MINUTES OF THE MAY 16, 1995
U. S. NUCLEAR REGULATORY COMMISSION/U.S. DEPARTMENT OF ENERGY
TECHNICAL MEETING ON THE EXPLORATORY STUDIES FACILITY

Staff from the U.S. Nuclear Regulatory Commission met with representatives of the U.S. Department of Energy (DOE) to discuss items of mutual interest regarding progress in tunnel boring for DOE's Exploratory Studies Facility (ESF) at Yucca Mountain, the drilling, testing and sampling program, the status of ESF and seismic design and the results of NRC's in-field verification. The meeting, held by videoconference between DOE facilities in Washington, D.C. and Las Vegas, Nevada, was convened at 12:00 PM EDT. Representatives of the State of Nevada (NV), Nye County, Clark County and the Nevada Nuclear Waste Task Force attended the meeting. Also in attendance were representatives of the DOE Civilian Radioactive Waste Management System Management and Operating Contractor, Weston, Los Alamos National Laboratory and Southwest Research Institute. Attachments 1 and 2 provide the attendance lists at the two videoconference locations. Attachment 3 is the meeting agenda.

DOE's representatives provided an update on ESF construction and described the geologic features encountered by the ESF north ramp. Attachment 4 provides details on progress of the tunnel boring machine (TBM). At the time of the meeting progress was slightly ahead of schedule and plans called for the TBM to advance an average of nine meters per day for five days a week. In answer to a question from NRC staff as to how close to the planned alignment the tunnel is, it was stated that the worst misalignment had occurred when excavation began and that planned tolerances have not been exceeded. DOE reported that ground conditions have been predominantly blocky-fractured rock conditions requiring heavy steel support. Low pressure grouting has proved to be successful in stabilizing blocky ground. Several recommended modifications to the TBM to improve its capability for negotiating fractured rock have been authorized. They include the ability to extend and retract the grippers larger distances and to cover exposed rock surfaces between grippers so as to shield workers from falling rock.

Next, DOE presented an update on the ESF drilling, testing, and sampling program (Attachment 5). The United States Geological Survey (USGS) was performing geohydrologic testing in Alcove No. 1 and planning for blast monitoring in Alcove No. 2, scheduled to be excavated in May 1995, was underway. Specific questions from NRC staff and the representative from Clark County were addressed. When it was stated that the test planning package for faulting had been released, NRC staff requested access to the package so as to learn about the kinds of tests for faulting that are planned. NRC also requested visibility of final design and blasting specifications through its on-site representatives. In response to a question, it was noted that the in-place strain gauges are being monitored. Rock mass quality evaluations are being done by Sandia National Laboratories. Core samples have been tested prior to drifting. In answer to the question of whether there will be blasting while the TBM is operating, it was stated that blasting and tunnel boring are being done on alternating shifts. In the discussion of surface-based testing, it was noted that the water level is about 6 feet below the expected depth. Borehole SD-12 will go down to the water-table. Boreholes UZ-4 and UZ-5 are ready for testing. Pneumatic instrumentation has been

monitored in boreholes NRG-6 and NRG-7a since December 1994 and Nye County has begun data collection in NRG-4 and ONC#1.

The following discussion was an overview of geologic information learned about the Yucca Mountain site as the TBM progressed (Attachment 6). Such geologic data has provided an opportunity to check data used for design. When geologic data collected from ESF construction was compared to data used for ESF design, it was noted that stratigraphic contacts in the tunnel are located nearly as predicted and rock mass quality data from boreholes compares well with data from scan line observations in the tunnel; but there appears to be a mismatch in one area of mapped faults with respect to the predicted locations. The imbricate fault zone was found as expected, but differed in some of the predicted details. The actual width, strike and dip of the fault zone and the number of faults are not yet known.

The status of ESF design was discussed next. Progress in design control resulting from recent design process reviews, including DOE's establishment of an independent checking group was described. There will be greater attention to detail and temporarily there will be additional reviews to assure compliance with quality assurance requirements. Attachment 7 provides an update of the status of ESF design and the design control process.

In response to a prior NRC request, DOE clarified the rationale for the seismic design values presented for underground permanent items and described the current seismic design basis for the ESF and how it was developed. Details of this presentation are given in Attachment 8.

Finally, NRC discussed the results from the In-field verification which took place April 3 to 5. The focus was design control and 2C corrective actions. The team report is complete and in concurrence, with issuance expected in 20 to 30 days.

In closing remarks, NRC noted that it continues to find these meetings useful in gathering information regarding the ESF and stated the need to find ways of looking at system issues together.

Pauline P. Brooks 8/10/95

Pauline P. Brooks
High-Level Waste & Uranium Recovery
Projects Branch
Division of Waste Management
Office of Nuclear Material Safety
and Safeguards
U.S. Nuclear Regulatory Commission

Christian E. Einberg 8/9/95

Christian E. Einberg
Regulatory Integration
Division
Office of Civilian Radioactive
Waste Management
U.S. Department of Energy

Attendance List
NRC/DOE Technical Meeting
Exploratory Studies Facility Design and Construction
May 16, 1995
Room 3E077, Forrestal Building
Washington, DC

Name	Organization	Telephone Number
Priscilla Burton	DOE	202 586-8365
Mark Delligatti	NRC/DWM	301 415-6620
Ram B. Murthy	DOE/RW 3.1	202-586-1239
Pauline Brooks	NRC/DWM	301 415-6604
Bakr Ibrahim	NRC/DWM	301 415-6651
Howard Mennuti	M&O/TRW	202-488-2305
Choon Quan	RW-37	202-586-2834
Prasanna Kumar	RW-46	202-586 8960
Mysore Nataraja	USNRC	301-415-6655
Michael Bell	USNRC/ENGB	301-415-7286
Arul Mozhi	Weston/RW-37	(202) 646-6748
John O. Thoma	NRC/DWM	301-415-7293
Sami Douara	Weston	202/646-6679
Alan Brown	DOE-RW-37	202 586-9362

Attachment 1

ATTENDANCE LIST

9th Floor Conference Room, Bank of America Center, Las Vegas, Nevada

DOE/NRC TECHNICAL MEETING
ON EXPLORATORY STUDIES FACILITY
MAY 16, 1995

PRINT NAME	ORGANIZATION	TITLE
Dan Dresser	Weston	Sr. Scientist
Rui Chen	SwRI	Research Engineer
Tom Rogers	M&O - WCFS	Sr. Geologist
Steve Frishman	State of NV	
ARCH GIRDLEY	DOE/AMSP	Testing Coordinator
Tim Sullivan	DOE/AMSD	Geology lead
WILLIAM Boyle	DOE	Phys. Scientist
Richard L. Craun	DOE	AMEFD
Chris Einberg	DOE	Reg. Int. Div.
Allen Segrest	M&O	[illegible]
Chad Glenn	NRC	On Site Representative
Bill BELKE	NRC	" " "
Carol Hanlon	DOE	Physical Scientist
Keith Lobo	PMO	M&OS support
MARK TYNAN	DOE/AMSP	Physical Scientist
Hemendra N. KALIA	Los Alamos	Project Leader
DICK McDONALD	M&O/CMD	CONST. MGR.
RICHARD QUITTMEYER	M&O	Site Investigations/Tech Anal
Tim Hawe	DOE AMSL	Physical Scientist

Attachment 2
Page 1 of 3

ATTENDANCE LIST

DOE/NRC TECHNICAL MEETING ON EXPLORATORY STUDIES FACILITY MAY 16, 1995

PRINT NAME	ORGANIZATION	TITLE
E.V. TIEBENHAUSEN	CLARK COUNTY	ENG. SPEC.
M.R. MURPHY	NYE COUNTY	Reg. Licensing
Jim GRUBB	STATE OF NV	ENGINEER
Judy Treichel	NV NWTF	Ex. Dir.
APRIL GIL	DOE/AMSL	Geologist
Ralph Wrsich	PNL-O	

ATTENDANCE LIST

DOE/NRC TECHNICAL MEETING ON EXPLORATORY STUDIES FACILITY MAY 16, 1995

PRINT NAME	ORGANIZATION	TITLE
PAT HAMMOND	M&O - RPC	SR. ENGINEER

DOE-NRC TECHNICAL MEETING AGENDA
EXPLORATORY STUDIES FACILITY DESIGN AND CONSTRUCTION
VIDEOCONFERENCE
Bank of America Center, 9th Floor Conference Room, Las Vegas, Nevada
Forrestal Building, Room 3E077, Washington, DC
May 16, 1995

9:00 PDT (Noon EDT)	Opening Remarks	DOE, NRC, NV, AUG
9:15 PDT (12:15 EDT)	ESF Construction Update	McDonald
9:45 PDT (12:45 EDT)	Drilling, Testing, and Sampling Program Update	Girdley
10:15 PDT (1:15 EDT)	Geologic Features Encountered by the TBM	Sullivan
10:45 PDT (1:45 EDT)	ESF Design Status - Design Progress Update - Design Control Process	Segrest
11:15 PDT (2:15 EDT)	Break	
11:30 PDT (2:30 EDT)	ESF Seismic Design - Source and Rationale for Design Values - Use in ESF Design	Quittmeyer
12:00 PDT (3:00 EDT)	Results from the April 3-6 In-field Verification	NRC
12:30 PDT (3:30 EDT)	Closing Remarks and Discussion	DOE, NRC, NV, AUG
1:00 PDT (4:00 EDT)	Adjourn	

