See Packet 1 for encl.

w/o enclosures

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JOBunting
MKnapp
MNataraja
REBrowning
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AUG 7 1984

TRIP/REPORT/84/07/31/MEMO

MEMORANDUM FOR: Seth Coplan
Repository Projects Branch, WM

FROM: John T. Greeves, Section Chief
Piyush K. Dutta
Naiem Tanious
Engineering Branch, WM

SUBJECT: NNWSI ROCKMECHANICS/DESIGN DATA REVIEW AND SITE VISIT

During July 17-20, 1984, we visited the Nevada test site and conducted a data review at the Sandia National Laboratories at Albuquerque, New Mexico. The attached report describes details of this visit, lists the attendees who participated in the data review, and presents the details on data either gathered or requested during the visit. We feel that the data review visit was productive because we could visit the test location, observe the test set-up and instrumentation, and examine raw data. Sandia National Laboratory has agreed to provide raw data as soon as they are cleared through their review procedures.

After we receive the requested data and related documents, we will review and analyse the data, and convey NRC concerns, if any, to DOE.

ORIGINAL SIGNED BY

John Greeves, Section Chief
Engineering Branch, WM

ORIGINAL SIGNED BY

Piyush Dutta
Engineering Branch, WM

ORIGINAL SIGNED BY

Naiem Tanious
Engineering Branch, WM

WM Record File 102.
WM Project 11
Docket No.
PDR ✓
LPDR ✓

Distribution:

(Return to WM, 623-SS)

Enclosures: As stated

8408220324 840807
PDR WASTE
WM-11 PDR

NV8480 69

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NAME	PKDutta/cj	NTanious	JGreeves				
DATE	84/08/6	84/08/6	84/08/6				

346
343

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After we receive the requested data and related documents, we will review and analyse the data, and convey NRC concerns, if any, to DOE.

John Greeves, Chief
Engineering Branch, WM

Piyush Dutta
Engineering Branch, WM

Naiem Tanious
Engineering Branch, WM

Enclosures: As stated

OFC	WMEG PKD	WMEG NST	WMEG				
NAME	PKDutta/cj	NTanious	JGreeves				
DATE	84/08/3	84/08/3	84/08/				

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After we receive the requested data and related documents, the following three steps of the data review process will be conducted:

1. Convey our preliminary observations to DOE.
2. Review and analyse the data.
3. Convey NRC concerns, if any, to DOE.

John Greeves, Chief
Engineering Branch, WM

Piyush Dutta
Engineering Branch, WM

Naiem Tanious
Engineering Branch, WM

Enclosures: As stated

OFC	WMEG PKD	WMEG NST	WMEG				
NAME	PKDutta/cj	NTanious	JGreeves				
DATE	84/08/02	84/08/	84/08/				

TRIP REPORT
ROCKMECHANICS/DESIGN DATA REVIEW MEETING
NEVADA TEST SITE (JULY 17) AND
SANDIA NATIONAL LABORATORIES (JULY 18-20)

1. Background

The purpose of the NRC visit to the NNWSI site at Nevada and the Sandia National Laboratories (SNL) at Albuquerque was to obtain and review test data relevant to NRC's evaluation of NNWSI's draft Environmental Assessment (EA) document and site characterization activities. The nature of the data review is stated clearly in NRC's (Seth M. Coplan's) letter to Dr. Donald L. Vieth of DOE dated June 7, 1984. The data review during the visit consisted mainly of independent evaluations by NRC of selected raw data and selected data analysis files. The visit was augmented by an examination of drill hole cores, visit of the proposed repository site at the Yucca Mountain and field tests at the G-Tunnel. It was distinctly not the purpose of this visit for NRC to hold any substantive discussions with DOE/SANDIA regarding NRC's official position related to the conduct and merit of any facet of DOE's rockmechanics/design related site characterization programs.

The NRC rockmechanics/design team present for the visit were:

1. John T. Greeves (WMEG, NRC)
2. Piyush K. Dutta (WMEG, NRC)
3. Naiem S. Tanious (WMEG, NRC)
4. Jaak Daemen (Univ. of Arizona)
5. Swapan Bhattacharya (Engineers International)
6. Mark C. Christianson (Itasca Consulting Group)
7. Lindsey Mundell (US Bureau of Mines)
8. Ed Hollop (US Bureau of Mines)
9. Thomas J. Schmitt (US NRC-RES)

Other NRC members present during the data review were:

1. Newton K. Stablein (WMRP-NRC)
2. Clayton L. Pittiglio (WMRP-NRC)
3. Jonathan Cutler (WMGT-NRC)
4. Paul T. Prestholt (Sr. OLR-NNWSI)
5. Susan G. Bilhorn (Jr. OLR-NNWSI)

Carl Johnson from state of Nevada was also present.

Names of participants from DOE/NNWSI are shown in the list of attendees, see attachment 1.

2. Site Visit:

On July 17, the site visit was conducted in Nevada. The G-Tunnel, Yucca Mountain and the Core Library were included in the visit.

2.1 G-Tunnel visit:

Following a short presentation (see copies of viewgraph - attachment #2) of the experiments the NRC team visited the following test and experiment sites inside the G-Tunnel:

1. Rockmechanics drift
2. Heated Block Alcove
3. Small Diameter Heater Alcove #2
4. Extensometer Drift
5. Small Diameter Heater Alcove #1
6. Instrumentation Alcove
7. Experiment Drift

2.2 Yucca Mountain visit:

The NRC team visited the top of the Yucca Mountain, to observe the regional layout of the anticipated repository. The repository 'block' is bounded on all sides by geologic features (faults). The NRC team also visited the site of the proposed surface facilities and the exploratory shaft.

2.3 USGS Core Library:

The USGS Core Library at Mercury was visited by the NRC team. 47 core boxes, identified by the NRC team before the visit were laid out for holes USW G-1, USW G-2, USW G-3, USW G-4 and UE-25A #1. Stratigraphical and structural logs were provided for holes USW G-1 and USW G-2 and hydrological test data for UE-25b #1. The lack of logs for USWG-3 and G-4 severely hampered interpretation of photographs from cores of these holes. Highly variable and intensive fracturing was observed in the Topopah Spring member of the geologic formation.

3. Data Review

The data review was conducted on July 18-20, at Sandia National Laboratories as per the schedule attached (see attachment #3). The data review session was preceded by a short introductory remarks by K. Stablein of NRC and a presentation by T. O. Hunter and J. R. Tillerson of Sandia (see attachment #4). Facilities for core handling, storage and rockmechanics testing laboratory were visited by the NRC team. The areas of data identified for review and the NRC lead person in each area are given below:

1)	Mechanical Properties of Rock:	Piyush K. Dutta
2)	Rock Classification:	Piyush K. Dutta
3)	Thermal Properties:	Naiem Tanious
4)	Bulk Properties:	Naiem Tanious
5)	Seismic Data:	Tom Schmitt
6)	G-Tunnel Rock Characteristics:	Jaak Daemen
7)	Small Diameter Heater Test:	Jaak Daemen
8)	Heated Block Test:	Jaak Daemen
9)	Sealing Test Data:	Jaak Daemen

Sample data in each area were identified and reviewed (see attachment #5). Copies of a number of documents and data identified during the data review were requested but were not made available for NRC pending review and approval by SNL. A list of these documents is attached (see attachment #6).

In summary, the data review and follow-up analyses will help determine data reliability for licensing. Data reliability is dependent on both technical accuracy and adequacy of documentation. The on-site data review is the first step in this process. In general we tried to achieve the following objectives:

1. Become familiar with the data available.

2. Understand how it was obtained and documented.

3. Identify and obtain selective data for independent analysis.

4. Training of staff and consultants, i.e., profit from doing.

The site visit and review of the data at SNL have fulfilled most of the above objectives. These objectives will be totally fulfilled if the DOE/SANDIA follow-up on sending the requested data/documents to NRC for independent analysis and evaluation at an early date.

ATTACHMENT 1

NRC DESIGN DATA REVIEW ATTENDANCE LIST
July 18, 1984

Name	Affiliation
NRC Participants:	
John Greeves	NRC - FTS 427-4734
Piyush Dutta	NRC - FTS 427-4742
Naiem Tanious	NRC - FTS 427-4736
Newton King Stablein	NRC - FTS 427-4611
Jonathan Cutler	NRC - FTS 427-4597
Clayton L. Pittiglio, Jr.	NRC - FTS 427-4793
Paul T. Prestholt	NRC - FTS 598-6125
Susan G. Bilhorn	NRC - FTS 427-4682
Tom Schmitt	NRC/RES FTS 427-4318
Swapan Bhattacharya	Engineers International, Inc. (Consultant to NRC) (312)-963-3460
Edward E.Hollop	Bureau of Mines - DOI, FTS 776-0739
R. Lindsay Mundell	Bureau of Mines - DOI, FTS 776-0741
Jaak J. Daemen	University of Arizona
Mark Christianson	ITASCA Consulting Group Inc., Mpls.MM (612)944-7114
State of Nevada:	
Carl Johnson	State of NV - (702-885-3744)
NNWSI Participants:	
Jerry S. Szymanski	DOE-NV FTS 575-1030
Joe Tillerson	SNL - Geotechnical Project FTS 844-5575
Leo Scully	SNL - Repository Design FTS 844-1849
Brenda Langkopf	SNL - Repository Perform. Assess. FTS 844-8777
Barry Schwartz	SNL - Geotechnical Project FTS 846-8268
Fran Nimick	SNL - Geotechnical Project FTS 844-6696
Ronald H. Price	SNL - Geomechanics FTS 844-8980
William A. Olsson	SNL - Geomechanics FTS 844-7344
Edward W. Shepherd	SNL - Investigations Project FTS 846-0184
Thomas O. Hunter	SNL - Depart. Mgr.-Investigations Proj. FTS 844-9160
Judy A. Geitgey	SNL - Librarian FTS 844-3044
Joe A. Fernandez	SNL - Geotechnical Project FTS 844-2365
Roger Zimmerman	SNL - Geotechnical Project FTS 846-0187
Luke Vortman	SNL - Ground Motion & Seismic FTS 844-7563
Hugh MacDougall	SNL - Repository Design, FTS 844-3133
Mike A. Glora	SAI-LV FTS 575-1463
Mike L. Wilson	SAI-LV 702-732-3320
Weston Participant:	
Hank Bermanis	Weston (301-963-6821)

See folder for memo to Captain Fr. Greeves
8-7-84
102

ATTACHMENT 2

G-TUNNEL UNDERGROUND FACILITY
FIELD EXPERIMENTS IN TUFF

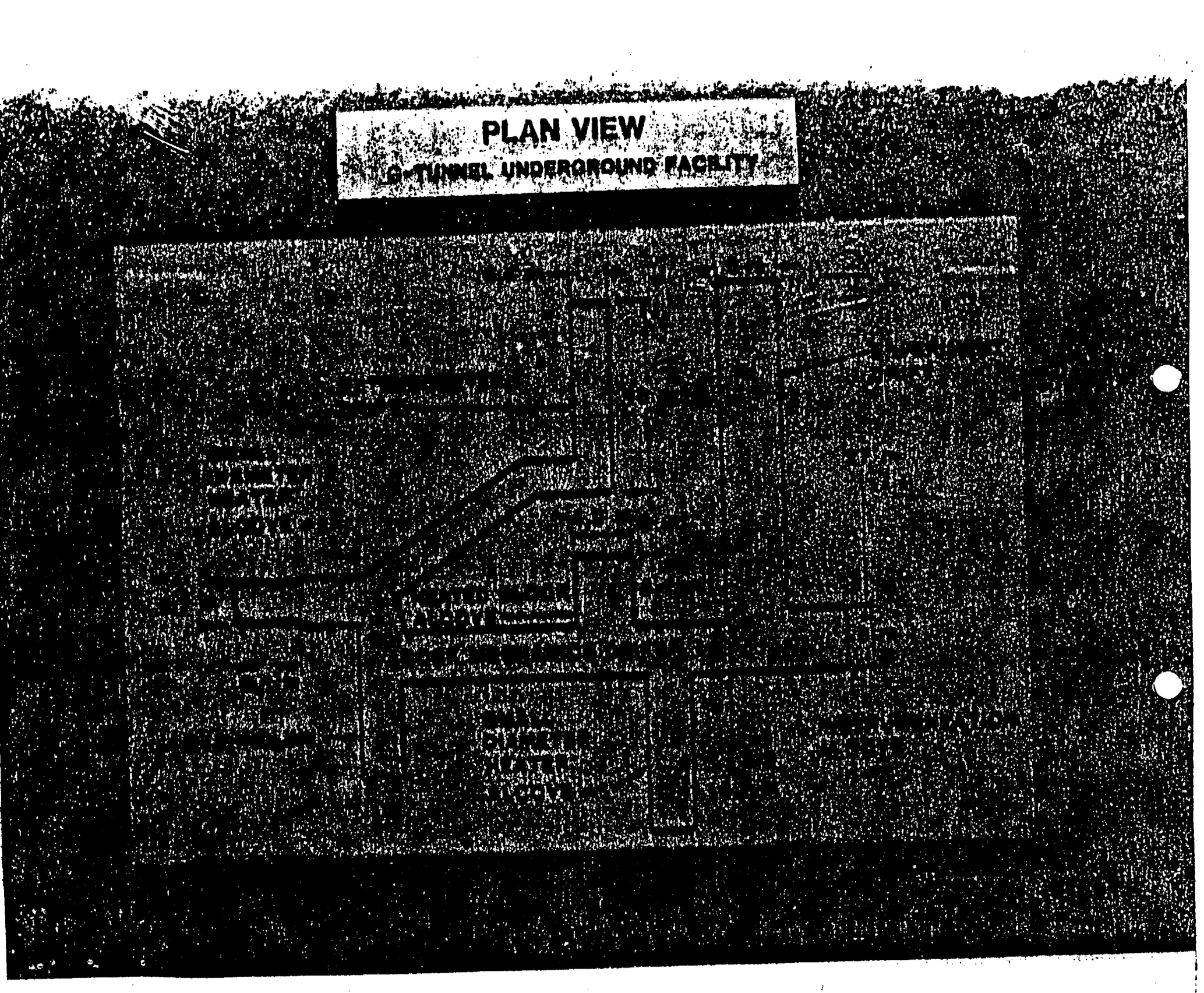
BY

NNWSI GEOTECHNICAL PROJECTS DIVISION

SANDIA NATIONAL LABORATORIES

FOR

NEVADA NUCLEAR WASTE STORGE INVESTIGATIONS


PLAN VIEW
G-TUNNEL UNDERGROUND FACILITY

G-TUNNEL UNDERGROUND FACILITY

PROGRAM PARTICIPANTS

PRIMARY

- SANDIA NATIONAL LABORATORIES
  - PROGRAM MANAGEMENT
  - TECHNICAL DIRECTION
  - DATA SYSTEM MANAGEMENT
  - EXPERIMENT MODELING

SUPPORT

- SCIENCE APPLICATIONS, INC.
  - INSTRUMENTATION INSTALLATION
  - CONTROL SYSTEM INSTALLATION
  - DATA SYSTEM OPERATION
- NORTH PACIFIC RESEARCH
  - SLOT CUTTING DEVELOPMENT
- RE/SPEC
  - EXPERIMENT MODELING
  - EXPERIMENT DEFINITION
- EG&G
  - TECHNICAL SUPPORT
- UNIVERSITY OF NEW MEXICO
  - GEOLOGICAL INVESTIGATIONS
- JENA
  - SLOT CUTTING

RELATED TESTING

- CALIFORNIA INSTITUTE OF TECHNOLOGY
- LOS ALAMOS NATIONAL LABORATORY
- LAWRENCE LIVERMORE NATIONAL LABORATORY
- UNITED STATES GEOLOGICAL SURVEY

CONTRIBUTIONS OF G-TUNNEL FIELD TESTING

SITE CHARACTERIZATION SUPPORT

- PROVIDE BASELINE INFORMATION AND ANALYSIS
- MONITOR CHANGES IN BASELINE INFORMATION
- ALLOW FOR CORRECTIVE ACTION

REPOSITORY DESIGN SUPPORT

- UNDERSTAND HOST ROCK BEHAVIOR
- UNDERSTAND WATER BEHAVIOR
- UNDERSTAND FRACTURE BEHAVIOR
- DEVELOP MODEL PREDICTION CONFIDENCE
- DEVELOP INSTRUMENTATION AND CONTROL SYSTEM EXPERIENCE
- EVALUATE EXCAVATION METHODS

Sandia National Laboratories

TUFFS

CONSOLIDATED DEPOSITS OF PARTICLES FRAGMENTED AND EJECTED DURING VOLCANIC ERUPTIONS

ASH-FLOW TUFFS

TUFFS DEPOSITED AS SHEETS FROM A GAS-CHARGED DENSITY CLOUD THAT ROLLS DOWN THE SLOPE OF A VOLCANO

ASH-FALL TUFFS

TUFFS EMPLACED BY THE AERIAL SETTLING OF PARTICULATES

WELDED TUFFS

EMPLACEMENT PROCESS WHERE THE TEMPERATURE AND LITHOSTATIC PRESSURE ARE SUFFICIENTLY HIGH TO RESULT IN PLASTIC COMPACTION AND COHESION OF THE GLASS FRAGMENTS

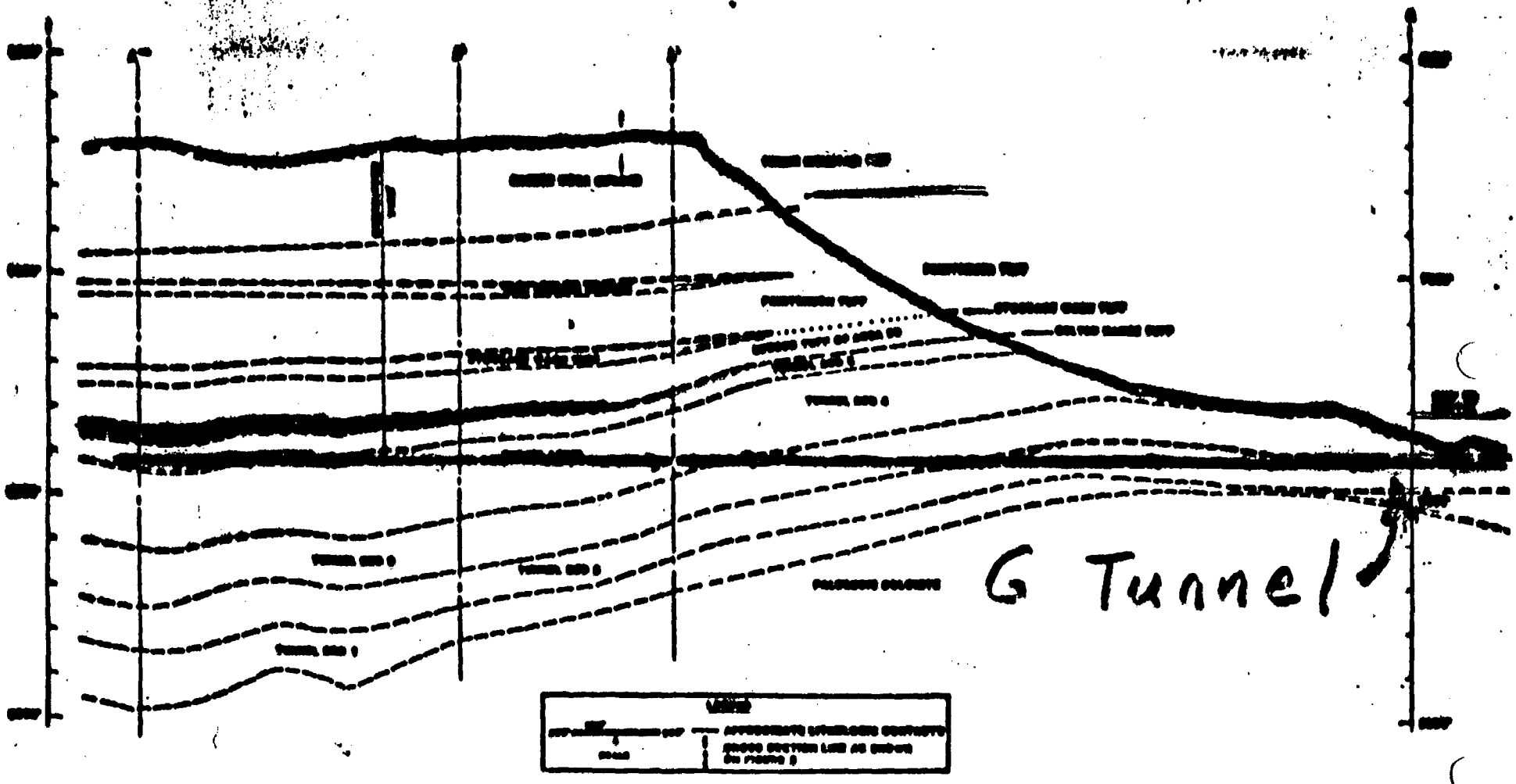


Figure 5. Partial Cross Section of Rainier Mesa (Cross-section lines are shown in Figure 3, adapted from Ref 3)

PHOTOGRAPH PICTURES OF THE G-TUNNEL

DID NOT COPY VERY WELL

G-TUNNEL ROCK MECHANICS FIELD EXPERIMENTS IN TUFF

Program Objectives

(1) To develop and conduct field experiments designed to evaluate the thermal, mechanical, thermomechanical and hydrothermal phenomena of tuff.

(2) To develop and conduct experiments to evaluate models using field measurements in order to provide predictive capabilities for a proposed repository.

(3) To develop techniques for making geotechnical measurements and accrue testing experience in tuff.

SMALL DIAMETER HEATER EXPERIMENTS

OBJECTIVES

PHASE I

(1) TO PERFORM EXPERIMENTS IN WELDED AND NONWELDED TUFFS TO MONITOR POSSIBLE HEATER ANNULUS WATER MIGRATION

(2) TO MEASURE HEATER AND VERTICAL EMPLACEMENT HOLE TEMPERATURE PROFILES DURING HEATING AND COOLDOWN PERIODS

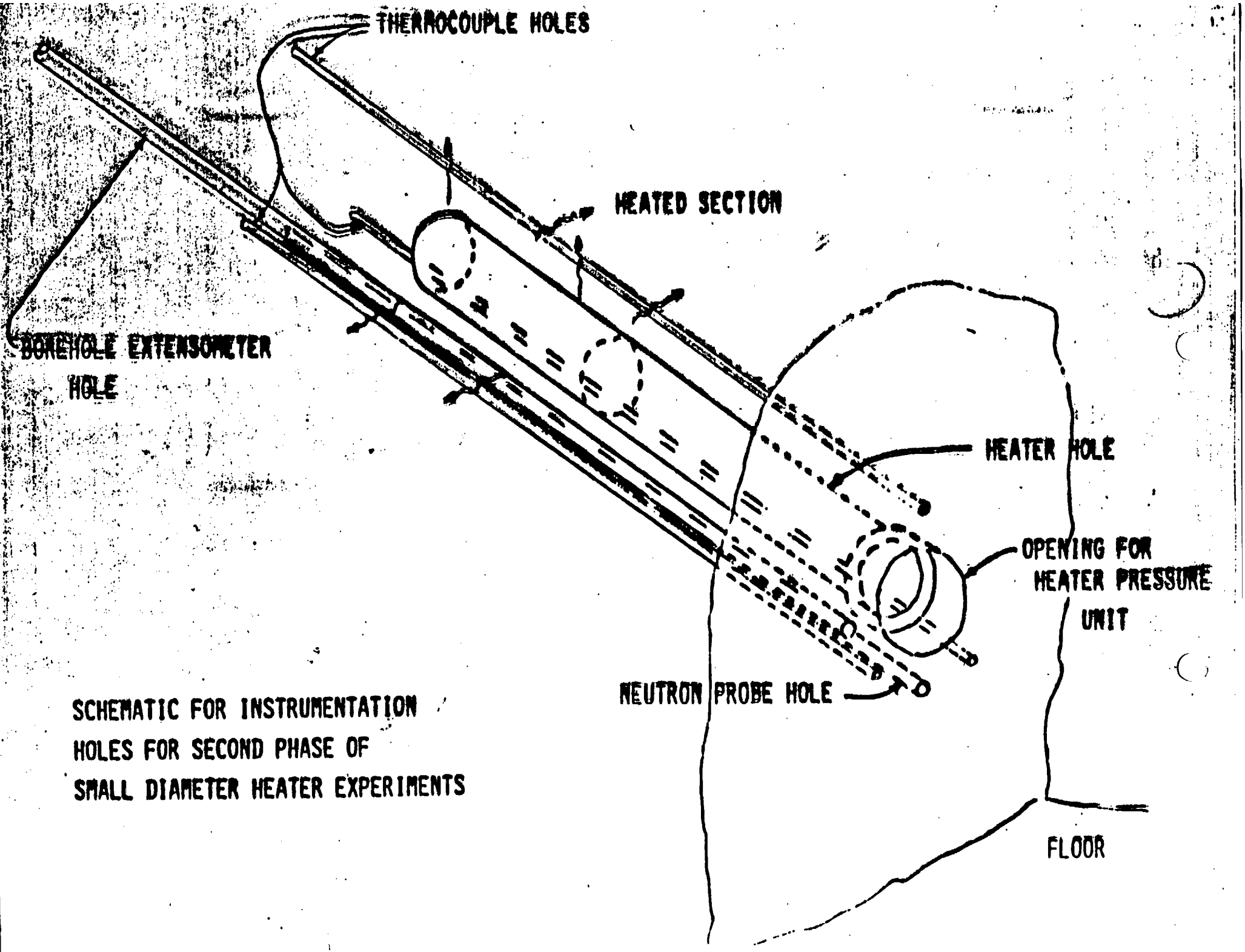
(3) TO EVALUATE METHODS OF MEASURING EMPLACEMENT HOLE SURFACE TEMPERATURES

(4) TO OBTAIN DATA FROM BOTH TUFFS IN SIMILAR SETTINGS TO FACILITATE REPOSITORY EVALUATIONS

PHASE II

(1) TO EVALUATE STATE-OF-THE-ART THERMAL MODELING WITH EXPERIMENTAL DATA IN THE HORIZONTAL SETTING

(2) TO CONDUCT A PROTOTYPE EXPERIMENT PLANNED FOR THE EXPLORATORY SHAFT



SCHEMATIC FOR INSTRUMENTATION HOLES FOR SECOND PHASE OF SMALL DIAMETER HEATER EXPERIMENTS

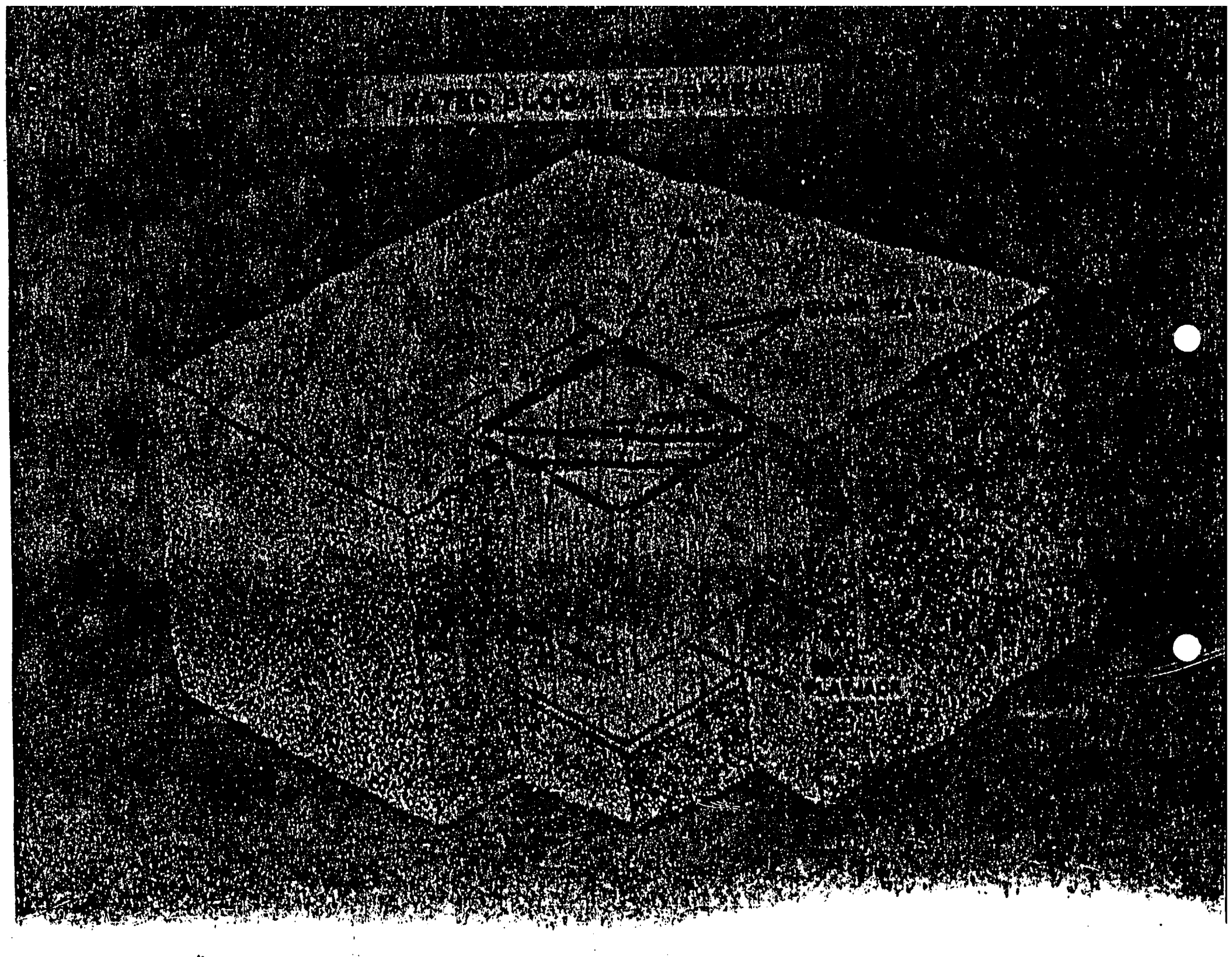
G-TUNNEL HEATED BLOCK EXPERIMENT

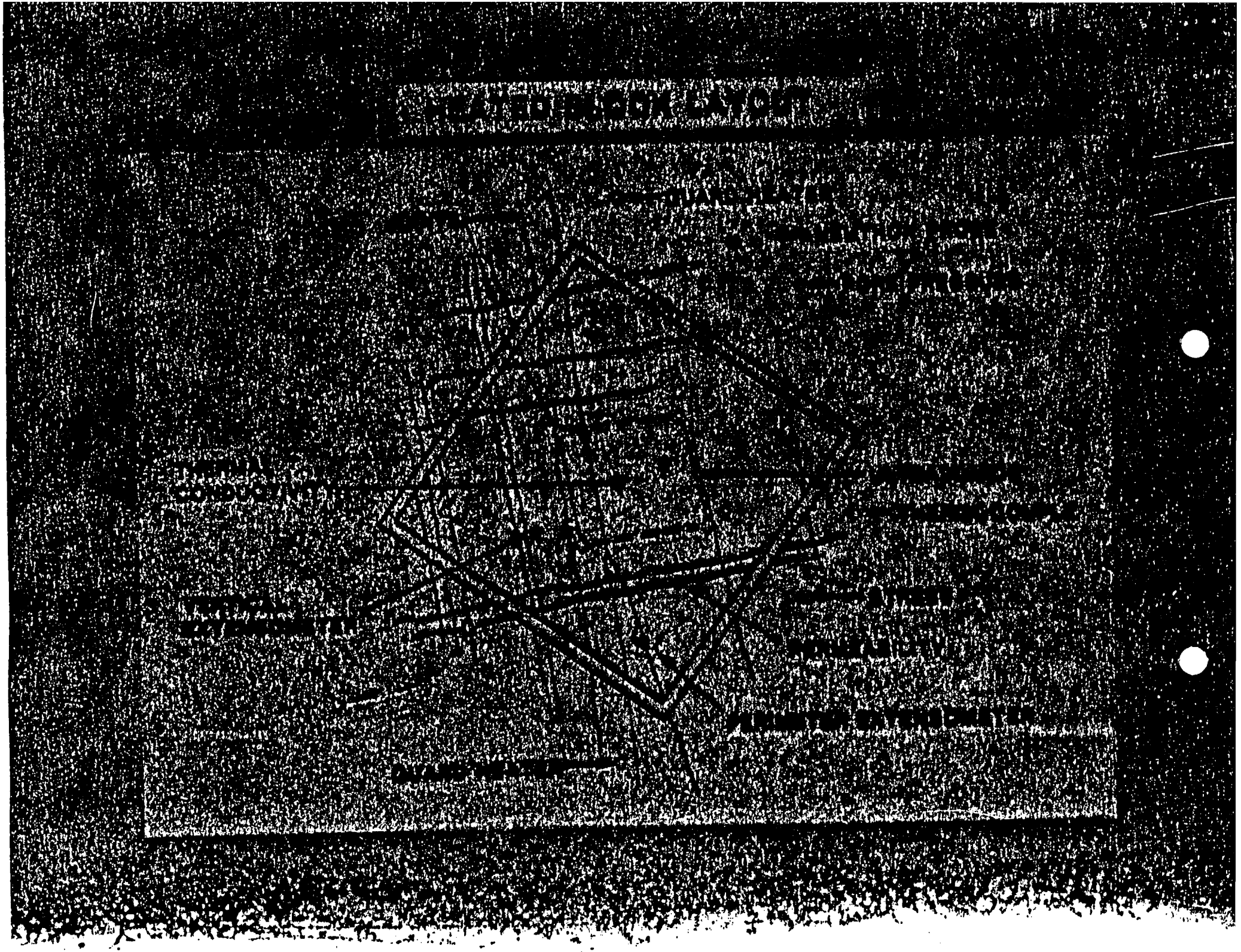
OBJECTIVES

(1) To measure rock-mass thermomechanical (thermal expansion) and mechanical (modulus of deformation, Poisson's ratio) properties of jointed tuff under independent thermal and mechanical loadings

