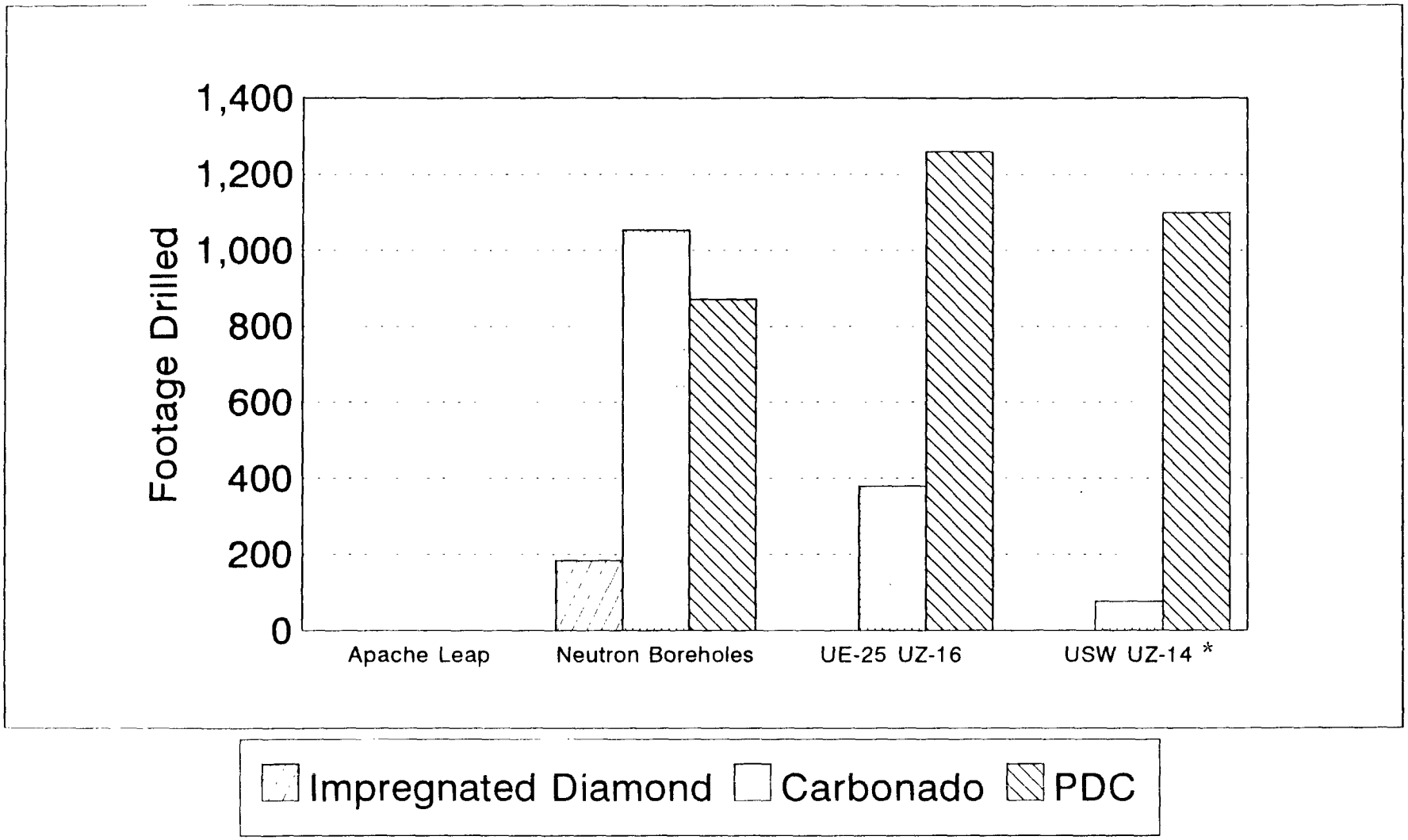
Bit Type vs Penetration Rate



*** UZ-14 data through 8/4/93 only**

Core Bit Performance

Bit Type versus Footage Drilled



*** UZ-14 data through 8/4/93 only**

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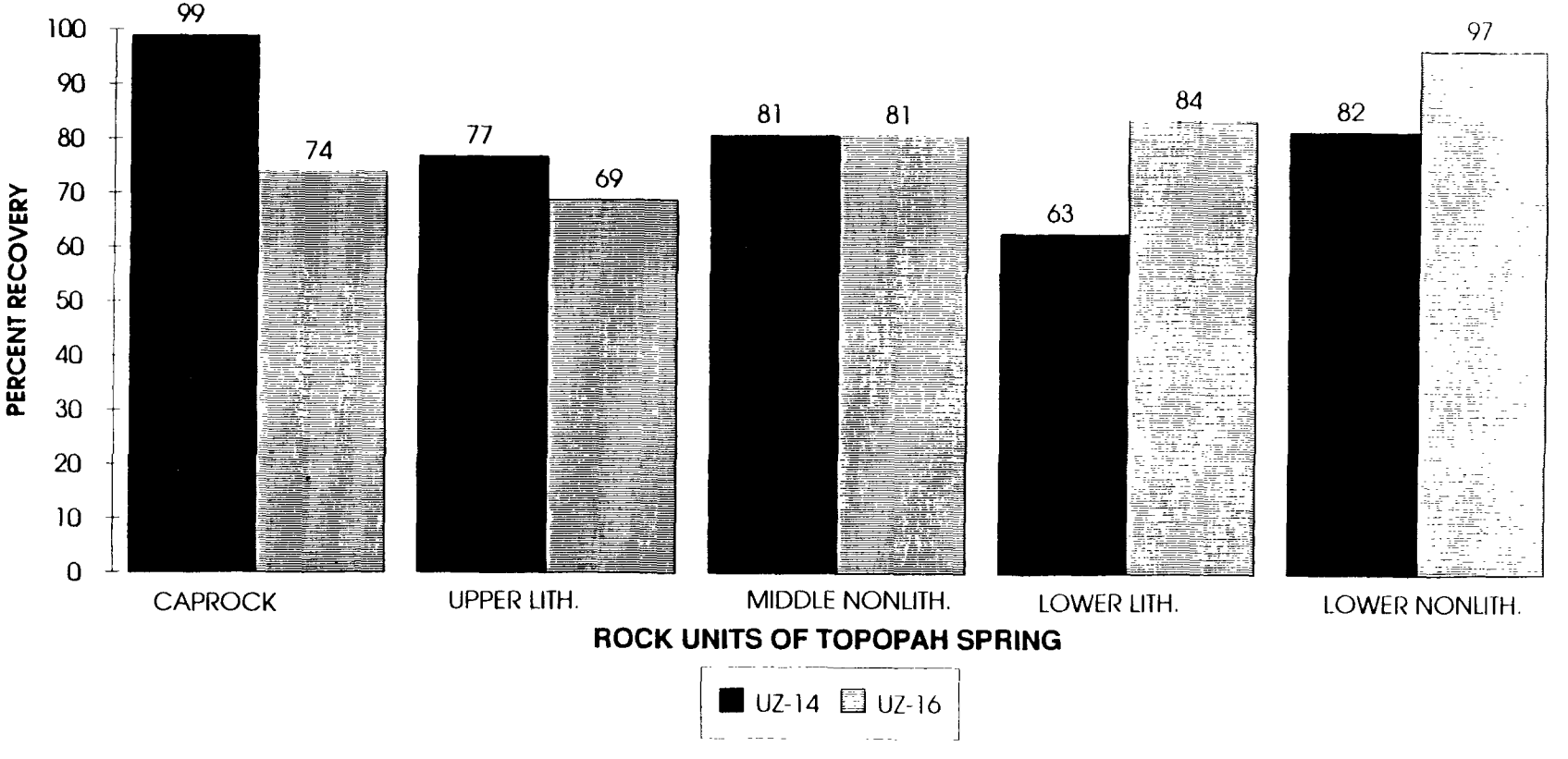
UZ-14 versus UZ-16 Average Percent Recovery for Common Rock Units



