See Packet 5 for encl.

Department of Energy
Chicago Operations Office
Salt Repository Project Office
505 King Avenue
Columbus, Ohio 43201-2693

WM DOCKET CONTROL CENTER

'84 SEP 11 A10:45

September 6, 1984

WM Record File 106
WM Project 16
Docket No.
PDR ✓
LPDR ✓
Distribution: REB CR WKerr
JLinehan MJB JJS
JDB DM
(Return to WM, 623-SS) HM C²

John J. Linehan, Section Leader
Salt Section
Repository Projects Branch
Division of Waste Management, MS 623-SS
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Linehan:

SUBJECT: TRANSMITTAL OF SUMMARIES OF MEETINGS WITH NRC

Enclosed for your information are meeting summaries and handouts from three recent meetings with the NRC. They are:

1) August 21-24, 1984 Rock Mechanics Data Orientation and Data Review for NRC,

2) August 22, 1984 SRP Geochemistry Program Overview for NRC, and

3) August 8, 1984 Information Management Systems Meeting

Sincerely,

J. O. Neff

J. O. Neff
Program Manager
Salt Repository Project Office

SRPO:LAC:max:3752B

Enclosures:
As Stated

8409260647 840906
PDR WASTE
WM-16 PDR

652

cc: R. Johnson, NRC, w/encl.
D. Dawson, ONWI, w/encl.
C. Knudsen, ONWI, w/encl.
C. Newton, DOE-HQ, w/encl.
W. Bennett, DOE-HQ, w/o encl.
D. Vieth, w/encl.
L. Olson, BWIP, w/encl.
J. Nelson, Weston, w/encl.
J. Sherwin, SRPO, w/o encl.
R. Waters, SRPO, w/o encl.

ST# 864-84

Encl. to ltr. to Linehan from Neff - 9/6/84

ROCK MECHANICS DATA ORIENTATION AND DATA REVIEW FOR NRC

Columbus, Ohio
August 21-24, 1984

The Rock Mechanics Staff and consultants of the NRC Salt Project conducted a Rock Mechanics Data Orientation and Data Review Meeting during August 21-24, 1984 at the SRPO/ONWI facilities in Columbus, Ohio. The objectives were:

- Orient NRC to the various types of rock mechanics and geotechnical engineering data from all sources used for the Salt Repository Project (SRP);
- Familiarize NRC with data used in geotechnical engineering analysis for the SRP;
- Allow NRC to understand how data was obtained and documented;
- Allow NRC to identify and obtain (on a selective basis) data to be analyzed by NRC at a later date.

Representatives of the DOE, ONWI, Louisiana Geological Survey, Mississippi Bureau of Geology, and U.S. Geological Survey (USGS) attended the data orientation meeting. Attachment No. 1 presents the list of attendees. Attachment No. 2 presents the agenda for the Data Orientation and Data Review Meeting.

1. Data Orientation and Data Review - Summary

August 21

After brief introduction by the DOE and NRC representatives, the DOE/ONWI/and their subcontractors made overview presentation on the rock mechanics data for the SRP. (See Attachment No. 2 for Agenda and Attachment No. 3 for copies of presentation viewgraphs.) The presentation included types and quantity of data; data management

in terms of data traceability and storage location of data, and QA at various organization levels. Various rock mechanics contractors to ONWI made brief presentations on the scope and data developed by their work. ONWI presented some generic data on Asse mine and Avery Island mine program. General data-related questions, which the NRC staff had submitted to DOE prior to this meeting, were briefly addressed during the presentation. In addition to the NRC/DOE/ONWI and their contractors, representatives from the states of Louisiana and Mississippi and USGS also attended the meeting (see Attachment No. 1, List of Attendees).

August 22

The NRC staff had previously submitted to DOE a list of published and unpublished reports (referenced in the EAs) which were not available to the NRC for review. During the meeting, the DOE/ONWI furnished all available references from the above list for NRC's use. DOE/ONWI also provided numerous examples of test records and data packets containing unpublished raw data for NRC review. The NRC staff and consultants started inventory and review of these reports and data packets. Because some of the ONWI contractors were scheduled to leave in the evening, the NRC staff concentrated their review on documents which would require input by those contractors.
ONWI staff demonstrated how to use the Records Information System (RIS) and access the SRP data. The NRC staff used the data terminal to trace needed references and also obtained microfilm copies of the Records Turnover Package (RTP) associated with some of the published reports.

August 23

The NRC staff and consultants continued data inventory and review of the unpublished reports provided by the ONWI. These reports are in draft version and will be published in the near future. At the end of the review meeting, the NRC presented to the DOE a list of documents to be shipped to the NRC's office in Silver Spring. (See Attachment No. 4.)

August 24

The NRC staff and consultants continued review of documents/reports in the morning. The NRC staff summarized the week's activities with the DOE and ONWI staff during a debriefing meeting.

2. NRC Staff Observations

2.1 Access to the DOE, ONWI, and contractor's staff during this data acquisition, orientation and clarification activity was very open and invaluable in assisting the NRC staff and consultants towards achieving the objectives of this review.

2.2 The Salt Repository Project Technical Data Management System (TDMS) was of great aid in accessing information pertinent to rock mechanics testing data. The Records Information System (RIS) served to expedite acquisition of bibliographic source summary for related topics and in checking completeness of the NRC document inventory. The Salt Repository Project Technical Data Base (SRP-TDB) also provided ready access to data contained in cataloged reports and served to aid the NRC staff in checking completeness of the NRC data inventory.

2.3 The project records portion of the TDMS contains a catalog of data in the Records Turnover Packages from the contractors. This system, while not yet fully current, is excellent and assisted the NRC team to locate specific records in the archive during the data review. The ready availability of microfilmed backup files containing detailed testing procedures and raw data files, as well as the ready access to equipment for reading the microfilms and to personnel assisting with locating, copying and reading the film, greatly improved the efficiency and productivity of the NRC data review.

2.4 Sufficient examples of the field and laboratory support records for rock mechanics testing accomplished in the Paradox Basin, the Permian Basin and the Gulf Coast States sites were provided to allow the NRC staff and consultants to acquire a general understanding of the reliability (technical accuracy and adequate documentation) of the data identified in the EAs of the SRP sites. Generic rock mechanics data developed in conjunction with the Avery Island and Asse program were available for acquisition and review.

2.5 The NRC staff and consultants consider that objectives of the Rock Mechanics Data Review (as detailed in Attachment No. 1 to the letter from J. Linehan of NRC to J. Neff of DOE, dated August 14, 1984; Subject: NRC Rock Mechanics Data Review Meeting) have been achieved.