(2) To determine the effects of stress and temperature on individual joint deformations and permeabilities

(3) To monitor changes in pore moisture content and relate these to changes in other properties (thermal conductivity, ultrasonic wave velocities)





MEASUREMENTS IN G-TUNNEL HEATED BLOCK EXPERIMENT

DISPLACEMENT

- MULTI-POINT BOREHOLE EXTENSOMETER
- HORIZONTAL SURFACE EXTENSOMETER
- WHITTEMORE MECHANICAL STRAIN GAGE
- STRAIN GAGE ROSETTE
- TAPE EXTENSOMETER

STRESS

- USBM BOREHOLE DEFORMATION GAGE
- CSIRO HOLLOW INCLUSION STRAIN CELL

THERMAL

- THERMOCOUPLE
- THERMAL PROBE

MOISTURE CONTENT

- NEUTRON PROBE
- CROSS-HOLE ULTRASONICS
- EMF TRANSMISSIONS
- PIEZOMETER

FRACTURE PERMEABILITY

FLATJACK PRESSURE

HEATER POWER

PRESSURIZED SLOT EXPERIMENTS

OBJECTIVES

(1) TO EVALUATE METHODS FOR CUTTING THIN-RELATIVELY UNDISTURBED SLOTS IN WELDED TUFF

(2) TO DEVELOP METHODS FOR PERFORMING PRESSURE-DEFORMATION MEASUREMENTS IN THIN SLOTS

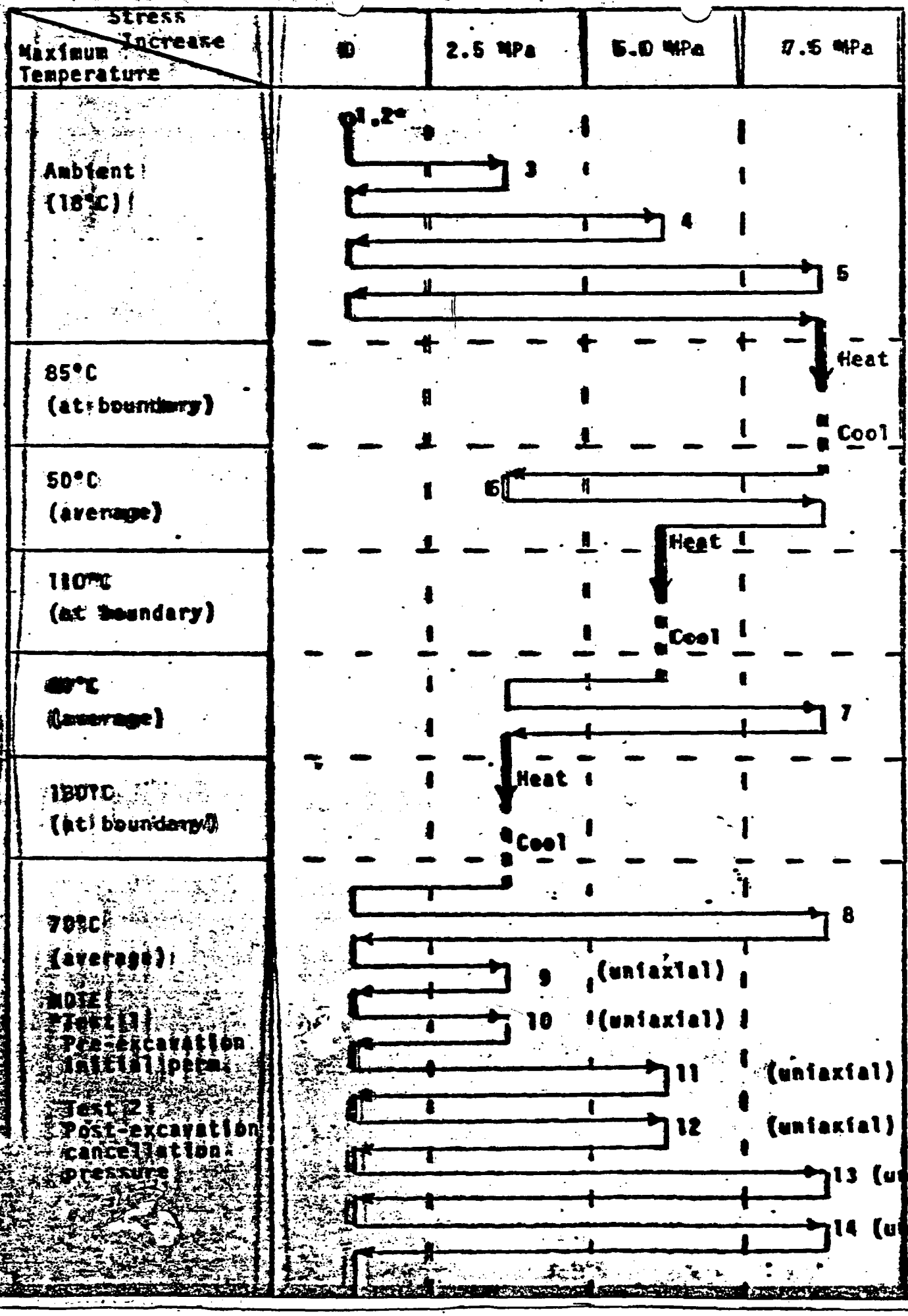
(3) TO MAKE ROCK-MASS MODULUS OF DEFORMATION MEASUREMENTS ON A LARGE SCALE

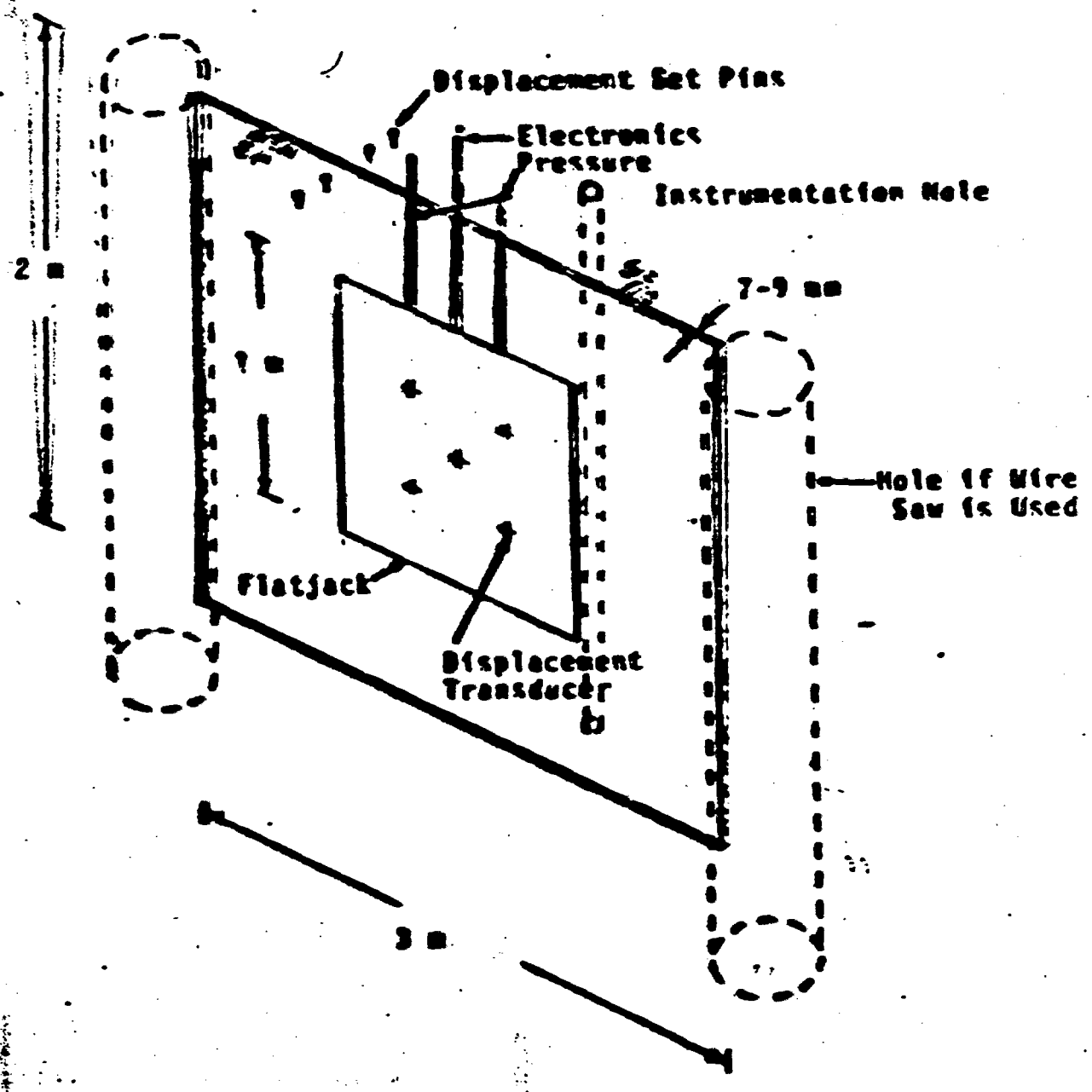
(4) TO DEVELOP METHODS FOR

- (A) EVALUATING ROCK MASS STRENGTHS
- (B) MEASURING TUNNEL SURFACE STRESSES

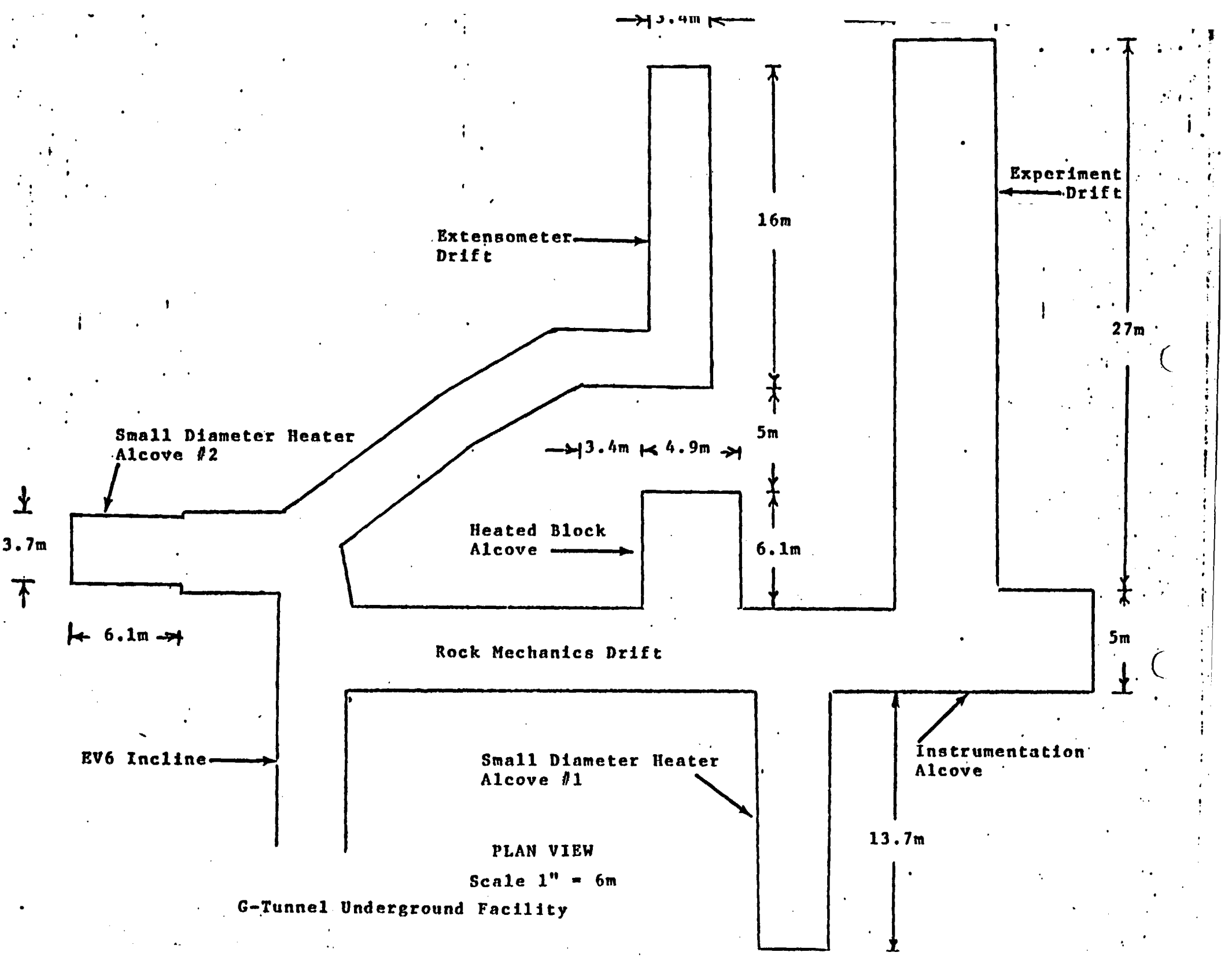
Sandia National Laboratories

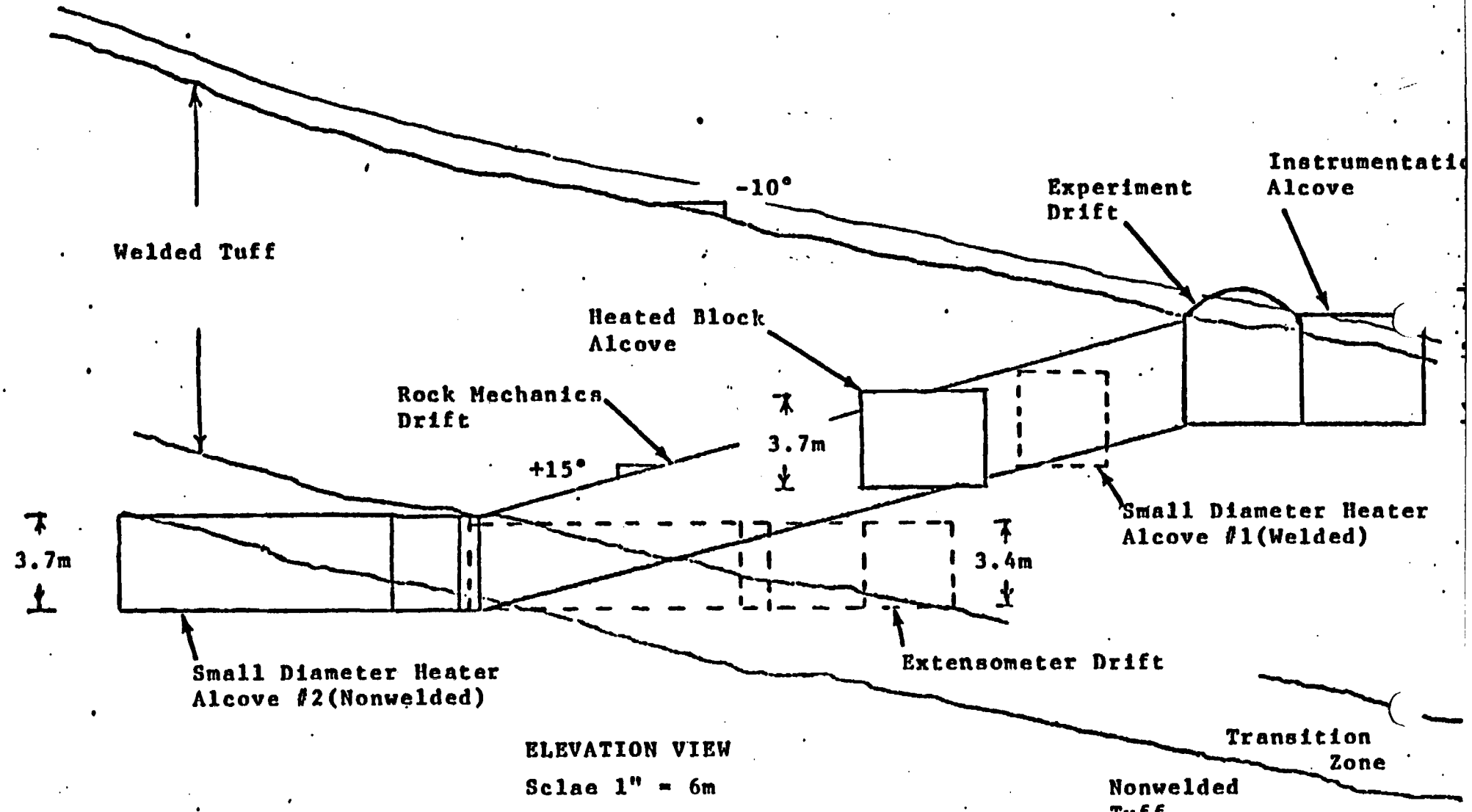
HEATED BLOCK - TEST MATRIX





PRESSURIZED SLOT

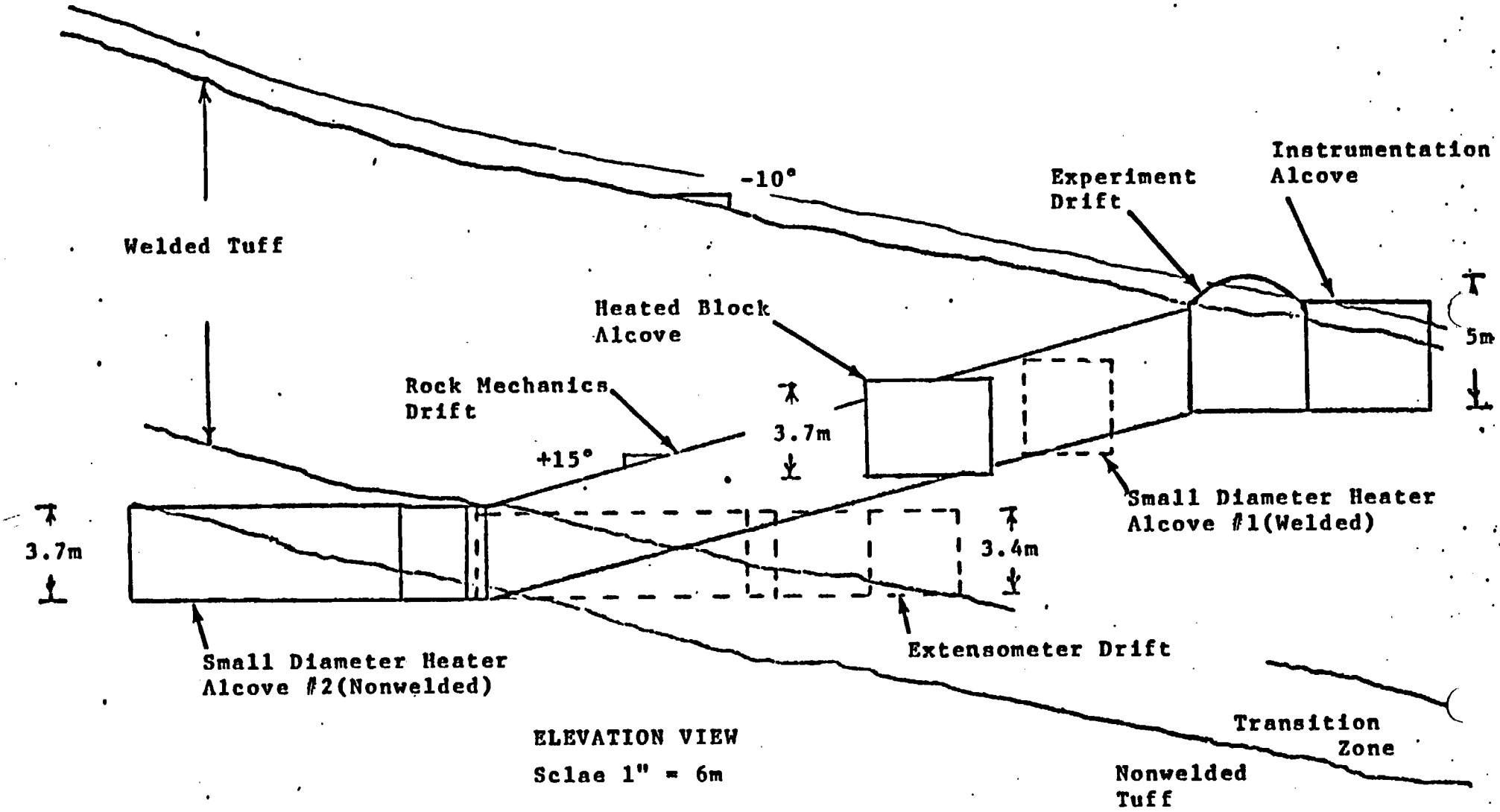

3.4m
16m
Experiment
Drift
Extensometer
Drift
27m
Small Diameter Heater
Alcove #2
5m
3.4m
4.9m
3.7m
Heated Block
Alcove
6.1m
6.1m
5m
Rock Mechanics Drift
EV6 Incline
Small Diameter Heater
Alcove #1
Instrumentation
Alcove
13.7m
PLAN VIEW
Scale 1" = 6m
G-Tunnel Underground Facility



ELEVATION VIEW

Sclae 1" = 6m

G-Tunnel Underground Facility



ELEVATION VIEW

Sclae 1" = 6m

G-Tunnel Underground Facility

NRC DESIGN/ROCK MECHANICS DATA REVIEW SCHEDULE
AT SANDIA NATIONAL LABORATORIES
(July 18-20, 1984)

July 18 Wednesday		July 19 Thursday		July 20 Friday		
1:00-3:00	3:00-5:30	8:00-11:30	12:30-5:30	8:30-10:00	10:00-11:30	11:30-12:00
1:00 Introductory Remarks J. Szymanski and K. Stablein 1:30 Synopsis - Data and Records Available T. O. Hunter and J. R. Tillerson Bldg. 822/A All NRC and NNWSI and Participants	Rock Mechanics Testing, Lab tour & data [JT] [RP] [BO] (SB) (LM) (PD)(SB 2) (JC) Bldg. 849 Bldg. 823/1020	Mech. Prop. Data [RP] [BO] (SB) (LM) (TS) (JC) (SB 2) Bldg. 823/1020	Mech. Prop. Data [RP] [BO] (SB) (TS) (PP) (JC) (SB 2) Bldg. 823/1020	Rock Classification Data [BL] [FN] (SB) (MC) (EH) (SB 2) Bldg. 823/1020	NRC Reviewers' Conference Session Bldg. 822/A	Data Review Wrap-up K. Stablein and J. Szymanski
2:30 Finalize Small Group Scheduling and Badging	Core handling & Storage facility lab tour & thermal prop. data [FN] [BS] (MC) (NT) (PP) (LP) Bldg. 672/2 & 4A Bldg. 892/166MB Bldg. 823/4071A	Bulk Prop. Data Data, Thermal Prop. Data [FN] [BS] (EH) (NT) (PP) (LP) Bldg. 823/4424B	Thermal Prop. Data [FN] [BS] (LM) (EH) (NT) (LP) Bldg. 823/4071A	Seismic Data [HM] [LV] (LM) (TS) (PP) (LP) (JC) Bldg. 823/4071A	NRC Participants Only	Bldg. 822/A
	G-Tunnel Rock Characterization-Data (Insitu Stress Data, Borehole Modulus Data) [RZ] [BL] (JD) (TS) (EH) (JG) (KS) Bldg. 823/4255	Small Diameter Heater Test Data [RZ] [BS 2] (JD) (PD) (MC) (JG) (KS) Bldg. 823/4255	Heated Block Test Data [RZ] [BS 2] (JD) (MC) (PD) (JG) (KS) Bldg. 823/4255	(1) Sealing Test Data (8:30-9:30) (2) Overflow data from any other area (9:30-10:00) [JT] [JF] (JD) (NT) (PD) (JG) (KS) Bldg. 823/4255		All NRC and NNWSI Participants

NRC Participants:
Paul Prestholt (PP), Thomas Schmitt (TS), Ed Hollop (EH), Lindsey Mundell (LM), Mark Christianson (MC), Swapan Bhattacharya (SB), Susan Billhorn (SB 2) Jaak Daeman (JD), Naiem Tanious (NT), Piyush Dutta (PD) John Greeves (JG), Larry Pittiglio (LP), King Stablein (KS), John Cutler, (JC).