YUCCA MOUNTAIN PROJECT

Studies

DOE-NRC Technical Meeting

ESF Construction Update

Presented by:
Dick McDonald
Construction Manager
M&O / M-K

May 16, 1995

U.S. Department of Energy
Office of Civilian Radioactive
Waste Management

Attachment 1

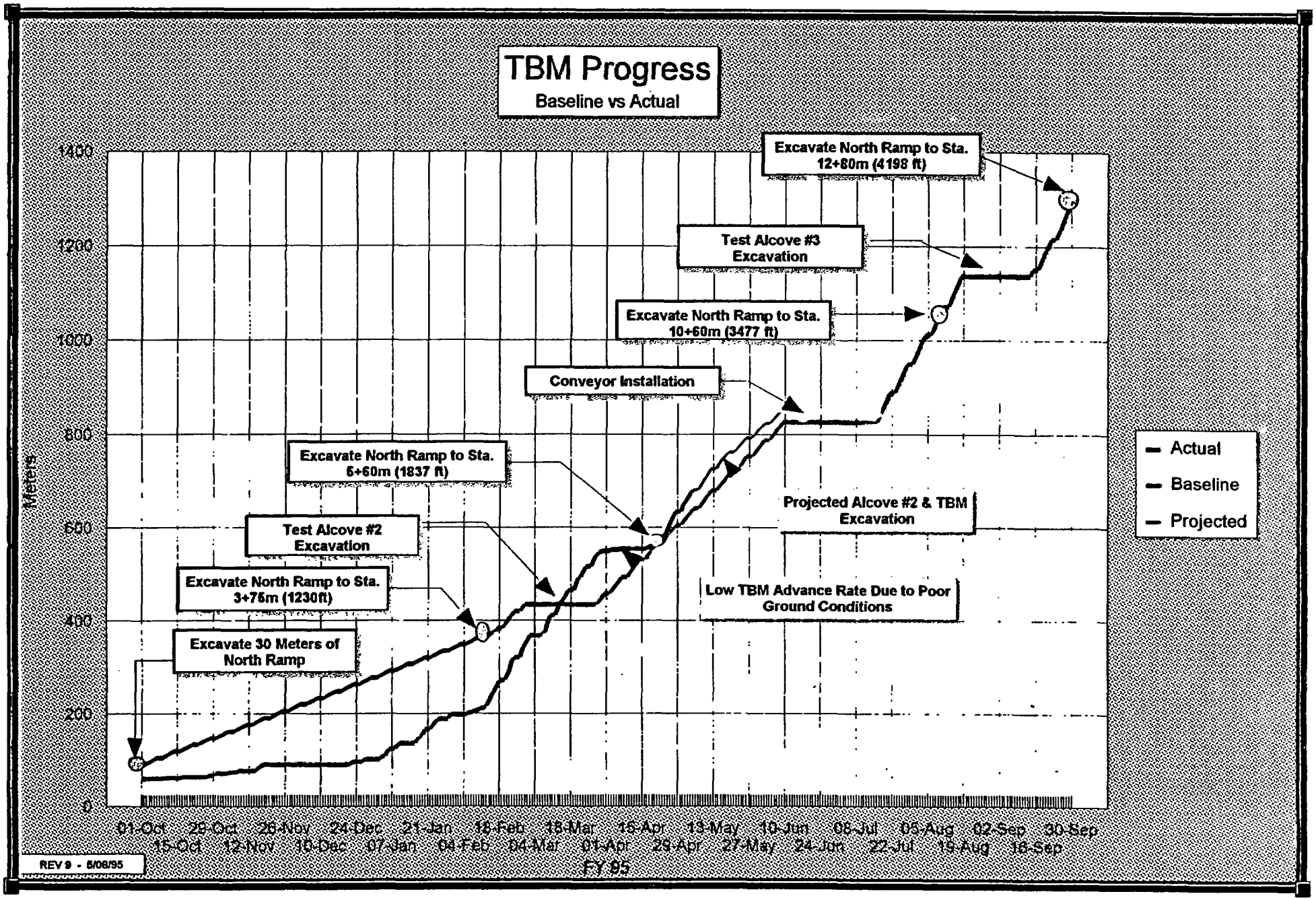
Construction Update

- **Underground work status**
  - The head of the TBM is at _____on___/___/___ at_____ AM. Average advance to date 9.75 M/Day
  - Current planning projects TBM to be at 12+80 meters by the end of FY95
  - Successfully negotiated several uncemented fractures in a zone at approx. 5+30>5+50 with controlled application of low pressure grout
  - Our planned rate of advance is estimated at approx. 9 meters per day (5 days/week, 3 shifts/day) using muck car haulage
  - Underground conveyor now under construction, expect initial use mid to late July
  - California switch installed and operational
  - Alcove #2 excavation to start this week

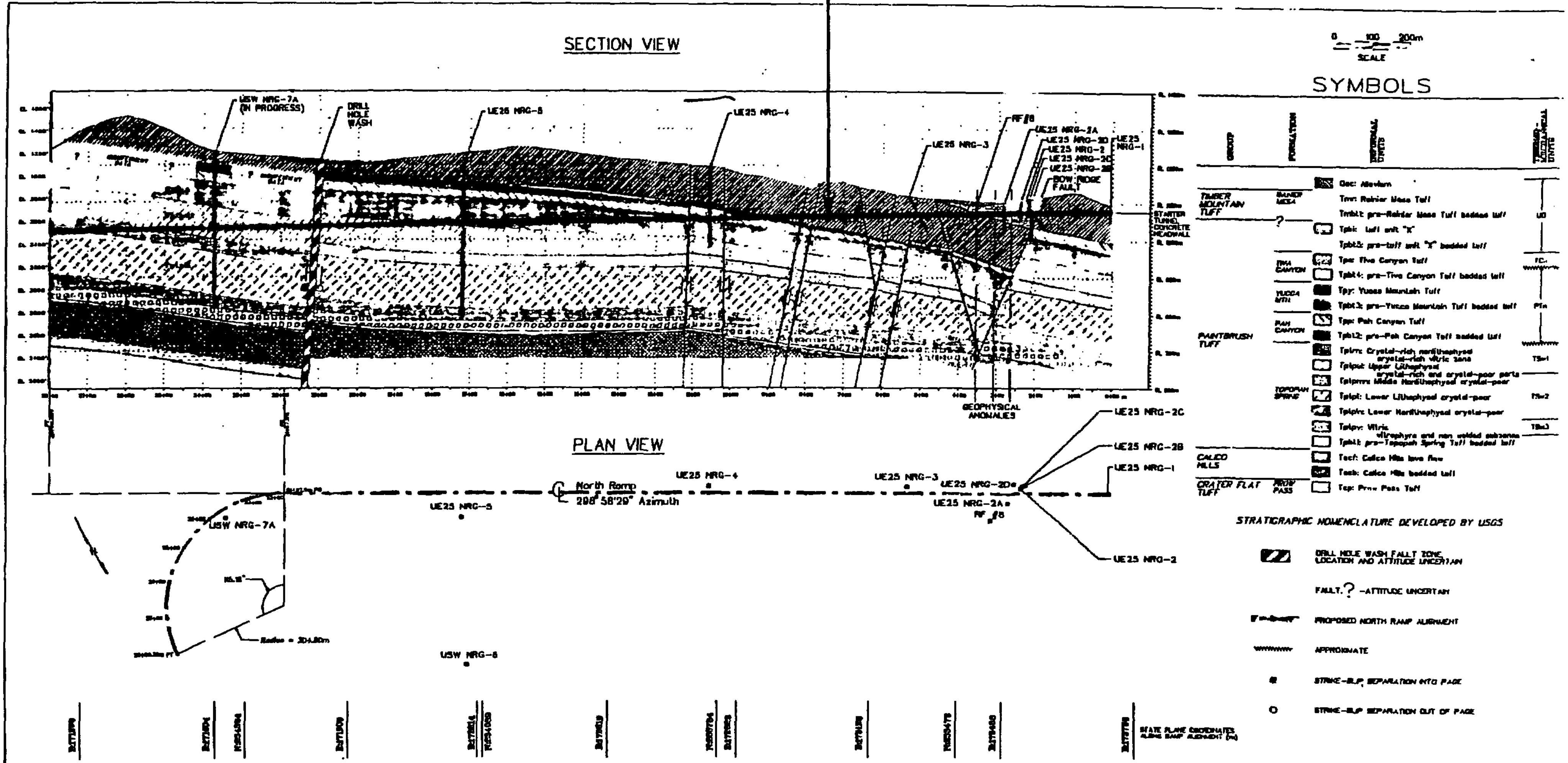
Construction Update

(Continued)

- Surface Work Status
  - Surface conveyor earthwork underway
  - Conveyor foundations on pad complete and structural steel being erected
  - Muck storage area topsoil removal underway
  - Water lines and water tanks in place at booster pump station. Need to complete booster pumps and tank tie in
  - Water tanks on Exile Hill under construction
  - Change house utilities and floor slab complete
  - Switch Gear Building nearly complete