2.6 No observations were provided for this meeting summary by the representatives of Louisianna and Mississippi.

3. Action Items

3.1 The NRC provided the DOE with a list of documents and data records which are to be reviewed by the NRC at a later date (see Attachment No. 4). The DOE agreed to transmit one copy of each (subject to completion of any patent review requirements) to the NRC in Silver Spring, MD.

3.2 The NRC staff will formally transmit to the DOE and the States copies of the data checklists and review sheets completed during this review meeting. These review sheets serve as a record of what NRC reviewed and indicate the type and range of data made available to NRC for review during the data review.

The above items were discussed and the above action items agreed to. The draft of this summary was signed by J. Neff of DOE/SRPO and R. Johnson and J. Pearring of NRC on August 24, 1984.

J. Neff 8/24/84

Robert L. Johnson 8/24/84

Jerome Pearring 8/24/84

[illegible] 8/24/84

ATTACHMENT NO 1

LIST OF ATTENDEES
ROCK MECHANICS DATA PRESENTATION TO NRC
August 21-24, 1984

Affiliation		Name	8/21	Phone Number	8/22	8/23	8/24
NRC		S. Grace	✓	(301)427-4686	✓	✓	✓
		B. Jagannath	✓	(301)427-4629	✓	✓	✓
		R. Johnson	✓	(301)427-4785	✓	✓	✓
		J. Pearring	✓	(301)427-4648	✓	✓	✓
		J. Peshel	✓	(301)427-4735	✓	✓	✓
		S. Smykowski	✓	(301)427-4109	✓	✓	✓
DOE/HQ		J. Rhoderck	✓	(301)353-5204	PT	—	—
DOE/CH		J. Neff	✓	(614)424-5916	—	—	✓
		J. A. Sherwin	✓	(614)424-5916	—	—	✓
DOE/Columbus		R. Waters	✓	(614)424-5919	PT	PT	✓
ONWI		A. Coyle	✓	(614)424-5037	PT	—	
		M. Golis	✓	(614)424-7806	—	—	—
		H. Hume	✓	(614)424-7570	✓	✓	✓
		G. Hummeldorf	✓	(614)424-6514	✓	✓	✓
		M. Karakouzian	✓	(614)424-7474	PT	PT	PT
		G. LaRue	✓	(614)424-4315	PT	PT	✓
		J. McConville	✓	(614)424-5155	—	—	—
		G. McNulty	✓	(614)424-5334	PT	—	—
		J. Moody	✓	(614)424-5536	—	—	—
		K. Oschman	✓	(614)424-4673	✓	✓	✓
		J. Parry	✓	(614)424-5090	PT	PT	✓
		S. Versluis	✓	(614)424-7645	PT	PT	—
		H. Weisser	✓	(614)424-4860	PT	PT	PT
Consultants	EI	A. Brown	✓	(303)973-9587	✓	✓	✓
	Engineers International	R. Cummings	✓	(312)963-3460	✓	✓	✓
	Univ. of Ariz.	J. Daeman	✓	(602)621-2501	✓	✓	—
	USBM	M. DeMarco	✓	(303)236-0745	✓	✓	—
	Earth Technology	F. Donath	✓	(213)595-6611	✓	—	
	Itasca Consul. Group	R. Hart	✓	(612)623-9599	✓	✓	✓
	LA Geological Survey	J. Holmes	✓	(504)342-7466	PT	✓	—
	Stone & Webster	T. Lamb	✓	(617)589-2056	✓	—	—
	USGS	A. LaSala	✓	(614)424-5916	—	—	—
	Earth Technology	B. Meyer	✓	(213)595-6611	✓	—	
	USBM	L. Mundell	✓	(303)736-0741	✓	✓	—
	Weston	J. Nelson	✓	(301)963-6800	✓	PT	—
	WCC/4	R. Nelson	✓	(714)553-5386	✓	—	—
	WCC	J. O'Rourke	✓	(415)945-3000	✓	—	—
	MS Bureau of Geology	C. Stover	✓	(601)354-6228	PT	✓	—
	SNL	K. Wahi	✓	(505)844-6268	✓	✓	
	RE/Spec	P. Senseny	✓	(605)394-6400	✓	—	

PT : Part time

ATTACHMENT NO. 2

AGENDA

ROCK MECHANICS DATA PRESENTATION TO NRC

[Project Management Center (PMC) Room 13-4-160]

August 21, 1984

9:00 - 9:30	DOE	Introduction	JA Sherwin (SRPO)
9:30 - 10:15	NRC	Introduction	R Johnson/J Pearring
10:15 - 10:45	ONWI	Rock Mechanics Introduction	HR Hume/S Versluis
10:45 - 11:00		**BREAK**	
11:00 - 11:30	ONWI	Scope of Rock Mechanics Data Presentation	HR Hume/S Versluis
11:30 - 12:00	ONWI	Data Management	MG Golis/G LaRue
12:00 - 1:00		**LUNCH**	
1:00 - 1:30	LLNL	Thermal Properties	W Durham
1:30 - 2:00	RE/SPEC	Elevated Temperature/ Pressure Data	P Senseny
2:00 - 3:00		Site Characterization Data:	
	SWEC	Permian	TJ Lamb
	WCC	Paradox	J O'Rourke
	ETC/ONWI	Gulf	HR Hume
3:00 - 3:15		**BREAK**	
3:15 - ~~4:00~~ 5:00	ONWI	Off Site Underground Testing:	
		ASSE Mine	AJ Coyle
		Avery Island Mine	AJ Coyle

~~4:00~~ ~~QUESTIONS~~

August 22, 1984

Review of Reports and Data Catalog

August 23, 1984

8:30 - ~~12:00~~ 5:00 NRC ~~Completion~~ of Review

~~1:00 - 3:00 NRC~~ ~~Debriefing~~

August 24, 1984

8:30 - ~~NRC~~ 12:00 ~~Optional~~ Debriefing

DETAILED DATA REPORTS
(DDR)

PURPOSE

- ACCESS TO DATA ON MAGNETIC TAPE
- ACCESS TO RECENT OR VALID DATA

TYPES OF DATA

- DOWNHOLE LABORATORY TESTS
- WELL LOGS
- SEISMIC, GRAVITY OR MAGNETIC SURVEYS
- ENVIRONMENTAL AND SOCIOECONOMIC
- METEROLOGIC AND GEOGRAPHIC

FILE SPECIFICATION & TAPE INFORMATION FORM

Record Type _____

Topic Type _____

Computer Program [] , Data Tape [] , Other _____

Availability: Unrestricted [], U.S. only [], Govt contract [],

other _____

Tape Short Title _____

_____

_____

Volume Serial Number _____,Version _____, Date _____

Tape Full Title _____

_____

_____

_____

_____

Reel # _____, # of Tapes _____

Status: New [], Replacement [], Revision [], Addition []