SNL Participants:
Joe Fernandez [JF], Tom Hunter [TH], Brenda Langkopf [BL], Hugh MacDougall [HM], Fran Nimick [FN], Bill Olsson [BO], Ron Price [RP], Barry Schwartz [BS], Joe Tillerson [JT], Luke Vortman [LV], Roger Zimmerman [RZ], Bill Shepherd [BS 2]

ALL UNCLEARED VISITORS MUST REPORT EACH DAY FOR BADGING AT BUILDING 822

ATTACHMENT 3

NWSI PROJECT

NRC DESIGN DATA REVIEW

PROPOSED PROCEDURE

SNL STAFF WILL LEAD THROUGH DISCUSSION OF AT LEAST 1 SET OF REPRESENTATIVE DATA

NRC REVIEWERS CAN THEN GO THROUGH DATA WHILE SNL STAFF WILL BE AVAILABLE TO ANSWER QUESTIONS

ATTACHMENT 4

NNWSI PROJECT

ROCK MECHANICS

DATA BASE STRATEGY

	Area to Location Screening	→	Horizon Selection	→	Conceptual Design	→	Title I & II Design
Lab	Yucca Mountain Grouse Canyon	+	Yucca Mountain Topopah Spring Calico Hills Bullfrog Tram Grouse Canyon	+	Topopah Spring Busted Butte	+	ES Samples Topopah Spring
Field			GTUF: GTUF Characterization Small Diameter Heater	+	GTUF: Small Diameter Heater Heated Block Pressurized Slot	+	GTUF: Mining Effects Strength Evaluation ES: Tests Being Defined

NNWSI PROJECT

ROCK MECHANICS DATA AVAILABLE

LABORATORY TESTING

Core Records	Fran Nimick
Bulk Properties	
Thermal Conductivity	Barry Schwartz
Thermal Expansion	
Mechanical Properties	Ron Price
Matrix Data	
Joint Effects Data	Bill Olsson

NNWSI PROJECT

ROCK MECHANICS DATA AVAILABLE

FIELD DATA

GTUF Characterization Studies

Small Diameter Heater Tests

Pressurized (Rocha) Slot

Heated Block Test

} Roger Zimmerman

Rockmass Classification

Holes USW-G1, USW-GU3, USW G-4, UE25A#1 — Brenda Langkopf

NNWSI PROJECT

WEAPONS TEST SEISMIC DATA AVAILABLE

For Each Test

Magnetic Tapes - Analog and Digital Data

Notebook - Processed Raw Data

SAND Document

Personnel -

Luke Vortman

Hugh MacDougall

NNWSI PROJECT

SEALING PROGRAM

DATA AVAILABLE

TUFF CONCRETE

GROUT AND CONCRETE MECHANICAL AND GEOCHEMICAL PROPERTIES

HYDROLOGIC DATA (USGS AND PERFORMANCE ASSESSMENT REVIEW)

PERSONNEL:

JOE FERNANDEZ

ATTACHMENT 6

6

PAGE 1 OF 1

DATA REQUEST SHEETS FOR:

NRC DESIGN/ROCK MECHANICS DATA REVIEW
JULY 18–20, 1984
SANDIA NATIONAL LABORATORIES

SUBJECT: Thermal Conductivity

SNL PARTICIPANTS:
F. Nimick
B. Schwartz

ITEM #	DATA/ITEM REQUESTED	REQUESTED BY	REVIEW STATUS	DATE RELEASED	COMMENTS
1.	SAND81-1873 (G-1 Thermal Conductivity)	N. Tanicala	Printed	7/19/84	
2.	SAND80-0769 (Thermal Conductivity)	"	"	"	
3.	SAND82-1164 (Thermal Conductivity)	"	"	"	
4.	TTRD-2A-2 (Thermal Conductivity Test Procedure)	L. Pettyjohn			
5.	Data Sheets, USW G-4 1155.4'	"			
6.	Data Sheets, USW G-2 2055.0'	"			
7.	Data Sheets, SDH-3 G-Tunnel, 2 c 2.5'	"			
8.	Data Sheets, USW G-2 1639.0'	"			
9.	~~Mathematical Section of TT conductivity paper~~	"			
9.	Terra Tek software for data reduction during conductivity tests	"			
10	SAND83-1711 § 1.5 (when available)	"			
	— LAST ITEM —				
	Frank Nimick 7/20/84				
	Barry Schwartz 7/20/84				

DATA REQUEST SHEETS FOR:

NRC DESIGN/ROCK MECHANICS DATA REVIEW
JULY 18–20, 1984
SANDIA NATIONAL LABORATORIES

SUBJECT: Thermal Expansion (Confined)

SNL PARTICIPANTS:
F. Nimick
B. Schwartz

ITEM #	DATA/ITEM REQUESTED	REQUESTED BY	REVIEW STATUS	DATE RELEASED	COMMENTS
1	TTRD-LP-3 (TerraTek Thermal Expansion Test Procedure)	L. Pittiglio			
2	Listing of ASTM Standards	"			
3.	Data Sheets, USW G-4 1172'	"			
4	Figure of Test Configuration	"			
5	Portions of TerraTek QAP relevant to this testing	"			
6.	Data Sheets, UTZ G-HB/MPBX1 91'	"			
7.	Data Sheets, USW G-1 2562'	"			
8	Sample Transmittal Letter (11/1/82)	"			
9	L.O.C for G4 1172' (12/2/82)	"			
	– LAST ITEM –				
	Frank Nimick 7/20/84				
	Barry Schwartz 7/20/84				

DATA REQUEST SHEETS FOR:

NRC DESIGN/ROCK MECHANICS DATA REVIEW
JULY 18–20, 1984
SANDIA NATIONAL LABORATORIES

SUBJECT: Thermal Expansion (Unconfined)

SNL PARTICIPANTS:
F. Nimick
B. Schwartz

ITEM #	DATA/ITEM REQUESTED	REQUESTED BY	REVIEW STATUS	DATE RELEASED	COMMENTS
1	QAP XI-5 Rev A through C (Thermal Expansion)	L. P. Higlio			
2	Schwartz' Thermal Expansion Memo (2/4/82)	L. P. Higlio			
3	QAP XI-11 Rev A (Core Library Proc.)	"			
4	Data Sheet, USW G-1 1047.1' (2/18/82)	"			
5	Data Sheet, USW G-1 446.8' (2/26/82)	"			
6	Data Sheet, VE-25a#1 1718.2' (5/4/82)	"			
7	Data Sheet, ~~VE-25a#1~~ USW G-2, 2498.' (3/24/82)	"			
8	Data Sheet, VE25a#1, 1366.5' (4/21/82)	"			
9	Data Sheet, USW G-1 3085 (2/25/82)	"			
10	Data Sheet, USW G-1, 1362.4 (3/1/83)	"			
11	Data Sheet, USW G-1, 1151.1 (12/15/82)	"			
12	Data Sheet, USW G-1, 1763.2 (11/8/82)	"			
13	Data Sheet, USW G-1, 2320.3 (8/17/82)	"			
14	Soak Test Report w/ α Data (when available	"			
15	SAND 78-1147 (Thermal expansion screening)	N. Tanlous	Printed	7/19/84	
	— LAST ITEM —				
	Fran Nimick 7/20/84				
	Barry Schwartz 7/20/84				

DATA REQUEST SHEETS FOR:

NRC DESIGN/ROCK MECHANICS DATA REVIEW
JULY 18–20, 1984
SANDIA NATIONAL LABORATORIES

SUBJECT: Bulk Properties

SNL PARTICIPANTS:
F. Nimick
B. Schwartz

ITEM #	DATA/ITEM REQUESTED	REQUESTED BY	REVIEW STATUS	DATE RELEASED	COMMENTS
1	QAP XI-4 Rev A (Bulk Properties)	L. Pettyjohn			
2	QAP XI-6 Rev A (Grain Density/Helium)	"			
3	QAP XI-10 Rev A (Grain Density/Saturated	"			
4	SAND83-1327 (Grain Density)	"			
5	GUSW GU-3 Density Memo (Schwartz, 1/13/83)	"			
6	Raw data sheets corresponding to memo in USW GU-3 Binders	"			
	— LAST ITEM —				
	Frank Nimick 7/20/84				
	Barry Schwartz 7/20/84				

DATA REQUEST SHEETS FOR:

NRC DESIGN/ROCK MECHANICS DATA REVIEW
JULY 18–20, 1984
SANDIA NATIONAL LABORATORIES

LABORATORY
SUBJECT: ROCK MECHANICS

SNL PARTICIPANTS:
R.H. (RON) PRICE RHPrice 7/20/8
W.A. (BILL) OLSSON

ITEM #	DATA/ITEM REQUESTED	REQUESTED BY	REVIEW STATUS	DATE RELEASED	COMMENTS
1	SAND 79-0114 (W.A.O.; HIT)	PIYUSH DUTTA	PRINTED	7/19/84	
2	SAND 80-1453 (WAO, AKJ; YM, GC)	"	"	"	
3	SAND 81-0212 (LWT, [redacted]; FRICTION)	"	"	"	
4	SAND 81-1664 (WAO; HIT BULLFROG)	"	"	"	
5	SAND 82-0481 (RHP, ET AL.; BULLFROG-G-1)	"	"	"	
6	SAND 82-1055 (RHP, ET AL.; TRAM-G-1)	"	"	"	
7	SAND 82-1314 (RHP, ET AL.; CALICO HILLS-G-1)	"	"	"	
8	SAND 82-1315 (RHP; ANALYSIS)	"	"	"	
9	SAND 82-1723 (RHP, ET AL.; TOPOPAH SPRING-G-1)	"	"	"	
10	SAND 83-0646 (D.J.H, A.K.J.; DATA REA)	"	"	"	
11	SAND 83-1646 (RHP, ET AL; TOPOPAH SPRING-G-1)	"	"	"	
12	MEMO, 7/20/83, PRICE TO TILLERSON, ASTM	"	UNREVIEWED	"	
13	MEMO, 2/24/84, PRICE TO NIMICK, PROCEDURES	"	"	"	
14	TEST DATA FOR RETOOL (WAO)	"	"		
15	CALIBRATION DATA FROM BIAX ROCK (WAO)	"	"		
16	1 TUFF FRICTION (DRY) DATA (LWT)	"	"		
17	3 TUFF FRICTION (WET) 10^{-4} cm/s DATA (LWT)	"	"		
18	5E TUFF FRICTION (WET) DATA (LWT)	"	"		
19	CALIBRATION DATA FOR GROUSE CANYON (SAND 80-1453) (WAO)	"	"		
20	GROUSE CANYON #101 DATA (SAND 80-1453) (WAO)	"	"		

DATA REQUEST SHEETS FOR:

NRC DESIGN/ROCK MECHANICS DATA REVIEW
JULY 18–20, 1984
SANDIA NATIONAL LABORATORIES

LABORATORY

SUBJECT: ROCK MECHANICS

SNL PARTICIPANTS:

R.H (RON) PRICE RH Price 7/20

W.A. (BILL) OLSON

ITEM #	DATA/ITEM REQUESTED	REQUESTED BY	REVIEW STATUS	DATE RELEASED	COMMENTS
21	CALICO HILLS, CH 4A DATA (RHP)	PIYUSH DUTTA	UNREVIEWED		
22	TOPOPAH SPRING, G1 1154.9 B DATA (RHP)	"	"		
23	TOPOPAH SPRING, G1 1163.6 DATA (RHP)	"	"		
24	TOPOPAH SPRING, G1 1189.0 DATA (RHP)	"	"		
25	TOPOPAH SPRING G1 1218.2A DATA (RHP)	"	"		
26	TOPOPAH SPRING, G1 1222.1B DATA (RHP)	"	"		
27	TOPOPAH SPRING, G1 1279.5 DATA (RHP)	"	"		
28	TOPOPH SPRING, LITH 8C DATA (RHP)	"	"		
29	DATA REDUCTION PROGR. USED IN TUFF FRICTION, SQUEEZE (LWT)	"			
30	COPY OF RAW DATA FOR DYNAMIC MEASUREMENTS				
	OSCILLISCOPE TRACES: 1067.8-1, 484-7-1, 760.9-5A GL3	"			DON'T EXIST
	LAST ITEM (RHP)				

DATA REQUEST SHEETS FOR:

NRC DESIGN/ROCK MECHANICS DATA REVIEW
JULY 18–20, 1984
SANDIA NATIONAL LABORATORIES

SUBJECT: Weapons Test Ground Motion

SNL PARTICIPANTS:
Scully, MacDougall
Voegtman

ITEM #	DATA/ITEM REQUESTED	REQUESTED BY	REVIEW STATUS	DATE RELEASED	COMMENTS
1.	REQUEST FOR FORELSNIED WEAPONS TEST GROUND MOTION DOCUMENTS (UNCLASSIFIED) BY C. J. VOEGTMAN ET AL.	NRC SCHMITT			
	LAST ITEM Hugh K. MacDougall				

DATA REQUEST SHEETS FOR:

NRC DESIGN/ROCK MECHANICS DATA REVIEW
JULY 18–20, 1984
SANDIA NATIONAL LABORATORIES

SUBJECT: Field Testing

SNL PARTICIPANTS: P Zimmerman Roger M Zimmerman 7/20/84

ITEM #	DATA/ITEM REQUESTED	REQUESTED BY	REVIEW STATUS	DATE RELEASED	COMMENTS
1	Prelim Design and Defin SAND 81-1972	K Stablein	Approved	7/18	4 copies
2	Concepts Design of Field Exp SAND 81-1768	"	"	"	4
3	Geotech Field Meas. SAND 81-1971	"	"	"	5
4	Issues Paper - 23rd Rock Mech Sympos	"	"	"	1
5	SDH Paper - 24 " " "	"	"	"	1
6	Amb Temp Paper - 25 " " "	"	"	"	1
7	Field Exper in G-Tunnel ONWI 212	"	"	"	1
8	Tuff Rock Mech Tests DOE/NWTS -15	"	"	"	1
9	Heated Block Concept Design SAND 81-1891	"	"	"	1
10	Petrol & Geochem SAND 81-1970	J Cutler	"	"	1
11	Site Explor for Rock Mech Field Test SAND	"	"		1
12	Goodman Jack Procedure by SINCO	J Greeves			1
13	Data Sheets Goodman Jack - P2 - 1V, 1H, 3H, 3H, 6H	"			1
14	Cal Test Goodman Jack	"			1
15	Perm Data (Raw from Found Sci.) RM P1-7	J Daeman			1
16	Final Design Report SAND 82-2200 (SDH)	"			1
17	Operational Test Plan SDH #2	"			1
18	Test Plan SAND 82-0108	"			1
19	Test Plan Heated Block SAND 82-2999	"			1
20	View Graphs G-Tunnel Tour Class Mining	K Stablein	Approved	7/19	20

DATA REQUEST SHEETS FOR:

NRC DESIGN/ROCK MECHANICS DATA REVIEW
JULY 18–20, 1984
SANDIA NATIONAL LABORATORIES

SUBJECT: Field Testing

SNL PARTICIPANTS: [illegible] [illegible] 7/20/84

ITEM #	DATA/ITEM REQUESTED	REQUESTED BY	REVIEW STATUS	DATE RELEASED	COMMENTS
21	View Graphs - GTUF Mining Eval	V Stablein			20
22	Tabulated Data Flatjack Ch 262 J257-58	J Daeman			1
23	" HSX Ch 421-26 "	"			1
24	" MPBX Ch 488-93 "	"			1
25	SAI Cal Sheet MPBX #2	"			1
26	Summary of Block Data for Load Increase	"			1
27	QA Sheet - Heated Block Change Proved	"			1
	— No more items —				

DATA REQUEST SHEETS FOR:

NRC DESIGN/ROCK MECHANICS DATA REVIEW
JULY 18–20, 1984
SANDIA NATIONAL LABORATORIES

SUBJECT: Rock Mass Classification

SNL PARTICIPANTS:
T. Langkopf
F. Nimick

ITEM #	DATA/ITEM REQUESTED	REQUESTED BY	REVIEW STATUS	DATE RELEASED	COMMENTS
1	Rock Mass Classification Data Package (including some charts) - 2 notebooks	P. Dutta			
2	SAND82-2034 (Rock Mass Classification)	"			
3.	Mapping Procedure for G-Tunnel Core (Geologic Support) - 1 page	"			
[illegible]	[illegible]	[illegible]			
4	SAND81-1897 (Site Exploration in G-Tunnel)	"			
	- LAST ITEM -				
	Frank Nimick 7/20/84				
	Barry Langkopf 7/20/84				

DATA REQUEST SHEETS FOR:

NRC DESIGN/ROCK MECHANICS DATA REVIEW
JULY 18–20, 1984
SANDIA NATIONAL LABORATORIES

1- 1561 [illegible]
2- 1561 [illegible]
3- 1561 6/6

SUBJECT: Repository Sealing

SNL PARTICIPANTS:
Joseph A. Fernandez
Joseph R Tillerson

ITEM #	DATA/ITEM REQUESTED	REQUESTED BY	REVIEW STATUS	DATE RELEASED	COMMENTS AVAILABILITY
1	Compatibility Between Select Cementitious Material and Topopah Spring Member Tuff	Jack Daemen	Initial Review		3-6 mo
2	Development of a Tuff Concrete	" "	Still being written		3-6 mo.
3	SAND83-1778 Repository Sealing Concepts Document	" "	Final Review		1-2 mon.

Recorded by Joseph A. Fernandez
7/20/84

Reviewer J. Daemen / N. Tanions

Date 7-20-84

- Draft Rock Mechanics Data Review Checklist
(Revision No. 0, January 18, 1984)

1. Name/type, identification number, and date of test.
Sealing program – large number of tests, most performed at PSU, WES, CASL. General survey of tests. Under direction of Joe Fernandez at SNL

1a. What is the overall objective of the test?
Sealing development, performance testing, especially mix design and testing of tuff-concrete

1b. What specific parameters are to be determined by the test?
Numerous: strength, permeability, size distribution of crushed tuff, creep, chemical composition, geochemical interactions, durability, etc..

1c. Is there redundancy in the test concept?
yes - multiple tests

1d. What criteria were used for test site (or sample) selection?
Access - G-tunnel

1e. How is the rock at the test site characterized?
Visual inspection, chemical characterization, X-ray diffraction, mineralogical diffraction,

1f. How was the test designed?
Many ASTM standards – WES procedures, PSU procedures

1g. Comments.

Reviewer Daemen-Tanious

Date 7-20-84

2. Is the procedure documented and complete, and is it in written form?

As per quick survey it appears that procedures are documented, complete and in written form

2a. Is it a standard (ASTM) procedure? If yes, provide reference.

Some - references at SNL, PSU, WTS

2b. If non-"standard", how was the procedure developed, reviewed, documented, and approved? For example, COE, USBM, USBR, USGS, NBS, or other (internal) processes.

COE used at WTS

2c. Have there been revisions and how and when were the revisions reviewed, documented, approved, and implemented?

2d. Comments.

Reviewer Daemen - Tanious

Date 7-20-84

3. How many of these tests have been performed?

Large number

3a. According to what procedure revisions?

3b. How may test results, obtained under different revisions, be compared?

3c. How many tests are in progress and which revision is in use?

3d. How many tests are planned?

Large number

3e. Comments.

Reviewer Daemen / Tanious

Date 7-20-84

4. What instrumentation is used for the test?

4a. How were the reliabilities* of the instruments specified?

4b. Is there a calibration system and were calibrations systematically carried out according to approved procedure?

At PSU, WES

4c. Are the calibrations traceable to national or industrial standards?

Probably, to be inspected at WES, PSU, LASL

4d. Comments.

* Reliability is defined as the probability of an instrument to perform a stated function under a stated environment for a stated time.

Reviewer Daemen / Tanious

Date 7-20-84

5. What are the data collection, reduction, and presentation techniques?

Manually filled out standard forms
Computer acquisition
Curve fitting - computer plotting

5a. How can the raw numerical data be retrieved?

5b. How can all data reduction steps prior to data storage be independently checked and/or duplicated?

5c. Are the data presented in a complete and clear format? (Comment also on the utility of the presentation.)

5d. Are the data keyed to geological, environmental, and other experimental conditions?

5e. Are the data traceable to a written procedure?

5f. Comments.

Reviewer Daemin - Tamius

Date 7-20-84

6. What techniques are involved in analyzing and interpreting the data?

6a. What empirical techniques?

6b. What analytical techniques?

6c. What numerical techniques?

6d. Comments.

Reviewer Damen/Tardiff

Date 7/20/84

7. What computer programs are used in collecting, reducing, storing, presenting, and analyzing the data?

7a. How are these programs verified, validated, documented, and controlled?

7b. Comments (for example, implicit assumptions, sensitivities, other comments).

Reviewer Dorman/Tarlow

Date 7/20/84

8. What are the acceptance/rejection criteria for the test data?

8a. Were these criteria established prior to test development?

8b. What is the logic behind the criteria?

8c. How are the criteria implemented? (Data handling, review procedure, corrective action.)

- Data Handling
- Review Procedure
- Corrective Action

8d. Comments.

Reviewer [illegible] / Tarrions

Date 7/20/84

9. How are deviations from established procedures documented?

9a. What is the cause of the deviation?

9b. How are deviations considered in data reduction and/or analyses?

9c. Is the use of deviated data controlled? (For example, not used withoug approval of system designer or authorized project manager.)

9d. Comments. (For example, equipment performance and its effect on test validity, other comments.)

Reviewer Dalman / Tavrory

Date 7/20/84

10. General comments (such as, relationship among different tests, impacts on interpretation, instrument redundancy, factors resulting in test closure, accuracy of measurements, limitations, additional uses of data, and other miscellaneous comments).

We had an overview of the Sandia scaling program which included development of traff concrete, testing of its properties...etc. The data is large and not yet assembled into ~~a~~ files easily retrievable, however it is our impression from this quick snapshot that the program and the data generated are technically sound.

Reviewer T.J. Schmitt

Date 7-20-84

Draft Rock Mechanics Data Review Checklist
(Revision No. 0, January 18, 1984)

1. Name/type, identification number, and date of test.

Seismic Recording, multiple ~~data~~ Numbers and date.

1a. What is the overall objective of the test?

Establish the attenuation of seismic wave energy from device. It is necessary to evaluate stability for testing in the event of end of threshold treaty ban. ~ 750 KT max at buckboard ~~Attenuation relation of yield~~ +

1b. What specific parameters are to be determined by the test?

Attenuation of peak ~~acc~~ vector acc.

1c. Is there redundancy in the test concept?

Multiple instruments
Each instrument multiple sensors

1d. What criteria were used for test site (or sample) selection?

N/A

1e. How is the rock at the test site characterized?

N

1f. How was the test designed?

~~DCS~~ Fixed ~~stations~~ stations designed to get ~~coverage~~ coverage in critical areas.

1g. Comments.

Reviewer T. J. Schaal

Date 7-20-84

2. Is the procedure documented and complete, and is it in written form?

— Procedures were described verbally due to mass of documents we were unable to review for all. ~~Upon Review of~~ Flow diagrams of entire procedures are given

2a. Is it a standard (ASTM) procedure? If yes, provide reference.

- NA

2b. If non-"standard", how was the procedure developed, reviewed, documented, and approved? For example, COE, USBM, USBR, USGS, NBS, or other (internal) processes.

-NA-

2c. Have there been revisions and how and when were the revisions reviewed, documented, approved, and implemented?

- NA -

2d. Comments.

Reviewer T.J. Schmidt

Date ~~FB~~ 7-20-1994

3. How many of these tests have been performed?

~ Several hundred tests.

3a. According to what procedure revisions?

~~~ ~~Unable to determine~~

~ Unable to determine. There have been improvements in instrumentation over the years. The procedures were ~~deceit~~ described verbaly.

3b. How may test results, obtained under different revisions, be compared?

– Unable to determine without reading documents – which we ~~have time~~ did not have time for.

3c. How many tests are in progress and which revision is in use?

~ Test now standard.

3d. How many tests are planned?

– As Each event will be monitored.

They have planned ~~specific~~ experiments to address specific information needs, such as anomalous station accelerations

3e. Comments.
~~~

Reviewer T.J. Schmitt

Date 7-20-

4. What instrumentation is used for the test?

3 component accelerometer.

4a. How were the reliabilities* of the instruments specified?

Because of time constraints we did not review in detail.

4b. Is there a calibration system and were calibrations systematically carried out according to approved procedure?

Yes and Yes.

4c. Are the calibrations traceable to national or industrial standards?

Because of time constraints we did not review procedure.

4d. Comments.

* Reliability is defined as the probability of an instrument to perform a stated function under a stated environment for a stated time.

Reviewer T.J. Schmitt

Date 7-20-84

5. What are the data collection, reduction, and presentation techniques?

—

5a. How can the raw numerical data be retrieved?

There is a tremendous amount of data. It is stored in digital data.

5b. How can all data reduction steps prior to data storage be independently checked and/or duplicated?

~~Must~~ They can be but we had insufficient time to review.

5c. Are the data presented in a complete and clear format? (Comment also on the utility of the presentation.)

Insufficient time for review

5d. Are the data keyed to geological, environmental, and other experimental conditions?

Yes - Very well

5e. Are the data traceable to a written procedure?

~ Yes.

5f. Comments.

Reviewer T. J. Schmitt

Date 7-20-84

6. What techniques are involved in analyzing and interpreting the data?

Accelerate Data is digitized, filtered digitally, and integrated to obtain velocity and displacement.

6a. What empirical techniques?

6b. What analytical techniques?

6c. What numerical techniques?

6d. Comments.

Reviewer T.J. Schmidt

Date 7-20-84

7. What computer programs are used in collecting, reducing, storing, presenting, and analyzing the data?

Data is subjected to considerable digital filtering.

7a. How are these programs verified, validated, documented, and controlled?

No time to review

7b. Comments (for example, implicit assumptions, sensitivities, other comments).

Programs were developed by unquestioned experts in digital filter processing. I assume programs were developed under Sandia procedures.

Reviewer T. J. Schmitt

Date 7-20-84.

8. What are the acceptance/rejection criteria for the test data?

They know certain seismic stations ~~are~~ have problems. They do not reject that data but ~~will~~ process it with and without the known strange stations.

8a. Were these criteria established prior to test development?

Yes

8b. What is the logic behind the criteria?

~~Known problem~~

The stations are known to have problems.

~~Reason~~ The cause of this is being investigated.

8c. How are the criteria implemented? (Data handling, review procedure, corrective action.)

- Data Handling
- Review Procedure
- Corrective Action

8d. Comments.

Reviewer T.J. Schmidt

Date 7-20-84

9. How are deviations from established procedures documented?

NA

9a. What is the cause of the deviation?

NA

9b. How are deviations considered in data reduction and/or analyses?

NA

9c. Is the use of deviated data controlled? (For example, not used withoug approval of system designer or authorized project manager.)

NA

9d. Comments. (For example, equipment performance and its effect on test validity, other comments.)

NA

Reviewer T. J. Schmidt

Date 7-20-84

10. General comments (such as, relationship among different tests, impacts on interpretation, instrument redundancy, factors resulting in test closure, accuracy of measurements, limitations, additional uses of data, and other miscellaneous comments).

Presentation was excellent!! We did not have time to review it well. The experiments are well designed!!

3

Reviewer SWAPAN BHATTACHARYA

Date 9/20/84

Draft Rock Mechanics Data Review Checklist
(Revision No. 0, January 18, 1984)

1. Name/type, identification number, and date of test.

Rock Classification Indices for G-Tunnel

1a. What is the overall objective of the test?

To arrive at rock competency ratings for the Grouse Canyon member

1b. What specific parameters are to be determined by the test?

Q-Ratings for NGI - Barton System
RMR Ratings for CSIRO - Bieniawski System

1c. Is there redundancy in the test concept?

No

1d. What criteria were used for test site (or sample) selection?

Core holes (NX) drilled from four locations in the G-Tunnel.

1e. How is the rock at the test site characterized?

N/A

1f. How was the test designed?

N/A

1g. Comments.

Reviewer S. Bhattacharyya

Date 7/20/84

2. Is the procedure documented and complete, and is it in written form?

A written guideline exists for mapping of joints and interpretations from rock coring. The procedure for arriving at rock classification numbers are presented in SAND report 82-2034. No other written procedure exists

2a. Is it a standard (ASTM) procedure? If yes, provide reference.

No

2b. If non-"standard", how was the procedure developed, reviewed, documented, and approved? For example, COE, USBM, USBR, USGS, NBS, or other (internal) processes.

An internal procedure has been prepared based on Barton's and Bieniawski's report and experience of SNL personnel.

2c. Have there been revisions and how and when were the revisions reviewed, documented, approved, and implemented?

Not applicable since no written procedure existed at the time of analysis

2d. Comments.

Reviewer S. Chattopadhyay

Date 7/20/84

3. How many of these tests have been performed?

4 coreholes were drilled at various locations of the G-Tunnel : U12g RMP # 1 - near vertical (-79°) S27E
U12g - RMD # 11 - horizontal 355°W
U12G - CB 1 - near horizontal (+20°)
U12G - CB 2 - near horizontal (≈ +20°)

3a. According to what procedure revisions?

N/A

3b. How may test results, obtained under different revisions, be compared?

The data from each of these holes were lumped together for a given formation, such as Grouse Canyon tuffs and tunnel bed 5 nonwelded tuff

3c. How many tests are in progress and which revision is in use?

Not known. probably not done specifically for rock classification.

3d. How many tests are planned?

Not specifically for rock classification purposes.

3e. Comments.

Reviewer S. Bhattacharyya

Date 7/20/81

4. What instrumentation is used for the test?

None

4a. How were the reliabilities* of the instruments specified?

N/A

4b. Is there a calibration system and were calibrations systematically carried out according to approved procedure?

N/A

4c. Are the calibrations traceable to national or industrial standards?

N/A

4d. Comments.

One instrument was used to orient the core in a manner that fracture direction can be identified. Not sufficient information was available regarding this instrument.

* Reliability is defined as the probability of an instrument to perform a stated function under a stated environment for a stated time.

Reviewer S. Bhattacharya

Date 7/20/84

Some of the mapped data are available in SAND 81-1897

5. What are the data collection, reduction, and presentation techniques?

The mapped core data were entered on sheets showing the drilled intervals and the nature (roughness, planarity), orientation, infillings and coatings, and frequencies of rock joints or fractures. Drill core recovery information are filled on "Core Index Record Sheet" forms (copy available). Data reduction consist of calculating RQD, CI, joint sets and numbers, intact rock strength etc on printed forms. Data are presented in the form of bar diagrams, tables and graphs

5a. How can the raw numerical data be retrieved?

The data exist on hardcopies.

5b. How can all data reduction steps prior to data storage be independently checked and/or duplicated?

The data reduction steps are are somewhat disjoined and documentation is not available for each step

5c. Are the data presented in a complete and clear format? (Comment also on the utility of the presentation.)

The raw data sheets are somewhat unclear and lack organization. The data presentation is clear, however, not as complete as could be expected.

5d. Are the data keyed to geological, environmental, and other experimental conditions?

The data are directly from the site

5e. Are the data traceable to a written procedure?

No

5f. Comments.

See comments in section 10.