TBM Progress
Baseline vs Actual
Excavate North Ramp to Sta. 12+80m (4198 ft)
Test Alcove #3 Excavation
Excavate North Ramp to Sta. 10+60m (3477 ft)
Conveyor Installation
Excavate North Ramp to Sta. 6+60m (1837 ft)
Projected Alcove #2 & TBM Excavation
Test Alcove #2 Excavation
Excavate North Ramp to Sta. 3+75m (1230ft)
Low TBM Advance Rate Due to Poor Ground Conditions
Excavate 30 Meters of North Ramp
Meters
1400
1200
1000
800
600
400
200
0
Actual
Baseline
Projected
01-Oct 29-Oct 26-Nov 24-Dec 21-Jan 18-Feb 18-Mar 15-Apr 13-May 10-Jun 08-Jul 05-Aug 02-Sep 30-Sep
15-Oct 12-Nov 10-Dec 07-Jan 04-Feb 04-Mar 01-Apr 29-Apr 27-May 24-Jun 22-Jul 19-Aug 16-Sep
FY 95
REV 9 - 5/08/95

Approx. Location of TBM on __/__/__ at _______



PRELIMINARY RAMP DATA
QA:NQ

Station (m)	Grade	State Plane Coord. (m) Northing	State Plane Coord. (m) Easting	Elevation (m)
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]		[illegible]	[illegible]	[illegible]
[illegible]		[illegible]	[illegible]	[illegible]
[illegible]		[illegible]	[illegible]	[illegible]
[illegible]		[illegible]	[illegible]	[illegible]
[illegible]		[illegible]	[illegible]	[illegible]
[illegible]		[illegible]	[illegible]	[illegible]
27+00		[illegible]	[illegible]	[illegible]
[illegible] (PT)		[illegible]	[illegible]	[illegible]

BOREHOLE PROJECTIONS
QA:QA

Borehole	Projection to Section along Azimuth	Ground Elevation (m)	Distance to Section (m)
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

REVISIONS

QA:QA

ESF NORTH RAMP
YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT
CROSS SECTION ALONG RAMP FROM 0+00 to 28+00.38m (PT)

Sandia National Laboratories

PRELIMINARY PREDECISIONAL DRAFT

Alcove #2 Construction Sequence

- Originally planned four weeks of down time for the TBM for excavation of Alcove #2 and installation of portions of the underground conveyor
- Originally planned another four weeks of down time for the TBM for excavation of Alcoves #3 & 4
- By working one shift of combined alcove excavation and TBM maintenance and two shifts of TBM excavation per day, the TBM advance rate is only slightly reduced during Alcove excavation instead of stopped for a matter of weeks
- Current thinking projects a TBM net delay of approx. ten days for alcove excavation (for #2, 3 &4) and conveyor installation instead of the original eight weeks delay by using this sequence

Lessons Learned

- Low pressure grout can be effectively used to enhance the TBM's ability to negotiate uncemented fractured rock. A program was developed and implemented which was agreed to by the regulatory and scientific staff of the project

Lessons Learned

(Continued)

- **A study was initiated to determine if modifications to the TBM could be made to enhance it's capability to negotiate fractured rock. The contractor has been authorized to make five modifications:**
  - **Modification of the gripper cylinder stroke to allow wider range of movement**
  - **Mechanically movable flaps are being installed to allow the gap between the top and side grippers to be closed when required**
  - **Provisions which allow the bottom gripper to engage by interacting with the side grippers, independent of the top gripper**
  - **Providing the necessary hydraulics and special shoe to allow supplementary thrust to be safely generated by pushing off of the invert segments**
  - **Modify gripper hydraulics to improve regripping cycle time**

Lessons Learned

(Continued)

- Other ideas still being studied include:
  - Improvements to the inching motor
  - Head reversing capability
  - Adjustable/removable bucket covers
  - Improved conveyor belt clearance
  - Reduction of gap behind cutterhead
  - Redesign of drill deck

Construction Progress Pictures

YUCCA MOUNTAIN PROJECT

Studies

DOE-NRC Technical Meeting

Drilling, Testing, and Sampling Program Update

Presented by:
W. Arch Girdley
Team Leader for Field Test Coordination
Yucca Mountain Site Characterization Office

May 16, 1995

U.S. Department of Energy
Office of Civilian Radioactive
Waste Management

Attachment 5

ESF Test Activities Summary Accomplishments and Near Term Objectives

Geohydrology (Permeability) Tests in Alcove #1

- Second phase hydrochemistry testing at variable depth in all three holes completed September, 1994
- TBM shutdown for mapping gantry installation resulted in 12-week delay in initiation of field preparation for cross-hole radial borehole testing (packers in all 3 holes) (from mid-November to mid-February, 1995)
- Cross-hole testing has been initiated
  - Holes were logged and clean-out completed during March, 1995
  - New compressor/air purifier was installed in alcove
  - Packer assemblies inserted during April
  - Cross-hole pressure testing was initiated during week of April 24

Construction Monitoring Activities

- Rock mass quality evaluations for ESF design verification were initiated February 23, 1995 and are ongoing
- Began instrumentation (strain gages and convergence pins) on 10% of placed steel sets on January 23, 1995. A total of 25 sets have been instrumented to date
  - Data submittals to A/E were initiated in late January and are ongoing
- Instrumented rock bolt and Multi-Point Borehole Extensometer (MPBX) installations in TBM main have been initiated
  - Single-Point Borehole Extensometer (SPBX) and MPBX installations began during April, 1995 (Station 4+12)
- Planning for blast monitoring (Alcove #2) underway
  - Blast and ground support (steel set) monitoring instrumentation is being set up for early May blasting initiation

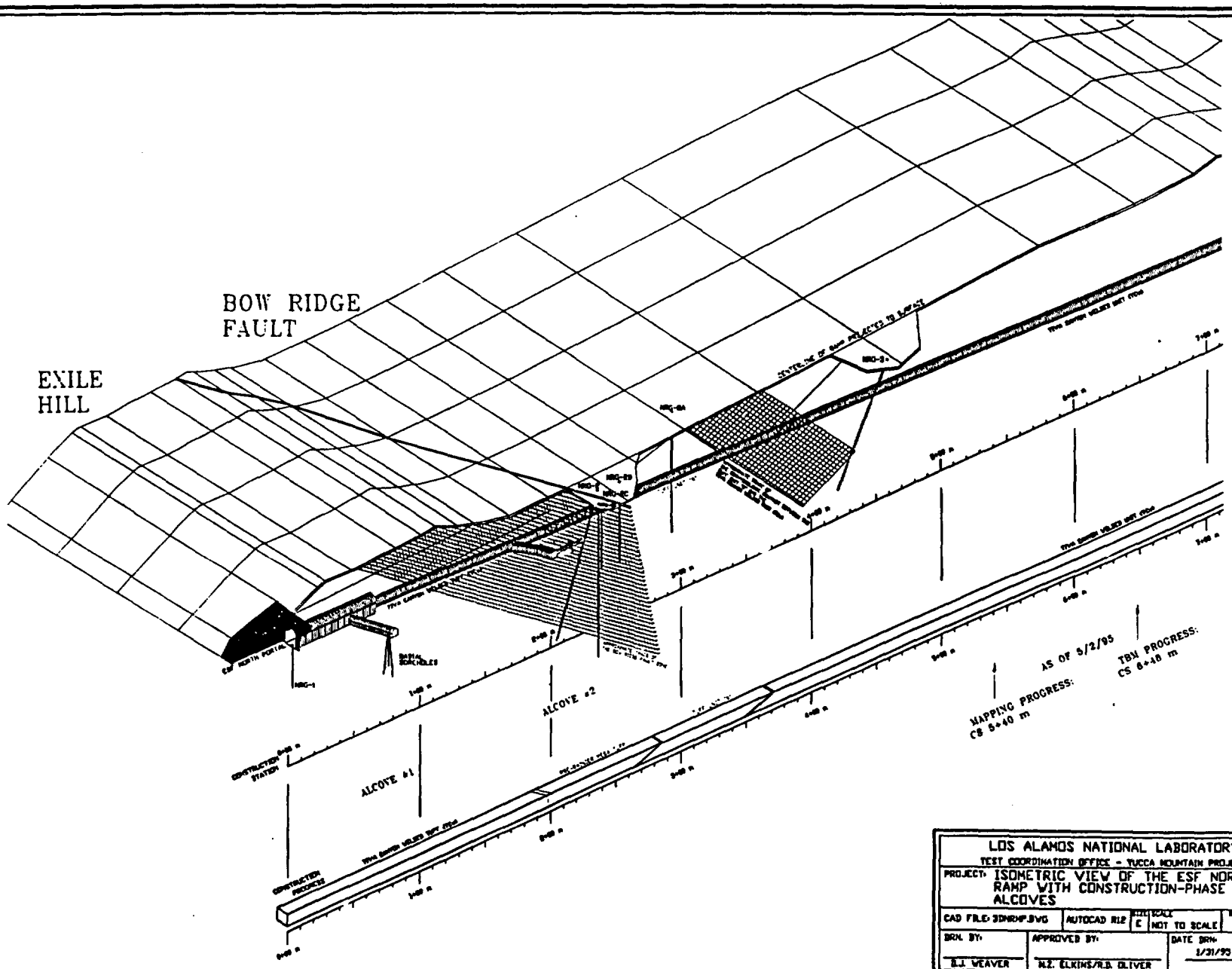
Other ESF Testing Activities

- Mapping of TBM opening using mapping platform/gantry began in January (TBM at construction station 01+45M)
- As of April 25, 1995, mapping has advanced (photogrammetry, full peripheral mapping, detailed line survey) complete through Station 5+00M
- As of April 25, 1995, 356 formal samples for site characterization Principal Investigators (PIs) have been catalogued and collected in the ESF
- Diesel emissions/exhaust ventilation test was successfully conducted on April 29, 1995 (1 day test, 3 replications)