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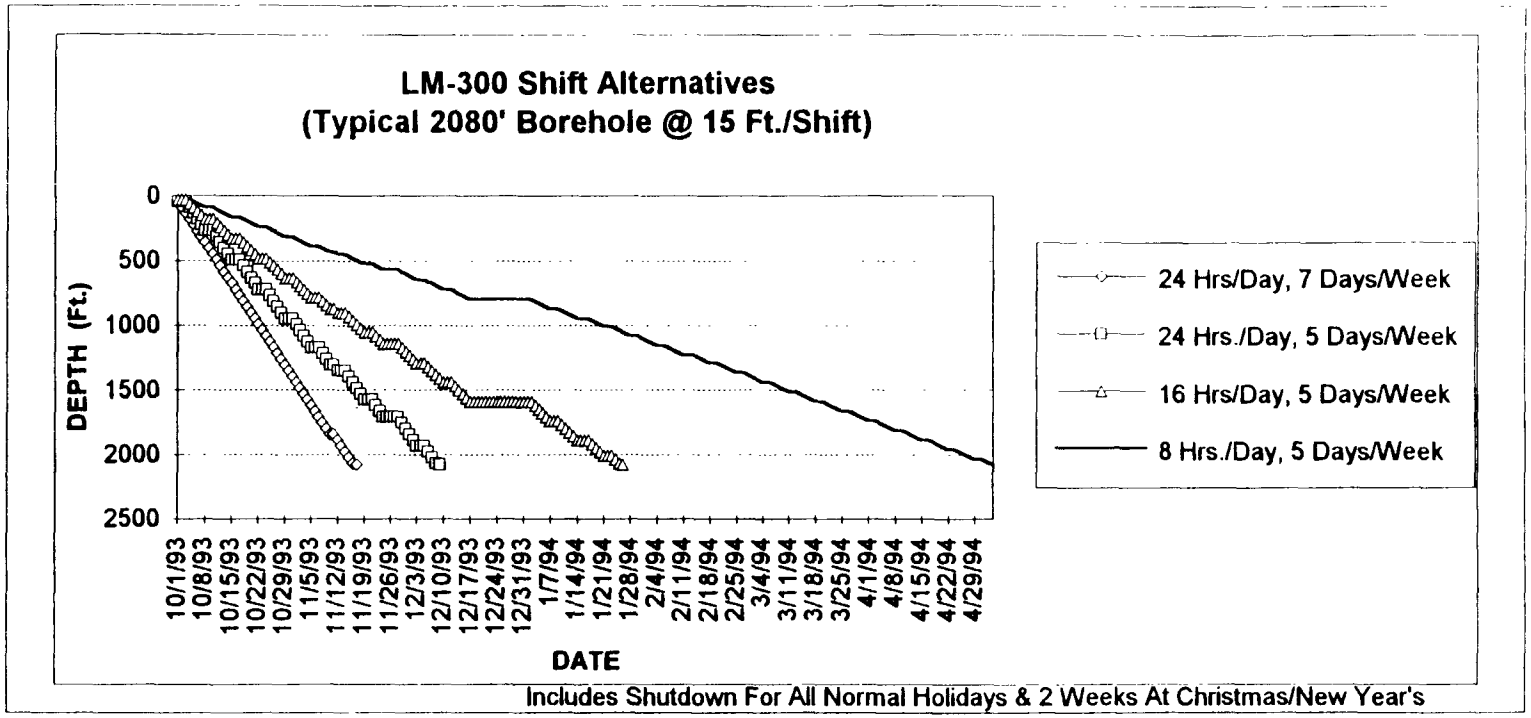
No Basis for Determining Efficiency

Utilization 21%



Includes Shutdown For All Normal Holidays & 2 Weeks At Christmas/New Year's

Shift Schedule	Shifts Per Week	Total Drilling Days	Total Drilling Shifts	Total Calendar Days	Total Available Shifts	Equipment Utilization
24 Hours/Day, 7 Days/Week (No Holidays)	21	46.2	138.7	46.2	138.7	100%
24 Hours/Day, 7 Days/Week	21	46.2	138.7	47.2	141.7	98%
24 Hours/Day, 5 Days/Week	15	46.2	138.7	69.2	207.7	67%
16 Hours/Day, 5 Days/Week	10	69.3	138.7	117.3	352.0	39%
8 Hours/Day, 5 Days/Week	5	138.7	138.7	215.7	647.0	21%

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FY93 Geophysics Accomplishments at Yucca Mountain

- **Geophysical Borehole Logging**
  - UE-25 UZ-16 - Standard suite, seismic (Zero-offset) and VSP walkaway surveys, gravity and magnetics, neutron, prototype logs (RAAX, pulsed neutron, radar, geochemical), downhole video 7/22-8/12, 1993
  - USW NRG-6, UE-25 NRG-2 - slim-hole suite, seismic check-shot, Gyro, TV, (also, magnetics and VSP in NRG-6)
  - USW UZ-1 - Gyro survey (in preparation for drilling UZ-14 on same pad)
  - USW WT-2 - VSP profiling and zero-offset seismic, 8/23-8/25, 1993 (LBL)
  - Neutron logging on all N-holes and WT-2
  - Prototype crosshole seismic work at CSM in preparation for VSP in UZ-16

FY93 Geophysics Accomplishments at Yucca Mountain

(Continued)

- **Seismic Refraction**
  - Windy Wash fault (SW of proposed repository area)
- **Gravity and Magnetics**
  - Yucca Wash area (North of proposed repository area)
  - Midway Valley (East of proposed repository area)
- **Geodetic Leveling**
  - Completed re-survey of level lines (base station network); re-surveyed GPS base stations

FY93 Geophysics Accomplishments at Yucca Mountain

(Continued)

- **Seismic Monitoring**
  - Continuous 24-hour coverage in Southern Great Basin Seismic Monitoring Network
  - Seismic field experiment in Midway Valley (ground motion site response for ESF surface facilities design)
  - Mapping of precariously balanced rocks (from which is inferred past levels of ground-shaking)
  - Three new broad-band stations installed near Beatty to improve earthquake location parameters
  - Recording of non-proliferation experiment (NPE) on September 22, 1993, with numerous portable seismographs
- **Engineering Geophysical Tests on Rock Samples**
  - Determined for North Ramp core samples in surface facilities areas

FY94 Planned Geophysics at Yucca Mountain

(Continued)