Previous ID _____

ONWI Project Manager _____

Functional Manager _____

Subcontractor _____

Subcontract # _____

Subcontract Project Manager _____

Subcontractor Tape # _____

NESC CIN _____

Unit 7-track [], 9-track []

Density 556 [], 800 [], 1600 [], 6250 [], bpi

Parity odd [], even [], NR []

Record Format _____

Character Code: ASCII [], EBCDIC [], BCD [], BINARY [],

other _____

Assigned Protection Key: write _____, read _____

Label: ANSI STD [], IBM STD [], Unlabeled [],

other _____

IBM Tape File Specifications

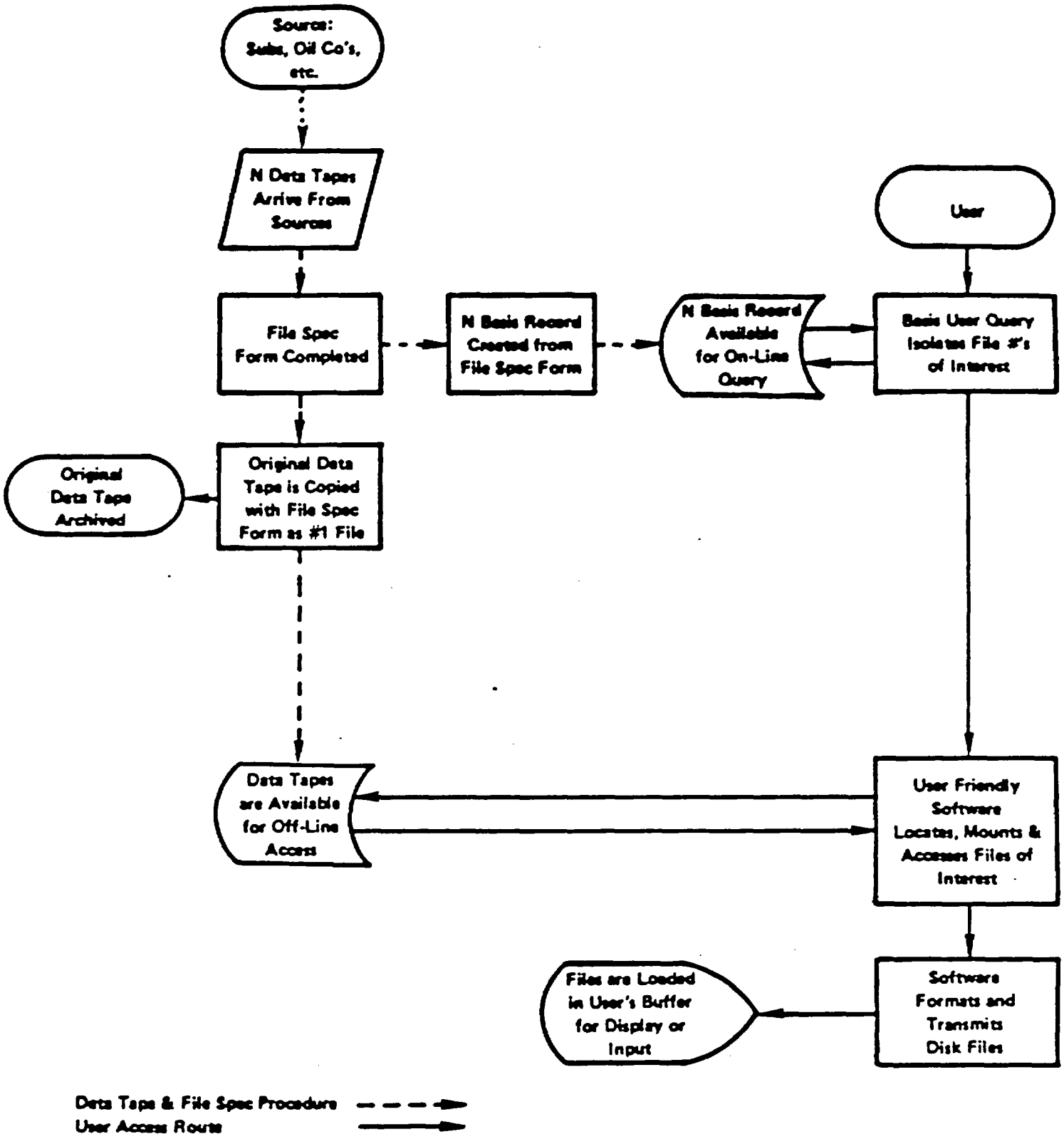
File #	RECFM	LRECL	BLKSIZE	# BLOCKS	contents
_____,	_____,	_____,	_____,	_____,	_____
_____					

Fixed Length File Specifications

File #	Logical Record Length	Blocking Factor	# Blocks	contents
_____,	_____,	_____,	_____,	_____
_____				

Variable Length Record File Specifications

File #	Max. Record Length	# Records	# Blocks	contents
_____,	_____,	_____,	_____,	_____
_____;				