Other ESF Testing Activities

(Continued)

- Formal test planning and preparation for following ESF tests is underway:
  - Intact fracture (ESF UZ percolation) (July/August 1995 start)
  - Contact radial boreholes (Tiva/Paintbrush non-welded and Paintbrush/Topopah Spring) (August 1995)
- Excavation for Alcove #2 (Bow Ridge Fault) scheduled for early May, 1995
  - Final alcove location established in early March (Alcove centerline at 1+72M)
  - Final design and blasting specifications were completed mid-April and released to constructor
  - Test Planning Package (TPP)/Job Package (JP) for fault testing completed and released for controlled distribution
  - Drilling/installation of test instrumentation planned May-June, 1995



LOS ALAMOS NATIONAL LABORATORY			
TEST COORDINATION OFFICE - YUCCA MOUNTAIN PROJECT			
PROJECT: ISOMETRIC VIEW OF THE ESF NORTH RAMP WITH CONSTRUCTION-PHASE ALCOVES			
CAD FILE: 3DNRMP.DWG	AUTOCAD R12	SIZE: E	SCALE: NOT TO SCALE
			REVISION: A3
DRN. BY: B.J. WEAVER	APPROVED BY: M.Z. ELKINS/R.D. OLIVER		DATE DRN: 1/31/95
NOTES: ADMINISTRATIVE/ILLUSTRATIVE USE ONLY			PLOT DATE:

Large Block Test

Under JP 93-10: Site preparation (Phase 1)

- Conduct demonstration saw cuts — 9/3/93
- Blast and excavate top of block flat — 10/28/93
- Drill and core vertical instrumentation holes in block — 12/17/93
- Make five (5) cuts with large saws to isolate block — 4/1/94

Large Block Test

(Continued)

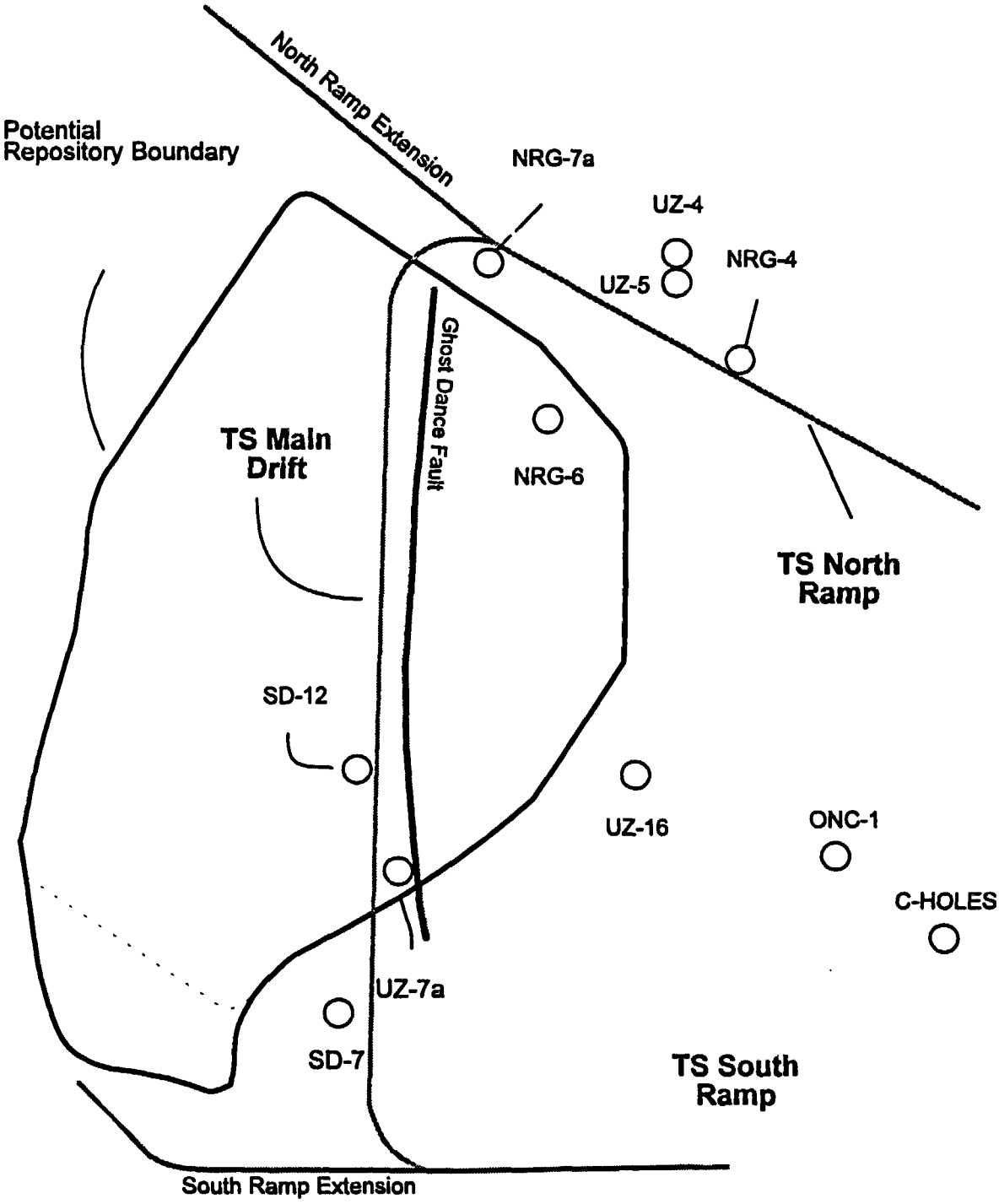
Under JP 93-10A: Test construction (Phase 2)

• Install vertical compression system	5/3/94
• Excavate rock around block to cutting height	5/17/94
• Cut the top of the block	5/18/94
• Remove large (1 cubic meter) sample	8/15/94
• Map Large Block volume	10/7/94
• Start drilling horizontal instrument/heater holes	3/20/95

Under JP 94-23: near-term (FY95/early FY96) objectives

• Begin instrumentation of the block	11/1/95
• Start Large Block Test	1/30/96

SBT Borehole Activities
May 1995



LYOTRD7.CDR.124/5-16-95

Drilling

Borehole SD-7

- Drilling temporarily suspended March 7, 1995 after encountering saturated condition at depth of 1600 feet
- USGS completed drawdown tests, assuming a 'perched water' condition
- Last reported water-level measurement ~ 1580.5 ft; first measured at 1574 ft
- Plan to extend drilling into regional water table (2850 ft) at a future date

Drilling
(Continued)

Borehole SD-12 (Splitwash)

- USGS still conducting air permeability testing of upper 1400 ft of borehole
- Plan to resume drilling in June to planned total depth of 2300 ft
- USGS will instrument hole for long-term monitoring

Drilling
(Continued)

Borehole UZ-7a (Ghost Dance Fault)

- Initiated drilling March 23, 1995
- Current coring depth _____ ft
- Planned depth is 750 ft
- USGS will conduct air permeability tests and install instruments to collect UZ data

Drilling
(Continued)

Borehole UZ-4, UZ-5 (Pagany Wash)

- Hole UZ-5 reamed and deepened to 400 ft to penetrate below Topopah Spring vitric caprock
- Reaming of UZ-4 in progress
- Air permeability testing and instrumentation to collect UZ data will follow in both holes

Borehole Testing

C-Holes

- Present status: C-Hole pad work is currently being completed to facilitate the long term testing program
- Testing of the pumping system is anticipated to begin the week of May 15 for open hole testing at a rate of up to 450 gpm

Borehole Testing

(Continued)

- NRG-6 and NRG-7a
  - USGS continues to monitor pneumatic instrumentation
- NRG-4 and ONC#1
  - Nye County completed installation of Westbay instrument arrays and initiated data collection using data loggers

Trenching Activities

- Crater Flat Fault
  - Trenches completed at four sites
  - Mapping in progress
- Rock Valley Fault System
  - Mapping in progress at two sites
  - Two existing trenches to be deepened in June

Trenching Activities
(Continued)

- Ghost Dance Fault
  - Additional trench (GDF-T5) being planned
  - Existing trench GDF-T4 to be deepened and test pit GDF-T3a to be added by July 95
- Bare Mountain Fault
  - Five test pits and one trench to be started in June
- Lathrop Wells Cone
  - Additional test pits completed by Los Alamos

Geophysics

- Borehole surveys
  - ONC#1 logged
- Surface surveys
  - Repository gravity, magnetics, and reflection seismic surveys are complete
  - Repository electromagnetic surveys to be complete in May
  - Additional reflection seismic gravity and magnetics surveys planned to begin in June for repository area
  - Seismic surveys are planned for Rock Valley in June

YUCCA MOUNTAIN PROJECT

Studies

DOE-NRC Technical Meeting

Geologic Features Encountered by the TBM

Presented by:
Tim Sullivan
Geology Team Leader, AMSP
Yucca Mountain Site Characterization Office