- **Geophysical Borehole Logging**
  - UZ-14: 4- or 6-arm caliper, gravity, video, gyro, dual induction, sidewall neutron, NPLT; possibly dielectric log, magnetics, velocity check shot, neutron moisture, prototype logging 11/93-12/93
  - UE-25 UZ-16: VSP reconnaissance survey with grouted-in 96-geophone string
  - NRG-2, -2a, -2b, -3, -4, -5, -6, and -7: Resistivity, gamma, density, neutron, gyro, video, caliper 10/93-11/93
  - WT-2: Resistivity, gamma, density, neutron, caliper, video, gyro deviation 10/93; also, heat flow
  - WT- and G-holes: Heat-flow surveys in about 30 boreholes
  - SD-12: Phased logging possible above and below WT; similar logs to those at UZ-14

FY94 Planned Geophysics at Yucca Mountain

(Continued)

- **Seismic Reflection**
  - Between WT-2 and UZ-16, in support of ESF main drift design (LBL)
  - Possible NW-SE line through Drill Hole Wash, in support of ESF north ramp design (LBL)
  - Possible survey along Yucca Crest Road, in support of faulting studies (LBL)
- **Seismic Monitoring**
  - Continuous 24-hour coverage in Southern Great Basin seismic monitoring network
  - Mapping of precariously balanced rocks (from which is inferred past levels of ground-shaking)

FY94 Planned Geophysics at Yucca Mountain

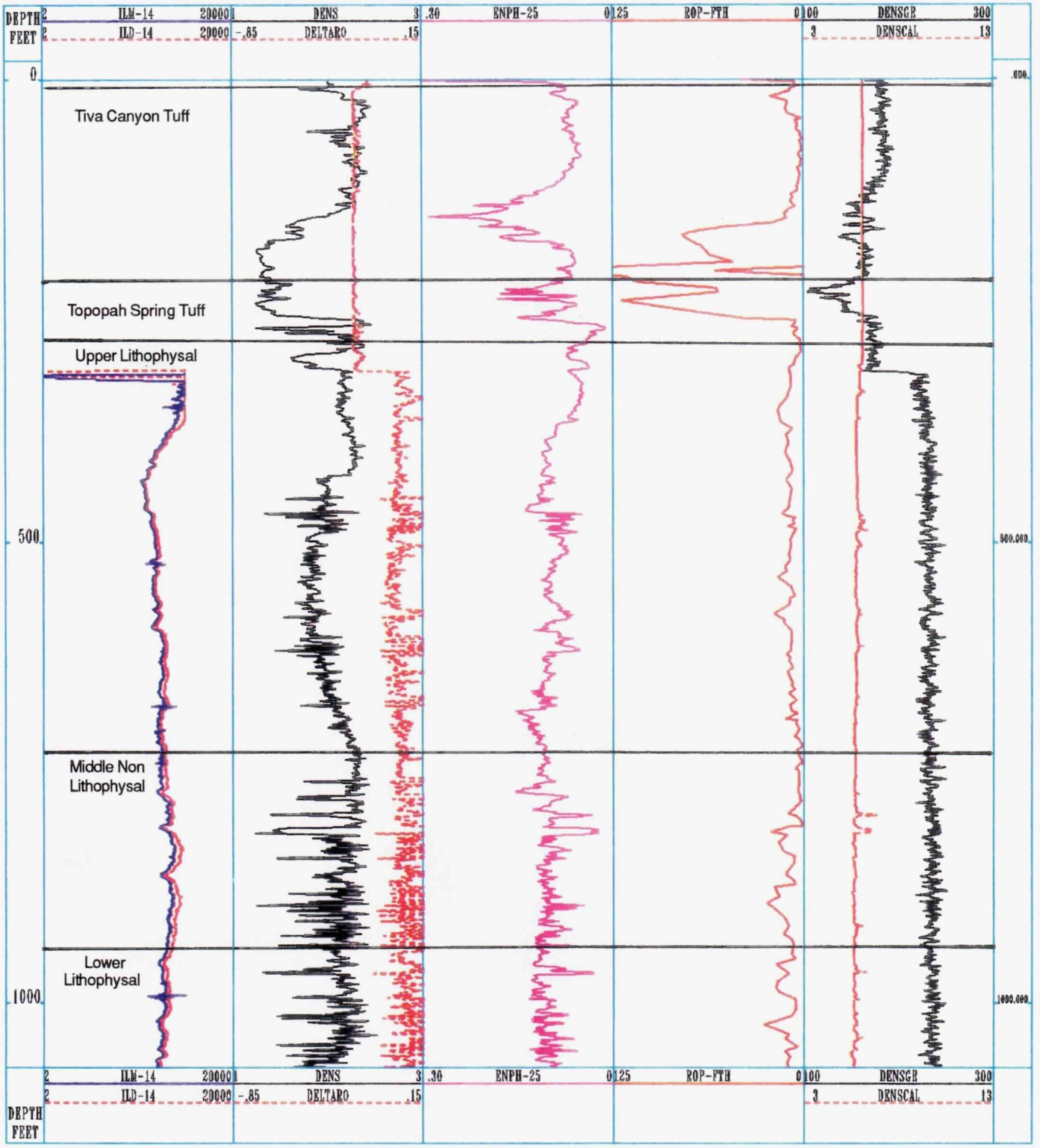
(Continued)

- **Geodetic Leveling**
  - Analyses of leveling data collected in FY93
- **Engineering Geophysical Tests on Rock Samples**
  - Determined for North and South Ramp core samples, surface facilities areas (SNL)
  - Unspecified geophysical tests in the North Ramp and alcoves (LANL; LLNL); possibly to include laser-induced breakdown spectroscopy