RAW DATA TAPE ACCESS SYSTEM – PHASE A

W. Dussinger

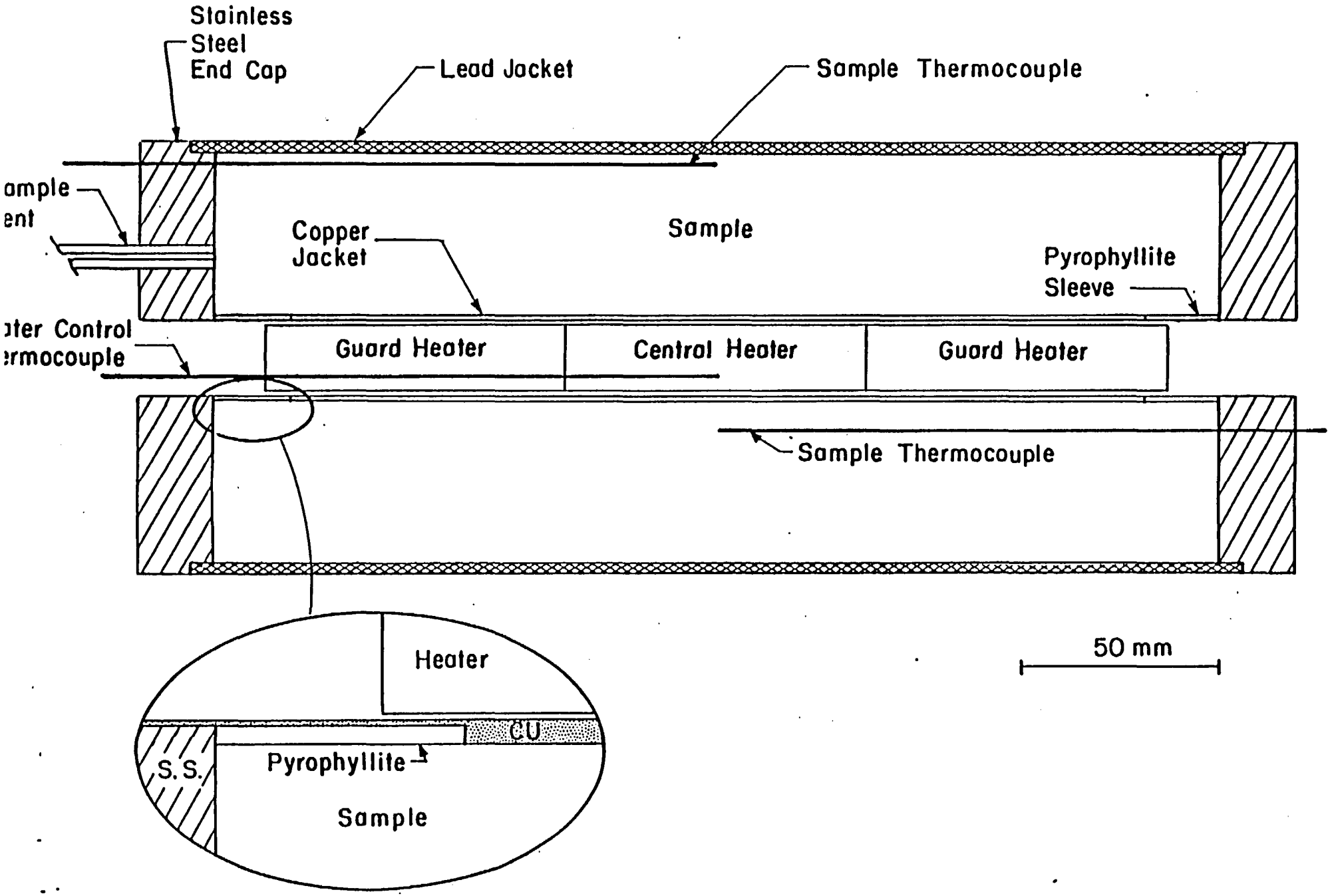
I. Intro

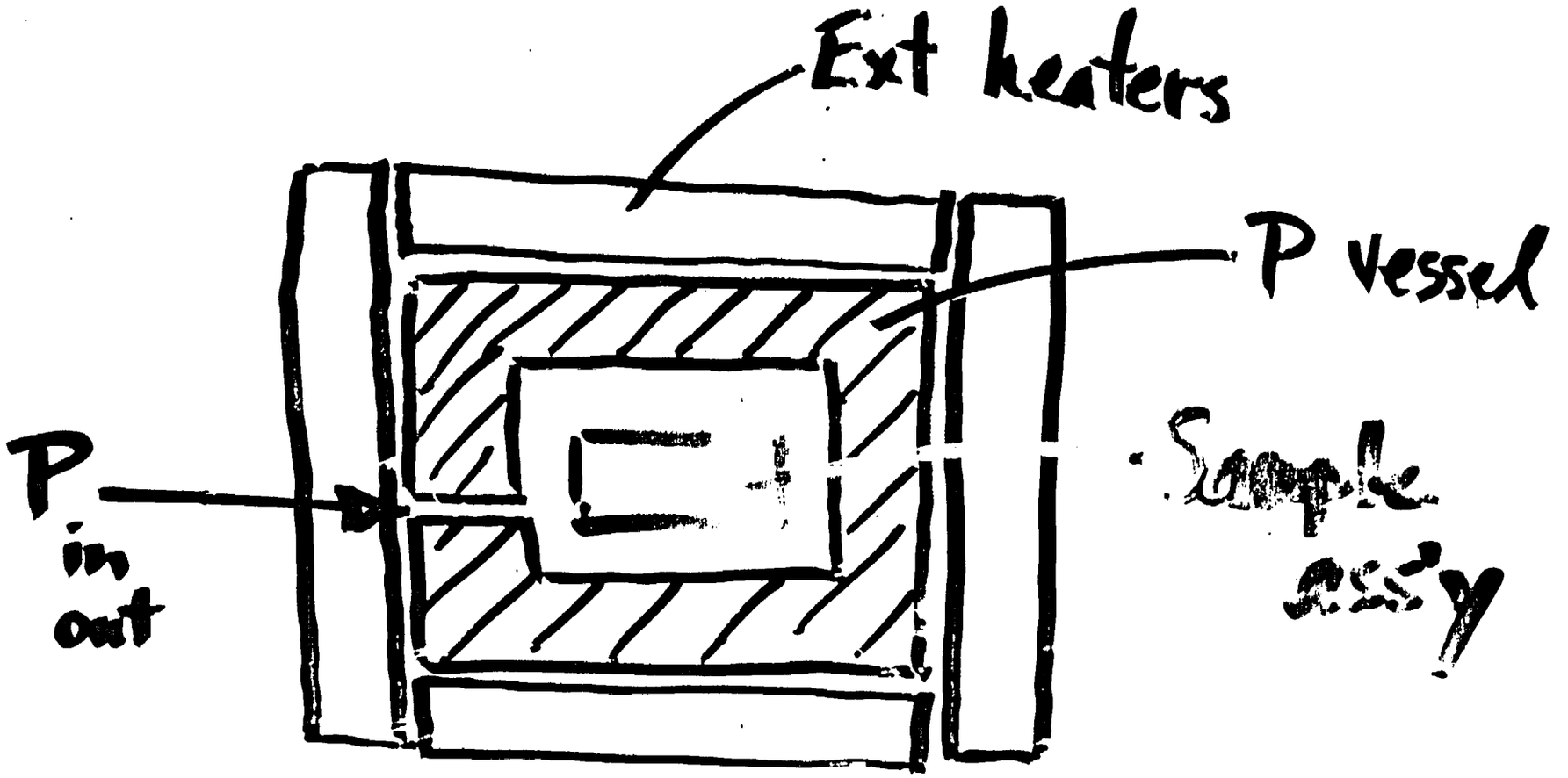
II. Apparatus + technique

III. Samples

IV. Results

V. Discussion + conclusion


Stainless
Steel
End Cap
Lead Jacket
Sample Thermocouple
ample
ent
Copper
Jacket
Sample
Pyrophyllite
Sleeve
ater Control
ermocouple
Guard Heater
Central Heater
Guard Heater
Sample Thermocouple
Heater
50 mm
Cu
S. S.
Pyrophyllite
Sample