Reviewer S. Bhattacharyya

Date 7/20/84

6. What techniques are involved in analyzing and interpreting the data?
Schmidt plots were prepared for oriented core data. Fracture frequencies were plotted against drift inclination on a vertical plane. These plots were derived by manipulation of raw fracture data using Terzaghi* and Hudson** analysis. Planarity and fracture coatings and fillings were characterized on the basis of the percentage of core in each horizon

6a. What empirical techniques? falling within each category eg. nonplanar/planar. clay, quartz, MnO_2 coatings.

All techniques are essentially empirical More information on these techniques are available in SAND 82-2084.

6b. What analytical techniques?

None

6c. What numerical techniques?

None

6d. Comments.

** Hudson, J.A et al., "Discontinuities and Rock Mass Geometry", Int. J. of Rock Mech. Min Sci, V. 16, p. 339-362, 1979.

* Terzaghi, R.D., "Sources of Error in Joint Surveys," Geotechnique 15: p. 287-304, 1965.

Reviewer S. Chattopadhyay

Date 7/20/84

7. What computer programs are used in collecting, reducing, storing, presenting, and analyzing the data?

A Schmidt-plot equal area plot program was used for joint orientation determination. Name of the code was not available

7a. How are these programs verified, validated, documented, and controlled?

no information was available

7b. Comments (for example, implicit assumptions, sensitivities, other comments).

N/A

Reviewer S. Chatterjee

Date 7/20/84

8. What are the acceptance/rejection criteria for the test data?

All data were presented. The only data that were rejected were during analysis phase presumably with adequate documentation.

8a. Were these criteria established prior to test development?

No.

8b. What is the logic behind the criteria?

Some isolated data that fit in within the ranges of parameter values were rejected. For rock fracture data this is not an inconsistent procedure.

8c. How are the criteria implemented? (Data handling, review procedure, corrective action.)

- Data Handling

- Review Procedure

  The rejection rationale are presumably documented and are available for review.

- Corrective Action

8d. Comments.

Reviewer S. Dinatale

Date 7/20/84

9. How are deviations from established procedures documented?

Not documented.

9a. What is the cause of the deviation?

Some of the procedures are developmental in type.

9b. How are deviations considered in data reduction and/or analyses?

Not known

9c. Is the use of deviated data controlled? (For example, not used withoug approval of system designer or authorized project manager.)

Not known

9d. Comments. (For example, equipment performance and its effect on test validity, other comments.)

The procedures used are derived from Bartoš and Bieniewski's works. However, many modifications were carried out in house. These are not adequately documented as yet but may be available in SAND 82-2034.

Reviewer [illegible]

Date 7/26/84

10. General comments (such as, relationship among different tests, impacts on interpretation, instrument redundancy, factors resulting in test closure, accuracy of measurements, limitations, additional uses of data, and other miscellaneous comments).

The results of rock classification are somewhat preliminary in nature. The largest shortcoming of the data presented was that all the ~~test~~ steps of data reduction and analysis are not clearly documented. Therefore, the flow of information between the raw data to the final ~~presentation~~ summary ~~are~~ is unclear. The final rock classification ratings were not presented and, therefore, no comments could be made by the reviewer on the adequacy of the interpretations.

The overall impression was that data reduction procedures need further clarification and documentation before the validity of the analyses can be commented upon.

4

Reviewer Cutler 7/20

Date

Draft Rock Mechanics Data Review Checklist
(Revision No. 0, January 18, 1984)

1. Name/type, identification number, and date of test.
Weapons testing seismic analyses

1a. What is the overall objective of the test?
Predicting ground motion as a function of yield + range.

1b. What specific parameters are to be determined by the test?

1c. Is there redundancy in the test concept?
No

1d. What criteria were used for test site (or sample) selection?
A range of rock/soil types and locations around NTS where holes are available.

1e. How is the rock at the test site characterized?
Roughly, but consistently.

1f. How was the test designed?

1g. Comments.

Reviewer C. Allen

Date 7/20

2. Is the procedure documented and complete, and is it in written form?

Procedure is documented in pub. doc's

2a. Is it a standard (ASTM) procedure? If yes, provide reference.

NA

2b. If non-"standard", how was the procedure developed, reviewed, documented, and approved? For example, COE, USBM, USBR, USGS, NBS, or other (internal) processes.

NA

2c. Have there been revisions and how and when were the revisions reviewed, documented, approved, and implemented?

2d. Comments.

Reviewer [illegible]

Date 7/20

3. How many of these tests have been performed?

114
53
164
21
240
550 Total

3a. According to what procedure revisions?

NA

3b. How may test results, obtained under different revisions, be compared?

Same test bar, 150 KT maximum. Older tests were larger and equipment used not as good. Data compared in this context.

3c. How many tests are in progress and which revision is in use?

Unknown

3d. How many tests are planned?

NA

3e. Comments.

Reviewer [illegible]

Date 7/20

4. What instrumentation is used for the test?

Most recent available.

~~Standard~~

4a. How were the reliabilities* of the instruments specified?

Instruments reliability and accuracy better than experimental error, are documented in Grace's (or natural variation)

4b. Is there a calibration system and were calibrations systematically carried out according to approved procedure?

Standard procedure for calibration of equipment is established + documented

4c. Are the calibrations traceable to national or industrial standards?

Yes

4d. Comments.

* Reliability is defined as the probability of an instrument to perform a stated function under a stated environment for a stated time.

Reviewer [illegible]

Date 7/20

5. What are the data collection, reduction, and presentation techniques?

Batch Processing

5a. How can the raw numerical data be retrieved?

Digitized from Analog

5b. How can all data reduction steps prior to data storage be independently checked and/or duplicated?

Plotted and checked against analog record.

5c. Are the data presented in a complete and clear format? (Comment also on the utility of the presentation.)

Yes.

5d. Are the data keyed to geological, environmental, and other experimental conditions?

Yes

5e. Are the data traceable to a written procedure?

Yes.

5f. Comments.

Data collection conditions rigorously recorded.

Reviewer C. Ho

Date 7/23

6. What techniques are involved in analyzing and interpreting the data?

6a. What empirical techniques?

Data plotted for accrd arrival time and noise filtered accordingly.

6b. What analytical techniques?

Equation derived which gives peak accel. as a function of yield + range.

6c. What numerical techniques?

Regression ~~tech~~ analysis gives above expression - with standard errors.

6d. Comments.

Also - data platians on alluvium separated from data on rock.

Reviewer [illegible]

Date 2/22

7. What computer programs are used in collecting, reducing, storing, presenting, and analyzing the data?

Data reduced by batch processing using standard ~~tables~~ procedures. Codes written in a structured way.

7a. How are these programs verified, validated, documented, and controlled?

Programs are not documented

7b. Comments (for example, implicit assumptions, sensitivities, other comments).

Processing consistency depends somewhat on having the same operators over a period of time

Reviewer [illegible]

Date 7/7[illegible]

8. What are the acceptance/rejection criteria for the test data?

The data are treated and analyzed/compared Three ways

I. All Data
II. Anomalous Data Rejected.
III. Yucca Mtn. Data Excluded.

8a. Were these criteria established prior to test development?

NO - NA

8b. What is the logic behind the criteria?

II. Anomalous data only anomalous ~~[illegible]~~ with respect to the derived regression equation. The reason for anomaly is type of rock.

III. Yucca data excluded because statistically more valid comparison of Yucca Mtn data to mean can be made.

8c. How are the criteria implemented? (Data handling, review procedure, corrective action.)

NA

- Data Handling

- Review Procedure

- Corrective Action

8d. Comments. The three approaches come at the analysis stage, all data ~~apparently~~ accepted after processing, if it can be processed at all. Instrumental errors are obvious in the field.

Reviewer [illegible]

Date 7/23

9. How are deviations from established procedures documented?

Procedures in S. Classified.

9a. What is the cause of the deviation?

9b. How are deviations considered in data reduction and/or analyses?

9c. Is the use of deviated data controlled? (For example, not used withoug approval of system designer or authorized project manager.)

9d. Comments. (For example, equipment performance and its effect on test validity, other comments.)

Reviewer _____

Date 7/20

10. General comments (such as, relationship among different tests, impacts on interpretation, instrument redundancy, factors resulting in test closure, accuracy of measurements, limitations, additional uses of data, and other miscellaneous comments).

5

5

Reviewer Mark Christianson

Date 7/20/84

Draft Rock Mechanics Data Review Checklist
(Revision No. 0, January 18, 1984)

1. Name/type, identification number, and date of test.
Rock mass Classification, Topopah Spring
USWG#1, UE25A#1, USWG#3/GU#3 USWG#4

1a. What is the overall objective of the test?
Assign relative qualitative assessment of rock

1b. What specific parameters are to be determined by the test?
RQD, fracture orientation, fracture planarity, fracture filling material

1c. Is there redundancy in the test concept?
data is collected from several boreholes in some formation

1d. What criteria were used for test site (or sample) selection?
Raw data were supplied by USGS

1e. How is the rock at the test site characterized?

1f. How was the test designed?
Classic to literature

1g. Comments.

Reviewer Mark Christiansen

Date 7/20/04

2. Is the procedure documented and complete, and is it in written form?

See Sand 82-2034 (Rock mass classification)

2a. Is it a standard (ASTM) procedure? If yes, provide reference.

RQD is a standard procedure "Rock mechanics in Engin practice" Stag + Zienkowitz (ed)

2b. If non-"standard", how was the procedure developed, reviewed, documented, and approved? For example, COE, USBM, USBR, USGS, NBS, or other (internal) processes.

fracture angle and Planarity data were supplied by USGS

2c. Have there been revisions and how and when were the revisions reviewed, documented, approved, and implemented?

No

2d. Comments.

Reviewer Mark Christian

Date 7/20/84

3. How many of these tests have been performed?
Data was collected for each 10' run for 5 boreholes in the potential repository horizons

3a. According to what procedure revisions?
NA

3b. How may test results, obtained under different revisions, be compared?
NA

3c. How many tests are in progress and which revision is in use?
none

3d. How many tests are planned?
Not for the EA

3e. Comments.

Reviewer Mark Christianson

Date 7/20/84

4. What instrumentation is used for the test?

None

4a. How were the reliabilities* of the instruments specified?

4b. Is there a calibration system and were calibrations systematically carried out according to approved procedure?

4c. Are the calibrations traceable to national or industrial standards?

4d. Comments.

* Reliability is defined as the probability of an instrument to perform a stated function under a stated environment for a stated time.

Reviewer Mark Christianson

Date 7/20/84

5. What are the data collection, reduction, and presentation techniques?

USGS soppplied the data, Sandia reduced the RQD data, and the fracture orientation. the rest are simply collected. Processes are discribed in SAND 82-2034

5a. How can the raw numerical data be retrieved?

from USGS Core Index record sheet

5b. How can all data reduction steps prior to data storage be independently checked and/or duplicated?

Yes, by going back to core stored by the USGS at NTS

5c. Are the data presented in a complete and clear format? (Comment also on the utility of the presentation.)

Some data is mislabeled (ie RQD for UE25A#1 1076'-1263')

5d. Are the data keyed to geological, environmental, and other experimental conditions?

Data is keyed to Borehole depths and stratigraphic member (ie Topopah Springs) but not to specific divisions with the member (ie vitrified, lithophysae)

5e. Are the data traceable to a written procedure?

would have to check with USGS

5f. Comments.

Reviewer Mark Christ

Date 7/20/84

6. What techniques are involved in analyzing and interpreting the data?

Empirical Techniques

6a. What empirical techniques?

All Rock classification Calculations are empirical

6b. What analytical techniques?

6c. What numerical techniques?

6d. Comments.

Reviewer Mark Christian

Date 7/00/84

7. What computer programs are used in collecting, reducing, storing, presenting, and analyzing the data?

Schmdt Plot program.

7a. How are these programs verified, validated, documented, and controlled?

Cannot be determined

7b. Comments (for example, implicit assumptions, sensitivities, other comments).

Reviewer Mark Christian

Date 7/20/84

8. What are the acceptance/rejection criteria for the test data?

All data are used
there is a criterion for rejecting core breaks which are thought to result from core handling rather than natural fractures.

8a. Were these criteria established prior to test development?

must ask USGS

8b. What is the logic behind the criteria?

Want to include natural fractures only

8c. How are the criteria implemented? (Data handling, review procedure, corrective action.)

Not available

- Data Handling
- Review Procedure
- Corrective Action

8d. Comments.

Reviewer Mark Christianson

Date 7/20/84

9. How are devfations from established procedures documented?

NA

9a. What is the cause of the deviation?

9b. How are deviations considered in data reduction and/or analyses?

9c. Is the use of deviated data controlled? (For example, not used withoug approval of system designer or authorized project manager.)

9d. Comments. (For example, equipment performance and its effect on test validity, other comments.)

Reviewer Mark Christiansen

Date 7/20/84

10. General comments (such as, relationship among different tests, impacts on interpretation, instrument redundancy, factors resulting in test closure, accuracy of measurements, limitations, additional uses of data, and other miscellaneous comments).

Procedures for data collection and fracture orientation data are only available from USGS. Sandia has no record of these procedures. Compilation of data and procedures followed by Sandia using the USGS supplied data is provided in Sand 82-2034. (which has been requested).

6

6

Reviewer P N Dutta.

Date 7/20/84

Draft Rock Mechanics Data Review Checklist
(Revision No. 0, January 18, 1984)

1. Name/type, identification number, and date of test.
Rock classification Data. Topopah Spring.
USGW #1 between 997 to 1250 ft depth — identified as horizon.

1a. What is the overall objective of the test?
Rock classification

1b. What specific parameters are to be determined by the test?
RQD, Fracture angle, Planarity, Fracture angle

1c. Is there redundancy in the test concept?
Data is collected from several boreholes.

1d. What criteria were used for test site (or sample) selection?
* Raw data came from USGS. — Primarily responsible for selecting the site.

1e. How is the rock at the test site characterized?
* USGS has done it.

1f. How was the test designed?
These data are primarily analyzed data based on USGS input.

1g. Comments.

Reviewer P. Dudt

Date 7/20/84

2. Is the procedure documented and complete, and is it in written form?

- Procedure for fracture mapping - w/o date and authors name - not applied for Topopah

2a. Is it a standard (ASTM) procedure? If yes, provide reference.

RQD is derived from the Core Index Record sheet provided by USGS.

Reference not available. Based on USGS data.

2b. If non-"standard", how was the procedure developed, reviewed, documented, and approved? For example, COE, USBM, USBR, USGS, NBS, or other (internal) processes.

Data from Core Index sheet has been used to determine RQD as per procedure being documented in a paper SAND82-2034

2c. Have there been revisions and how and when were the revisions reviewed, documented, approved, and implemented?

Procedure written in this paper similar preparation required above

2d. Comments.

→ Procedure for mapping is with USGS.

Reviewer PCDuke

Date 7/20/84

3. How many of these tests have been performed?

one

3a. According to what procedure revisions?

given in 2

3b. How may test results, obtained under different revisions, be compared?

N/A

3c. How many tests are in progress and which revision is in use?

N/A

3d. How many tests are planned?

NNO

3e. Comments.

Reviewer PN Dick

Date 7/20/84

4. What instrumentation is used for the test?

Primarily these data are from the field data – no instrument involved.

4a. How were the reliabilities* of the instruments specified?

N/A

4b. Is there a calibration system and were calibrations systematically carried out according to approved procedure?

N/A

4c. Are the calibrations traceable to national or industrial standards?

N/A

4d. Comments.

* Reliability is defined as the probability of an instrument to perform a stated function under a stated environment for a stated time.

Reviewer PURDUE

Date 7/20/84

5. What are the data collection, reduction, and presentation techniques?

Raw Data collected by USGS
USGS Data

5a. How can the raw numerical data be retrieved?

Can be retrieved from USGS

5b. How can all data reduction steps prior to data storage be independently checked and/or duplicated?

By recalculation

5c. Are the data presented in a complete and clear format? (Comment also on the utility of the presentation.)

& Complete data has not been presented. Hence no comment can be made.

5d. Are the data keyed to geological, environmental, and other experimental conditions?

Yes, But no data

5e. Are the data traceable to a written procedure?

No.

5f. Comments.

Reviewer Purdue

Date 7/20/84

6. What techniques are involved in analyzing and interpreting the data?

Core Index Formula (used by USGS)
= [(broken core + Core loss + 1/2 joints)/(total length of interval cored)] x 100

RQD = [Sum of all core lengths > 4 in /(total length of interval cored)] x 100

6a. What empirical techniques?

as above

6b. What analytical techniques?

N/A

6c. What numerical techniques?

N/A

6d. Comments.

N/A

Reviewer Pudrea

Date 7/20/84

7. What computer programs are used in collecting, reducing, storing, presenting, and analyzing the data?

N/A

7a. How are these programs verified, validated, documented, and controlled?

N/A

7b. Comments (for example, implicit assumptions, sensitivities, other comments).

N/A

Reviewer [illegible]

Date 7/20/84

8. What are the acceptance/rejection criteria for the test data?

N/A

8a. Were these criteria established prior to test development?

N/A

8b. What is the logic behind the criteria?

N/A

8c. How are the criteria implemented? (Data handling, review procedure, corrective action.)

N/A

- Data Handling

- Review Procedure

- Corrective Action

8d. Comments.

Reviewer Pugsley

Date 5/20/84

9. How are deviations from established procedures documented?

(None)

9a. What is the cause of the deviation?

N/A

9b. How are deviations considered in data reduction and/or analyses?

N/A

9c. Is the use of deviated data controlled? (For example, not used withoug approval of system designer or authorized project manager.)

N/A

9d. Comments. (For example, equipment performance and its effect on test validity, other comments.)

N/A

Reviewer [illegible]

Date 5/20/84

10. General comments (such as, relationship among different tests, impacts on interpretation, instrument redundancy, factors resulting in test closure, accuracy of measurements, limitations, additional uses of data, and other miscellaneous comments).

- The data reviewed is basically a derived data from the USGS core index sheet

- Core index sheets from USGS is not available for review.

(3)'

7

Thermal Conductivity
Terra Technical Corp.

Reviewer Ed Pettigrew

Date 7/19/84

Draft Rock Mechanics Data Review Checklist
(Revision No. 0, January 18, 1984)

1. Name/type, identification number, and date of test.
TTRD-LP-2 (Quality Assurance Program)
USWG4, 1155.4'

1a. What is the overall objective of the test?
Determination of thermal conductivity of rock as a function of temperature, confining pressure and saturation.

1b. What specific parameters are to be determined by the test?
Thermal Conductivity

1c. Is there redundancy in the test concept?
Same samples were recycled

1d. What criteria were used for test site (or sample) selection?
Criteria were written for thermal conductivity same criteria for thermal expansion and in cases rock samples were same.

1e. How is the rock at the test site characterized?
Characterized at site by USGS

1f. How was the test designed?
Test matrix for the above properties

1g. Comments.

Reviewer E. Pettijohn

Date

2. Is the procedure documented and complete, and is it in written form?
yes TTRD-LP-2 agreed to be furnished to NRC

2a. Is it a standard (ASTM) procedure? If yes, provide reference.
NO

2b. If non-"standard", how was the procedure developed, reviewed, documented, and approved? For example, COE, USBM, USBR, USGS, NBS, or other (internal) processes.
Internal process - compared to Standarized procedures on known material Reference furnished in QAP.

2c. Have there been revisions and how and when were the revisions revfewed, documented, approved, and implemented?
Str. of Criteria were incorporated and included as part of the QAP (Quality Assurance Program)

2d. Comments.

Revfewer C. Pittiglio

Date 7/19/84

3. How many of these tests have been performed?

100 tests performed

3a. According to what procedure revisions?

QAP established for test - NRC will receive a copy

3b. How may test results, obtained under different revisions, be compared?

Each revision is documented for each test conducted. Direct comparison

3c. How many tests are in progress and which revision is in use?

NONE

3d. How many tests are planned?

NONE

3e. Comments.

Reviewer C. Pittiglio

Date 2/19/84

4. What instrumentation is used for the test?

Confining pressure vessel, heater pipe assembly (non standard tests in QAP)

4a. How were the reliabilities* of the instruments specified?

No nonconformance sheets were received by Sandia however mechanism was established in QAP for nonconformance.

4b. Is there a calibration system and were calibrations systematically carried out according to approved procedure?

yes 1. Calibration procedures

2. Calibration checks

4c. Are the calibrations traceable to national or industrial standards?

~~N/A~~ Appendix to SAND 81-1873 for description

4d. Comments.

* Reliability is defined as the probability of an instrument to perform a stated function under a stated environment for a stated time.

Reviewer C. L. Pettigrew

Date 7/19/84

5. What are the data collection, reduction, and presentation techniques?

test procedures for data collection
data reduction - curve fit to raw data
(raw data saved)

5a. How can the raw numerical data be retrieved?

Stored on Magnetic Tape at T.T.

5b. How can all data reduction steps prior to data storage be independently checked and/or duplicated?

Retrieve raw data and run
indepent check.

5c. Are the data presented in a complete and clear format? (Comment also on the utility of the presentation.)

Yes Clearly document and referenced

5d. Are the data keyed to geological, environmental, and other experimental conditions?

yes Keyed to depth and geologic unit.
other experimental condition are listed on individual
data sheets

5e. Are the data traceable to a written procedure?

yes ~~trac~~ changes on procedure for
data are included in QAP
(Ltr of criteria)

5f. Comments:

Reviewer [signature]

Date 2/19/84

6. What techniques are involved in analyzing and interpreting the data?

Series of equations for curve fit
Standard equation for curve
Sand 81-1873 page 27 for equation

6a. What empirical techniques?

NA

6b. What analytical techniques?

Curve fit see 6

6c. What numerical techniques?

see 6

6d. Comments.

Reviewer C L Pottiglio

Date 7/19/84

7. What computer programs are used in collecting, reducing, storing, presenting, and analyzing the data?

Software was prepared by Tera Tech and classified as proprietary, presently unavailable. NRC is requesting through Sandia

7a. How are these programs verified, validated, documented, and controlled?

Tera Tech verified by running program on stand materials to determine validity. Documentation is incomple. Changes to Software covered 1.1 QA.

7b. Comments (for example, implicit assumptions, sensitivities, other comments).

Reviewer C. L. Pettey/CO

Date 7/19/84

8. What are the acceptance/rejection criteria for the test data?

See LP-2, page 72 of QAP

8a. Were these criteria established prior to test development?

Appendix Sand 81-1873 for rejection criteria

8b. What is the logic behind the criteria?

Procedures to Establish to a level of accuracy

8c. How are the criteria implemented? (Data handling, review procedure, corrective action.)

N A

- Data Handling
- Review Procedure
- Corrective Action

8d. Comments.

Reviewer C L Pdleylo

Date 7/19/84

9. How are deviations from established procedures documented?

Required to fill out non conformance sheets

9a. What is the cause of the deviation?

None

9b. How are deviations considered in data reduction and/or analyses?

deviation are document on non conformance sheets

9c. Is the use of deviated data controlled? (For example, not used withoug approval of system designer or authorized project manager.)

Yes Evaluated on individual basis by Sandia personnel

9d. Comments. (For example, equipment performance and its effect on test validity, other comments.)

Reviewer C. Pittyla

Date 7/19/84

10. General comments (such as, relationship among different tests, impacts on interpretation, instrument redundancy, factors resulting in test closure, accuracy of measurements, limitations, additional uses of data, and other miscellaneous comments).

Additional Test Data examined

USW G 2 2055.0' (Calico Hills)

SDH 3 G Tunnel (2.0'-2.5') Tunnel Bed 5

USW G 2 1639.0'

(1) 8

Reviewer Naiem S Tanbouy

Date July 18, 1984

Draft Rock Mechanics Data Review Checklist
(Revision No. 0, January 18, 1984)

1. Name/type, identification number, and date of test. → 2/18/82
Barry Schwartz → ran the test
Hole USWG1 - Depth interval 1047.1 ft, sample length 1.000 inch
(209) convenient number cross reference

Ia. What is the overall objective of the test?
To determine the coefficient of thermal expansion under unconfined conditions (No stress applied)

Ib. What specific parameters are to be determined by the test?
Negative expansion or contraction of tuff
Negative hysteresis
thermal coefficient of expansion

Ic. Is there redundancy in the test concept?
yes some tests were repeated

Id. What criteria were used for test site (or sample) selection?
samples were selected by tuff mineralization, USGS supplied the whole core from which samples at Sandia were selected for thermal testing

Ie. How is the rock at the test site characterized?
selected different tuffs (welded) - Fenix & Scission geologist characterized the core under supervision from USGS

If. How was the test designed?
Theta ~~Diltatometer~~ Diltometer was purchased - modified slightly to run the test

Ig. Comments.
The tests we saw were very well documented

Reviewer Nalini Tumkur

Date 7/18/84

2. Is the procedure documented and complete, and is it in written form?

QAP XI-5 Rev A thru C

2a. Is it a standard (ASTM) procedure? If yes, provide reference.

yes it is ASTM - modified slightly
Standard
test

2b. If non-"standard", how was the procedure developed, reviewed, documented, and approved? For example, COE, USBM, USBR, USGS, NBS, or other (internal) processes.

NA

2c. Have there been revisions and how and when were the revisions reviewed, documented, approved, and implemented?

QAP XI - 5 Revisions

2d. Comments.

Reviewer Naeem Tanious

Date 7/18/84

3. How many of these tests have been performed?

409 (including calibration tests)
tests

3a. According to what procedure revisions?

QAP XI-B Rev A thru C

3b. How may test results, obtained under different revisions, be compared?

3c. How many tests are in progress and which revision is in use?

None - these were run in 82

3d. How many tests are planned?

Tests are completed at this stage. The tests were run from 1980 to 1982 - However it is indefinite as how many tests, if any will be conducted

3e. Comments.

Reviewer Nalem Tanlong

Date 7/18/84

4. What instrumentation is used for the test?

Theta Diltametes model 820

4a. How were the reliabilities* of the instruments specified?

100 % - machine never failed

4b. Is there a calibration system and were calibrations systematically carried out according to approved procedure?

platinum rod 1 inch long
the whole system was calibrated

4c. Are the calibrations traceable to national or industrial standards?

National Bureau of Standards → NBS platinum calibration - referred to in the theta manual

4d. Comments.

* Reliability is defined as the probability of an instrument to perform a stated function under a stated environment for a stated time.

100/MSN/84/01/17/1

4

Reviewer Nalen Tanious

Date 7/18/84

5. What are the data collection, reduction, and presentation techniques?

5a. How can the raw numerical data be retrieved?

they are in files at Sandia - these are data sheets of X, Y plots from the test recorder.

5b. How can all data reduction steps prior to data storage be independently checked and/or duplicated?

Not applicable
Data was reduced after storage

5c. Are the data presented in a complete and clear format? (Comment also on the utility of the presentation.)

yes - they are plots

5d. Are the data keyed to geological, environmental, and other experimental conditions?

yes - they are keyed to the geologic core

5e. Are the data traceable to a written procedure?

yes

5f. Comments.

the data on the thermal coefficient of expansion is in excellent documentation and can be traced very easily

Reviewer Valerie Cannon

Date 7/18/84

6. What techniques are involved in analyzing and interpreting the data?
the data in raw form

6a. What empirical techniques?
refer to Memo by Schwartz

6b. What analytical techniques?

6c. What numerical techniques?

6d. Comments.

Reviewer Naiem Tanious

Date 7/18/84

7. What computer programs are used in collecting, reducing, storing, presenting, and analyzing the data?

None

7a. How are these programs verified, validated, documented, and controlled?

Not applicable

7b. Comments (for example, implicit assumptions, sensitivities, other comments).

Reviewer Valerie Tarkow

Date 7/18/84

8. What are the acceptance/rejection criteria for the test data?
Data was rejected because of equipment calibration discrepancy - mostly when the equipment show error far in excess of 2.5 %

8a. Were these criteria established prior to test development?

QAP-XI 5 A thru C

8b. What is the logic behind the criteria?
reasonable equipment performance within the 2.5 % / Variability in geologic data is much greater than the 2.5 %

8c. How are the criteria implemented? (Data handling, review procedure, corrective action.)

- Data Handling
- Review Procedure
- Corrective Action

} these are all included in QAP XI-5 Section 6.2

8d. Comments.

Reviewer Valerie Tanicus

Date 7/18/84

9. How are deviations from established procedures documented?

None

9a. What is the cause of the deviation?

NA

9b. How are deviations considered in data reduction and/or analyses?

NA

9c. Is the use of deviated data controlled? (For example, not used withoug approval of system designer or authorized project manager.)

NA

9d. Comments. (For example, equipment performance and its effect on test validity, other comments.)

Reviewer Narim Tanbour

Date 7/18/84

10. General comments (such as, relationship among different tests, impacts on interpretation, instrument redundancy, factors resulting in test closure, accuracy of measurements, limitations, additional uses of data, and other miscellaneous comments).

In addition to the test selected randomly and which was identified in the front sheet of this check list, the following tests were also checked and selected randomly:

1. Data sheet USGW-1 – 446.8' (2/26/82)
2. " " VE25a #1 1718.2' (5/4/82)
3. " " USW G-2 2498' (3/24/82)
4. " " UE 25a #1, 1366.5' (4/21/82)
5. " " USW G-1 3085 (2/25/82)
6. " " USW G-1 1362.4' (3/1/83) time dependent
7. " " USW G-1 1151.1' (12/15/82) time dependent
8. " " USW G-1 1763.2 (11/8/82) " "
9. " " USW G-1 2320.3 (8/17/82)

the data sheets for the 10 tests will be taken back to NRC - Waste Managment Division.