May 16, 1995

U.S. Department of Energy
Office of Civilian Radioactive
Waste Management

Attachment 6

Geology Data for ESF Design

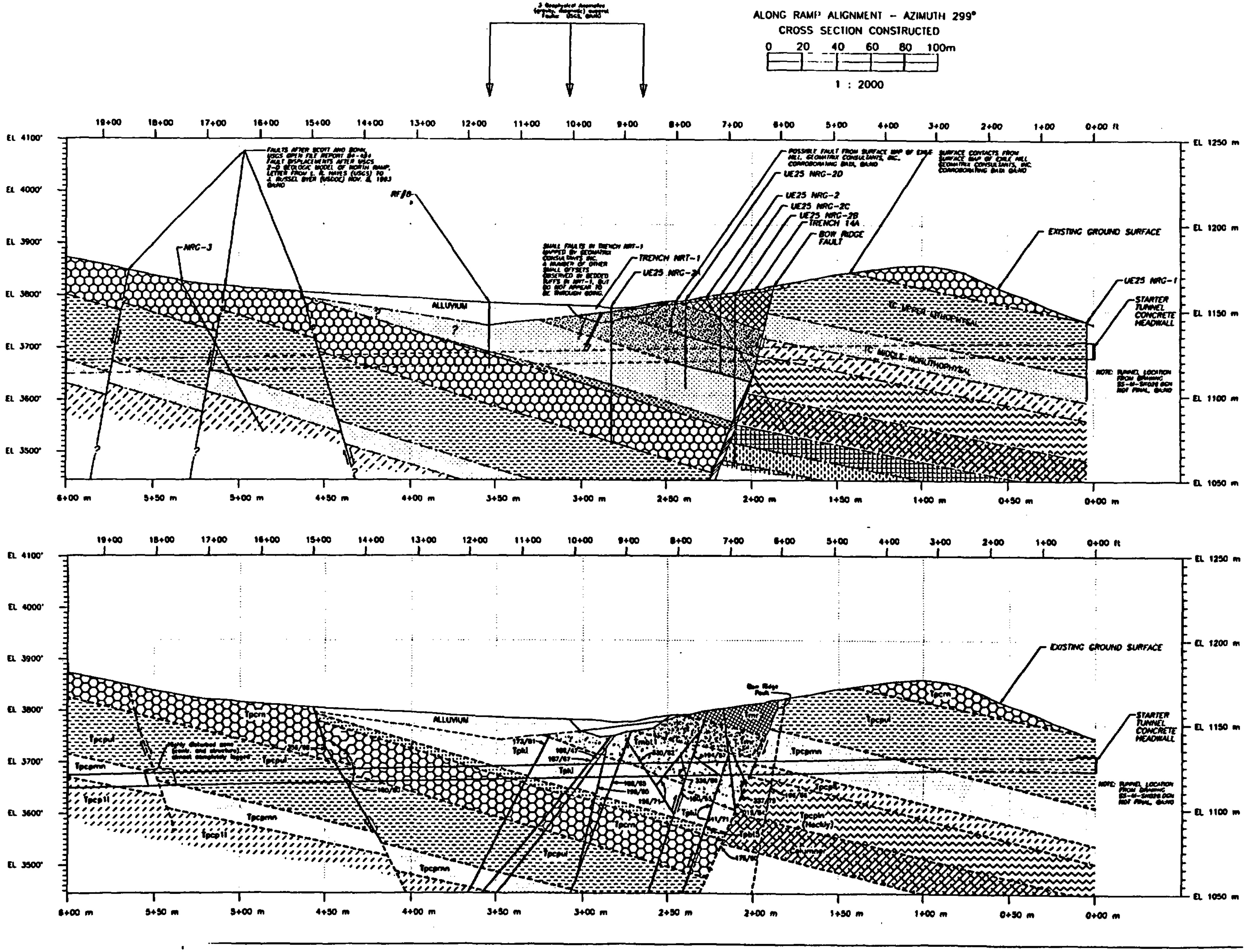
- Study Plan 8.3.1.14.2 *Soil and Rock Properties of Potential Locations of Surface and Subsurface Facilities* - SNL
- North Ramp geotechnical report SAND-95-0488/1 includes cross sections, geologic data, geotechnical data developed by SNL with support from USGS and M&O Design Team
- Main drift geotechnical report - May 1995
- South Ramp geotechnical report - FY 1996

Geologic Data From ESF

- ESF mapping - detailed tunnel map to 5 + 00 will be available in June 95
- Construction monitoring - Rock Mass Quality data provided to designer and constructor as tunnel is constructed

What Have We Learned

- Geology - mapped faults are located in the tunnel as predicted to station 5 + 00; between 5 + 00 and 6 + 00 there is an apparent mismatch
- Geology - stratigraphic contacts are located in the tunnel nearly as predicted
- Rock Quality - Rock Mass Quality data from north ramp boreholes compares well with Rock Mass Quality data from scan line observations in the tunnel


ALONG RAMP ALIGNMENT - AZIMUTH 299°
CROSS SECTION CONSTRUCTED
0 20 40 60 80 100m
1 : 2000
19+00 18+00 17+00 16+00 15+00 14+00 13+00 12+00 11+00 10+00 9+00 8+00 7+00 6+00 5+00 4+00 3+00 2+00 1+00 0+00 ft
EL 4100'
EL 4000'
EL 3900'
EL 3800'
EL 3700'
EL 3600'
EL 3500'
EL 1250 m
EL 1200 m
EL 1150 m
EL 1100 m
EL 1050 m
6+00 m 5+50 m 5+00 m 4+50 m 4+00 m 3+50 m 3+00 m 2+50 m 2+00 m 1+50 m 1+00 m 0+50 m 0+00 m
NRC-3
RF#8
ALLUVIUM
TRENCH NRT-1
UE25 NRG-3
UE25 NRG-2D
UE25 NRG-2
UE25 NRG-2C
UE25 NRG-2B
TRENCH 14A
BOW RIDGE FAULT
EXISTING GROUND SURFACE
UE25 NRG-1
STARTER TUNNEL CONCRETE HEADWALL
Tc UPPER LITHOPHYSAL
Tc MIDDLE NONLITHOPHYSAL
Tpcrn
Tpcpul
Tpcpmn
Tpcpll
Tpkl
Tmbt
Tpcpln (Hackly)
Tpbt3
Tpcpv
Columnar

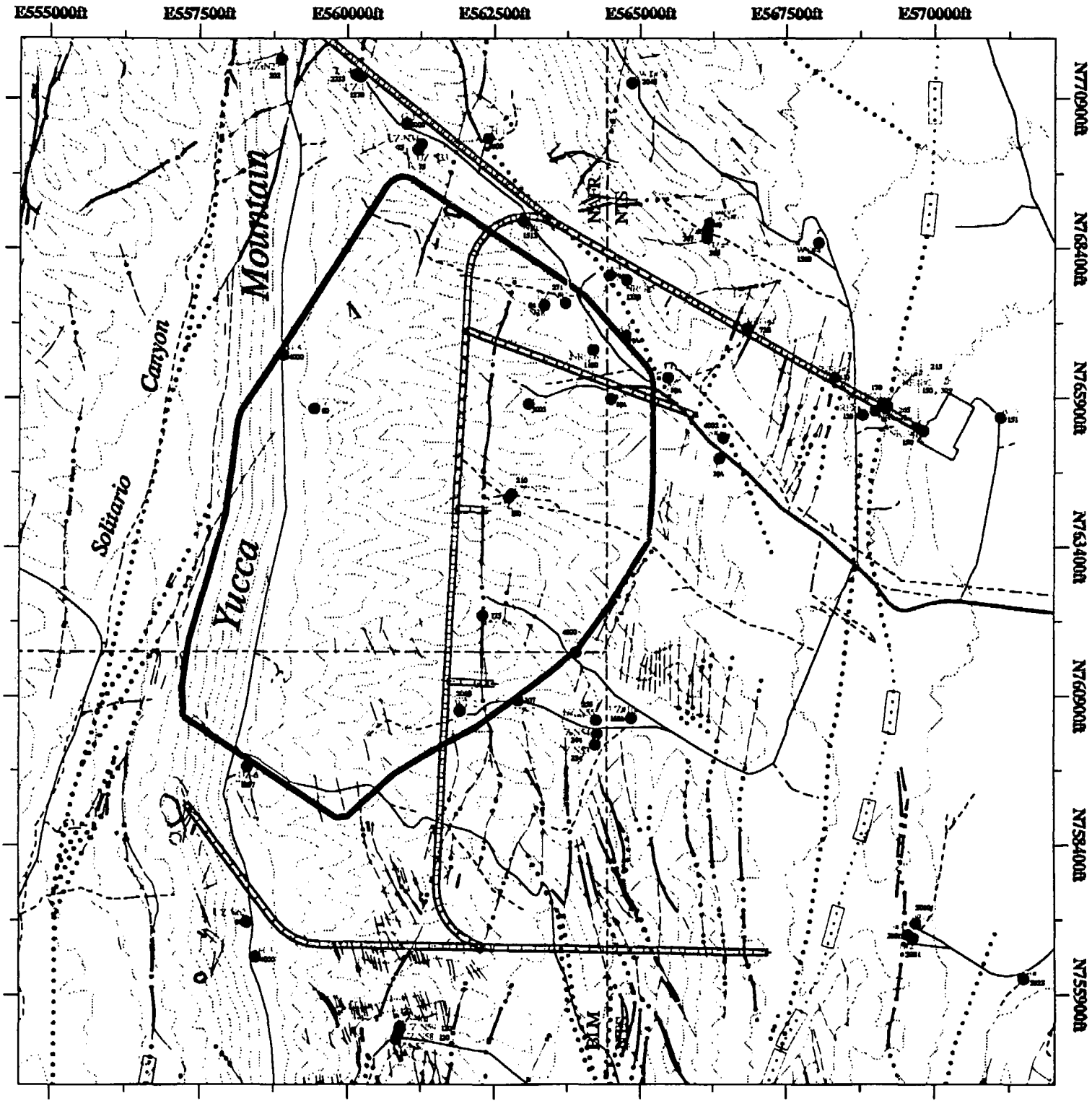
Imbricate Fault Zone

- Zone(s) of closely spaced faults in eastern part of structural blocks in the Yucca Mountain area - Scott (1990) GSA Memoir 176