Ext heaters
P vessel
P
in
out
Sample
assy

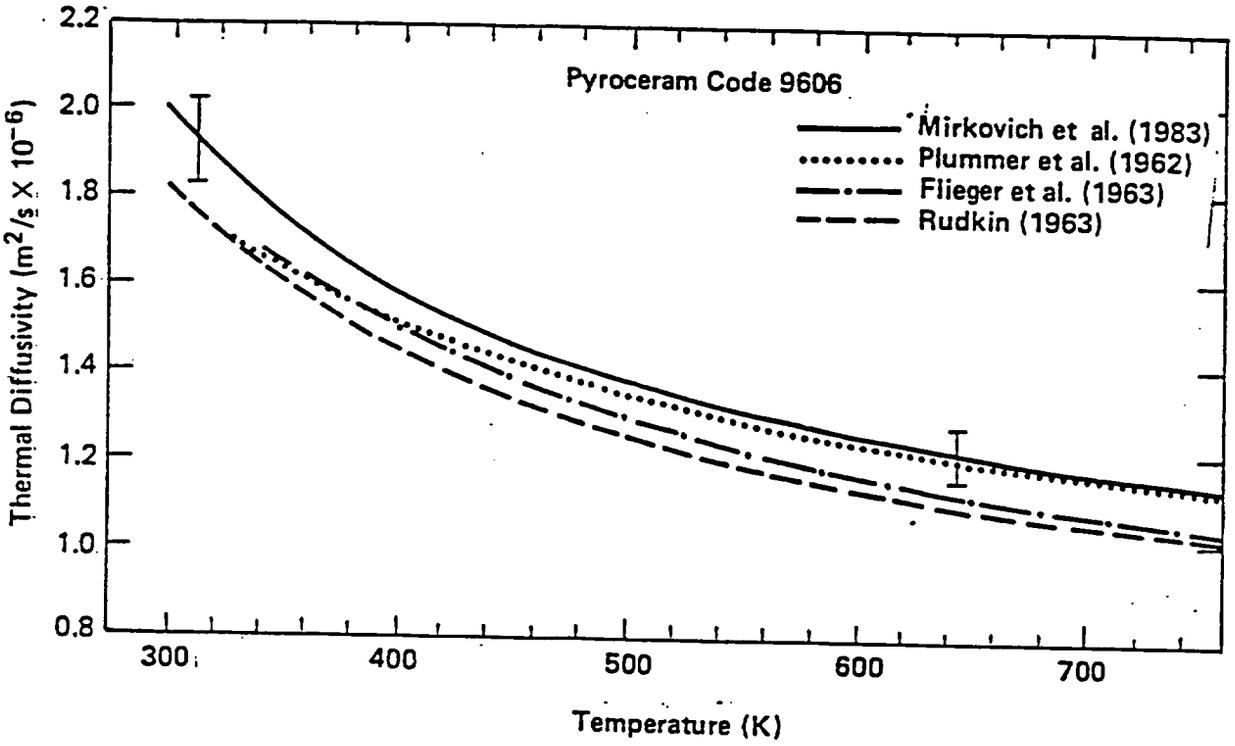

Pyroceram Code 9606
Mirkovich et al. (1983)
Plummer et al. (1962)
Flieger et al. (1963)
Rudkin (1963)
Thermal Diffusivity ($m^2/s \times 10^{-6}$)
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
300
400
500
600
700
Temperature (K)

Figure 1

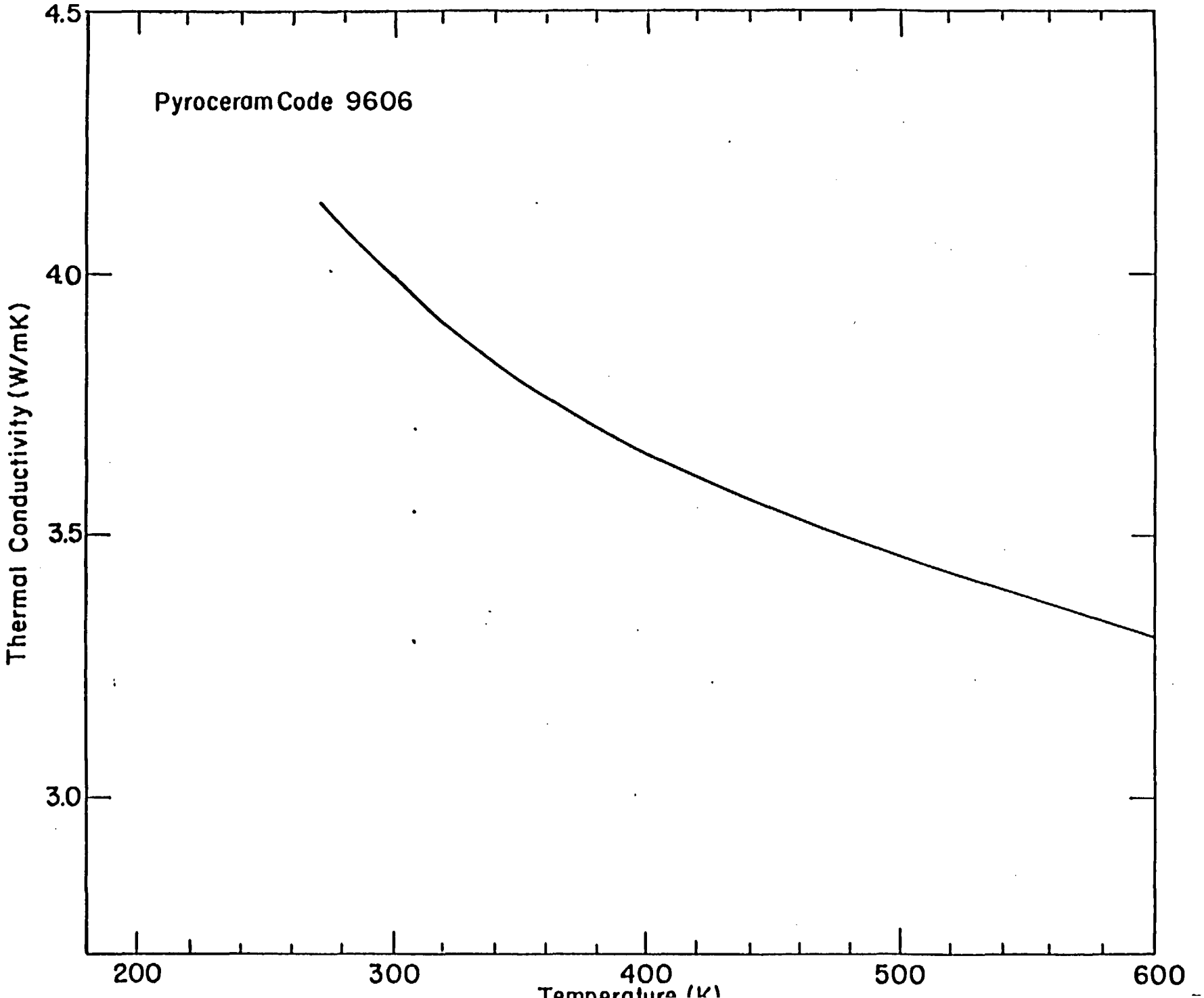

Pyroceram Code 9606
Thermal Conductivity (W/mK)
4.5
4.0
3.5
3.0
200
300
400
500
600
Temperature (K)

Table 1. Description of sample material and summary of the petrographic analyses.