UZ-16 Lithology Compared to UZ-16 Geophysical Logs

USW NRG6

AREA 25 NTS 29-JUN-1993



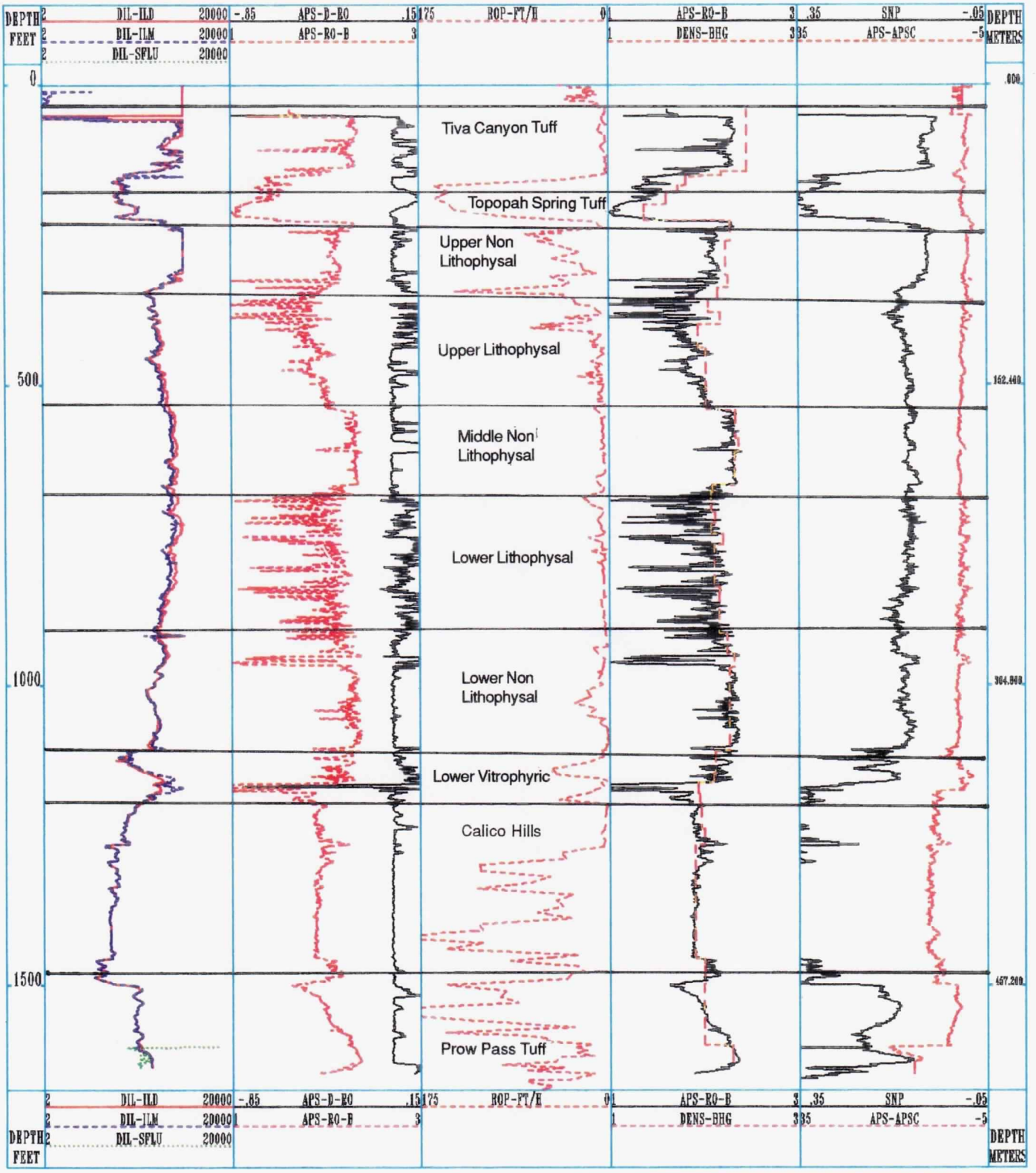
YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT
TECHNICAL AND MANAGEMENT SUPPORT SERVICES
Drilling Support and Sample Management
INFORMATION COPY QA:N/A October 11, 1993

USW NRG6

AREA 25 NTS 29-JUN-1993

UE 25 UZ 16 (VSP 2)

AREA 25 AUGUST, 1993



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UE 25 UZ 16 (VSP 2)

AREA 25 AUGUST, 1993

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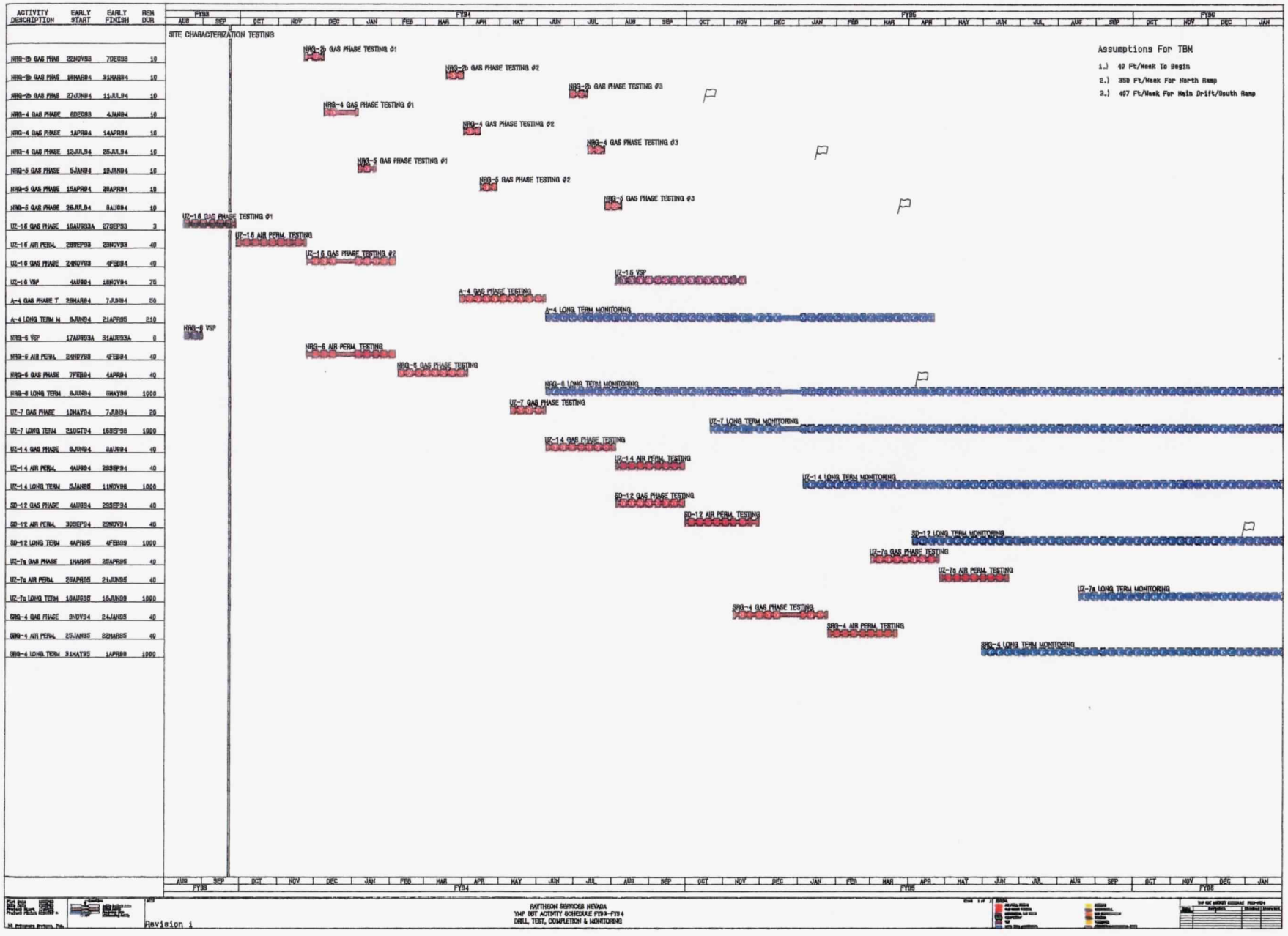
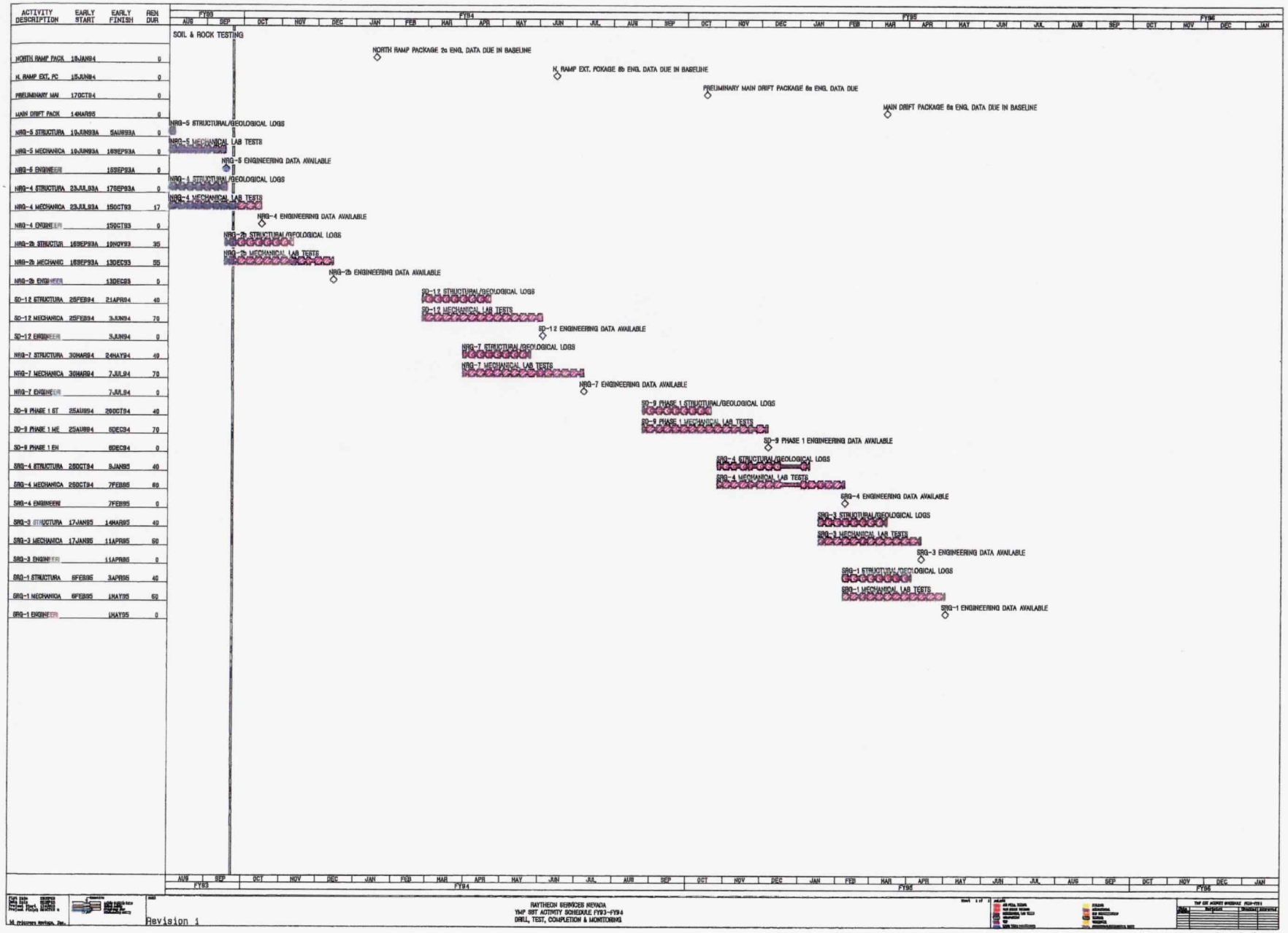