(2)

9

Reviewers Narim Tamiory and Larry Pottiglio
Ed Hollop

Date 7/19/84

Draft Rock Mechanics Data Review Checklist
(Revision No. 0, January 18, 1984)

1. Name/type, identification number, and date of test.
TTRD-LP-3 Thermal expansion test → Test Procedure
Test ID: USWG4 1172' Topopah spring unit
No date on the test - these tests were run by Terratek under contract with Sandia

1a. What is the overall objective of the test?
Determine the thermal coefficient of expansion under hydrostatic pressure, Pore Pressure, temperature, and saturation

1b. What specific parameters are to be determined by the test?
Thermal expansion coefficient

1c. Is there redundancy in the test concept?
Some redundancy were done - some samples were cycled - that is ran the same test

1d. What criteria were used for test site (or sample) selection?
sampling of every interval (30-50 ft) within the geologic unit - at least one sample per interval

1e. How is the rock at the test site characterized?
at the test site by USGS based on lithological description

1f. How was the test designed?
To answer the variability expected in the above variables (Pore Pressure, temp., saturation, and hydrostatic

1g. Comments.

Larry Pistiglio
Ed ~~Hollow~~

Reviewers Nelson Tanlong

Date 7/19/84

2. Is the procedure documented and complete, and is it in written form?

yes - a copy will be supplied to NRC
TTRD-LP-3

2a. Is it a standard (ASTM) procedure? If yes, provide reference.

No - it is not ASTM

2b. If non-"standard", how was the procedure developed, reviewed, documented, and approved? For example, COE, USBM, USBR, USGS, NBS, or other (internal) processes.

it falls under ~~under~~ internal process - that is developed by cooperation between Sandia and Terratek and covered in the letter of criteria which establishes the procedure

2c. Have there been revisions and how and when were the revisions reviewed, documented, approved, and implemented?

letters of criteria - they are in QAP

2d. Comments.

Ed Hollop
Larry Pittiglio
Reviewers Valerie Carlson

Date 7/19/84

3. How many of these tests have been performed?

59 tests

3a. According to what procedure revisions?
every series was run a little differently because of the parameters - but the overall ~~the QAP~~ procedure is in the QAP

3b. How may test results, obtained under different revisions, be compared?
each revision is documented for each test so the comparison is made directly

3c. How many tests are in progress and which revision is in use?

None

3d. How many tests are planned?

None

3e. Comments.
After analysis of the data there may be a need for more tests

Larry Pottiglio
Ed. Hollop

Reviewers Nelene Cantous

Date 7/19/84

4. What instrumentation is used for the test?

1) Dilatometer modified for the test (Non standard item)
2) XY recorders
3) confined vessel

4a. How were the reliabilities* of the instruments specified?

Sandia never received any non conformance sheets in which instrument failure or malfunction had been reported - also no verbal communication with terratek indicated reliability problems

4b. Is there a calibration system and were calibrations systematically carried out according to approved procedure?

yes - calibration systems and were carried out according to procedure

4c. Are the calibrations traceable to national or industrial standards?

yes traceable to NBS standards

4d. Comments.

* Reliability is defined as the probability of an instrument to perform a stated function under a stated environment for a stated time.

Ed Hollop
Doug Pittiglio

Reviewers Nalini Tanlons

Date 7/19/84

5. What are the data collection, reduction, and presentation techniques?

No data reduction

plots of different parameters

5a. How can the raw numerical data be retrieved?

stored on Mag tape at Terratek
tape is indexed and referenced

5b. How can all data reduction steps prior to data storage be independently checked and/or duplicated?

NA

5c. Are the data presented in a complete and clear format? (Comment also on the utility of the presentation.)

yes all graphs are clear

5d. Are the data keyed to geological, environmental, and other experimental conditions?

yes
depth

yes
- temp
- pressure
- time, pore press, saturation

5e. Are the data traceable to a written procedure?

yes - any variation in the sequence are documented in the letters of criteria

5f. Comments.

Larry Pittiglio
Ed Wallop

Reviewers Nelson Tamions

Date 7/19/84

6. What techniques are involved in analyzing and interpreting the data?

50% analyzed – getting α
Interpretation – None yet

6a. What empirical techniques?

standard definition of $\alpha = \frac{\Delta L}{L \Delta t}$

6b. What analytical techniques?

NA

6c. What numerical techniques?

None

6d. Comments.

Larry Pittiglio
Ed Mollop

Reviewers Nirens Tanions

Date 7/19/84

7. What computer programs are used in collecting, reducing, storing, presenting, and analyzing the data?

only computer programs are the ones used to run and control the test equipment

No Programs for the data - the data were stored on Mag tape

7a. How are these programs verified, validated, documented, and controlled?

NA

7b. Comments (for example, implicit assumptions, sensitivities, other comments).

NA

Ed Hollop
Larry Pittiglio

Reviewers Nilum Canions

Date 7/19/84

8. What are the acceptance/rejection criteria for the test data?
there are rejection criteria in the QAP

8a. Were these criteria established prior to test development?
yes they were developed as part of the test - prior to testing

8b. What is the logic behind the criteria?
procedure to define the level of accuracy

8c. How are the criteria implemented? (Data handling, review procedure, corrective action.)
they are established in the QAP which were followed

- Data Handling

- Review Procedure

- Corrective Action

8d. Comments.

Larry Attiglio
Ed Hollop

Reviewers Nilem Cantoris

Date 7/19/84

9. How are deviations from established procedures documented?

fill the non conformance sheets as established in QAP

9a. What is the cause of the deviation?

malfunction of components (see rejection criteria list provided by Sandia)

9b. How are deviations considered in data reduction and/or analyses?

deviations are documented in the non-conformance sheets

9c. Is the use of deviated data controlled? (For example, not used withoug approval of system designer or authorized project manager.)

9d. Comments. (For example, equipment performance and its effect on test validity, other comments.)

Ed Hollop
Larry Pettigrew

Reviewers Nanini Tanlong

Date 7/19/84

10. General comments (such as, relationship among different tests, impacts on interpretation, instrument redundancy, factors resulting in test closure, accuracy of measurements, limitations, additional uses of data, and other miscellaneous comments).

Copies of the following are attached to this checklist:

1) ~~Data sheets for~~ QAP TTRD-LP-3
2) ASTM standards
3) Data sheets VSW G-4 1172' top of Pah spring
4) " " U12G-HB/MPBX1-9 feet G tunnel
5) " " USWG-1 2562'
6) Portions of QAP relevant to this test

(3)

10

Reviewer Nalini Tandons

Date 7/19/84

Draft Rock Mechanics Data Review Checklist
(Revision No. 0, January 18, 1984)

1. Name/type, identification number, and date of test.
Thermal Conductivity
TTRD-LP-2, Terratek corporation, Salt Lake City
USW-G4 1155.4'

1a. What is the overall objective of the test?
Determination of thermal conductivity as a function of temp, Pressure (confining), and saturation

1b. What specific parameters are to be determined by the test?
thermal conductivity

1c. Is there redundancy in the test concept?
Some samples were cycled more than once (repeated the test)

1d. What criteria were used for test site (or sample) selection?
Same criteria used for thermal expansion coefficient the rock samples for this test were in many cases the same - Interval in borehole was sampled every at least one every (30-50) feet

1e. How is the rock at the test site characterized?
by USGS

1f. How was the test designed?
A test matrix was designed to answer variability in the variability in the above parameters

1g. Comments.

Reviewer Valerie Collins

Date 7/19/84

2. Is the procedure documented and complete, and is it in written form?

2a. Is it a standard (ASTM) procedure? If yes, provide reference.

No it is not

2b. If non-"standard", how was the procedure developed, reviewed, documented, and approved? For example, COE, USBM, USBR, USGS, NBS, or other (internal) processes.

was adopted from 2-3 articles in the literature - these are referenced in the QAP

2c. Have there been revisions and how and when were the revisions reviewed, documented, approved, and implemented?

Only through the letters & criteria which are part of the QAP

2d. Comments.

Reviewer Narina Tamons

Date 7/19/84

3. How many of these tests have been performed?

100 Tests

3a. According to what procedure revisions?

same overall QAP - however some changes were used depending on the parameters

3b. How may test results, obtained under different revisions, be compared?

direct comparison - each revision was documented in the letter of criteria

3c. How many tests are in progress and which revision is in use?

None

3d. How many tests are planned?

None at this time

3e. Comments.

Reviewer Nolan Cannons

Date 7/19/84

4. What instrumentation is used for the test?

- confining pressure vessel
- heater probe assembly

Non-standard tests documented

4a. How were the reliabilities* of the instruments specified?

No non-conformance sheets were received from Terratek

4b. Is there a calibration system and were calibrations systematically carried out according to approved procedure?

yes

4c. Are the calibrations traceable to national or industrial standards?

No - but see SAND 81-1873 Appendix

4d. Comments.

* Reliability is defined as the probability of an instrument to perform a stated function under a stated environment for a stated time.

Reviewer Noreen Tamura

Date 7/19/84

5. What are the data collection, reduction, and presentation techniques?

test procedures for the data collection
had some data reduction - curve fit done automatically to raw data
presentation is plots

5a. How can the raw numerical data be retrieved?

Data stored on tape at Terratek

5b. How can all data reduction steps prior to data storage be independently checked and/or duplicated?

retrieve data (raw) and curve fit it to independently check

5c. Are the data presented in a complete and clear format? (Comment also on the utility of the presentation.)

yes - the graphs are all clear

5d. Are the data keyed to geological, environmental, and other experimental conditions?

yes these are listed on the data sheet — depth and geologic units

5e. Are the data traceable to a written procedure?

yes - QAP but any changes are traceable through the letters of criteria

5f. Comments.

Reviewer Narim Tamony

Date 7/19/84

6. What techniques are involved in analyzing and interpreting the data?

there are sides of equations ~~the~~ that should fit the data – ~~these equations will be supplied by NRC~~ they were found in SAND 81-1873 Page 27

6a. What empirical techniques?

NA

6b. What analytical techniques?

see 6 above – yes analytical see SAND 81-1873 Page 27

6c. What numerical techniques?

See 6 above – yes to curve fit

6d. Comments.

Reviewer William Tarbox

Date 7/19/84

7. What computer programs are used in collecting, reducing, storing, presenting, and analyzing the data? The software prepared by TerraTek is not available and Sandia has stated that TerraTek considers this proprietary - NRC is requesting the software

7a. How are these programs verified, validated, documented, and controlled?

see 7, they (TerraTek) run the program on standard materials according to Sandia

7b. Comments (for example, implicit assumptions, sensitivities, other comments).

Reviewer Narein Tanvirs

Date 7/19/84

8. What are the acceptance/rejection criteria for the test data?

No acceptance/rejection criteria in the test procedure (Page 72), See SAND81-1873 Appendix for ~~[illegible]~~ further description

8a. Were these criteria established prior to test development?

8b. What is the logic behind the criteria?

8c. How are the criteria implemented? (Data handling, review procedure, corrective action.)

N/A

- Data Handling

- Review Procedure

- Corrective Action

8d. Comments.

Reviewer Valeri Tremont

Date - 7/19/84

9. How are deviations from established procedures documented?

there were no deviations in the procedures

however whenever problems in the equipment that caused deviations

by filling non conformance sheets

9a. What is the cause of the deviation?

None

9b. How are deviations considered in data reduction and/or analyses?

9c. Is the use of deviated data controlled? (For example, not used withoug approval of system designer or authorized project manager.)

yes - Sandia evaluated the non-conformance sheets

9d. Comments. (For example, equipment performance and its effect on test validity, other comments.)

Reviewer Nilima Tanjore

Date 7/19/84

10. General comments (such as, relationship among different tests, impacts on interpretation, instrument redundancy, factors resulting in test closure, accuracy of measurements, limitations, additional uses of data, and other miscellaneous comments).

(4)

11

Reviewer Nalim Tanious

Date 7/19/84 Larry Pittiglio John Cutter

Draft Rock Mechanics Data Review Checklist
(Revision No. 0, January 18, 1984)

1. Name/type, identification number, and date of test.

RAP 6, 9, 10 and SAND-83-1327 (1984)
USW-GU-3 (923.75'-924.1'), 8/2/82
Bulk Properties by Sandia, Terra Tek, and Holmes & Narver
Depth

1a. What is the overall objective of the test?

to determine the percent moisture content, degree of saturation, and porosity - Also to measure these 3 properties; grain density, dry bulk density, natural state or saturated bulk density

1b. What specific parameters are to be determined by the test?

Same as 1a - give range of error with the parameter

1c. Is there redundancy in the test concept?

~~No the test was run once~~
tests were not repeated on the same specimen but samples were taken right next to Sandia's sample and were provided to Homestead Narver

1d. What criteria were used for test site (or sample) selection?

Sandia selected the samples based on depth interval

1e. How is the rock at the test site characterized?

was characterized by USGS

1f. How was the test designed?

to determine the above properties according to a slightly modified ASTM procedures to allow for the tuffaceous rocks

1g. Comments.

Reviewer Naiem Tanious
Larry Pitigho
John Cutter

Date 7/19/84

2. Is the procedure documented and complete, and is it in written form?

QAP 6, 9, and 10 included the test procedures they are in a written form and will be supplied to NRC

2a. Is it a standard (ASTM) procedure? If yes, provide reference.

yes - modified to fit the tuff rock, list of ASTM, ISRM will be supplied to NRC the change is to account for the hygroscopic & low permeability rocks

2b. If non-"standard", how was the procedure developed, reviewed, documented, and approved? For example, COE, USBM, USBR, USGS, NBS, or other (internal) processes.

~~letter of criteria was used to document~~

50 % standard
50 % developed, reviewed at Sandia

2c. Have there been revisions and how and when were the revisions reviewed, documented, approved, and implemented?

revisions were reviewed and documented in the letters of criteria to Terratek which become part of the QAP

2d. Comments.

Quartz sand used for calibration, very high standards are maintained

100/MSN/84/01/17/1

2

Reviewer Jim Tanious
Larry Pittiglio
~~John Cutler~~

Date 7/19/84

3. How many of these tests have been performed?

185 tests on the topopah spring
it is estimated that between Sandia, Terratek, and Homes and Narver - 1000 tests were run for the bulk properties

3a. According to what procedure revisions?

according to QAP procedure and letters of criteria

3b. How may test results, obtained under different revisions, be compared?

each revision was documented in the letter of criteria

3c. How many tests are in progress and which revision is in use?

12 tests are in progress last week - None at the present time

3d. How many tests are planned?

None are specifically planned at this time but definitely there will be more tests from the new boreholes and exploratory shaft

3e. Comments.

Reviewer Nalem Carrions, Larry Pittiglio, John Cather

Date 7/19/84

4. What instrumentation is used for the test?

- water pycnometer
- stainless steel or maginisium
- balance

See testing procedures sheets

4a. How were the reliabilities* of the instruments specified?

calibrated according to the QAP

4b. Is there a calibration system and were calibrations systematically carried out according to approved procedure?

both the calibration system and the calibrations were according to QAP

4c. Are the calibrations traceable to national or industrial standards?

NBS materials were used - yes it traceable

4d. Comments.

* Reliability is defined as the probability of an instrument to perform a stated function under a stated environment for a stated time.

Reviewer Nairn Tanious
Larry Pittiglio, John Cutter

Date 7/19/84

5. What are the data collection, reduction, and presentation techniques?

Calculation of density, Porosity, ... Etc
Presentation is in the form

5a. How can the raw numerical data be retrieved?

Go to the central files and obtain it.
they are making copies of the data stored in a separate location

5b. How can all data reduction steps prior to data storage be independently checked and/or duplicated?

raw data can be retrieved and independent checks run

5c. Are the data presented in a complete and clear format? (Comment also on the utility of the presentation.)

Yes - all given in tables

5d. Are the data keyed to geological, environmental, and other experimental conditions?

Yes depth and geologic unit are keyed
Experimental conditions are traced back to QAP

5e. Are the data traceable to a written procedure?

Same as 5d

5f. Comments.

Larry Pittiglio
John Cutter.

Reviewer Nalem Cantons

Date 7/19/84

6. What techniques are involved in analyzing and interpreting the data?

these are basic data and used as is or to support other modeling or similiar activities

6a. What empirical techniques?

NA

6b. What analytical techniques?

NA

6c. What numerical techniques?

NA

6d. Comments.

Larry Pettiglio
John Cutler

Reviewer Nalem Tanions

Date 7/19/84

7. What computer programs are used in collecting, reducing, storing, presenting, and analyzing the data?

No computer Programs were used

7a. How are these programs verified, validated, documented, and controlled?

None - NA

7b. Comments (for example, implicit assumptions, sensitivities, other comments).

Craig Pettiglio
John Cutler

Reviewer Allen Carlson

Date 7/19/84

8. What are the acceptance/rejection criteria for the test data?

each section of the QAP has its own acceptance /rejection criteria

8a. Were these criteria established prior to test development?

based on trial and error procedures

8b. What is the logic behind the criteria?

Most rigorous practicable criteria has been used without getting error range of variation in the natural

8c. How are the criteria implemented? (Data handling, review procedure, corrective action.)

They were incorporated in the QAP procedures and were followed

- Data Handling
- Review Procedure
- Corrective Action

} same as above

8d. Comments.

Valerie Tarrious
Larry Pettiglio

Reviewer John Cutler

Date 7/19/83

9. How are deviations from established procedures documented?

No deviations from Procedures - ~~however there were few cases where the oven's thermometer may have been slightly off~~

9a. What is the cause of the deviation?

~~Operators error~~ NA

9b. How are deviations considered in data reduction and/or analyses?

Not applicable
data was rejected at the source in Terratek

9c. Is the use of deviated data controlled? (For example, not used withoug approval of system designer or authorized project manager.)

Data Not used

9d. Comments. (For example, equipment performance and its effect on test validity, other comments.)

tests were conducted based on good laboratory Procedures

Reviewers Nelson Tanious
Larry Pittiglio
Date 7/19/84

10. General comments (such as, relationship among different tests, impacts on interpretation, instrument redundancy, factors resulting in test closure, accuracy of measurements, limitations, additional uses of data, and other miscellaneous comments).

There are additional Data sheets.

1. Tables ~~&~~ (in Barry Schwartz Memo) USWGU 3

2.

(1) 12

Reviewer PR Dutta

Date 7/19/84

- Draft Rock Mechanics Data Review Checklist
(Revision No. 0, January 18, 1984)

1. Name/type, identification number, and date of test.

Frictional Properties Test on artificial surfaces.
Test no. RFT 001, NNWSI sample ntbd. no. 16B-AA/16B-CC, 7/12/84
Experimenter: OLSSON.

1a. What is the overall objective of the test?

To determine effect of normal stress on joint closure and finally to correlate the normal and shear stress permeability.

1b. What specific parameters are to be determined by the test?

1) Normal joint stiffness. — (Not done yet)
2) Coefficient of friction — 1 result obtained to date.
(Analysis not completed → Raw data consists of Torque vs angle of twist.

1c. Is there redundancy in the test concept?

No

1d. What criteria were used for test site (or sample) selection?

Sample collected from Topopah Spring formation located at Busted Butte.

1e. How is the rock at the test site characterized?

Characterized Busted Butte location (outcrop).
USGS characterized the site, not Sandia.

1f. How was the test designed?

By Sandia — Bill Olson. This is at developmental stage. The test technique is being probed and limits and ranges of loading are being explored.

1g. Comments.

Not a standard test. Conceived by Sandia. Data will help determining relationship between normal stress and permeability through joints — Not known now how ...

Reviewer PaDutta

Date 7/19/84

2. Is the procedure documented and complete, and is it in written form?

No

2a. Is it a standard (ASTM) procedure? If yes, provide reference.

No

2b. If non-"standard", how was the procedure developed, reviewed, documented, and approved? For example, COE, USBM, USBR, USGS, NBS, or other (internal) processes.

The procedure was conceived by experimenter, Olsson, although some work of this nature has been done by Univ. of Utah (Ref. Proc. 4th Rock Mech. Congress at Denver 1974) and by Kutter of Germany (1974)

2c. Have there been revisions and how and when were the revisions reviewed, documented, approved, and implemented?

Developmental stage. Under continuous change till first written procedure is developed.

2d. Comments.

Reviewer PWD

Date 7/19/84

3. How many of these tests have been performed?

One

3a. According to what procedure revisions?

No written procedure yet, no revision.

3b. How may test results, obtained under different revisions, be compared?

First procedure conceived by experimenter - and being developed.

3c. How many tests are in progress and which revision is in use?

First test has just been completed. Data not analyzed.

3d. How many tests are planned?

No definite number.

3e. Comments.

Scoping type of experiment

Reviewer Pu Dutt.

Date 7/18/84

4. What instrumentation is used for the test?

MTS - Tension - Torsion - Compression Testing machine designed by MTS for metallurgical/mechanical Testing complete with Load Cells, LVDT, Rotary Voltage Differential Transformer, Slip gage for joint-slip measurement.

4a. How were the reliabilities* of the instruments specified?

All instruments are calibrated.
Complete calibration data requested by reviewer (Dutt)

4b. Is there a calibration system and were calibrations systematically carried out according to approved procedure?

Approved calibration procedure exists.

4c. Are the calibrations traceable to national or industrial standards?

Traceable to NBS

4d. Comments.

Calibration data will be provided.

* Reliability is defined as the probability of an instrument to perform a stated function under a stated environment for a stated time.

Reviewer PNDutt.

Date 7/19/84

5. What are the data collection, reduction, and presentation techniques?

Collection — Sensor output voltage to A/D converter output in voltage ~~to computer and computer prints out digital data and x-y plot data~~. → computed as data are stored in computer

5a. How can the raw numerical data be retrieved?

Raw data as stored by the computer on disc can be retrieved. Also hard copy kept in file.

5b. How can all data reduction steps prior to data storage be independently checked and/or duplicated?

Data can be reduced but only raw data (as parameter ~~voltage~~) is stored in computer.

5c. Are the data presented in a complete and clear format? (Comment also on the utility of the presentation.)

The data in its present form does not clearly show what is the coefficient of friction without further analysis and assumption.

5d. Are the data keyed to geological, environmental, and other experimental conditions?

No

5e. Are the data traceable to a written procedure?

No

5f. Comments.

Reviewer PuDutt

Date 7/19/84

6. What techniques are involved in analyzing and interpreting the data?

Measuring Torque and slip (in angle) at first. The torque vs slip is plotted.

Torque (in-lb) $T = \frac{\pi T_f}{12(1-K^4)}\left[D_o^3 - D_i^3\right]$ where T_f = Friction stress (stress req'd for sliding)

D_o = Outside dia. of

D_i = Inside Dia cylinder (in.)

(Smith + Side Bottom — Mechanics of Deformable bodies)

K = Ratio of internal / external diameter.

$J = \frac{\pi R^4}{12}$

6a. What empirical techniques?

None

6b. What analytical techniques?

As per above eq.

6c. What numerical techniques?

None.

6d. Comments.

Reviewer PK Dutta

Date 7/19/84

7. What computer programs are used in collecting, reducing, storing, presenting, and analyzing the data?

Sandia's Standard laboratory program.
Sandia document no. SAND83-0646 Aug. 83.
by Holcomb D.J. and Jones, A.K.

7a. How are these programs verified, validated, documented, and controlled?

Documented by above document.
By System calibration can be done but not done for this test.

7b. Comments (for example, implicit assumptions, sensitivities, other comments).

Reviewer Pandita

Date 2/9/84

8. What are the acceptance/rejection criteria for the test data?

No results rejected.
Anomalies are recorded in data sheets

8a. Were these criteria established prior to test development?

None

8b. What is the logic behind the criteria?

—

8c. How are the criteria implemented? (Data handling, review procedure, corrective action.)

None to implement.

- Data Handling

- Review Procedure

- Corrective Action

8d. Comments.

Reviewer PWDuttc

Date 7/19/84

9. How are deviations from established procedures documented?

None

9a. What is the cause of the deviation?

Developmental test. Deviations if any will be considered in revising test procedure.

9b. How are deviations considered in data reduction and/or analyses?

9c. Is the use of deviated data controlled? (For example, not used withoug approval of system designer or authorized project manager.)

No. procedure exist now.

9d. Comments. (For example, equipment performance and its effect on test validity, other comments.)

No problem with equipment performance.

EF

Reviewer P. N. Dutta

Date 7/19/84

10. General comments (such as, relationship among different tests, impacts on interpretation, instrument redundancy, factors resulting in test closure, accuracy of measurements, limitations, additional uses of data, and other miscellaneous comments).

- Developmental test.
- Data will be important for N. Waste program.
- Only one data is available now.
- Analysis is not complete so coefficient of friction has not been calculated yet.

Raw Data package in NNWSI Friction Test file requested. can not be attached now - Sandia has not completed its review of this data for release at this time to NRC, As developmental data has limited use for supporting EA.

TORSIONAL SHEAR MEASUREMENTS OF THE FRICTIONAL PROPERTIES OF WESTERLY GRANITE

R.J. Christiansen, S.R. Swanson
W.S. Brown

p. 221-225

ROTARY SHEAR TESTING OF ROCK JOINTS

H.K. KUTTER

p. 254-262

BOTH: "ADVANCES IN ROCK MECHANICS"
3rd ISRM CONGRESS
Vol. II-A, 1974

(C) 13

Reviewer SWAPAN BHATTACHARYA

Date 7/19/84

Draft Rock Mechanics Data Review Checklist
(Revision No. 0, January 18, 1984)

I. Name/type, identification number, and date of test.

Triaxial compression test on Topopah Spring tuff, Sample Numbers G1-1163.6, G1-1154.9B, and G1-1189.0, run at 5 MPa, 5MPa, and 10 MPa respectively, on July 13, July 13, and July 14, 1982, resp., by Price.

1a. What is the overall objective of the test?

Confined compressive strength and elastic properties of the Topopah Spring unit.

1b. What specific parameters are to be determined by the test?

Confined compressive strength
Strain to failure
Young's modulus
Poisson's ratio
Bulk modulus (for some tests)

1c. Is there redundancy in the test concept?

None

1d. What criteria were used for test site (or sample) selection?

Availability of intact rock sample of adequate size, Samples selected by Al Lappin (and not by experimenter)

1e. How is the rock at the test site characterized?

Primarily on the basis of USGS core logs. At the lab test site the samples were examined for preexisting voids or fractures. Some of the cores were photographed before and after test.

1f. How was the test designed?

The tests were designed following prioritization of test parameters such as effect of water saturation, strain rate, confining pressure, and temperature. However, due to unavailability of samples of similar mineralogy and bulk properties not all the above test parameters were investigated in detail. The confining pressures were selected on the basis of expected lithologic stress conditions of the depth the samples were taken from.

1g. Comments.

Reviewer S. Bhattacharya

Date 7/19/84

2. Is the procedure documented and complete, and is it in written form?

Yes (Copy attached, Letter of Feb 24, 1984 by R.H. Price) and letter of July 20, 1983 by R.H. Price)

2a. Is it a standard (ASTM) procedure? If yes, provide reference.

Yes, a standard procedure for Sandia National Laboratory, Reference as above.

2b. If non-"standard", how was the procedure developed, reviewed, documented, and approved? For example, COE, USBM, USBR, USGS, NBS, or other (internal) processes.

Developed at Sandia National Laboratory for internal use (modified from ASTM and ISRM standards). Not formally reviewed by Sandia or other personnel. QA aspects have been reviewed in details.

2c. Have there been revisions and how and when were the revisions reviewed, documented, approved, and implemented?

No revisions

2d. Comments.

The formalized test procedure was not written up during the period of testing. However the test procedure adopted were claimed to be in force during the testing process.

Revfewer S. Bhattacharya

Date 7/19/84

3. How many of these tests have been performed?

Tiro Canyon : 3
Topopah Spring : 7
Prow Pass : 3
Calico Hills : 19
Bullfrog : 10
Tram : -

3a. According to what procedure revisions?

Based on same procedure (no revisions)

3b. How may test results, obtained under different revisions, be compared?

All were compared, since no revisions were involved.

3c. How many tests are in progress and which revision is in use?

None at present.

3d. How many tests are planned?

Approximately 40 test planned on Topopah Spring member in the next 6 months. No modifications of test parameters are planned.

3e. Comments.

Reviewer S. Bhattacharya

Date 7/19/84

4. What instrumentation is used for the test?

(1) MTS loading frame, 20 kips, 200 kips, 400 kips, 1,000 kips
(2) MTS load cells
(3) LVDT - axial strains (Schaevitz)
(4) Schuler gages - lateral strains
(5) Lateral deformation gages (using LVDTs or gage heads)
(6) Pressure cells (BLH cells for data and Heise gages for backup)

4a. How were the reliabilities* of the instruments specified?

Manufacturers of equipment specify the reliability of instruments over the range of test conditions. Most instruments are not subjected to varying environmental conditions.

4b. Is there a calibration system and were calibrations systematically carried out according to approved procedure?

A standard procedure for calibration is adopted for each instrument (Letter of Feb 24, 1984). Load cells calibrated annually by MTS, LVDTs are calibrated prior to each test series, at Sandia LVDTs are also calibrated before and after each test series using aluminium cylinder, Pressure cells calibrated annually by MTS, and Schuler gages and LDGs prior to each test series and against aluminium cylinder. Results of calibration reported in tabular form in SAND reports (eg SAND 82-1723)

4c. Are the calibrations traceable to national or industrial standards?

MTS calibrations are traceable to US Bureau of Standards

Sandia calibrations are made against a micrometer head, which in turn is calibrated against a standard displacement gage at the Calibration Division of SNL. (These standards are traceable to USBS)

4d. Comments.

Results of calibrations are included with test results in SAND 82-1723

* Reliability is defined as the probability of an instrument to perform a stated function under a stated environment for a stated time.

Reviewer S. Bhattacharya

Date 7/19/84

5. What are the data collection, reduction, and presentation techniques?

These are described in SAND 83-0646. Stresses are calculated by the load divided by original cross-sectional areas; strains are calculated by displacements / original gage lengths; strain rates are calculated by looking at axial strains against a real-time plot and using a least square fit. Data collection is fully computerized and digitized and presented in the form of tables and graph (see raw data sheets)

The data storage locations are also included in the raw data sheets.

5a. How can the raw numerical data be retrieved?

The raw data are filed systematically in boxes as hard copies. All data stored on floppy disks and can be accessed by identification code. Some recent data are further stored online on the VAX computer and can be readily accessed

5b. How can all data reduction steps prior to data storage be independently checked and/or duplicated?