Sample	Well	Depth (ft)	Composition (%)			Distance to nearest petrographic analysis (ft)
			Halite	Clay	Anhydrite	
TP7	Detten #1	2454-2455	78-85	6-12	8-9	5
TP8	G. Friemel #1	2523-2524	93-94	2-5	1-3	10
TP9	G. Friemel #1	2308-2309	89	2	8	1.5
TP10	Detten #1	2654-2655	–[a]	–[a]	–[a]	~180
TP11	Detten #1	2655-2656	–[a]	–[a]	–[a]	~180

[a] Analysis not available.

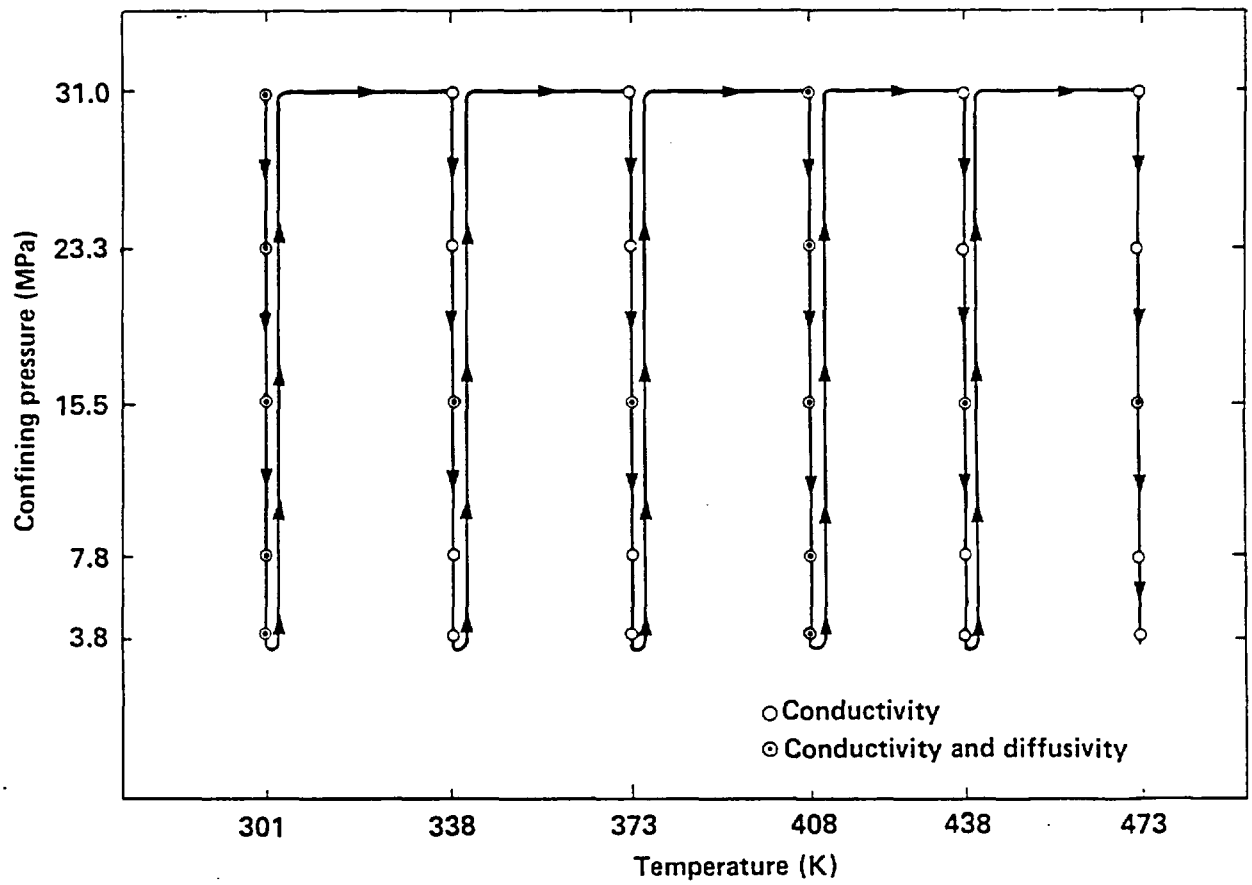
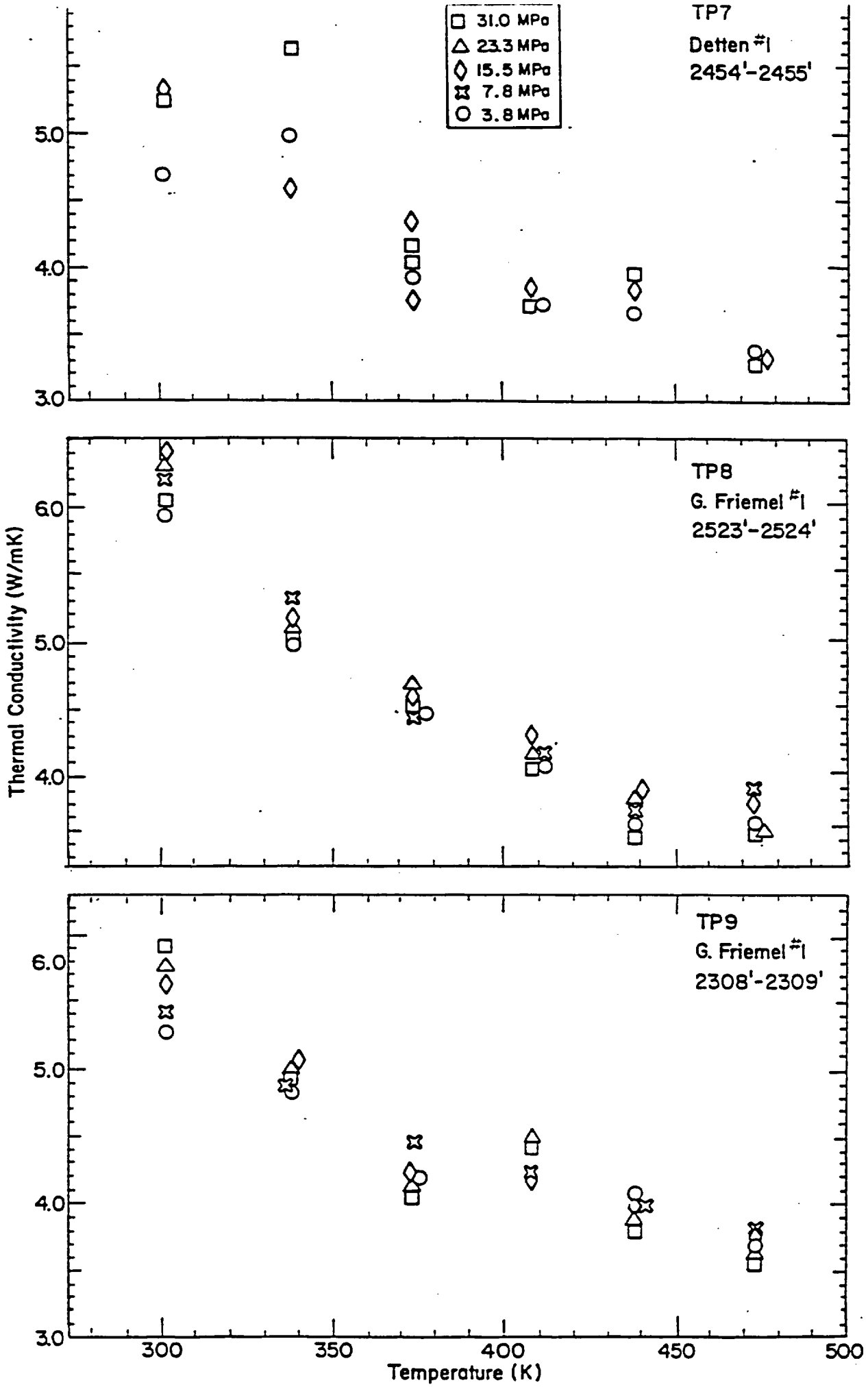
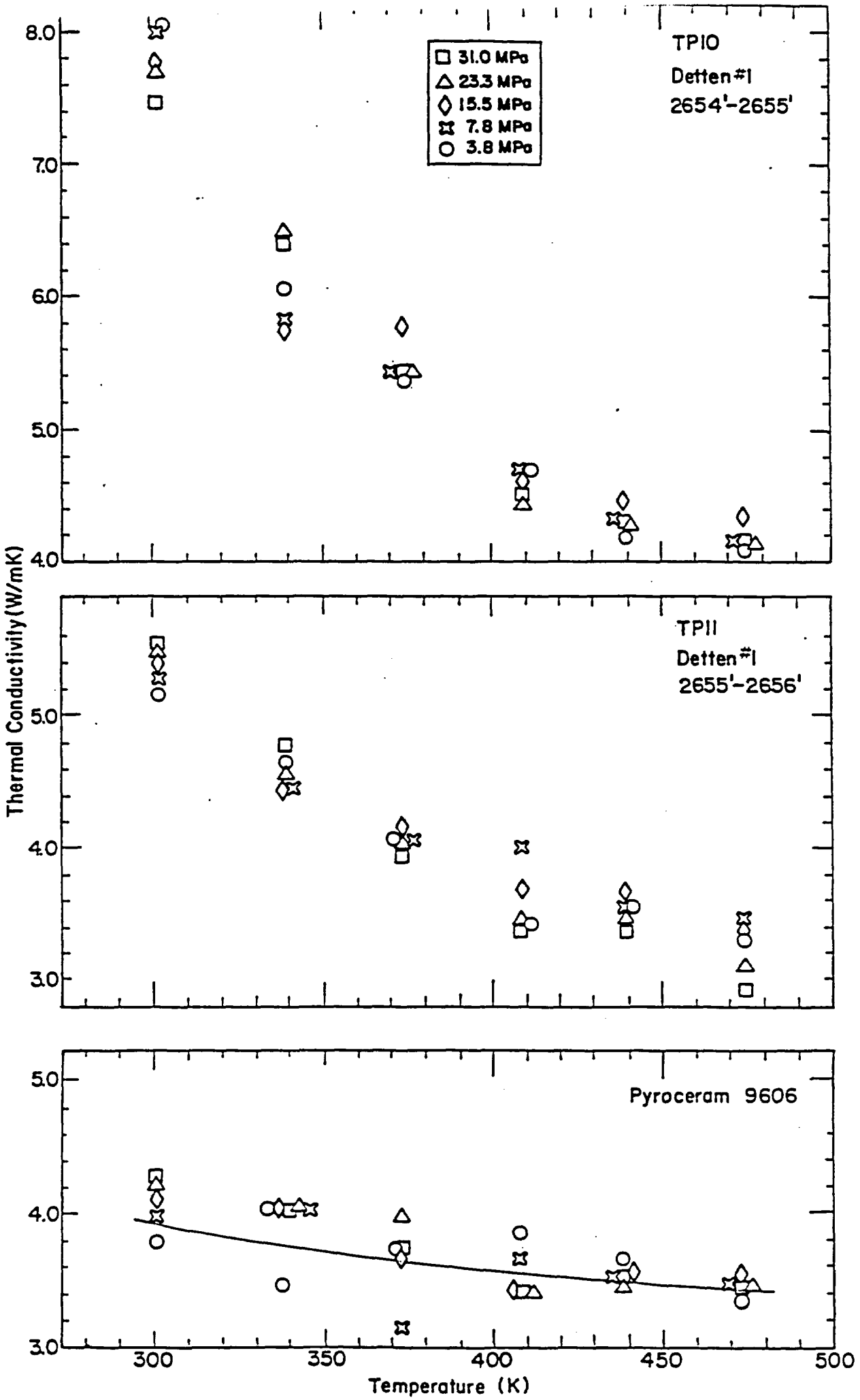