Issued 9/23/93


ACTIVITY DESCRIPTION
EARLY START
EARLY FINISH
REM DUR
FY93
FY94
FY95
FY96
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JAN
SOIL & ROCK TESTING
NORTH RAMP PACK 19JAN94 0
N. RAMP EXT. PC 15JUN94 0
PRELIMINARY MAI 17OCT94 0
MAIN DRIFT PACK 14MAR96 0
NRG-5 STRUCTURA 19JUN93A 5AUG93A 0
NRG-5 MECHANICA 19JUN93A 16SEP93A 0
NRG-5 ENGINEER 16SEP93A 0
NRG-4 STRUCTURA 23JUL93A 17SEP93A 0
NRG-4 MECHANICA 23JUL93A 15OCT93 17
NRG-4 ENGINEER 15OCT93 0
NRG-2b STRUCTUR 16SEP93A 19NOV93 35
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SD-12 STRUCTURA 25FEB94 21APR94 40
SD-12 MECHANICA 25FEB94 3JUN94 70
SD-12 ENGINEER 3JUN94 0
NRG-7 STRUCTURA 30MAR94 24MAY94 40
NRG-7 MECHANICA 30MAR94 7JUL94 70
NRG-7 ENGINEER 7JUL94 0
SD-9 PHASE 1 ST 25AUG94 20OCT94 40
SD-9 PHASE 1 ME 25AUG94 6DEC94 70
SD-9 PHASE 1 EN 6DEC94 0
SRG-4 STRUCTURA 28OCT94 9JAN95 40
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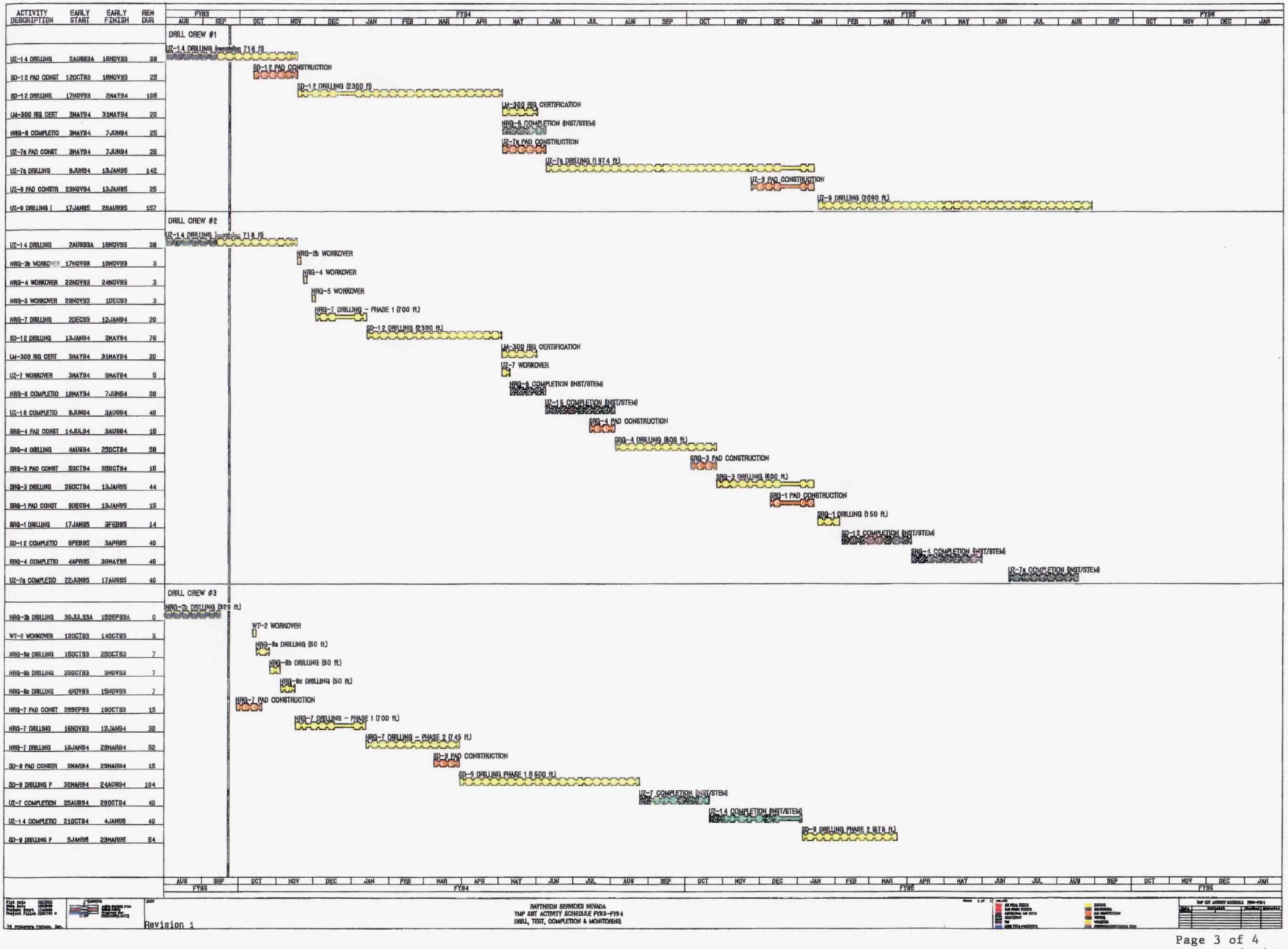
SRG-1 STRUCTURA 6FEB95 3APR95 40
SRG-1 MECHANICA 6FEB95 1MAY95 60
SRG-1 ENGINEER 1MAY95 0
NORTH RAMP PACKAGE 2a ENG. DATA DUE IN BASELINE
N. RAMP EXT. PCKAGE 8b ENG. DATA DUE IN BASELINE
PRELIMINARY MAIN DRIFT PACKAGE 6a ENG. DATA DUE
MAIN DRIFT PACKAGE 6a ENG. DATA DUE IN BASELINE
NRG-5 STRUCTURAL/GEOLOGICAL LOGS
NRG-5 MECHANICAL LAB TESTS
NRG-5 ENGINEERING DATA AVAILABLE
NRG-4 STRUCTURAL/GEOLOGICAL LOGS
NRG-4 MECHANICAL LAB TESTS
NRG-4 ENGINEERING DATA AVAILABLE
NRG-2b STRUCTURAL/GEOLOGICAL LOGS
NRG-2b MECHANICAL LAB TESTS
NRG-2b ENGINEERING DATA AVAILABLE
SD-12 STRUCTURAL/GEOLOGICAL LOGS
SD-12 MECHANICAL LAB TESTS
SD-12 ENGINEERING DATA AVAILABLE
NRG-7 STRUCTURAL/GEOLOGICAL LOGS
NRG-7 MECHANICAL LAB TESTS
NRG-7 ENGINEERING DATA AVAILABLE
SD-9 PHASE 1 STRUCTURAL/GEOLOGICAL LOGS
SD-9 PHASE 1 MECHANICAL LAB TESTS
SD-9 PHASE 1 ENGINEERING DATA AVAILABLE
SRG-4 STRUCTURAL/GEOLOGICAL LOGS
SRG-4 MECHANICAL LAB TESTS
SRG-4 ENGINEERING DATA AVAILABLE
SRG-3 STRUCTURAL/GEOLOGICAL LOGS
SRG-3 MECHANICAL LAB TESTS
SRG-3 ENGINEERING DATA AVAILABLE
SRG-1 STRUCTURAL/GEOLOGICAL LOGS
SRG-1 MECHANICAL LAB TESTS
SRG-1 ENGINEERING DATA AVAILABLE
RAYTHEON SERVICES NEVADA
YMP SST ACTIVITY SCHEDULE FY93-FY94
DRILL, TEST, COMPLETION & MONITORING