- Western edge of an imbricate fault zone forms the eastern margin of the repository lower block

YUCCA MOUNTAIN
SITE CHARACTERIZATION PROJECT

EXISTING BOREHOLES
with GEOLOGIC STRUCTURE



YMP-95-319.0

YUCCA MOUNTAIN
SITE CHARACTERIZATION PROJECT

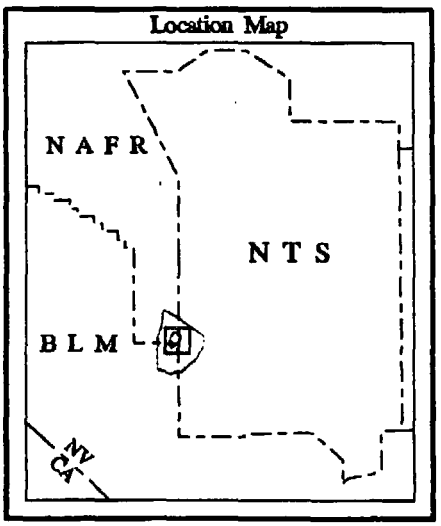
EXISTING BOREHOLES
with GEOLOGIC STRUCTURE

- Existing Borehole with Depth (feet)
- Fault
- Faults That Cut Alluvium
- Inferred Fault
- Inferred Fault Cutting Alluvium
- Concealed Fault
- Aeromagnetic Fault
- Scarp
- Potential Repository Outline
- Conceptual Controlled Area Boundary
- ESF Ramps
- Two-Lane Paved
- Unpaved, Improved Road
- Trail
- North Portal

1000 0 1000 2000 3000 4000 5000 6000 FEET

1000 0 1000 2000 METERS

Contour Interval 100 Feet



Borehole information processed by EG&G/EM from the Distribution of Lithostratigraphic Units Within Central Block of Yucca Mountain, Nevada, USGS, August 1994.

Potential Repository Outline processed by EG&G/EM from Title I Design Summary Report for the Exploratory Studies Facility.

Yucca Mountain Faults processed by EG&G/EM from USGS Open-File Report 84-494 Preliminary geologic map of Yucca Mountain with sections, Nye County, Nevada.

Topographic contours obtained from 1:6,000 scale orthophotographic mission.

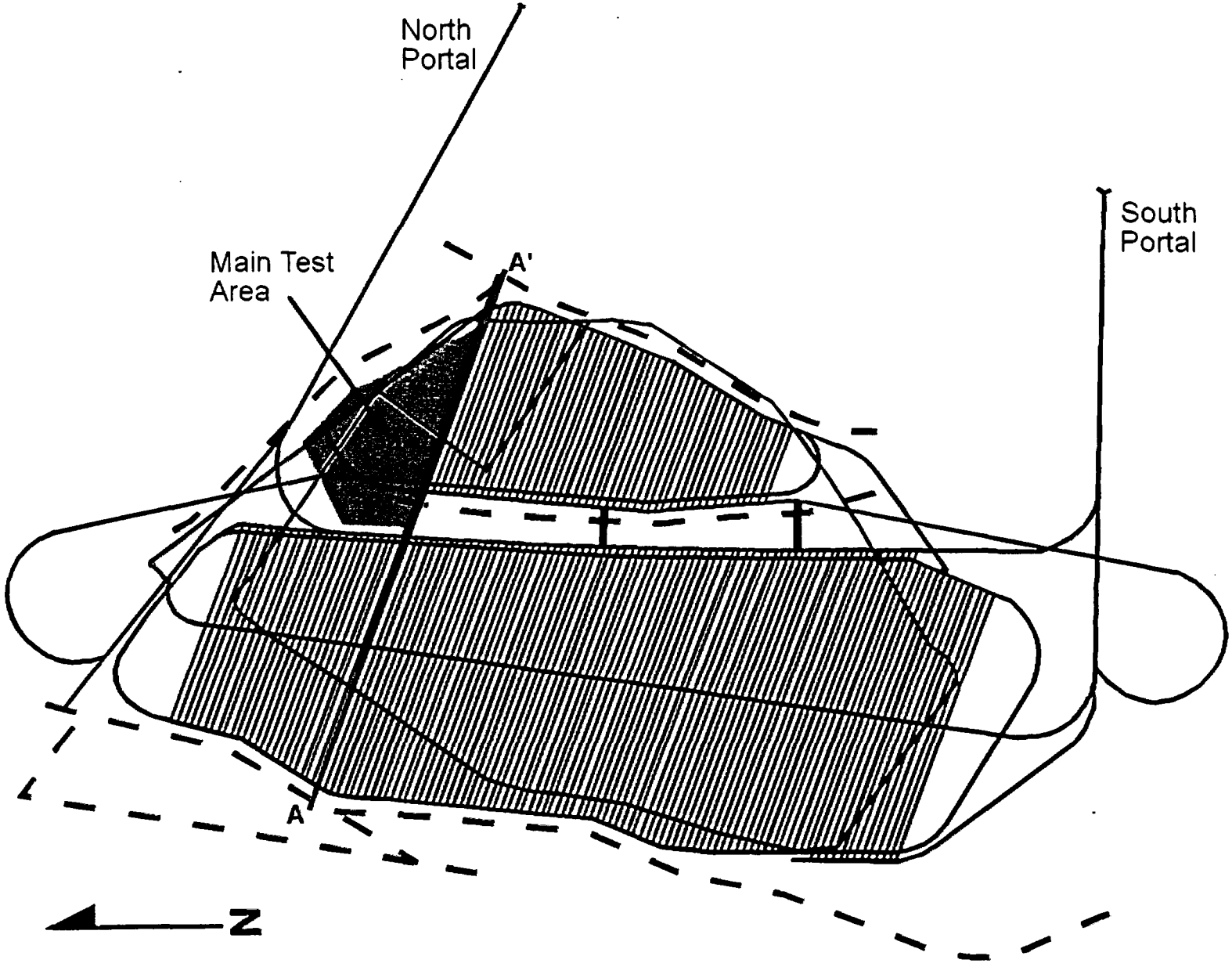
Road features obtained from 1:6,000 scale orthophoto mission. Photo interpretation completed by EG&G/EM 1991.

Projection is Transverse Mercator with coordinates based on Nevada State Plane Coordinate System, Central Zone.

Map compiled May 8, 1995 by DOE Remote Sensing Laboratory operated by EG&G/EM..

PRELIMINARY - INFORMATION ONLY: YAP-SIII.3Q, Section 5.2.2 states that, "The data provided herein have not received complete technical and quality checks and, therefore, are considered to be preliminary. These data are for information only and cannot be used for licensing activities.."

Adjusted Primary Area



Faulting - Observations to 6 + 00

- Faulting with small offset (<5m) between 5 + 00 and 6 + 00 have wide zones of disruption (may be as much as 20m) in densely welded tuff
- Bow Ridge fault (offset >100m) has limited zone of disruption (<5m)

Fracturing - Observations to 5 + 50

- Densely welded tuffs most fractured, especially Tiva upper lithophysal unit
- Moderately welded tuff less fractured - Tiva caprock
- Nonlithified tuffs least fractured (Pre-Rainier Mesa Tuffs)

YUCCA MOUNTAIN PROJECT

Studies

DOE-NRC Technical Meeting

ESF Design Status

Presented by:
Alden M. Segrest
Manager, MGDS Development
CRWMS Management and Operations Contractor