The data are simultaneously recorded by a X-Y plotter, as a back-up to the digitized system. The operator may sometimes choose not to use the X-Y plotter if the computer system is functioning properly.

5c. Are the data presented in a complete and clear format? (Comment also on the utility of the presentation.)

Yes, they are complete and clear.

5d. Are the data keyed to geological, environmental, and other experimental conditions?

Yes, the temperatures, pressures, and degree of saturation correlate with insitu conditions. The strain rates may or may not correlate to actual fields conditions, since these are not known.

5e. Are the data traceable to a written procedure?

Yes.

5f. Comments.

The data reduction steps are not always clearly documented. eg. the data values quoted in the summary tables (in SAND 82-1315) cannot be read of directly from the plots.

Some of the items not included in the raw data sheets include:

(1) Lithologic description of rock
(2) Date of sampling and storage environment
(3) Types of failure
(4) Sketch of original sample showing inhomogeneities and post-failure condition

Reviewer S. Bhattacharyya

Date 7/19/84

6. What techniques are involved in analyzing and interpreting the data?

Standard rock mechanics numerical analyses (Ref. SAND 80-1454 and SAND 82-1315). The rock parameters were correlated with certain mineralogical and bulk properties for data interpretation.

6a. What empirical techniques?

Derived cohesion and angle of internal friction properties were correlated against effectively porosity (ie porosity + clay content). No apparent correlation was noted.

6b. What analytical techniques?

Mohr failure envelopes were developed on the basis of triaxial test data. The failure envelopes were drawn by using a best fit of the ultimate stress data against confinement pressures. (SAND 82-1315)

6c. What numerical techniques?

Some of the above may be considered to be numerical techniques.

6d. Comments.

The Young's modulus and Poisson's ratio data refer to the part of the curve between 0 to 60% of the ultimate stress. This is consistent with ASTM recommendation.

Reviewer S. Bhattacharyya

Date 7/19/84

7. What computer programs are used in collecting, reducing, storing, presenting, and analyzing the data?

Computer program developed at SNL — DATAVG. (Ref. SAND83-0646)

7a. How are these programs verified, validated, documented, and controlled?

A QA program exists for all Sandia software (details of the QA program not available from Rice, the reference document may contain some info)

7b. Comments (for example, implicit assumptions, sensitivities, other comments).

Assumptions, limitations, sensitivities cannot be stated without thorough knowledge of the program used. Some information is available in SAND83-0646

Reviewer S. Bhattacharya

Date 7/19/84

8. What are the acceptance/rejection criteria for the test data?

Test data were not included in analyses on two basic premises:

i) if equipment malfunction was detected

ii) if large pore space of lythophysal cavities were detected internal to the sample

8a. Were these criteria established prior to test development?

Yes.

8b. What is the logic behind the criteria?

Obvious.

8c. How are the criteria implemented? (Data handling, review procedure, corrective action.)

N/A.

- Data Handling

  All test data, good or bad, are reported and are comments on the grounds of rejection are included.

- Review Procedure

  Experimentor makes the decision of rejecting data and the data sheet is available for scrutiny by other personnel reviewing reports.

- Corrective Action

  Not included in data analysis

8d. Comments.

Reviewer S. Bhattacharyya

Date 7/19/84

9. How are deviations from established procedures documented?

Changes in environmental conditions are reported on the data sheets. Any special deviations would be included in the comments section of the data sheets.

9a. What is the cause of the deviation?

Operator error, electronic malfunction etc

9b. How are deviations considered in data reduction and/or analyses?

They are given due consideration (either eliminated from analysis or test parameters altered)

9c. Is the use of deviated data controlled? (For example, not used withoug approval of system designer or authorized project manager.)

Yes, Experimenter reports deviation and project manager reviews test results.

9d. Comments. (For example, equipment performance and its effect on test validity, other comments.)

Reviewer S. Bhattacharya

Date 7/19/84

10. General comments (such as, relationship among different tests, impacts on interpretation, instrument redundancy, factors resulting in test closure, accuracy of measurements, limitations, additional uses of data, and other miscellaneous comments).

The principal limitations of the triaxial test data are the inconsistencies between different data sets and inadequate correlation between strength and elastic property data with mineralogy or bulk properties of the rock. These inconsistencies reflect on the variability of tuffs at Yucca Mountain.

The test procedures appear adequate and tests are carried out consistent with standard procedures. Some of the deficiencies in data reduction and presentation are noted at appropriate locations.

Sandia National Laboratories
Albuquerque, New Mexico 87185

date: July 20, 1983

to: J. R. Tillerson, 6313

Ron Price

from: R. H. Price, 1542

subject: Comparison of Division 1542 Mechanical Testing Procedures with ASTM Guidelines

References:

[1] R. H. Price, A. K. Jones and K. G. Nimick (1542), SAND82-0481
Uniaxial Compression Test Series on Bullfrog Tuff
April 1982

[2] R. H. Price and K. G. Nimick (1542), SAND82-1055
Uniaxial Compression Test Series on Tram Tuff
July 1982

[3] R. H. Price and A. K. Jones (1542), SAND82-1314
Uniaxial and Triaxial Compression Test Series on Calico Hills Tuff
October 1982

[4] R. H. Price, K. G. Nimick and J. A. Zirzow (1542), SAND82-1723
Uniaxial and Triaxial Compression Test Series on Topopah Spring Tuff
October 1982

[5] R. H. Price (1542), SAND82-1315
Analysis of Rock Mechanics Properties of Volcanic Tuff Units from Yucca Mountain
(in preparation).

[6] ASTM D 3148-80
Standard Test Method for:
Elastic Moduli of Intact Rock Core Specimens in Uniaxial Compression

[7] ASTM D 2938-79
Standard Test Method for:
Unconfined Compressive Strength of Intact Rock Core Specimens

[8] ASTM D 2664-80
Standard Test Method for:
Triaxial Compressive Strength of Undrained Rock Core Specimens Without Pore Pressure Measurements

The purpose of this memo is to report the comparison of procedures used in the mechanical experiments reported by Division 1542 in references [1], [2], [3], [4] and [5] with the applicable ASTM Standard Test Methods (references [6], [7] and [8]). With only one exception, our methods meet or exceed ASTM standards. The deviation from the ASTM guidelines and sections not applicable (N/A) to our test procedures (e.g., the sections dealing with sample specifications, since sample preparation was handled by personnel in your division) are listed in the following paragraphs.

ASTM D 3148-80

Section 3.4 Only one, instead of "at least two", lateral deformation gage (specifically a 'Schuler' ring gage) was used for lateral strain, and therefore Poisson's ratio, determinations.

Section 4. N/A

ASTM D 2938-79

Section 4. N/A

ASTM D 2664-80

Section 6. N/A

Copy to:

W. Herrmann 1500
W. C. Luth 1540
B. M. Butcher 1542
L. W. Teufel 1542
R. H. Price 1542
A. K. Jones 1542
F. B. Nimick 6313
B. M. Schwartz 6313

(3) 14

Reviewer SWAPAN BHATTACHARYA

Date 7/19/84

Draft Rock Mechanics Data Review Checklist
(Revision No. 0, January 18, 1984)

1. Name/type, identification number, and date of test.

Elevated temperature and pore pressure test on Bullfrog Tuff, Sample No. 6, date 4-1-81, Experimenters - Jones & Nimick

1a. What is the overall objective of the test?

The effect of temperature and pore pressure on rock strength and Young's modulus.

1b. What specific parameters are to be determined by the test?

Confined Compressive strength
Young's modulus

1c. Is there redundancy in the test concept?

None

1d. What criteria were used for test site (or sample) selection?

Samples provided by NNWSI, no control of Experimenter.

1e. How is the rock at the test site characterized?

USGS characterized cores from USW-G1 borehole. No further characterization done in the lab.

1f. How was the test designed?

Confining pressures were based on approximate in-situ conditions, pore pressures were based on the premise that water did not turn into vapor, and temperature was limited by instrument (heater) capability.

1g. Comments.

Reviewer S. Bhattacharya

Date 7/19/84

2. Is the procedure documented and complete, and is it in written form?

No standard procedure document was in use during time of test.

2a. Is it a standard (ASTM) procedure? If yes, provide reference.

Sandia standard procedure (not documented)

2b. If non-"standard", how was the procedure developed, reviewed, documented, and approved? For example, COE, USBM, USBR, USGS, NBS, or other (internal) processes.

Procedure developed based on experience of SNL personnel.

2c. Have there been revisions and how and when were the revisions reviewed, documented, approved, and implemented?

None

2d. Comments.

The confining pressure was applied first, followed by heating. This is the standard procedure for such tests. The temperature variations during test period were not specifically recorded.

Reviewer S. Bhattacharyya

Date 7/19/84

3. How many of these tests have been performed?

7 tests

3a. According to what procedure revisions?

N/A

3b. How may test results, obtained under different revisions, be compared?

N/A

3c. How many tests are in progress and which revision is in use?

None

3d. How many tests are planned?

Not Known

3e. Comments.

Reviewer S. Bhattacharya

Date 7/19/84

4. What instrumentation is used for the test?
   - Internally designed loading frame and heat cell
   - LVDT's

4a. How were the reliabilities* of the instruments specified?
   None of the instrument were in the heated zone. Instruments were reliable at room temperature. Insulation was provided such that instruments did not heat up.

4b. Is there a calibration system and were calibrations systematically carried out according to approved procedure?
   Yes +, on the basis of calibration procedure developed internally at SNL & referred in Sandia Report.
   For the LVDTs a standard micrometer head was used.

4c. Are the calibrations traceable to national or industrial standards?
   Not directly traceable
   The LVDT's calibrations were traceable

4d. Comments.

* Reliability is defined as the probability of an instrument to perform a stated function under a stated environment for a stated time.

Reviewer S. Bhattacharya

Date 7/19/84

5. What are the data collection, reduction, and presentation techniques?

Data collection by X-Y plotter and data retrieved by digitizer. Data were reduced manually at discrete point on XY plotter curves. Presented in the form of table and graphs manually.

5a. How can the raw numerical data be retrieved?

Yes, from raw data sheets.

5b. How can all data reduction steps prior to data storage be independently checked and/or duplicated?

Data were stored as hardcopies and all data reduction are provided on the data sheets.

5c. Are the data presented in a complete and clear format? (Comment also on the utility of the presentation.)

They are handwritten and fairly clear.

5d. Are the data keyed to geological, environmental, and other experimental conditions?

Yes, as far as confining pressures are concerned.

5e. Are the data traceable to a written procedure?

Yes, not written formally

5f. Comments.

Reviewer S. Bhattacharya

Date 7/19/89

6. What techniques are involved in analyzing and interpreting the data?

Standard rock mechanics numerical derivations along with a graphical correlation of data.

6a. What empirical techniques?

A measure of sample shear strength, $(\sigma_1 - \sigma_3)/(\sqrt{3})$, was correlated with effective mean pressure $\left(\frac{\sigma_1 + \sigma_2 + \sigma_3}{3} - P_p\right)$. A straight line least square fit was obtained

6b. What analytical techniques?

6c. What numerical techniques?

6d. Comments.

Reviewer S. Bhattacharya

Date 7/19/84

7. What computer programs are used in collecting, reducing, storing, presenting, and analyzing the data?

None

7a. How are these programs verified, validated, documented, and controlled?

N/A

7b. Comments (for example, implicit assumptions, sensitivities, other comments).

Reviewer S. Bhattacharya

Date 7/19/84

8. What are the acceptance/rejection criteria for the test data?

No data rejected

8a. Were these criteria established prior to test development?

N/A

8b. What is the logic behind the criteria?

N/A

8c. How are the criteria implemented? (Data handling, review procedure, corrective action.)

N/A

- Data Handling
- Review Procedure
- Corrective Action

8d. Comments.

Reviewer S. Bhattacharya

Date 7/19/84

9. How are deviations from established procedures documented?

No deviations

9a. What is the cause of the deviation?

N/A

9b. How are deviations considered in data reduction and/or analyses?

N/A

9c. Is the use of deviated data controlled? (For example, not used withoug approval of system designer or authorized project manager.)

N/A

9d. Comments. (For example, equipment performance and its effect on test validity, other comments.)

Reviewer S. Bhattacharya

Date 7/19/84

10. General comments (such as, relationship among different tests, impacts on interpretation, instrument redundancy, factors resulting in test closure, accuracy of measurements, limitations, additional uses of data, and other miscellaneous comments).

The results obtained from these tests are not likely to have much relevance in design since the tests were performed on the Bullfrog member and tested at one single temperature. The relationship between strength of the tuff and temperature was not characterized of the basis of these tests.

15

(4)

Reviewer Mundell, R.L.

Date 7/18/84

Draft Rock Mechanics Data Review Checklist
(Revision No. 0, January 18, 1984)

1. Name/type, identification [redacted], and date of test.

Uniaxial Compression, Topopah Spring Tuff
~~6/30~~, 1982 [Sample ID No. G11222.1 SL3]
(Ron Price) (pg. 15 Sand 82-1723 10/82)

1a. What is the overall objective of the test? to determine strength and elastic properties

1b. What specific parameters are to be determined by the test?

(1) Unconfined Strength
(2) Strain to Failure
(3) Young's Modulus
(4) Poisson's Ratio

1c. Is there redundancy in the test concept?

No

1d. What criteria were used for test site (or sample) selection?

Availability of intact rock in Repository Horizon [of adequate size]
Sample selection by Al Lappin (independent of person conducting test)

1e. How is the rock at the test site characterized?

USGS characterized rock at NTS using Stratigraphic Logs.

NO characterization preformed at Experiment test site (Sandia Lab) by experimentor

NOTE: After 6/83 Fran Nimick & Ron Price performed more detailed characterization at Sandia Lab
① Color, ② texture, ③ welding
④ fabric, ⑤ inhomogeneities

1f. How was the test designed?

Test was designed according to available equipment and sample size by the experimentor
parameters to be examined were prioritized

effect of: mineralogy & bulk properties, water rate, pressure, temperature [effect of parameters to be examined limited by no. of intact core samples]

1g. Comments.

Some tests of this type performed on 100% saturated rock rock, including this test.

[Conservative strength condition for silica rock]

NOTE: Additional comments on next page

UNIAXIAL test Results must be correlated from all core sample boreholes due to the variation in parameter values determined.

Reviewer Mundell, R.L.

Date 7/18/84

2. Is the procedure documented and complete, and is it in written form?

yes, see attached memo from Price to Nimick dated 2/24/84

2a. Is it a standard (ASTM) procedure? If yes, provide reference.

NO, but similar. See attached memo dated Feb. 24, 1984

⊛ Unconfined drained compressive strength testing procedure

⊛ [standard within Sandia Nat'l Laboratories] Also see attached Price to Tillerson memo dated 7/20/83

2b. If non-"standard", how was the procedure developed, reviewed, documented, and approved? For example, COE, USBM, USBR, USGS, NBS, or other (internal) processes.

by Sandia, see attached memo, procedure has been employed as the standard Sandia (internal) testing procedure

2c. Have there been revisions and how and when were the revisions reviewed, documented, approved, and implemented?

No. Not formally reviewed by Sandia personnel

QA general procedures have been reviewed in detail.

2d. Comments.

QA reviewed and approved

In general, test procedures appear to be adequate; however, see general comments under 10 on pg. 10.

Reviewer Mundell, R.L.

Date 7/18/84

3. How many of these tests have been performed? FOR TIVA CANYON: 2
FOR TOPOPAH SPRING TUFF SAMPLES: 78
CALICO HILLS: 49
PROW PASS: 6
BULLFROG: 63
TRAM: 45

3a. According to what procedure revisions?
ALL TESTS WERE CONDUCTED USING SAME PROCEDURE
VARIATION IN TEST PROCEDURES

3b. How may test results, obtained under different revisions, be compared?

NA

3c. How many tests are in progress and which revision is in use?

NONE

3d. How many tests are planned?

80 TOTAL TESTS

≈ 40 UNIAXIAL
≈ 40 TRIAXIAL
} TO BE CONDUCTED IN NEXT 6 MONTHS — NO MODIFICATIONS TO TESTING PROCEDURE PLANNED.

3e. Comments.

SPECIFIC TESTS: IN ADDITION: REVIEWED RAW TEST DATA FOR SAMPLES ID. G11218.2 SL
G11239.5 SL ALSO

THESE THREE UNIAXIAL TEST RESULTS (OF A TOTAL OF 11 IN SERIES) REPRESENT A WIDE RANGE OF UNCONFINED COMPRESSIVE STRENGTHS, 44.9 — 176.6 MPa AND YOUNG'S MODULI, 22.9 — 40.8 GPa, AND POISSON'S RATIOS, .15 — .33

100/MSN/84/01/17/1

Reviewer Mundell, R.L.

Date 7/18/84

4. What instrumentation is used for the test?

(1) MTS loading FRAMES
- 20 Kips
- 200 Kips
- 600 "
- 1000 "

(2) MTS load cells
(3) LVDT – Axial strains (Schenitz)
(4) Schuler gages – lateral strains
(5) Lateral deformation gages (Al ring)
Curing LVDT's on gage leads

4a. How were the reliabilities* of the instruments specified?

MOST ll calibrated before test series.

NOTE: Equip. manufacturers specify reliability for given range of environmental test conditions. NO significant change in environmental test conditions.

4b. Is there a calibration system and were calibrations systematically carried out according to approved procedure?

(1) load cells calibrated annually by MTS
(2) LVDT's calibrated prior to each test series

Standard calibration procedures (in Sandia data report SAND 82-1315)

Schuler gages and lateral deformation gages calibrated with micrometer

4c. Are the calibrations traceable to national or industrial standards?

Yes, MTS calibration of load cells traceable to US Bureau of Standards

4d. Comments.

TEST procedures followed were NOT written formally until 2/24/84 (memo attached from Price to Minick)

* Reliability is defined as the probability of an instrument to perform a stated function under a stated environment for a stated time.

Reviewer Mundell, R.C.

Date 7/18/84

5. What are the data collection, reduction, and presentation techniques?

Software package described in Sand Report 83-0645

Stress calculated by Force (load) / Original X-sectional area

Strain " by displacement / original gage lengths

data collection computerized & digitized and presented in tables & graphs [see raw data sheets]

Pressures measured directly

Strain rates determined by = axial strains vs. time plot & least squares fit

5a. How can the raw numerical data be retrieved?

Last 3 series stored on VAX computer

All raw data stored on floppy discs and can be retrieved by file ID's

5b. How can all data reduction steps prior to data storage be independently checked and/or duplicated?

Most data independently checked with X-Y plotter [back-up to digitized system] operator may not use X-Y plotter if computer system is functioning properly.

5c. Are the data presented in a complete and clear format? yes.
(Comment also on the utility of the presentation.)

5d. Are the data keyed to geological, environmental, and other experimental conditions? yes. In general in-situ temp, pore pressures & degree of H_2O saturation — primary parameters correlated with in-situ conditions

Strain rates may or may not correlate with actual field conditions, which are not known.

5e. Are the data traceable to a written procedure?

yes.

5f. Comments.

Reviewer Mundell, R.C.

Date 7/18/84

6. What techniques are involved in analyzing and interpreting the data?
ANALYZING: Standard rock mechanics numerical analyses [SAND 80-1453, 82-1315]

INTERPRETING: Rock properties: mineralogical and bulk, correlated for data interpretation.

6a. What empirical techniques?
See SAND 82-1315

6b. What analytical techniques?
See SAND 82-1315

6c. What numerical techniques?
See SAND 82-1315

6d. Comments.
Evaluated correlations of:
Young's modulus vs. grain density
" " " porosity + clay content (%)
poisson's Ratio " " grain density (gm/cc)
" " " " " "
ULTIMATE STRESS (AXIAL) POROSITY (%)
" " " " + CLAY CONTENT (%)
" " " GRAIN DENSITY (gm/cc)
AXIAL GRAIN AT FAILURE (%) " POROSITY + CLAY CONTENT (%)
" " " GRAIN DENSITY (gm/cc)

Reviewer Mundell, R.L.

Date 7/18/84

7. What computer programs are used in collecting, reducing, storing, presenting, and analyzing the data? DATAVG – program developed at Sandia [see Sand 83-0474, pg. 1]

7a. How are these programs verified, validated, documented, and controlled? This program used by all Sandia divisions

Q A program in effect for all software

7b. Comments (for example, implicit assumptions, sensitivities, other comments).

Reviewer Mundell, C.L.

Date 7/18/84

8. What are the acceptance/rejection criteria for the test data?

test sample could be rejected upon initial examination
instrument/equipment malfunction during test
test data not included in analyses if test sample rejected
after test if examination indicates sample not valid
[for example, excessive, unknown and/or large voids] not homogeneous]

8a. Were these criteria established prior to test development?

yes

8b. What is the logic behind the criteria?

8c. How are the criteria implemented? (Data handling, review procedure, corrective action.)

- Data Handling
  All test data reported, irregularities noted

- Review Procedure
  experimentor accepts or rejects data

- Corrective Action

8d. Comments.

Reviewer Mundell, R.L.

Date 7/18/84

9. How are deviations from established procedures documented?

See comment section of test Report sheet

irregularities, deviations reported on test Report sheet

And Price to Nimick memo - dated 2/24/84, attached.

9a. What is the cause of the deviation?

operator error
electronic malfunction

9b. How are deviations considered in data reduction and/or analyses? Not included

9c. Is the use of deviated data controlled? (For example, not used without approval of system designer or authorized project manager.) yes. Experimentor makes decision initially, project manager reviews all data

9d. Comments. (For example, equipment performance and its effect on test validity, other comments.)

Reviewer Mundell, R. L.

Date 7/18/84

10. General comments (such as, relationship among different tests, impacts on interpretation, instrument redundancy, factors resulting in test closure, accuracy of measurements, limitations, additional uses of data, and other miscellaneous comments).

INCONSISTENT TEST RESULTS for series

Wide range of unconfined compressive strength, 44.9 – 171.6 MPa
" " " Young's moduli, 22.9 – 40.8 GPa
" " " Poisson's ratios, .15 – .33
in this test series III uniaxial compressive tests conducted

for example,

Raw test report sheets should be more complete. Most importantly, a accurate sketch of the test sample before the test should be included. Preparation details on two of the three tests not documented.
Sketch of test sample after failure should also be included on test report.

Have requested the raw data test reports for:

DATE	SAMPLE ID NO.	
6/20/84	G1-1221.1 B	UNIAXIAL COMPRESSION TESTS
7/2/84	G1-1271.5	
?	G1-1218.2	
7/12	G1-1154.9 B	TRIAXIAL COMPRESSION TESTS
7/13	G1-1162.6	
7/14	G1-1159.0	

Also: UNIAXIAL COMPRESSION TEST ON large lithophysal sample of BULLFROG TUFF:

12/1/83 8C

Sandia National Laboratories
Albuquerque, New Mexico 87185

date: February 24, 1984

to: F. B. Nimick, 6313

Ron Price

from: R. H. Price, 1542

subject: Rock Mechanics Laboratory Test Procedures for Obtaining Intact Rock Properties for the NNWSI Project

I have gathered the following information in order to meet your Quality Assurance (QA) guidelines concerning the laboratory methods employed within the Geomechanics Division 1542 rock mechanics lab. This memo includes a detailed outline of our test procedures (pages 2-6), a copy of our test report sheet (pages 7,8), and a table listing the report numbers that detail the Safe Operating Procedures (SOP) for our equipment (page 9).

The test procedures will outline all of our techniques and routines in the preparation and testing of calibration and rock samples for the NNWSI project. The procedures described herein are specifically designed for use in compressional, constant strain rate, room temperature experiments on intact rock samples only; however, modifications are easily made to these procedures if other test types are needed. Please note that the procedural steps marked with a [T] are necessary only in experiments at elevated pressures (i.e., triaxial). In addition, the sample/test ID noted in the procedures (e.g., see Section I-C-1) always includes the drillhole number or location abbreviation, a depth (if applicable), and an additional sample number.

Prior to and immediately following the testing of any sample group, a calibration of each of the measuring gages (see Section I-A) and of the entire test setup (Section I-B) is performed. The test system is usually calibrated by mounting the measuring gages on a cylindrical sample of aluminum, which is nominally the same size as the samples to be tested.

Please feel free to contact me for any additional information and/or clarification.

RHP:rhp

PROCEDURES

I. Pre-Test Procedures

A. Gage calibrations.

1. Load cell.
2. Axial displacement gage(s).
3. Lateral displacement gage(s).

B. System Calibration.

1. Mount gages on aluminum sample.
2. Uniaxially compress aluminum sample to approximately 150 MPa.
3. Create plots of data (Y versus X), with linear fits to data.
   a. Axial (differential) stress versus axial strain, with a fit to the linear portion of this curve for Young's modulus.
   b. Transverse strain versus axial strain, with a fit to the linear portion of this curve for Poisson's ratio.
   c. Axial strain versus time, with a fit to the linear portion of this curve for axial strain rate.
4. Compare Young's modulus (E) and Poisson's ratio (ν) values to the ideal values for aluminum.
   a. 6061 Aluminum : $E = 69.7$ GPa , $\nu = .333$
   b. 7075 Aluminum : $E = 72.4$ GPa , $\nu = .320$
5. Once the test values have been compared :
   a. If the measured elastic moduli are both within five percent of ideal, continue on to Section I-C.
   b. If one or both of the measured elastic moduli deviate more than five percent from ideal, the reason(s) for the difference must be determined and steps I-B-1 to 5 repeated.

I. Pre-Test Procedures (continued)

C. Initial Sample Handling

1. Mark sample with sample/test ID.
2. Measure and note sample length and diameter.

   Each sample should also be checked for ends that are:

   a. Parallel.

   b. Perpendicular to the cylindrical axis.

   c. Clean and smooth.
3. Locate and mark gage mount points on the sample.
4. Attain appropriate sample saturation (e.g., 0 or 100 percent), following NNWSI program directives.

D. Fill out test report sheet.

E. Sample-assembly preparation steps.

1. Prepare appropriately sized end caps.

   Each end cap should be checked for ends that are:

   a. Parallel.

   b. Perpendicular to the cylindrical axis.

   c. Clean and smooth.
2. Place sample between end caps.
3. Put jacket around sample and end caps.
4. Shrink jacket snugly around the sample and end caps.
5. Seal ends of jacket at the end caps with:

   a. O-rings.

   b. Wire.

   c. Both.
6. Mount displacement gages on sample.

   a. Axial gages (2) (if necessary).

   b. Lateral gage(s) (1 or 2).
7. Place sample assembly between the test apparatus loading platens.
8. Check gage connections and set gages in the null position.

I. Pre-Test Procedures (continued)

F. Test apparatus preparation steps.

1. Fill the pressure vessel with confining fluid [T].
2. Put vessel end plug on [T].
3. Tap loading piston through seal down onto sample assembly [T].
4. Bring loading platens into contact with the sample assembly or piston to eliminate spaces in the entire loading column.

G. Electronic controls preparation steps.

1. Set each signal conditioner to desired gain and range.
2. Set the control variable span to desired magnitude.
3. Set function generator options to appropriate settings.

H. Computer data acquisition preparation steps.

1. Input appropriate set-up file parameters.
2. Check input voltages for correct readings and correct data channels.
3. Prepare the data acquisition program for the start of experiment.
4. Input parameters, appropriate axes labels and units, and ranges of axes values for the real-time plot to be monitored during the experiment (this plot can be whatever the operator feels is most significant for the test being performed, but is normally axial stress versus axial strain).

II. Test Procedures

A. Begin data collection program.

B. Begin hydrostatic loading [T] and allow sample to stabilize at the desired pressure for at least 30 minutes.

C. Begin axial loading.

D. Monitor real-time plot, sample, and parameter voltages.

E. Decrease axial loading until sample is in a hydrostatic state of stress.

Accomplished by :

1. Manual return.

   Due to:

   a. Sample failure.

   b. Desired strain reached.

2. Automatic return.

   a. Function generator reverses the loading because the time limit and ultimate range of the control parameter have been reached.

E. Decrease hydrostatic load until sample is completely unloaded [T].

F. Stop data collection program.

III. Post-Test Procedures

A. Print out data table (in standard units).

1. Axial (differential) stress (MPa : megapascals).
2. Axial strain (milli : millistrain).
3. Lateral strain (milli : millistrain).
4. Confining pressure (MPa : megapascals) [T].
5. Time (s : seconds).

B. Create plots of data (Y versus X), with linear fits to data when needed.

1. See Section I-B for specific plots.

   In addition, the following plots :

2. Axial stress versus transverse strain.
3. Axial stress versus volume strain.

C. Take vessel apart and remove sample.

1. Open up large gaps in the loading column by moving the loading platens.
2. Remove loading piston [T].
3. Remove vessel end plug [T].
4. Drain remaining fluid from vessel [T].
5. Remove sample assembly from vessel [T].
6. Remove gages that are mounted on sample.
7. Remove jacketing material.
   a. If sample is competent, remove entire jacket.
   b. If sample is not competent, remove jacket from end caps only.
8. Clean and store sample in a container with the sample/test ID.
9. Clean and store endcaps.

D. Note test information.

1. Note anything unusual about test and/or sample on the test report sheet.
2. Note test information in the log book for the test apparatus.
   a. Date.
   b. Sample/test ID.
   c. Operator(s).
   d. Set-up and data file numbers.