Revision 1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JUL
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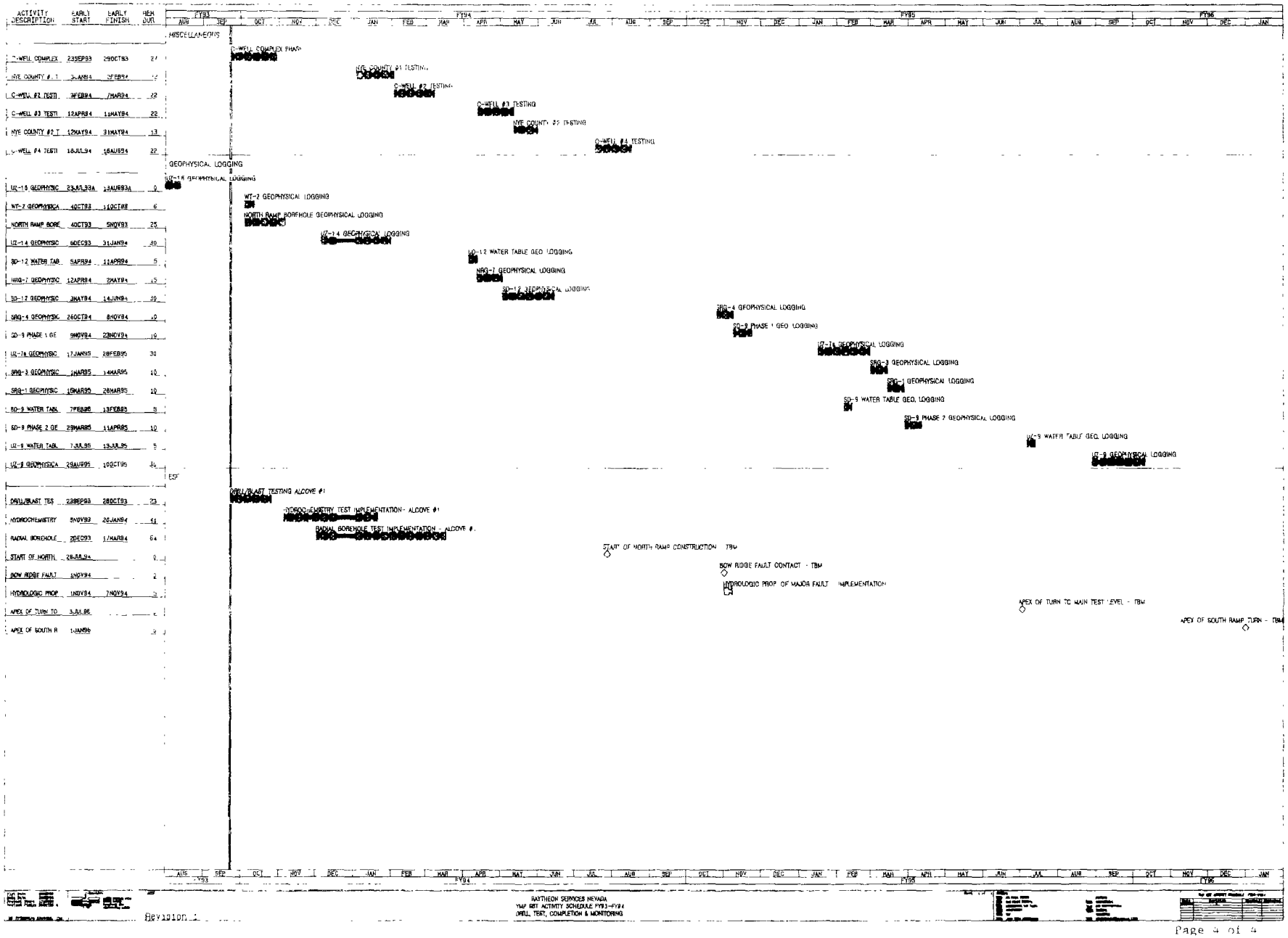
OCT
NOV
DEC
JAN
DRILL CREW #1
UZ-14 DRILLING 2AUG93A 16NOV93 38
SD-12 PAD CONSTRUCTION
SD-12 DRILLING (2300 ft)
LM-300 RIG CERTIFICATION
NRG-6 COMPLETION (INST/STEM)
UZ-7a PAD CONSTRUCTION
UZ-7a DRILLING (1974 ft)
UZ-9 PAD CONSTRUCTION
UZ-9 DRILLING (2090 ft)
DRILL CREW #2
UZ-14 DRILLING 2AUG93A 16NOV93 38
NRG-2b WORKOVER
NRG-4 WORKOVER
NRG-5 WORKOVER
NRG-7 DRILLING - PHASE 1 (700 ft)
SD-12 DRILLING (2300 ft)
LM-300 RIG CERTIFICATION
UZ-7 WORKOVER
NRG-6 COMPLETION (INST/STEM)
UZ-15 COMPLETION (INST/STEM)
SRG-4 PAD CONSTRUCTION
SRG-4 DRILLING (800 ft)
SRG-3 PAD CONSTRUCTION
SRG-3 DRILLING (600 ft)
SRG-1 PAD CONSTRUCTION
SRG-1 DRILLING (150 ft)
SD-12 COMPLETION (INST/STEM)
SRG-4 COMPLETION (INST/STEM)
UZ-7a COMPLETION (INST/STEM)
DRILL CREW #3
NRG-2b DRILLING (329 ft)
WT-2 WORKOVER
NRG-6a DRILLING (50 ft)
NRG-6b DRILLING (50 ft)
NRG-6c DRILLING (50 ft)
NRG-7 PAD CONSTRUCTION
NRG-7 DRILLING - PHASE 1 (700 ft)
NRG-7 DRILLING - PHASE 2 (745 ft)
SD-9 PAD CONSTRUCTION
SD-9 DRILLING PHASE 1 (1500 ft)
UZ-7 COMPLETION (INST/STEM)
UZ-14 COMPLETION (INST/STEM)
SD-9 DRILLING PHASE 2 (875 ft)
RAYTHEON SERVICES NEVADA
YMP SBT ACTIVITY SCHEDULE FY93-FY94
DRILL, TEST, COMPLETION & MONITORING
Revision 1