May 16, 1995

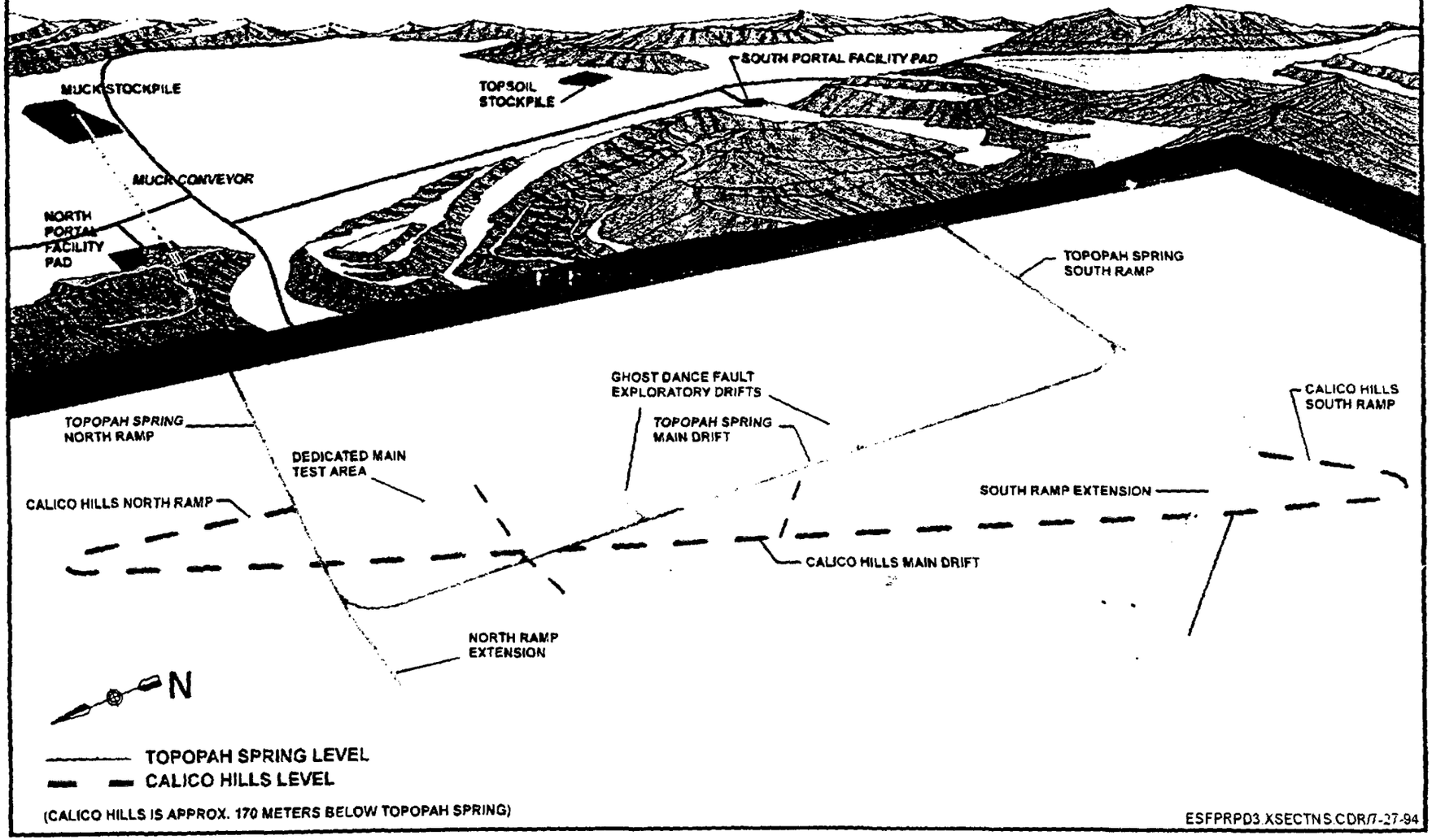
U.S. Department of Energy
Office of Civilian Radioactive
Waste Management

Attachment 7

Scope

- Design Progress Update
- Design Control Process Update

Exploratory Studies Facility Design



Design Progress Update

- **ESF Design Packages**
  - 1A. Site preparation and starter tunnel of North Ramp
  - 1B. Surface facilities at North Portal
  - 1C. Surface utilities at North Portal
  - 1D. Surface facilities & foundations at North Portal
  - 1E. Surface facilities at North Portal
  - 2A. North Ramp from starter tunnel to Topopah Spring Level (TSL), analyses & early procurement
  - 2B. North Ramp from starter tunnel to TSL, analyses & early procurement
  - 2C. North Ramp from starter tunnel to TSL, specifications & drawings

Design Progress Update

(Continued)

- **ESF Design Packages**
  - 3A. Site preparation and partial portal of South Ramp
  - 3B. Surface facilities at South Portal
  - 4. South Ramp from portal to TSL
  - 5. North Ramp from Calico Hills (CH) turnout to CH level
  - 6. South Ramp from CH turnout to CH level
  - 7. Full length drift at the CH level
  - 8A. Main Drift at TSL
  - 8B. North Ramp extension drift
  - 9. Main Test Level core area
  - 10. Shaft at north end - Surface to Main Test Level

Design Progress Update

- North Portal Auxiliary Power Generators (1E)
  - Reviews of design products include external organizations
  - External review began May 15, 1995
  - Scheduled for release to Constructor July 19, 1995

Design Progress Update

- Integrated Data & Control System
  - Procurement currently underway by the M&O
  - Temporary installation for collecting construction monitoring data planned for July, 1995
  - Revision 01 to specification in process to provide requirements for tests to be fielded during next quarter

Design Progress Update

- Subsurface Drill and Blast Specification
  - Revision 01 baselined April 14, 1995
- Bow Ridge Fault Test Alcove
  - Drawings baselined April 21, 1995

Design Progress Update

- Alternative Utility Construction Approach
  - Construction utilities used during excavation
    - » Designed and installed by the constructor
    - » Design reviewed and approved by the A/E
  - Health and safety standards enforced by M&O Construction Management Operation (CMO)
  - This constructor was authorized to proceed with this approach March 13, 1995

Design Progress Update

- ESF Main Drift Design (8A)
  - Maximize reuse of North Ramp (2C) products
  - Complete Geotech, Mining and Structural Analyses revisions to support 25' TBM excavations to the South Portal (8A and 4)
  - Issue for construction Plan & Profile Drawings to support tunnel excavations to approximately station 50+00 (8A)
  - Issue for construction Ground Support and other Standard Drawings and Specifications to support tunnel excavations to South Portal (8A + 4)
  - Issue for construction Plan & Profile Drawings to excavate Ghost Dance drifts

Status of Improvements Being Made to the Design Control Process

Design Control Process

- *Overall Problem*
  Lack of attention to details

- *Impact*
  Design documentation was not in compliance with QA procedure requirements

- *Lessons Learned*
  Culture shift emphasizing attention to details in all areas must be achieved

  Additional reviews are required to assure QA compliance in the short term; these will be lifted when process is functioning properly

  Past actions were not effective

Design Control Process

- ***Lessons Learned*** *(continued)*
  Root cause analysis preliminary results identify the following as issues:
  - **Inadequate management support for training**
  - **Lack of training database**
  - **Checking process not adequate**
  - **No process for identifying and correcting problems which are not CAR conditions**
  - **Management expectations not communicated**
  - **Lack of successful follow-through**
  - **Time pressure**

Design Control Process

- *Problem*
  Errors not found due to inadequate checking
- *Impact*
  CAR YM-94-065 was written identifying errors which should have been found during checking
- *Lessons Applied*
  An independent checking group was established 1/02/95 for the purpose of checking all design products

Checking Group progress:

- Checking Group accomplishments have completed the remedial action specified in CAR YM-94-065

Design Control Process

- ***Lessons Applied*** *(continued)*
  Checking Group progress (continued):
  - Continue checking for technical adequacy and procedural compliance of all design products
    - » 13 Q products
    - » 58 non-Q products
  - Looking for trends and inconsistencies, communicating results and instructions back to designers and supervisors

Design Control Process

- ***Lessons Applied*** *(continued)*
  Checking Group progress (continued):
  - **MGDS Design Guidelines Manual development**
    - » **Draft document received commendation from NRC during In-Field Verification**
    - » **Includes new Checking Procedure**
    - » **Plan to issue May 17, 1995**

Design Control Process

- ***Problem***
  Design control procedures difficult to use
- ***Impact***
  Verbatim compliance with QA requirements not accomplished
- ***Lessons Applied***
  Developing new procedure for impact reviews

  Developing procedures for preparation of non-Q design products

  Developing new procedure for engineering calculations

  Continuing to improve procedures for specifications and drawings

Design Control Process

- *Problem*
  Design analyses prepared in parallel with drawings and specifications

- *Impact*
  Some specifications and drawings did not address all requirements contained in the analyses

- *Lessons Applied*
  Design process and schedule modified to add more separation between preparation of analyses and preparation of drawings and specifications

  DIEs are reviewed at an external review earlier in the process

Design Control Process

- *Problem*
  Unrealistic schedules for completion of work

- *Impact*
  Sufficient time for check and review of products not always allowed

- *Lessons Applied*
  Culture shift emphasizes quality as highest priority with schedule important but secondary

  Schedules for preparing and checking products must be realistic and carefully planned

  Continuing to streamline the review and issue processes to relieve schedule pressures which impact checking and approval

Design Control Process

- *Problem*
  Errors in BFD - difficulties in capturing all inputs and preparing accurate traceability matrices.. BFD is a very difficult document to develop and revise
- *Impact*
  Flowdown of requirements to design could not be demonstrated in some cases and document was prone to errors
- *Lessons Applied*
  Simplify process for documenting basis for design

Design Control Process

- ***Lessons Applied*** *(continued)*

  Near Term Simplification

  - **Developed Requirements Allocation Analyses for allocating and tracing design inputs**
  - **Used Inputs Lists for each drawing and specification**

Design Control Process

- ***Lessons Applied*** *(continued)*

  Long Term Simplification

  - **Established a Document Development Team* to revise the ESF Design Requirements (ESFDR) Document**
    - » **The revised ESFDR will assign applicable requirements to the appropriate CI**
    - » **More clearly identify 10CFR60 requirements**
    - » **Identify which CIs are Q vs. non-Q**
    - » **ESFDR revision scheduled to be submitted for review in September, 1995**

* **Document Development Team consists of representatives from System Requirements, ESF & Repository Design, DIE, Regulatory & Licensing and Site Characterization**

Design Control Process

- *Problem*
  Insufficient awareness of importance of QA and adherence to QA requirements
- *Impact*
  Documentation not completed correctly
- *Lessons Applied*
  All training of design control QAPs performed by classroom briefing

  Reviewing existing QA training program

Design Control Process

- *Problem*
  Inconsistency in content and format of design products between disciplines