Test Report Sheet

TEST REPORT DATE _____

EXPERIMENT _____

_____

EXPERIMENTER _____

TECHNICIAN(S) _____

TEST APPARATUS _____

SAMPLE DESCRIPTION - SAMPLE ID _____

SKETCH

DIMENSIONS length. _____

diam. _____

_____

MASS _____

COATING _____

OTHER

_____ _____

_____ _____

_____ _____

PREPARATION DETAILS _____

_____

_____

INSTRUMENTATION

TYPE & SERIAL #	GAGE LENGTH (or other relevent info)	LOCATION ON SAMPLE

Test Report Sheet (continued)

TEST CONDITIONS

CONTROLLER SETTINGS

CONTROLLER 1

VARIABLE	RANGE (100,50,20,10) %	COMPLETE FOR THE SERVO-CONTROLLED VARIABLE: RATE FIXED VALUE	SPAN SETTING	TIME

CONTROLLER 2

DATA- (CAN USE COMPUTER SET-UP SHEET OR X-Y RECORDER STAMP)

VARIABLES RECORDED	SCALES

DATA STORAGE (COMPUTER)

FILE ID'S	CONTENTS

COMMENTS:

Table 1. Safe Operating Procedure (SOP) Reports for the Test Facilities in the Geomechanics 1542 Rock Mechanics Laboratory

Unit	Description	SOP
1	Main Hydraulic Pressure System	-
2‡	1.0 MN (220 kip) Load Frame	92100 8311
3‡	1.8 MN (400 kip) Load Frame	45100 8210
4	0.7 MN (150 kip) Load Frame	-
5‡	0.1 MN (22 kip) Load Frame	00300 8401
6	Biaxial Machine	39500 8207
7‡	5.0 MN (1100 kip) Load Frame	91600 8311
10-12	Creep Frames	45000 8210
20	Kolsky (Hopkinson) Bar	-
21	Sample Preparation Equipment	45200 8210

‡ These machines have been used in the testing of intact rock samples for the NNWSI Project.

Copy to:

1500 W. Herrmann
1510 J. W. Nunziato
1520 D. J. McCloskey
1530 L. W. Davison
1540 W. C. Luth
1542 B. M. Butcher
1542 W. A. Olsson
1542 R. H. Price
1542 S. J. Spence
1542 L. W. Teufel
6310 T. O. Hunter
6313 J. R. Tillerson
6313 B. M. Schwartz

(5) 6

Reviewer PK Dutta.

Date 7/19/84

Draft Rock Mechanics Data Review Checklist
(Revision No. 0, January 18, 1984)

1. Name/type, identification number, and date of test.
Grouse Canyon Welded Tuff from G-Tunnel (Room Temp.) Maximum stress difference ($\sigma_1 - \sigma_3$, uniaxial test), Modulus of Elasticity. Date ?

1a. What is the overall objective of the test?
① To determine effect of strain rate on compressive strength and effect of saturation.

1b. What specific parameters are to be determined by the test?
① Maxm Stress difference (strength (compressive))
② Young's modulus

1c. Is there redundancy in the test concept?
Possible - but not known immediately. Field tests for determination of young's modulus possibly conducted. — check.

1d. What criteria were used for test site (or sample) selection?
Not known, The rock was available in sufficient & size for sample.

1e. How is the rock at the test site characterized?
Not known.

1f. How was the test designed?
Standard uniaxial compressive strength — Size was determined for getting a fixed number of samples from the given volume of rock.

1g. Comments.

Reviewer Pus

Date 7/8/84

2. Is the procedure documented and complete, and is it in written form?

well documented in Sandia report no. Sand 80-1453 by W. Olsson and Jones, A.K., 1980

2a. Is it a standard (ASTM) procedure? If yes, provide reference.

Standard uniaxial test normally followed by Sandia — Procedure written in the above report.

2b. If non-"standard", how was the procedure developed, reviewed, documented, and approved? For example, COE, USBM, USBR, USGS, NBS, or other (internal) processes.

N/A

2c. Have there been revisions and how and when were the revisions reviewed, documented, approved, and implemented?

N/A

2d. Comments.

Reviewer PWD

Date 7/19/84

3. How many of these tests have been performed?

20

3a. According to what procedure revisions?

Procedure as reported in Report SAND 80-1453

3b. How may test results, obtained under different revisions, be compared?

No revision

3c. How many tests are in progress and which revision is in use?

None

3d. How many tests are planned?

None

3e. Comments.

Reviewer RWD

Date 5/15/84

4. What instrumentation is used for the test?

MTS —
in conjunction with LVDT, and MTS load cell.

4a. How were the reliabilities* of the instruments specified?

Calibration system/data requested —
but may not be available — as
with new tests old calibration data in computer
is erased.

4b. Is there a calibration system and were calibrations systematically carried out according to approved procedure?

4c. Are the calibrations traceable to national or industrial standards?

4d. Comments.

* Reliability is defined as the probability of an instrument to perform a stated function under a stated environment for a stated time.

Reviewer Paul

Date 7/19/84

5. What are the data collection, reduction, and presentation techniques?

Load : Loadcell → A/D converts → Computer → compute stress and strain and compute young's modulus. Presents graphical result.

Displacement : LVDT →
Schultgage →

5a. How can the raw numerical data be retrieved?

Raw data in terms of voltage can not be retrieved but reduced data in terms of stress, strain, modulus are stored in computer and in hard copies.

5b. How can all data reduction steps prior to data storage be independently checked and/or duplicated?

By using the data reduction computer program. C. Program not immediately available.

5c. Are the data presented in a complete and clear format? (Comment also on the utility of the presentation.)

yes.

5d. Are the data keyed to geological, environmental, and other experimental conditions?

NO

5e. Are the data traceable to a written procedure?

Written procedure in SAND 80-1453. document-

5f. Comments.

Reviewer PWD

Date 7/19/84

6. What techniques are involved in analyzing and interpreting the data?

Standard rock mechanics analytical techniques ? computing modulus from stress - strain data. Strength observed from the peak stress. (Not yield stress).

6a. What empirical techniques?

N/A

6b. What analytical techniques?

As above

6c. What numerical techniques?

None

6d. Comments.

none

Reviewer PMD

Date 7/19/84

7. What computer programs are used in collecting, reducing, storing, presenting, and analyzing the data?

SAND SQUEEZE 1 PROGRAM
Not immediately available

7a. How are these programs verified, validated, documented, and controlled?

Not known

7b. Comments (for example, implicit assumptions, sensitivities, other comments).

Reviewer RWJ

Date 7/19/84

8. What are the acceptance/rejection criteria for the test data?

None.
Inconsistencies reported/noted

8a. Were these criteria established prior to test development?

None

8b. What is the logic behind the criteria?

N/A

8c. How are the criteria implemented? (Data handling, review procedure, corrective action.)

N/A

- Data Handling

- Review Procedure

- Corrective Action

8d. Comments.

Reviewer Pandey

Date 2/15/84

9. How are deviations from established procedures documented?

N/A
No deviation.

9a. What is the cause of the deviation?

N/A

9b. How are deviations considered in data reduction and/or analyses?

N/A

9c. Is the use of deviated data controlled? (For example, not used withoug approval of system designer or authorized project manager.)

N/A

9d. Comments. (For example, equipment performance and its effect on test validity, other comments.)

Reviewer Pinnette

Date 7/19/84

10. General comments (such as, relationship among different tests, impacts on interpretation, instrument redundancy, factors resulting in test closure, accuracy of measurements, limitations, additional uses of data, and other miscellaneous comments).

(1) Data in reduced form reported in SAND-80-1453 NOV. 1980. in Table 2.

(2) Test Ind. No 101 required to be applied to NLC

(6)

17

Reviewer T.J. Schmitt

Date 7-19-84

Draft Rock Mechanics Data Review Checklist
(Revision No. 0, January 18, 1984)

I. Name/type, identification number, and date of test.

Seismic velocity measurements.

1a. What is the overall objective of the test?

Determine velocity tensor - V_{ij} $\sum_{1}^{3}\sum_{1}^{3} V_{ij}$, where i is direction of propagation of wave, j is direction of particle motion.

1b. What specific parameters are to be determined by the test?

The test measures length of a sample, and time for sonic pulse to cross sample.

1c. Is there redundancy in the test concept?

in multi axial.

939

1d. What criteria were used for test site (or sample) selection?

~~N/A~~

1e. How is the rock at the test site characterized?

N/A

1f. How was the test designed?

~~The~~ Based on conservations, the test is off the shelf equipment

1g. Comments.

Reviewer T.J. Smith

Date 7-19-84

2. Is the procedure documented and complete, and is it in written form?

Not documented in file.

2a. Is it a standard (ASTM) procedure? If yes, provide reference.

Not documented in file

2b. If non-"standard", how was the procedure developed, reviewed, documented, and approved? For example, COE, USBM, USBR, USGS, NBS, or other (internal) processes.

Not documented in file

2c. Have there been revisions and how and when were the revisions reviewed, documented, approved, and implemented?

?

2d. Comments.

?

Reviewer T.J. Schmidt

Date 19-July 84

3. How many of these tests have been performed?

~ 50

3a. According to what procedure revisions?

Not documented in File

3b. How may test results, obtained under different revisions, be compared?

11

3c. How many tests are in progress and which revision is in use?

11

3d. How many tests are planned?

11

3e. Comments.

Reviewer T.J. Schmidt

Date 7-19-1984

4. What instrumentation is used for the test?

Not documented

4a. How were the reliabilities* of the instruments specified?

(1

4b. Is there a calibration system and were calibrations systematically carried out according to approved procedure?

The calibration of the platter factor is given.

4c. Are the calibrations traceable to national or industrial standards?

Not documented

4d. Comments.

* Reliability is defined as the probability of an instrument to perform a stated function under a stated environment for a stated time.

Reviewer T.J. Schmidt

Date 7-19-94

5. What are the data collection, reduction, and presentation techniques?

Table of sample length, Δt, and platten correction factor.

5a. How can the raw numerical data be retrieved?

No

5b. How can all data reduction steps prior to data storage be independently checked and/or duplicated?

Not clear

5c. Are the data presented in a complete and clear format? (Comment also on the utility of the presentation.)

Presentation of velocities is clear.

5d. Are the data keyed to geological, environmental, and other experimental conditions?

No

5e. Are the data traceable to a written procedure?

N/A

5f. Comments.

Reviewer T. J. Schmitt

Date 7-19-84

6. What techniques are involved in analyzing and interpreting the data?

Average. Standard deviation

6a. What empirical techniques?

6b. What analytical techniques?

6c. What numerical techniques?

6d. Comments.

Reviewer T.J. Schmidt

Date 7-19-84

7. What computer programs are used in collecting, reducing, storing, presenting, and analyzing the data?

Not documented —

7a. How are these programs verified, validated, documented, and controlled?

NA

7b. Comments (for example, implicit assumptions, sensitivities, other comments).

NA

Reviewer T.J. Schmidt

Date 7-18-84

8. What are the acceptance/rejection criteria for the test data?

Not documented

8a. Were these criteria established prior to test development?

8b. What is the logic behind the criteria?

8c. How are the criteria implemented? (Data handling, review procedure, corrective action.)

- Data Handling
- Review Procedure
- Corrective Action

8d. Comments.

Reviewer Thomas J. Schell

Date 7-19-84

9. How are deviations from established procedures documented?

Not documented

9a. What is the cause of the deviation?

9b. How are deviations considered in data reduction and/or analyses?

9c. Is the use of deviated data controlled? (For example, not used withoug approval of system designer or authorized project manager.)

9d. Comments. (For example, equipment performance and its effect on test validity, other comments.)

Reviewer Thomas J Schmidt

Date 7-19-87

10. General comments (such as, relationship among different tests, impacts on interpretation, instrument redundancy, factors resulting in test closure, accuracy of measurements, limitations, additional uses of data, and other miscellaneous comments).

The dynamic modulus measurements, velocity measurements, of the core were performed on what was apparently off the shelf equipment.

The procedures were not formally documented, presumably it would be very easy to meet all question proposed.

Results look good.

Request made for copy of procedures,

Request copy of data set for

Samples 1067.8-1

484.7-1

760.9-5A

(7) 18

Reviewer P K Dutta

Date 7/19/84

Draft Rock Mechanics Data Review Checklist
(Revision No. 0, January 18, 1984)

1. Name/type, identification number, and date of test.

Triaxial Compression Test for Calico Hill.
Sample i.d. CH4A Calico Hills Tuff Dec 4, 1981
reported in sand82-1314 as G11487.4 SL94 sample i.d.

1a. What is the overall objective of the test?

'To determine Poisson's ratio, Young's modulus and compressive strength and effect of confining pressure on those properts

1b. What specific parameters are to be determined by the test?

- Axial stress vs Axial Strain
- Transverse strain vs Axial Strain
- Axial Strain vs time
- Axial stress vs vol. Strain

1c. Is there redundancy in the test concept?

None

1d. What criteria were used for test site (or sample) selection?

The material was from the proposed repository horizon at that time

1e. How is the rock at the test site characterized?

N/A

1f. How was the test designed?

Test was designed by Rob Price based on available volume of rock available and no. of samples decided.

1g. Comments.

Reviewer PWD

Date 7/19/84

2. Is the procedure documented and complete, and is it in written form?

Yes - by memo # nil, bTg F.B. Nimick by R. H. Price, 15-42, dt. Feb 24, 84

2a. Is it a standard (ASTM) procedure? If yes, provide reference.

Procedure as above

2b. If non-"standard", how was the procedure developed, reviewed, documented, and approved? For example, COE, USBM, USBR, USGS, NBS, or other (internal) processes.

NA See above

2c. Have there been revisions and how and when were the revisions reviewed, documented, approved, and implemented?

No revision to the above procedure

2d. Comments.

Reviewer PWD

Date 7/19/84

3. How many of these tests have been performed?

19

3a. According to what procedure revisions?

Procedure as sited in 2.

3b. How may test results, obtained under different revisions, be compared?

N/A

3c. How many tests are in progress and which revision is in use?

N/A

3d. How many tests are planned?

N/A

3e. Comments.

Reviewer RED

Date 7/9/84

4. What instrumentation is used for the test?

MTS - 400kips.
and associated LVDT, and Load Cells.
Ring Gage (Strain Gage)

4a. How were the reliabilities* of the instruments specified?

Instruments are periodically calibrated against NBS.

4b. Is there a calibration system and were calibrations systematically carried out according to approved procedure?

MTS - machine are calibrated once a year.
Sensors/Transducers are calibrated before the test series. calibration data reported in SAND 82-1314 - oct 82.

4c. Are the calibrations traceable to national or industrial standards?

NBS.

4d. Comments.

* Reliability is defined as the probability of an instrument to perform a stated function under a stated environment for a stated time.

Reviewer PVD

Date 7/18/84

5. What are the data collection, reduction, and presentation techniques?

Sensor – to Computer.
Reduction of data by computer.
Raw data in terms of voltage not stored

5a. How can the raw numerical data be retrieved?

Reduced data are stored as:
1) Axial stress
2) Load
3) Axial Strain
4) Trans. Strain.
5) Pressure (confining)

5b. How can all data reduction steps prior to data storage be independently checked and/or duplicated?

Can not be checked.

5c. Are the data presented in a complete and clear format? (Comment also on the utility of the presentation.)

Raw Data as computer printout can be connected to the published report using a unit change Calculation.

5d. Are the data keyed to geological, environmental, and other experimental conditions?

Geological conditions: same as id of the sample reflect.
environmental: No document available now.
Other experimental condition: Not known

5e. Are the data traceable to a written procedure?

yes.

5f. Comments.

Reviewer RWD

Date 2/8/84

6. What techniques are involved in analyzing and interpreting the data?

Standard rockmechanics procedure

6a. What empirical techniques?

as above

6b. What analytical techniques?

as above

6c. What numerical techniques?

N/A

6d. Comments.

Reviewer RKD

Date 7/18/84

7. What computer programs are used in collecting, reducing, storing, presenting, and analyzing the data?

See Sandia report SAND 83-0646

7a. How are these programs verified, validated, documented, and controlled?

See above.

7b. Comments (for example, implicit assumptions, sensitivities, other comments).

Reviewer LWD

Date 7/18/84

8. What are the acceptance/rejection criteria for the test data?

Data were rejected if
① Operator error
② Discovery of inhomogeneity after test

8a. Were these criteria established prior to test development?

yes.

8b. What is the logic behind the criteria?

Distorted results would have been obtained if these data were not rejected.

8c. How are the criteria implemented? (Data handling, review procedure, corrective action.)

All data are reported.
Note were made in the analysis where data was rejected.

- Data Handling

- Review Procedure

- Corrective Action

8d. Comments.

Reviewer

Date 2/18/85

9. How are deviations from established procedures documented?

No deviation

9a. What is the cause of the deviation?

N/A

9b. How are deviations considered in data reduction and/or analyses?

N/A

9c. Is the use of deviated data controlled? (For example, not used withoug approval of system designer or authorized project manager.)

N/A

9d. Comments. (For example, equipment performance and its effect on test validity, other comments.)

Reviewer PwD

Date 2/15/84

10. General comments (such as, relationship among different tests, impacts on interpretation, instrument redundancy, factors resulting in test closure, accuracy of measurements, limitations, additional uses of data, and other miscellaneous comments).

- Calico Hills Tuff is not currently the first priority site.
- Not checked against any other parallel TBT.
- Copy of CH4A. TBT requested.

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Reviewer J. Greeves / Mark Christiano

Date 7/18/84

- Draft Rock Mechanics Data Review Checklist
(Revision No. 0, January 18, 1984)

1. Name/type, identification number, and date of test.
Goodman Jack Approx 60 tests
Model 52101 & 52102
with 52127 indicator

1a. What is the overall objective of the test?
Conduct test to determine intact elastic modulus of rock.

1b. What specific parameters are to be determined by the test?
Intact elastic modulus of rock = E

1c. Is there redundancy in the test concept?
~~Also~~ Two LVDTs were used to measure displacements.
Also [illegible]
[illegible]

1d. What criteria were used for test site (or sample) selection?
Judgment of test team based on core evaluation and surface mapping
Tried to find locations [illegible] sound and relatively smooth, desire was to [illegible] as possible to

1e. How is the rock at the test site characterized? Compare with lab modulus values
Borehole core logs were studied and test areas selected

1f. How was the test designed?
See SINCO instruction manual and Refs under item #2

1g. Comments.
See SAND81-1971 for reported summary

Reviewer J Greeves

Date 7/18/84

2. Is the procedure documented, yes and complete, and is it in written form? yes

~~Ref. R.E. Goodman et Al. Meas. of Rock Permeability (?) in Proc. 10th Symp. Rock Mechanics~~

Ref. R.E. Goodman and V.K. Tran Univ of Calif Berkely, May 1968

A Salem, M.Sc Thesis, Dept of C.E. Univ. of ~~[illegible]~~ Colo., Boulder Oct. 1976

2a. Is it a standard (ASTM) procedure? If yes, provide reference.

No. See above refs.

2b. If non-"standard", how was the procedure developed, reviewed, documented, and approved? For example, COE, USBM, USBR, USGS, NBS, or other (internal) processes;

See above refs. also an instruction manual by *SINCO is included in the data package

* Seattle Washington 98103

2c. Have there been revisions and how and when were the revisions reviewed, documented, approved, and implemented?

No.

2d. Comments.

Procedures are relatively clear at this time

However it is not possible to determine from the data package if all procedures were followed - no statements are noted re. this package

No indication of independent checks is identified

Reviewer [illegible]

Date 4/18/84

3. How many of these tests have been performed?

23 tests RMP-2-1 thru 6 both H & V
EV 6-13-1 thru 4 " " "
RM-P-1 & 2H (Note these are not reported in SAND81-1971
2(H&V) exp. it is fractured rock experiment not useful data.
(all were performed at 3 pressure tests

3a. According to what procedure revisions?

all performed under SINCO instructions manual

3b. How may test results, obtained under different revisions, be compared?

N.A.

3c. How many tests are in progress and which revision is in use?

N. A.

3d. How many tests are planned?

N. A.

3e. Comments.

Reviewer J Grewe

Date 7/18/84

4. What instrumentation is used for the test?
Goodman Jack models (52101 & 52102)
LVDT's Trans-Tek model 241-000
Displacement Indicator model 52127

4a. How were the reliabilities* of the instruments specified?
Instructions recommend calibration in a protected shop environment (pg 15)

4b. Is there a calibration system and were calibrations systematically carried out according to approved procedure?
Calibration sheets are attached to instructions for both near LVDT and Far LVDT
Note date is 3-14-77

4c. Are the calibrations traceable to national or industrial standards?

No

4d. Comments.
Calibration data is not available in file

* Reliability is defined as the probability of an instrument to perform a stated function under a stated environment for a stated time.

Reviewer A Reeves

Date 7/18/84

5. What are the data collection, reduction, and presentation techniques?
Noted in instruction Manual

5a. How can the raw numerical data be retrieved?
Field Data Sheets are in the file

5b. How can all data reduction steps prior to data storage be independently checked and/or duplicated?
Raw data is avisible

5c. Are the data presented in a complete and clear format? (Comment also on the utility of the presentation.)
Raw data is clear
Some data is on non standard form

5d. Are the data keyed to geological, environmental, and other experimental conditions?
Not provided in data summary

5e. Are the data traceable to a written procedure?
Yes

5f. Comments.
Test RMP-2 H-5 is not initialed
~~RMP-2-6H~~ ~~(on non-std form)~~ error "ok"
~~EV6-5H~~ ok
P2-3V is not initialed or dated

Reviewer G Hayeres

Date 7/18/84

6. What techniques are involved in analyzing and interpreting the data?

graphical plot of applied pressure vs deformation
tangent modulus along slope of linear portion of plot.

6a. What empirical techniques?

See instructions manual

6b. What analytical techniques?

See instruction manual

6c. What numerical techniques?

$$E = 0.86\, K(v)\, \frac{\Delta Q}{\Delta U_d / d}$$

ΔQ = plate pressure
ΔU_d = displacement
d = borehole dia 3.00 in.
$K(v)$ = patch constant

6d. Comments.

Data analysis procedures need to be more clearly presented and documented

Reviewer J. Greeves

Date 7/18/84

7. What computer programs are used in collecting, reducing, storing, presenting, and analyzing the data?

N.A.

7a. How are these programs verified, validated, documented, and controlled?

N.A.

7b. Comments (for example, implicit assumptions, sensitivities, other comments).

N.A.

Reviewer J Gneuss

Date 7/18/84

8. What are the acceptance/rejection criteria for the test data?

None

8a. Were these criteria established prior to test development?

No. Although judgment was exercised in SAND 81-1971 ept after tests were evaluated

8b. What is the logic behind the criteria?

N.A.

8c. How are the criteria implemented? (Data handling, review procedure, corrective action.)

These are not detailed. Future tests should account for these items.

- Data Handling
- Review Procedure
- Corrective Action

8d. Comments.

Reviewer JH

Date 7/18/84

9. How are deviations from established procedures documented?
Notes on Data sheets. No real deviations occurred

9a. What is the cause of the deviation?
N.A

9b. How are deviations considered in data reduction and/or analyses?
NA.

9c. Is the use of deviated data controlled? (For example, not used withoug approval of system designer or authorized project manager.)
N.A.

9d. Comments. (For example, equipment performance and its effect on test validity, other comments.)
See EV 6-13 (4-2) dated 7/21/81
"Good" statement of Pumps failure is noted on Form.

Reviewer [illegible]

Date 7/18/84

10. General comments (such as, relationship among different tests, impacts on interpretation, instrument redundancy, factors resulting in test closure, accuracy of measurements, limitations, additional uses of data, and other miscellaneous comments).

- Data is not in a form or document adequately 4 items identified as important to S.C. To meet needs in the HLW program. Future tests should document data under a well documented and qualified (Generic) procedures. This particular set of data is not critical to site characterization needs However it does indicate that better documented procedures and data recording is needed for future tests of all types.
- Some follow up evaluation of data analyses will be done when copies of data sheets are provided by NRC
- It is recognized that this type of test (i.e. Goodman Jack) has some inherent problems and may not be used at all in future test programs

Requested Copies of

SINCO Master Manual
P2-1H dated 7/15/81
P2-1V " "
P2-3V " "
P2-3H " "
P2-6H " "

See Next Page

Reviewer Mark Christiansen

Date 7/19/84

10. General comments (such as, relationship among different tests, impacts on interpretation, instrument redundancy, factors resulting in test closure, accuracy of measurements, limitations, additional uses of data, and other miscellaneous comments).

[illegible] 1 [illegible] the [illegible] [illegible] [illegible] the Good[illegible] [illegible] were [illegible] [illegible] [illegible] He reports that [illegible] [illegible] to poor [illegible] with the porchle wall. We should [illegible] by Hustrulid [illegible] 2. [illegible] only [illegible] [illegible] [illegible] [illegible]

1. [illegible], Vol. [illegible] "Geotechnical [illegible] G-Tunnel Nevada test Site" SAND 81-1971, UC-70 May 1982
2. W. A. Hustrulid, "An analysis of the Goodman Jack" 17th U.S. Symposium on Rock Mechanics, Snowbird, UTAH August 1976

(2)

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Reviewer Schmitt

Date July 18 1984

Draft Rock Mechanics Data Review Checklist
(Revision No. 0, January 18, 1984)

1. Name/type, identification number, and date of test.
USBM / In Situ Stress Measurements, ___, FY81
Location Rock Mechanics Drift, G Tunnel.

1a. What is the overall objective of the test?
(1) Establish baseline for heated block test,
Gain Field Exp-

1b. What specific parameters are to be determined by the test?
3 Boreholes, per borehole components of strain ⊥ to borehole,
Also modulus. Modulus by laboratory & borehole jack method.
~~Orthogonal~~

1c. Is there redundancy in the test concept?
≈ Multiple horizons were measured per hole. For strain
≈ Modulus by both lab & also borehole jacks.
≈ # Samples

1d. What criteria were used for test site (or sample) selection?
- Location of Drifts was important in selecting site.
- Drilling Logistics

1e. How is the rock at the test site characterized?
≈ Coring & Mapping

1f. How was the test designed?
≈ Designed around

1g. Comments.

Reviewer T. Schmidt

Date July 18 1984

2. Is the procedure documented and complete, and is it in written form?

Yes, Partially Complete. Strain measurements for procedures were given. ~~Biaxial modulus measurements were not given. (Ross ea~~

2a. Is it a standard (ASTM) procedure? If yes, provide reference.

Overcore, NO, Standard in development
Based, ?
Goodman Jack, ?

2b. If non-"standard", how was the procedure developed, reviewed, documented, and approved? For example, COE, USBM, USBR, USGS, NBS, or other (internal) processes.

Procedure is described in detail.
Also, USBM Circular is referenced.
Deviations from USBM recommended procedures not given.

2c. Have there been revisions and how and when were the revisions reviewed, documented, approved, and implemented?

The extent which procedure deviate from USBM reccomended procedures is not clear.
There

2d. Comments.

Rational for choice of modulas for calculations not given. Rational for method of interpreting strain from individual strain readings not given

Reviewer T.J. Schmidt

Date July 18 1984

3. How many of these tests have been performed?

1 total stress measurement -

3a. According to what procedure revisions?

Modi: Procedures given

3b. How may test results, obtained under different revisions, be compared?

Results were compared with other stress measurements in a tunnel, conducted by other techniques

3c. How many tests are in progress and which revision is in use?

NA

3d. How many tests are planned?

NA

3e. Comments.

Reviewer T. Schmidt

Date 7-18-84

4. What instrumentation is used for the test?

USBM.

4a. How were the reliabilities* of the instruments specified?

~ Anticipated problems described

4b. Is there a calibration system and were calibrations systematically carried out according to approved procedure?

- There is a calibration system specified.
- There is no mention in the field notes of calibration frequency or if or even if it was done.

4c. Are the calibrations traceable to national or industrial standards?

~ ± B Calibration procedures specify use of micrometer. This could be NBS traceable if necessary.

~

4d. Comments.

* Reliability is defined as the probability of an instrument to perform a stated function under a stated environment for a stated time.

Reviewer T. Schmitt

Date 7-18-84

5. What are the data collection, reduction, and presentation techniques?

5a. How can the raw numerical data be retrieved?
~ Data for strain means is shown in analog form, that strains can be recovered from

5b. How can all data reduction steps prior to data storage be independently checked and/or duplicated?
~yes.

5c. Are the data presented in a complete and clear format? (Comment also on the utility of the presentation.)
yes

5d. Are the data keyed to geological, environmental, and other experimental conditions?
~ yes in field notes but I did not have the time to read them completely

5e. Are the data traceable to a written procedure?
yes - See comments.

5f. Comments.

Reviewer T. Schmitt

Date 7-18-1986

6. What techniques are involved in analyzing and interpreting the data?

The Strain data and modulus data must be combined to yield stress estimate.

1

6a. What empirical techniques?

None

6b. What analytical techniques?

Method of Reduction of Data are given in Appendix

6c. What numerical techniques?

None

6d. Comments.

The determination of modulus is probably the most critical controversial aspect of the measurements.

Reviewer T. J. Schmidt

Date 7-18-84

7. What computer programs are used in collecting, reducing, storing, presenting, and analyzing the data?

Manipulation done by computer, Program not given but probably very simple.

7a. How are these programs verified, validated, documented, and controlled?

Simple manipulation, full verification etc not necessary

7b. Comments (for example, implicit assumptions, sensitivities, other comments).

- Manipulations are generally simple.

Reviewer T.J. Schmitt

Date 7-18-

8. What are the acceptance/rejection criteria for the test data?

8a. Were these criteria established prior to test development?

Some were -

8b. What is the logic behind the criteria?

8c. How are the criteria implemented? (Data handling, review procedure, corrective action.)

- Data Handling
- Review Procedure
- Corrective Action

8d. Comments.

Reviewer T. J. Schmitt

Date July 18 1984

9. How are deviations from established procedures documented?

~ In notes

9a. What is the cause of the deviation?

9b. How are deviations considered in data reduction and/or analyses?

9c. Is the use of deviated data controlled? (For example, not used withoug approval of system designer or authorized project manager.)

9d. Comments. (For example, equipment performance and its effect on test validity, other comments.)

Reviewer T.J. Schmitt

Date 7-18-84.

10. General comments (such as, relationship among different tests, impacts on interpretation, instrument redundancy, factors resulting in test closure, accuracy of measurements, limitations, additional uses of data, and other miscellaneous comments).

~~The data indicated~~
The study determined the state of stress in a tunnel.
It also documented that USBM overcore will be a useful technique.