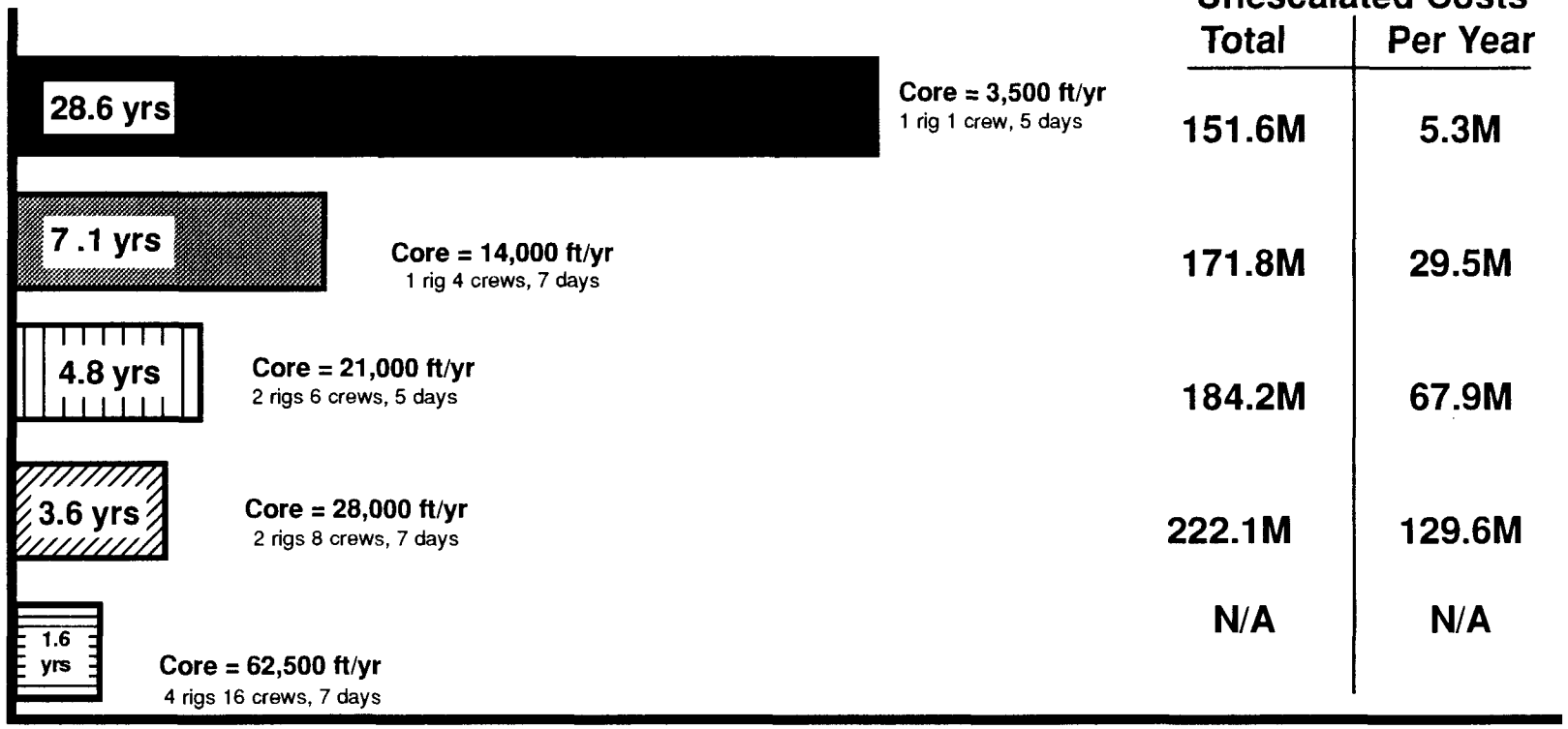

ACTIVITY DESCRIPTION
EARLY START
EARLY FINISH
REM DUR
FY93
FY94
FY95
FY96
MISCELLANEOUS
C-WELL COMPLEX 23SEP93 29OCT93 27
NYE COUNTY #1 T 3JAN94 3FEB94 22
C-WELL #2 TESTI 3FEB94 7MAR94 22
C-WELL #3 TESTI 12APR94 11MAY94 22
NYE COUNTY #2 T 12MAY94 31MAY94 13
C-WELL #4 TESTI 18JUL94 16AUG94 22
GEOPHYSICAL LOGGING
UZ-16 GEOPHYSIC 23JAN93A 13AUG93A 0
WT-7 GEOPHYSICA 4OCT93 11OCT93 6
NORTH RAMP BORE 4OCT93 5NOV93 25
UZ-14 GEOPHYSIC 6DEC93 31JAN94 40
SD-12 WATER TAB 5APR94 11APR94 5
NRG-7 GEOPHYSIC 12APR94 2MAY94 15
SD-12 GEOPHYSIC 3MAY94 14JUN94 30
SRG-4 GEOPHYSIC 26OCT94 8NOV94 10
SD-9 PHASE 1 GE 9NOV94 23NOV94 10
UZ-7a GEOPHYSIC 17JAN95 28FEB95 30
SRG-3 GEOPHYSIC 1MAR95 14MAR95 10
SRG-1 GEOPHYSIC 15MAR95 28MAR95 10
SD-9 WATER TAB 7FEB96 13FEB96 5
SD-9 PHASE 2 GE 29MAR95 11APR95 10
UZ-9 WATER TAB 7JUL95 13JUL95 5
UZ-9 GEOPHYSICA 25AUG95 10OCT95 36
ESF
DRILL/BLAST TES 23SEP93 28OCT93 23
HYDROCHEMISTRY 9NOV93 26JAN94 44
RADIAL BOREHOLE 2DEC93 1MAR94 64
START OF NORTH 28JUL94 0
BOW RIDGE FAULT 1NOV94 2
HYDROLOGIC PROP 1NOV94 7NOV94 3
APEX OF TURN TO 3JUL96 0
APEX OF SOUTH R 1JAN96 0
C-WELL COMPLEX PHASE
NYE COUNTY #1 TESTING
C-WELL #2 TESTING
C-WELL #3 TESTING
NYE COUNTY #2 TESTING
C-WELL #4 TESTING
UZ-16 GEOPHYSICAL LOGGING
WT-2 GEOPHYSICAL LOGGING
NORTH RAMP BOREHOLE GEOPHYSICAL LOGGING
UZ-14 GEOPHYSICAL LOGGING
SD-12 WATER TABLE GEO LOGGING
NRG-7 GEOPHYSICAL LOGGING
SD-12 GEOPHYSICAL LOGGING
SRG-4 GEOPHYSICAL LOGGING
SD-9 PHASE 1 GEO LOGGING
UZ-7a GEOPHYSICAL LOGGING
SRG-3 GEOPHYSICAL LOGGING
SRG-1 GEOPHYSICAL LOGGING
SD-9 WATER TABLE GEO. LOGGING
SD-9 PHASE 2 GEOPHYSICAL LOGGING
UZ-9 WATER TABLE GEO. LOGGING
UZ-9 GEOPHYSICAL LOGGING
DRILL/BLAST TESTING ALCOVE #1
HYDROCHEMISTRY TEST IMPLEMENTATION - ALCOVE #1
RADIAL BOREHOLE TEST IMPLEMENTATION - ALCOVE #1
START OF NORTH RAMP CONSTRUCTION - TBM
BOW RIDGE FAULT CONTACT - TBM
HYDROLOGIC PROP OF MAJOR FAULT - IMPLEMENTATION
APEX OF TURN TO MAIN TEST LEVEL - TBM
APEX OF SOUTH RAMP TURN - TBM
RAYTHEON SERVICES NEVADA
YMP SBT ACTIVITY SCHEDULE FY93-FY96
DRILL, TEST, COMPLETION & MONITORING
Revision 1

Overview

- Sampling-and-testing objectives
- LM-300 as a sampling-and-testing system
- YMP drilling development history
- Drilling progress from recent experience
- Research and development emphasis in FY94
- System utilization
- Geophysical logging
- FY94 drill, test, complete and monitor schedule
- Long term
- Specific questions/comments

LM-300 Schedule for 40 Deep Boreholes (SCP Plan)

(Based on UZ-14 Performance)



	Unescalated Costs	
	Total	Per Year
Core = 3,500 ft/yr, 1 rig 1 crew, 5 days	151.6M	5.3M
Core = 14,000 ft/yr, 1 rig 4 crews, 7 days	171.8M	29.5M
Core = 21,000 ft/yr, 2 rigs 6 crews, 5 days	184.2M	67.9M
Core = 28,000 ft/yr, 2 rigs 8 crews, 7 days	222.1M	129.6M
Core = 62,500 ft/yr, 4 rigs 16 crews, 7 days	N/A	N/A

* Basis

- 40 Deep holes @ 2,500 ft/hole = 100,000 ft core for program
- 1 crew can drill out 3,500 ft core/year assuming 250 working days, 5 days/week, 50 weeks at 14 ft/crew.

WBS Elements

(1) 1.2.3.5 Drilling
(2) 1.2.3 Site Investigation
(3) 1.2.7.3 FOC
1.2.13.2 Safety & Health
1.2.15.2 Administrative Support
(4) 1.2.7.8 NTS
1.2.9.2 Project Control
1.2.13.3 Environmental Compliance