- *Impact*
  No impact on the technical adequacy of the design

- *Lessons Applied*
  Reorganization combined ESF Surface and Subsurface design organizations under a single line manager

  Repository design reorganized in the same manner

  Design Process Guidelines Manual includes guidance for development of design products to ensure consistency

Design Control Process

- NRC In-Field Verification
  - April 3 - 6, 1995
  - Commendation received regarding the MGDS Design Guidelines Manual
  - Recommendations regarding ESF design
    - » Expand numerical modeling of rock bolts
      - ◆ Swellex added to analysis
      - ◆ Modeling of combinations in different ground conditions
      - ◆ Analysis currently in checking
    - » Evaluate quality classification of inverts

YUCCA
MOUNTAIN
PROJECT

Studies

DOE-NRC Technical Meeting

ESF Seismic Design Basis - An Update

Presented by:
Richard C. Quittmeyer
Manager, Site Investigations Technical Analysis
CRWMS M&O, Woodward & Clyde Federal Services

May 16, 1995

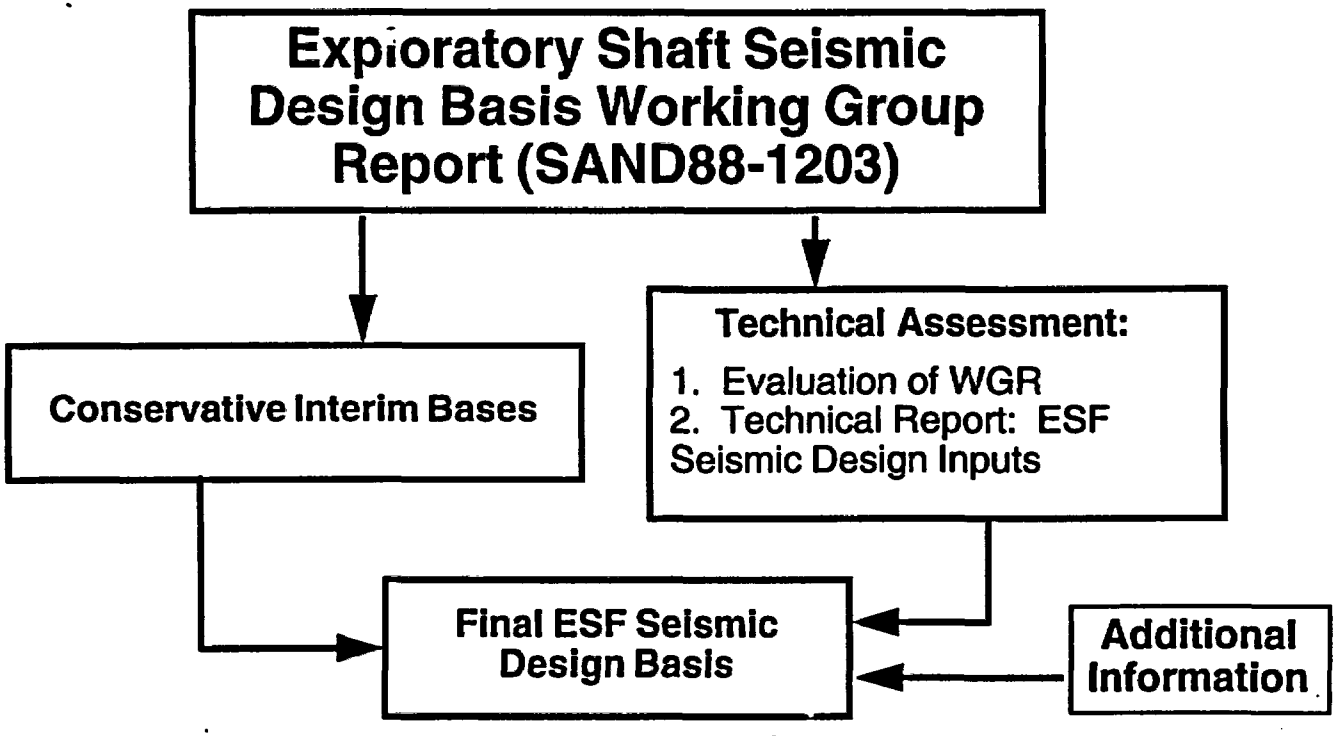
U.S. Department of Energy
Office of Civilian Radioactive
Waste Management

Attachment 8

Scope of Presentation

- Evolution of Seismic Design Basis for ESF
  - Focus of this presentation:
    - » Technical Assessment - Development of recommended ESF seismic design inputs
    - » Current ESF Seismic Design Basis
  - Covered in previous Technical Exchanges:
    - » Exploratory Shaft Seismic Design Basis Working Group Report (SAND88-1203)
    - » Interim Bases
    - » Technical Assessment of SAND88-1203 - Evaluation of Working Group Report

Evolution of ESF Seismic Design



Summary of Past Presentations

- **Working Group Report**
  - Based on available information in the late 1980's, recommended a seismic design basis for an Exploratory Shaft Facility
- **Interim Bases**
  - Recognized need to assess the recommendation of the Working Group Report based on the new ESF configuration and a growing geologic and tectonic knowledge base
  - Initiated a Technical Assessment
  - Established an interim seismic design basis for the ESF, pending results of the Technical Assessment

Summary of Past Presentations

(Continued)

- Technical Assessment
  - Recommendations of the Working Group Report needed to be updated
  - Initiated an effort to develop new recommendations for ESF seismic design inputs

ESF Seismic Design Inputs Report

- Approach
  - Use philosophy of "performance-goal based design"
  - Carry out a probabilistic seismic hazard assessment using available data
  - Examine depth reduction of ground motion using available data

Performance Goal-Based Design

- Graded approach
- Items are classified according to performance categories based on the adverse consequences of their failure
  - Extension of philosophy used in nuclear power reactor design
  - Concept similar to "importance factor" of the Uniform Building Code
- Performance goals and seismic design criteria are associated with each category

Performance Goal-Based Design

(Continued)

- Higher categories
  - Greater adverse consequences of failure
  - More stringent design criteria
  - Lower target annual probabilities of failure
- Goal is risk consistent design
  - Risk = Likelihood of Occurrence x Adverse Consequences
  - If adverse consequences are greater, reduce risk by reducing probability of failure (performance goal)

Performance Goal-Based Design

(Continued)

- Hazard for design
  - Defined in terms of annual probability with which hazard (e.g., peak ground acceleration) will be exceeded (P_H)
  - Depends on:
    - » Performance goal - Annual probability with which failure should not be exceeded (P_F)
    - » Risk reduction (R_R) afforded by seismic design criteria
  - $P_H = R_R \times P_G$

Performance Goal-Based Design

(Continued)

- Five performance categories (DOE STD-1021)
  - PC-0: Not important for safety, mission, or cost effectiveness
  - PC-1: Human occupancy, worker safety, cost-effective to design
  - PC-2: Safety function in a low hazard safety system, used for large gatherings
  - PC-3: Safety function in a moderate hazard safety system
  - PC-4: Safety function in a high hazard safety system

ESF Seismic Design Inputs Report

- Rev 0 issued on April 1994
- Recommendations
  - Design loading should be based on ground motion with a 90% probability of not being exceeded in 50 years:
    - » Mean peak ground acceleration of 0.2 g
    - » Design earthquake determined from deaggregating hazard: Magnitude 5.7 at a distance of 9 km
    - » Response spectrum and peak horizontal velocity (12 cm/sec) determined consistent with design earthquake
  - Depth reduction factors should be used based on the site-specific analysis
  - Near-surface fault displacement need not be considered in ESF design

Current ESF Seismic Design Basis

- Graded Approach
- Consideration of Additional Information
- Added Conservatism

Current ESF Seismic Design Basis

(Continued)

- **Classification of ESF Items**
  - **Temporary items**
    - » **Mission: Worker safety, no hazard safety function**
    - » **Performance Category 1**
  - **Permanent items**
    - » **Mission: Potential for moderate hazard safety function**
    - » **Performance Category 3**

- **Note: A Topical Report - Seismic Design Methodology for a Geologic Repository at Yucca Mountain - will provide method for classification of repository SSCs.**

Current ESF Seismic Design Basis

(Continued)

- **Design Basis for Temporary Items**
  - **Information considered**
    - » **Recommendations in Seismic Design Inputs for the ESF at Yucca Mountain (0.2 g)**
    - » **DOE STD 1020 (Appendix C) - specifies use of UBC Zone 3 seismic design values for PC-1 items at NTS**
    - » **DOE Standards developed for surface facilities**
  - **Conservative selection of mean peak horizontal ground acceleration design value of 0.3g (UBC Zone 3)**
  - **Recommended response spectrum scaled to 0.3 g**
  - **Recommended depth reduction factors may be used for underground design**

Current ESF Seismic Design Basis

(Continued)

- Design Basis for Permanent Items
  - Information considered
    - » Seismic Design Inputs report gives 0.37 g for annual exceedance probability of 5×10^{-4}
    - » DOE Standards developed for surface facilities
  - Conservative selection for design of mean peak ground acceleration of 0.4 g
  - Recommended depth reduction factors may be used for underground design

Summary

- ESF seismic design basis has evolved as new data and analyses became available
- ESF seismic design basis is consistent with its mission as a testing facility
- If any ESF components are incorporated in a geologic repository, they will be made consistent with the repository seismic design basis
- ESF seismic design basis is conservative with respect to a site-specific analysis