From a technical point of view, there was not sufficient information for adequate review. That may or may not be critical, it was noted that the contractor did not submit a final report in usual form but rather a letter report.

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Reviewer J. Daemen

Date 7-18-84

Draft Rock Mechanics Data Review Checklist
(Revision No. 0, January 18, 1984)

1. Name/type, identification number, and date of test.

In Situ Permeability Measurement Using Zone Packer Injection Method. FSI-GT-004. Test No. RM-P-1-7. Undated

1a. What is the overall objective of the test?

Measure single borehole permeabilities of selected joints within the rock mass and determine a reasonable range of values to be expected.

1b. What specific parameters are to be determined by the test?

Fracture Aperture - Fracture Permeability

1c. Is there redundancy in the test concept?

Not for individual "point" measurements (instrument redundancy), but redundancy build in by repeating tests at various pressures

1d. What criteria were used for test site (or sample) selection?

to best evaluate a wide range of conditions

1e. How is the rock at the test site characterized?

from study of drill logs, borescope mapping of fractures, but maps of boreholes are not available at this location.

1f. How was the test designed?

Procedures developed by Foundation Sciences, Inc.

1g. Comments.

Reviewer J. Daemen

Date 7-18-84

2. Is the procedure documented and complete, and is it in written form?

yes

2a. Is it a standard (ASTM) procedure? If yes, provide reference.

No

2b. If non-"standard", how was the procedure developed, reviewed, documented, and approved? For example, COE, USBM, USBR, USGS, NBS, or other (internal) processes.

Foundation Sciences, Inc developed procedures which had been submitted to R.N. Zimmerman prior to starting of the tests, as confirmed by Sandia QA Audit performed on Foundation Sciences, Inc., per PR [illegible] 74-9415

2c. Have there been revisions and how and when were the revisions reviewed, documented, approved, and implemented?

No revisions

2d. Comments.

Written procedures do not include review/approval.

Reviewer J. Daemen

Date 7-18-84

3. How many of these tests have been performed? 13

3a. According to what procedure revisions?

Original - minor revisions as noted in QA Audit Report of Foundation Sciences, Inc. per PR 74-1415, Ref # 4537-01

3b. How may test results, obtained under different revisions, be compared?

No revisions - all tests can be compared directly

3c. How many tests are in progress and which revision is in use?

None

3d. How many tests are planned?

Six holes - multiple measurements - for Gtunnel

More tests for Exploratory Shaft.

3e. Comments.

Reviewer J. Daemen

Date 7-18-84

4. What instrumentation is used for the test?

Pneumatic double packer - nitrogen tank - nylon tubing - Turbine pump - water pipe - thermometer - intake hose - discharge hose - packer hose - return hose - pressure gage - water meter - control manifold - measuring tape - water tank - miscellaneous

4a. How were the reliabilities* of the instruments specified?

Not specified

4b. Is there a calibration system and were calibrations systematically carried out according to approved procedure?

in accordance with QA, according to procedures - QA, calibration procedures and records not available, but Sandia National laboratories Quality Assurance Program Audit, Audit I.D. 4537-06, on instruments

4c. Are the calibrations traceable to national or industrial standards?

yes - identified in Sandia ~~QA~~ QA Audit I.D. 4537-06 for instrument components

4d. Comments.

Instrumentation described clearly in test procedures. Calibration confirmed as per Sandia QA audit, but not available at this location.

* Reliability is defined as the probability of an instrument to perform a stated function under a stated environment for a stated time.

Reviewer J. Daemen

Date 7-18-84

5. What are the data collection, reduction, and presentation techniques?

Manually filling out standard forms GT-004-01 and GT-004-001, parts of standard testing procedure.

5a. How can the raw numerical data be retrieved?

Originals at Foundation Sciences, Inc.

5b. How can all data reduction steps prior to data storage be independently checked and/or duplicated?

Needs to be checked at Foundation Sciences, Inc.

5c. Are the data presented in a complete and clear format? (Comment also on the utility of the presentation.)

Yes - graphs illustrate linearity directly

5d. Are the data keyed to geological, environmental, and other experimental conditions?

Indirectly, especially through SAND 81-1971

5e. Are the data traceable to a written procedure?

Yes, for actual measurement data.
No, for pre-testing borehole mapping and fracture number determination.

5f. Comments.

Reviewer J. Daemen

Date 7-18-84

6. What techniques are involved in analyzing and interpreting the data?

Analytical - Graphical

6a. What empirical techniques?

None

6b. What analytical techniques?

flowrate / hydraulic conductivity / aperture formulas - listed in files and in SAND 81-1971, appear to be for saturated flow

6c. What numerical techniques?

None

6d. Comments.

Reviewer J. Daemen

Date 7-18-84

7. What computer programs are used in collecting, reducing, storing, presenting, and analyzing the data?

None

7a. How are these programs verified, validated, documented, and controlled?

N. A.

7b. Comments (for example, implicit assumptions, sensitivities, other comments).

Reviewer J. Daemen

Date 7-18-84

8. What are the acceptance/rejection criteria for the test data?

None

8a. Were these criteria established prior to test development?

N. A.

8b. What is the logic behind the criteria?

N. A.

8c. How are the criteria implemented? (Data handling, review procedure, corrective action.)

N. A.

- Data Handling

- Review Procedure

- Corrective Action

8d. Comments.

Reviewer J. Daemen

Date 7-18-84

9. How are deviations from established procedures documented?

In Table of Results/Measurements

9a. What is the cause of the deviation?

Objective: obtain more results, repeat second part of test

9b. How are deviations considered in data reduction and/or analyses?

not applicable - data not analyzed

9c. Is the use of deviated data controlled? (For example, not used withoug approval of system designer or authorized project manager.)

NA

9d. Comments. (For example, equipment performance and its effect on test validity, other comments.)

Fall off part of test repeated - very low hydraulic conductivity -

Reviewer _____

Date _____

10. General comments (such as, relationship among different tests, impacts on interpretation, instrument redundancy, factors resulting in test closure, accuracy of measurements, limitations, additional uses of data, and other miscellaneous comments).

(4) 22

Reviewer J. Daemen

Date 7-18-84

Draft Rock Mechanics Data Review Checklist
(Revision No. 0, January 18, 1984)

1. Name/type, identification number, and date of test.

In Situ Permeability Measurements Using Zone Packer Injection Method

1a. What is the overall objective of the test?

Measure single borehole permeabilities of selected joints within the rock mass and determine a reasonable range of values to be expected.

1b. What specific parameters are to be determined by the test?

Fracture permeability - Fracture aperture

1c. Is there redundancy in the test concept?

Not for individual (point) measurements of flow/pressure - yes for overall conductivity measurement

1d. What criteria were used for test site (or sample) selection?

Test locations and intervals selected to best evaluate the entire range of lithologic features, including shattered and jointed zones, bedding planes, and uniform, undisturbed bedrock.

1e. How is the rock at the test site characterized?

From study of drill logs and other available information. Borescope mapping of fractures. (according to SAND 81-1971)

1f. How was the test designed?

1g. Comments.

This set of data ~~sh~~ review sheets is a summary of comments based on all 13 tests performed.

Reviewer J. Daemen

Date 7-18-84

2. Is the procedure documented and complete, and is it in written form?

Yes, for actual testing procedure
no, for pre-testing borehole mapping and fracture count

2a. Is it a standard (ASTM) procedure? If yes, provide reference.

No

2b. If non-"standard", how was the procedure developed, reviewed, documented, and approved? For example, COE, USBM, USBR, USGS, NBS, or other (internal) processes.

Developed by Foundation Sciences, Inc., on contract - approved by Roger Zimmerman for Sandia, (not in writing), as per acceptance of results/report, as noted in SANDIA QA Audit Performed on Science Foundation per PR 74-9415

2c. Have there been revisions and how and when were the revisions reviewed, documented, approved, and implemented?

No revisions that affect substance of results - minor revisions as needed to allow successful completion of tests

2d. Comments.

Written review and approval would be desirable for future editions of procedures

Reviewer J. Daemen

Date 7-18-84

3. How many of these tests have been performed?

13

3a. According to what procedure revisions?

Original

3b. How may test results, obtained under different revisions, be compared?

Results summarized in Table and Graph

3c. How many tests are in progress and which revision is in use?

See "comments"

3d. How many tests are planned?

3e. Comments.

A significantly different and improved test but with same objective is being used in heated block test

Reviewer J. Daemen

Date 7-18-84

4. What instrumentation is used for the test?

listed in procedure: Geotechnical Test Procedure GT-004, Foundation Sciences, Inc., FSI-GT-004, 3/81

4a. How were the reliabilities* of the instruments specified?

No information given - probably not explicitly specified except as given in manufacturers catalogs/instrument sheets - pressure gage identified in Sandia QA audit of Foundation Sciences, Inc.

4b. Is there a calibration system and were calibrations systematically carried out according to approved procedure?

yes, identified in report SAND 81-1971, no data available in data file - might be at Foundation Sciences

4c. Are the calibrations traceable to national or industrial standards?

yes - for individual instruments (pressure gage, flow rate)

no - for overall system calibration

4d. Comments.

It would be highly desirable to include at least copies of calibration curves/data with data file

* Reliability is defined as the probability of an instrument to perform a stated function under a stated environment for a stated time.

Reviewer J. Daemen

Date 7-18-84

5. What are the data collection, reduction, and presentation techniques?

Collection: manually fill out standard forms GT-004-01 and GT-004-001

5a. How can the raw numerical data be retrieved?

From originals at Foundation Sciences, Inc., ~~photocopies of [illegible]~~

5b. How can all data reduction steps prior to data storage be independently checked and/or duplicated?

No reduction prior to recording

5c. Are the data presented in a complete and clear format? (Comment also on the utility of the presentation.) yes, but only after first reduction step - raw data not available at this site

5d. Are the data keyed to geological, environmental, and other experimental conditions?

- to number of fractures / test interval
- hole number identified

5e. Are the data traceable to a written procedure? yes

5f. Comments.

Reviewer J. Daemen

Date 7-18-84

6. What techniques are involved in analyzing and interpreting the data?

- analytical
- graphical

6a. What empirical techniques?

None

6b. What analytical techniques?

Hydraulic conductivity - fracture aperture equations $K_s = \frac{e^2 \gamma_w}{12 \mu}$

(K_s: hydraulic conductivity (cm/s)
e: aperture (cm)
γ_w: weight per unit volume (N/cm^3)
μ: viscosity of water ($N\text{-}s/cm^2$)

$$e = \left(\frac{12 \mu Q \ln(L/r)}{12 \pi n H_o \gamma_w} \right)^{1/3}$$

Q: flow rate through test section (cm^3/s)
n: number of intersecting joints
H_o: pressure head (cm)
L: length of test section (cm)
r: hole radius (cm)

6c. What numerical techniques?

None

6d. Comments.

References to analytical methods are included in SAND 81-1971

Saturated flow implied - steady state observed - all flow assumed to be fracture flow

Reviewer J. Daemen

Date 7-18-84

7. What computer programs are used in collecting, reducing, storing, presenting, and analyzing the data?

None

7a. How are these programs verified, validated, documented, and controlled?

NA

7b. Comments (for example, implicit assumptions, sensitivities, other comments).

NA

Reviewer J. Daemen

Date 7-18-84

8. What are the acceptance/rejection criteria for the test data?

None

8a. Were these criteria established prior to test development?

NA

8b. What is the logic behind the criteria?

NA

8c. How are the criteria implemented? (Data handling, review procedure, corrective action.)

NA

- Data Handling

- Review Procedure

- Corrective Action

8d. Comments. Purpose was to identify broad range of results.

Reviewer J. Daemen

Date 7-18-84

9. How are deviations from established procedures documented?

Minor deviations identified in Sandia QA Audit Report of Foundation Sciences, Inc. per PR 74-2415, Ref # 4537-06

9a. What is the cause of the deviation?

Excessive flowrate, needed modification of flowrate measurements - based on observations during tests

9b. How are deviations considered in data reduction and/or analyses?

does not influence analysis

9c. Is the use of deviated data controlled? (For example, not used withoug approval of system designer or authorized project manager.)

Not applicable

9d. Comments. (For example, equipment performance and its effect on test validity, other comments.)

Probably no problems with test validity

Reviewer J. Daemen

Date 7-18-84

10. General comments (such as, relationship among different tests, impacts on interpretation, instrument redundancy, factors resulting in test closure, accuracy of measurements, limitations, additional uses of data, and other miscellaneous comments).

Test appears to be intended primarily for development of testing procedures, and for obtaining generic results of welded tuff fracture permeabilities. The tests clearly have been very successful in both regards. With respect to procedures, the author has identified several improvements that will be implemented for future tests of a similar type. All indications are that the permeability numbers obtained are reliable. It would be desirable if the data files maintained at this location were complete, i.e. included all calibration tests, pre-testing borehole maps prepo

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Reviewer Mark Christianson

Date 7/19/84

Draft Rock Mechanics Data Review Checklist
(Revision No. 0, January 18, 1984)

I. Name/type, identification number, and date of test.
Phase I, Small Diameter Heater Experiment ; Non Welded Tuff

1a. What is the overall objective of the test?
1. Monitor the possible migration of water into the annulus around the heater and evaluate its liquid and vapor states.
2. measure temperature distributions to evaluate possible effects of hydrothermal phenomena.
3. evaluate two methods of measuring rock surface temperatures

1b. What specific parameters are to be determined by the test?
NA.

1c. Is there redundancy in the test concept?
yes

1d. What criteria were used for test site (or sample) selection?
Site available in non welded tuff.

1e. How is the rock at the test site characterized?

1f. How was the test designed?
based on experience gained from tests in Welded tuff

1g. Comments.

Reviewer Mark Christianson

Date 7/19/84

2. Is the procedure documented and complete, and is it in written form?

Yes

" Operating Test Plan, Phase I - Small Diameter Heater Experiment : Non Welded Tuff"
August 1982

2a. Is it a standard (ASTM) procedure? If yes, provide reference.

No

2b. If non-"standard", how was the procedure developed, reviewed, documented, and approved? For example, COE, USBM, USBR, USGS, NBS, or other (internal) processes.

Sandia Internal review process

2c. Have there been revisions and how and when were the revisions reviewed, documented, approved, and implemented?

No

2d. Comments.

Reviewer Mark Christianson

Date 7/19/84

3. How many of these tests have been performed?

1

3a. According to what procedure revisions?

NA

3b. How may test results, obtained under different revisions, be compared?

NA

3c. How many tests are in progress and which revision is in use?

NA

3d. How many tests are planned?

None

3e. Comments.

Reviewer Mark Christiansen

Date 7/19/84

4. What instrumentation is used for the test?
Thermal Couples, Relative humidity, Water level, water pressure,
Data aquisition System.
Described on Table 1, Page 7, Test plan document.

4a. How were the reliabilities* of the instruments specified?
Operational Design limits given on Table 2, Page 11
of Test plan document

4b. Is there a calibration system and were calibrations systematically carried out according to approved procedure?
Yes
Ices Standard
DC Voltage Standard
Temperature of reference Junction on Scanner Card
Central Calibrator is part of data aquisition system.

4c. Are the calibrations traceable to national or industrial standards?
Ice point and Dvm are traceable to NBS Standards

4d. Comments.

* Reliability is defined as the probability of an instrument to perform a stated function under a stated environment for a stated time.

Reviewer Mark Christiansen

Date 7/19/84

5. What are the data collection, reduction, and presentation techniques?
Data is collected by HP-9845 Computer then Stored on floppy Diskettes

5a. How can the raw numerical data be retrieved?
Computer floppy Disks (HP 9845 Computer)

5b. How can all data reduction steps prior to data storage be independently checked and/or duplicated?
raw data is stored, data reduction occurs after this step

5c. Are the data presented in a complete and clear format? (Comment also on the utility of the presentation.)
Scan Sheets provide Numeric data for all instruments and calibrations for a point in time. In addition to plots of quantity measured as a function of Time.

5d. Are the data keyed to geological, environmental, and other experimental conditions?
Room temperature, and relative humidity are on Scan Sheet.

5e. Are the data traceable to a written procedure?
Pg 16 of data review plan describes data collection procedure

5f. Comments.

Reviewer Mark Christian

Date 7/19/84

6. What techniques are involved in analyzing and interpreting the data?

Comparison of computer generated profiles with actual data for temperature
& validation assessment of moisture migration potential

6a. What empirical techniques?

6b. What analytical techniques?

6c. What numerical techniques?

6d. Comments.

Reviewer Mark Christianson

Date 7/19/84

7. What computer programs are used in collecting, reducing, storing, presenting, and analyzing the data?

SDH-D Program to receive/store + plot data
" -E

7a. How are these programs verified, validated, documented, and controlled?

7b. Comments (for example, implicit assumptions, sensitivities, other comments).

Reviewer _____

Date _____

8. What are the acceptance/rejection criteria for the test data?

8a. Were these criteria established prior to test development?

8b. What is the logic behind the criteria?

8c. How are the criteria implemented? (Data handling, review procedure, corrective action.)

- Data Handling
- Review Procedure
- Corrective Action

8d. Comments.

Reviewer _____

Date _____

9. How are deviations from established procedures documented?

9a. What is the cause of the deviation?

9b. How are deviations considered in data reduction and/or analyses?

9c. Is the use of deviated data controlled? (For example, not used withoug approval of system designer or authorized project manager.)

9d. Comments. (For example, equipment performance and its effect on test validity, other comments.)

Reviewer _____

Date _____

10. General comments (such as, relationship among different tests, impacts on interpretation, instrument redundancy, factors resulting in test closure, accuracy of measurements, limitations, additional uses of data, and other miscellaneous comments).

6 24

Reviewer J. Daemen

Date 7-19-84

Draft Rock Mechanics Data Review Checklist
(Revision No. 0, January 18, 1984)

1. Name/type, identification number, and date of test.

Small Diameter Heater Experiment in Tuff - phase I - welded Tuff

1a. What is the overall objective of the test?

Identified on p. 6 of SAND 82-200, Draft 4/84 - water migration, temperature distributions, instrument evaluation, compare welded and nonwelded tuffs; also Operational Test Plan, Phase I, pg. 3-

1b. What specific parameters are to be determined by the test?

1c. Is there redundancy in the test concept?

1d. What criteria were used for test site (or sample) selection?

1e. How is the rock at the test site characterized?

1f. How was the test designed?

1g. Comments.

Reviewer Y. Daemen

Date 7-19-84

2. Is the procedure documented and complete, and is it in written form?

Yes

2a. Is it a standard (ASTM) procedure? If yes, provide reference.

No

2b. If non-"standard", how was the procedure developed, reviewed, documented, and approved? For example, COE, USBM, USBR, USGS, NBS, or other (internal) processes.

Developed by R.M. Zimmerman, W.H. Barrett, C.O. Duimstra, Test Plan, SAND 82-2200, Draft 4/84. - Not released
Operational Test Plan - March, 1982 - reviewed, documented approved as per 26 of Operational Test Plan

2c. Have there been revisions and how and when were the revisions reviewed, documented, approved, and implemented?

Memorandum of Record, May 10, 1982 from R.M. Zimmerman to J.R. Tillerson

2d. Comments.

Reviewer J. Daemen

Date 7-19-84

3. How many of these tests have been performed?

Two

3a. According to what procedure revisions?

Operational Test Plan - August 1982

3b. How may test results, obtained under different revisions, be compared?

Tests under second operational test plan were performed in nonwelded tuff - tests under first operational test plan were in welded tuff

3c. How many tests are in progress and which revision is in use?

None

3d. How many tests are planned?

Phase II - operational test plan has been prepared but not yet approved
Test planned is prototype test for Exploratory shaft.

3e. Comments.

Reviewer J. Daemen

Date 7-19-84

4. What instrumentation is used for the test?

Summarized in Table 1, p. 8, of Operational Test Plan - Phase I - Small Diameter Heater Experiment: Welded Tuff; refers to SAND 82-0108 for complete design details, installation procedures, data evaluation

4a. How were the reliabilities* of the instruments specified?

Operational design limits of the instruments are given in Table 2 of Operational Test Plan, Phase I - Small diameter heater experiment: Welded Tuff, 1982 | Also in SAND 81-1972, p.10

4b. Is there a calibration system and were calibrations systematically carried out according to approved procedure?

Detailed calibration of Rockwall Temperature Measurement Devices is documented in memo from R.P. Fleming to R. Zimmerman, June 3, 1983, and Follow-Up dated July 12, 1983 from R.P. Fleming to J.R. Tillerson

4c. Are the calibrations traceable to national or industrial standards?

ANSI standards for thermocouples on p.7 of Operational Test Plan

Other calibrations performed at SNL calibration laboratory -

4d. Comments.

* Reliability is defined as the probability of an instrument to perform a stated function under a stated environment for a stated time.

Reviewer J. Daemen

Date 7-19-84

5. What are the data collection, reduction, and presentation techniques?

HP 9845 desk top computer data acquisition system, tape cartridge, floppy disk, thermal printer/plotter

5a. How can the raw numerical data be retrieved?

- data storage file: floppy disks + copies of Principal Investigator and in QA file

5b. How can all data reduction steps prior to data storage be independently checked and/or duplicated?

All data stored as raw voltage - no data reduction prior to storage

5c. Are the data presented in a complete and clear format? (Comment also on the utility of the presentation.)

Yes - scan sheets are very clear, and can be obtained from data files - complete plots are included, and more detailed curves can be generated

5d. Are the data keyed to geological, environmental, and other experimental conditions?

Yes, as per Operational Test Plan, Phase I, p. 11 - which gives test location

5e. Are the data traceable to a written procedure?

Yes

5f. Comments.

Reviewer J. Daemen

Date 7~~8~~-19-84

6. What techniques are involved in analyzing and interpreting the data?

6a. What empirical techniques?

~~Klaus~~ See Zimmerman, First Phase of Small Diameter Heater Experiments in Tuff

6b. What analytical techniques?

6c. What numerical techniques?

Finite element analysis

6d. Comments.

Reviewer J. Daemen

Date 7-19-84

7. What computer programs are used in collecting, reducing, storing, presenting, and analyzing the data?

SDH-D : receive store and plot data (4-12-82)

SDH-E " " " " (8-25-82)

Copies included in data file

SNL programs

7a. How are these programs verified, validated, documented, and controlled?

Calibrate with thermocouples hooked into data acquisition system and reference points: ice point

Scanner cards validated by HP-

7b. Comments (for example, implicit assumptions, sensitivities, other comments).

Reviewer J. Daemen

Date 7-19-84

8. What are the acceptance/rejection criteria for the test data?

8a. Were these criteria established prior to test development?

8b. What is the logic behind the criteria?

8c. How are the criteria implemented? (Data handling, review procedure, corrective action.)

- Data Handling
- Review Procedure
- Corrective Action

8d. Comments.

Reviewer J. Daemen

Date 7-19-84

9. How are deviations from established procedures documented?

in Memorandums of Record
e.g. May 10, 1982

9a. What is the cause of the deviation?

9b. How are deviations considered in data reduction and/or analyses?

9c. Is the use of deviated data controlled? (For example, not used withoug approval of system designer or authorized project manager.)

9d. Comments. (For example, equipment performance and its effect on test validity, other comments.)

Reviewer _____

Date _____

10. General comments (such as, relationship among different tests, impacts on interpretation, instrument redundancy, factors resulting in test closure, accuracy of measurements, limitations, additional uses of data, and other miscellaneous comments).

25

Reviewer J. Daemen / M. Christianson

Date 7-19-84

Draft Rock Mechanics Data Review Checklist
(Revision No. 0, January 18, 1984)

1. Name/type, identification number, and date of test.

G-Tunnel Heated Block Experiment

1a. What is the overall objective of the test?

Draft-SAND 82-2999-page 14
- Theimomechanical properties of jointed tuff
- effects of stress and temperature changes on joint
- pore moisture content

to improve measurement techniques for use at Yucca Mtn.

1b. What specific parameters are to be determined by the test?

Thermal conductivity, in situ modulus of deformation, Poisson's ratio, joint deformation, joint strength, and ultrasonic wave velocities

1c. Is there redundancy in the test concept?

yes - 200 thermocouples / 6 horizontal strains / 2-4 anchor MPBX / double flat jacks / 2-GUSBM gages / 2-5 CSIRO gages / (See Instrument list.)

1d. What criteria were used for test site (or sample) selection?

Accessibility, stratigraphy, rock fracture

Test plan, SAND 82-2999, p. 2

1e. How is the rock at the test site characterized?

Surface mapping; pilot hole drilling; fracture permeability measurements; borescope observations

1f. How was the test designed?

SAND 81-1841: Conceptual design - has been the subject of extensive revision

1g. Comments.

Reviewer J. Daemen / M. Christianson

Date 7-19-84

2. Is the procedure documented and complete, and is it in written form?

Documented in Test Plan, Draft SAND 82-2999
Previous Version: Final Design Report - G Tunnel
Heated Block Experiment Oct 1982

2a. Is it a standard (ASTM) procedure? If yes, provide reference.

NO

2b. If non-"standard", how was the procedure developed, reviewed, documented, and approved? For example, COE, USBM, USBR, USGS, NBS, or other (internal) processes.

Developed: nine authors - SNL/SAI
Review:
Documents
Approval:

2c. Have there been revisions and how and when were the revisions reviewed, documented, approved, and implemented?

revisions: Conference/Telecon note 7/6/84

2d. Comments.

Reviewer J. Daemen/R Christianson

Date 7-19-84

3. How many of these tests have been performed?

One in progress, but each the test consists of six loading cycles at ambient temperatures, for some tests load was maintained / Eight thermal cycles with various heat and pressure loads.

3a. According to what procedure revisions?

3b. How may test results, obtained under different revisions, be compared?

Direct comparison of numerical results, and/or graphs of results

3c. How many tests are in progress and which revision is in use?

One in progress

3d. How many tests are planned?

planned for exploratory shaft-

3e. Comments.

Reviewer J. Daemen/N. Chris

Date 7-19-84

4. What instrumentation is used for the test?

SAND 82-2999, unreleased draft, Table 1, p. ~~4~~ 65,

4a. How were the reliabilities* of the instruments specified?

SAND 82-2999, unreleased draft, Table 1, lists reference standards, p.

4b. Is there a calibration system and were calibrations systematically carried out according to approved procedure?

SAND 82-2999, unreleased draft, p. 85 - "calibrations by manufacturers - not necessary to repeat these calibrations, for much of the instrumentation - SAI performs calibrations on incoming instrument

4c. Are the calibrations traceable to national or industrial standards?

Data system calibration standards have been sent to the Sandia National laboratories Calibration luboratory

4d. Comments.

Complete calibration files are at SAI but can readily be obtained through SNL

* Reliability is defined as the probability of an instrument to perform a stated function under a stated environment for a stated time.

Reviewer J. Daemen / M. Christianson

Date 7-19-84

5. What are the data collection, reduction, and presentation techniques?

HP 9845B, HP 3497 Scanner, two expansion boxes - Two Winchester disks, weekly backed up on tape, shipped to SNL,

5a. How can the raw numerical data be retrieved?

Recoverable from Winchester Disks at SAI, with copies at SNL

5b. How can all data reduction steps prior to data storage be independently checked and/or duplicated?

Stored both ways - as raw data and as converted files Hard copies ~~of~~ (paper) of at least every tenth scan, sheet, every single one during rapid changes

5c. Are the data presented in a complete and clear format? (Comment also on the utility of the presentation.)

yes { scan sheets / plots

5d. Are the data keyed to geological, environmental, and other experimental conditions?

Location given in SAND 82-2999, not released, in G-Tunnel, Grouse Canyon - allows referencing to geology Environmental conditions: monitored on every scan, printed out on scan sheet

5e. Are the data traceable to a written procedure?

yes - SAND 82-2999, not released,

5f. Comments.

Reviewer J. Daemen / M. Christianson

Date 7-19-84

6. What techniques are involved in analyzing and interpreting the data?

Graphical - analytical - numerical

stress-strain curve plotting;

6a. What empirical techniques?

Neutron probe

EMF

6b. What analytical techniques?

E, ν, thermal expansion

6c. What numerical techniques?

3-D, stealth : finite difference code

in planning/progress stage

6d. Comments.

Reviewer J. Daemen/M. Christianson

Date 7-19-84

7. What computer programs are used in collecting, reducing, storing, presenting, and analyzing the data?

BLOCKE, BLOCKF : stores data, converts to strain, stress, etc. - temperature compensation

Programs are available (hard copies) in SNL data file

Five other programs at SAI for individual separate instrumentation aspects

7a. How are these programs verified, validated, documented, and controlled?

For most instruments, e.g. NPBX, physically apply certain displacement, and compare with ~~physical~~ independent measurement after ~~program~~ data is ~~reduced~~ scanned, reduced.

7b. Comments (for example, implicit assumptions, sensitivities, other comments).

Reviewer J. Daemen / N. Christiansen

Date 7-19-84

8. What are the acceptance/rejection criteria for the test data?

Judgmental, based on expected results, e.g. comparison with pre-calculations,

8a. Were these criteria established prior to test development?

Not explicitly

8b. What is the logic behind the criteria?

Experience, judgment

8c. How are the criteria implemented? (Data handling, review procedure, corrective action.)

- Data Handling

Data loss: in most cases only converted data is lost — in most cases can be recovered from raw data

- Review Procedure

SAI and SNL perform calculations independently, for publications followed by review within Sandia

- Corrective Action

Recover converted data from raw data files

8d. Comments.

Reviewer J. Daemen/N. Christianson

Date 7-19-84

9. How are deviations from established procedures documented?

Conference / Telecon Vote 7/6/84 Heated Block

9a. What is the cause of the deviation?

on site requirements

9b. How are deviations considered in data reduction and/or analyses?

N. A.

9c. Is the use of deviated data controlled? (For example, not used withoug approval of system designer or authorized project manager.)

N A

9d. Comments. (For example, equipment performance and its effect on test validity, other comments.)