1.2.15.3 Training

Assumptions

A. Incremental Crew Cost Increases as a result of Weekend Rates
B. Includes $250K/Yr/Crew for drilling consumables
C. Reflects increases due to concurrent work required with second LM-300
D. Includes 10,000K 1 time capital cost for additional LM-300

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Overview

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- Specific questions/comments

Specific Question/Comment #1
Large Diameter Holes versus Small Diameter Holes

Considerations

- **Preservation of *in situ* borehole wall conditions**
  - **Dual-wall reverse circulation in larger diameter holes**
- **Larger diameter holes required for borehole instrumentation packages**
- **Small-diameter holes are being used, where feasible**

Specific Question/Comment #2
Drilling/Testing Decision-Making Process

- **Work-Scope Consolidation**
  - SD-12 and MDG-2 requirements combined in one borehole
- **Borehole catalog incorporates results of drilling-consolidation workshop**
- **Organizations: DOE, M&O, and Participants**

Specific Question/Comment #3
Intermittent versus Continuous Core

- Tremendous need for core samples, especially in early part of program
- Drilling-consolidation workshop documented in borehole catalog (total program core requirement reduced 30,000-38,000 ft = 25-30%)
- Experience in Topopah (i.e., NRG-5)

Specific Question/Comment #4
Needs for Dry-Drilled Core

Considerations

- **Study Plans** 8.3.1.2.2.3 (Surface-Based)
  8.3.1.2.2.4 (ESF-Based)

  Major unsaturated-zone study plans dry core and uncontaminated wall

Specific Question/Comment #5
Contracting Options

- **REECo is the M&O for the DOE Nevada Test Site (YMP included) and is responsible for all drilling and construction**
- **For rapid ramp-up considerations, REECo can subcontract to fill drilling need, if they do not have an in-house capability**
  - **Provides capability for additional support for boreholes requiring LM-300-type drilling systems (most demanding requirements)**
  - **"Standard Drilling" requirements would be determined on an *ad hoc* basis (BIR 800 on JF-3)**

Specific Question/Comment #6
Borehole Testing from Within ESF

Considerations

- Size of openings 25' diameter, nominal
- Dry-drilling underground
  - Dust control
  - Ventilation system
  - All-electric power requirements
- Creation of direct pathways from repository level into primary barrier

10 CFR 60.15

Specific Question/Comment #7
New Core Tools Could Have Substantial Positive Impact on Core Production

Considerations

- Increased coring rate from 7.39 to 21.4 ft/hr from UZ-16 to UZ-14, which led to nearly doubling the shift rate from 9 ft/shift to 17 ft/shift
- Faster penetration with aggressive bits (PDCs) puts greater vibration on coring string
- Faster penetration may lead to more fishing time (4% at UZ-16 versus 12% at UZ-14)
- Coring is 10% time component in UZ-14

Specific Question/Comment #8
Emphasize Testing in ESF versus SBT

Considerations

- ESF is primarily directed to details of specific targets and to the lateral variability of key horizons, the proposed repository level, and the Calico Hills level
- SBT is a whole-block framework with emphasis on vertical and lateral spatial variability