Figure 4. Path followed in pressure-temperature space for the measurements. Note that conductivity was measured at each stopping point; diffusivity was measured only at some of the stopping points.


31.0 MPa
23.3 MPa
15.5 MPa
7.8 MPa
3.8 MPa
TP7
Detten #1
2454'-2455'
TP8
G. Friemel #1
2523'-2524'
TP9
G. Friemel #1
2308'-2309'
Thermal Conductivity (W/mK)
Temperature (K)
3.0
4.0
5.0
6.0
300
350
400
450
500

gure 5


31.0 MPa
23.3 MPa
15.5 MPa
7.8 MPa
3.8 MPa
TP10
Detten #1
2654'-2655'
TP11
Detten #1
2655'-2656'
Pyroceram 9606
Thermal Conductivity (W/mK)
Temperature (K)
8.0
7.0
6.0
5.0
4.0
3.0
300
350
400
450
500

ure 5
nt.)

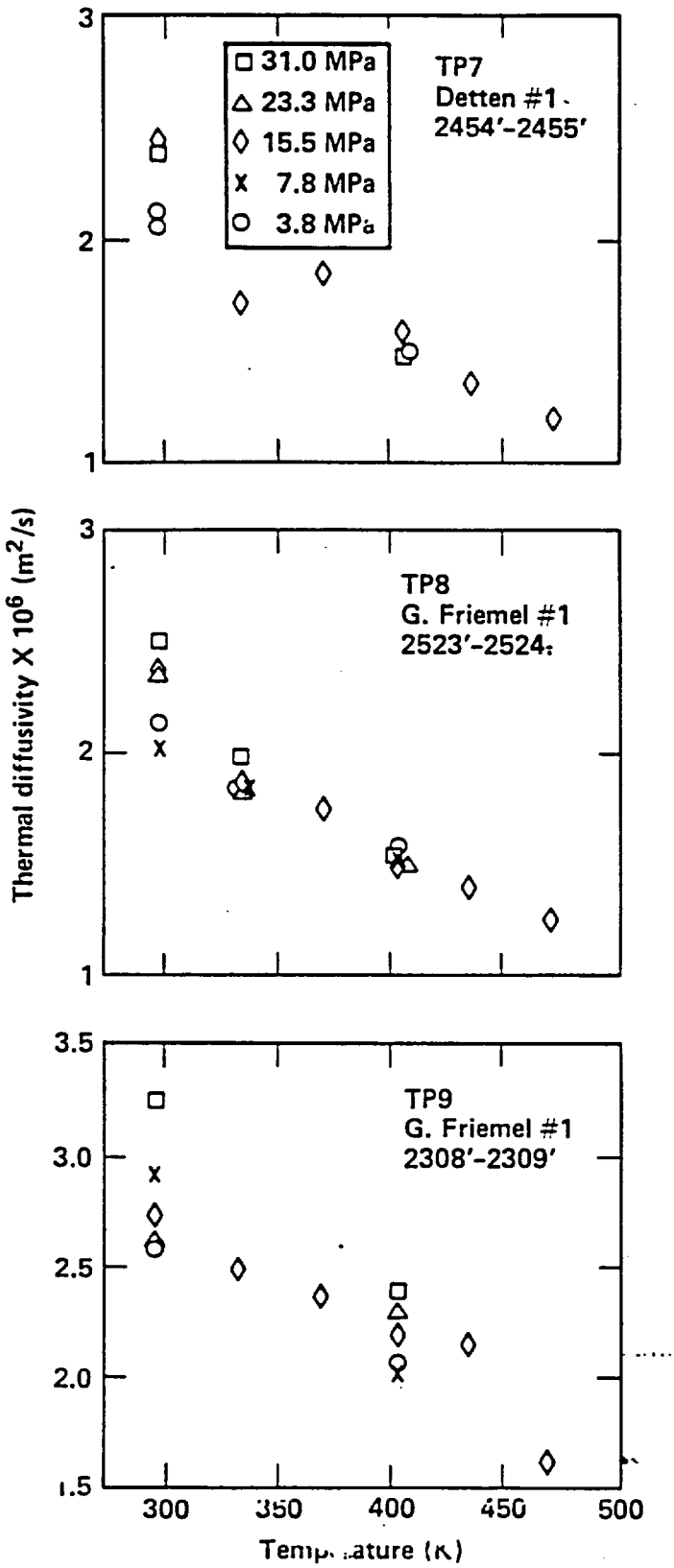


Figure 6. Results of thermal diffusivity vs temperature and pressure for five rock salt samples and the reference standard. The curve through the data for the Pyroceram 9606 is taken from Fig. 1.

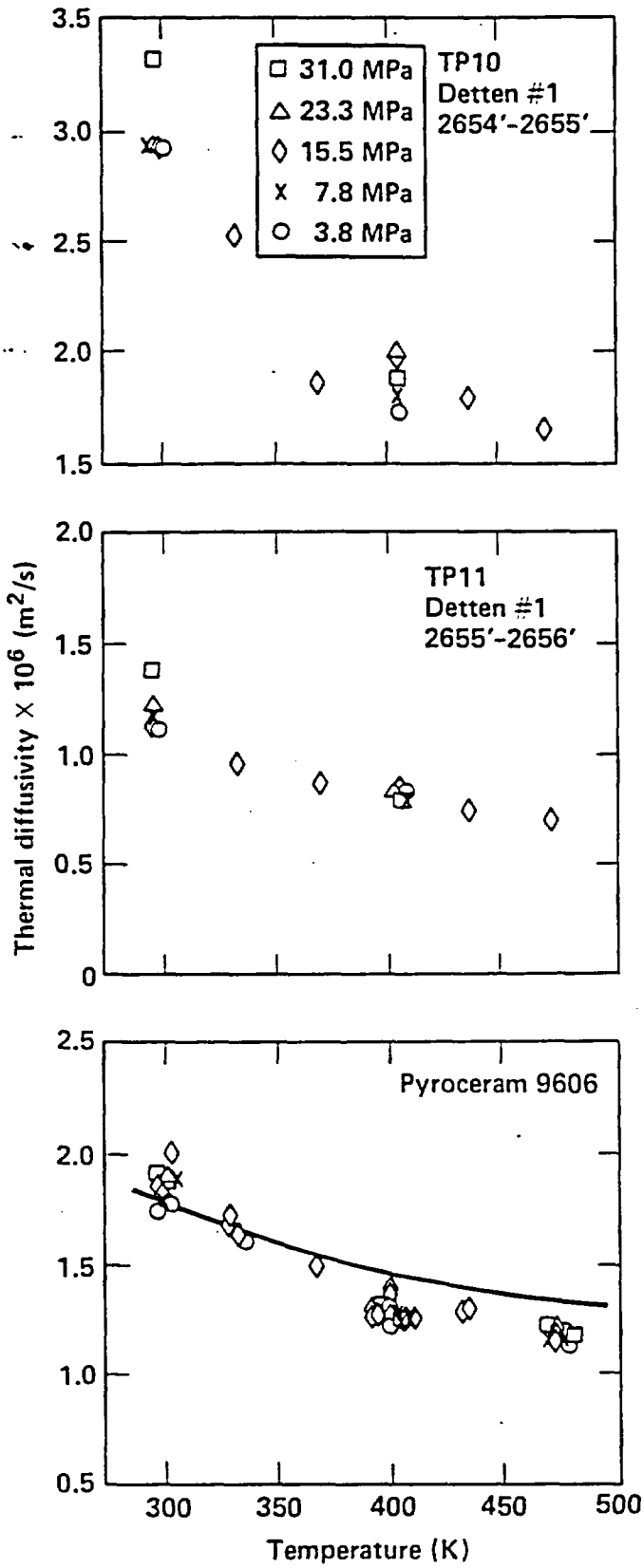
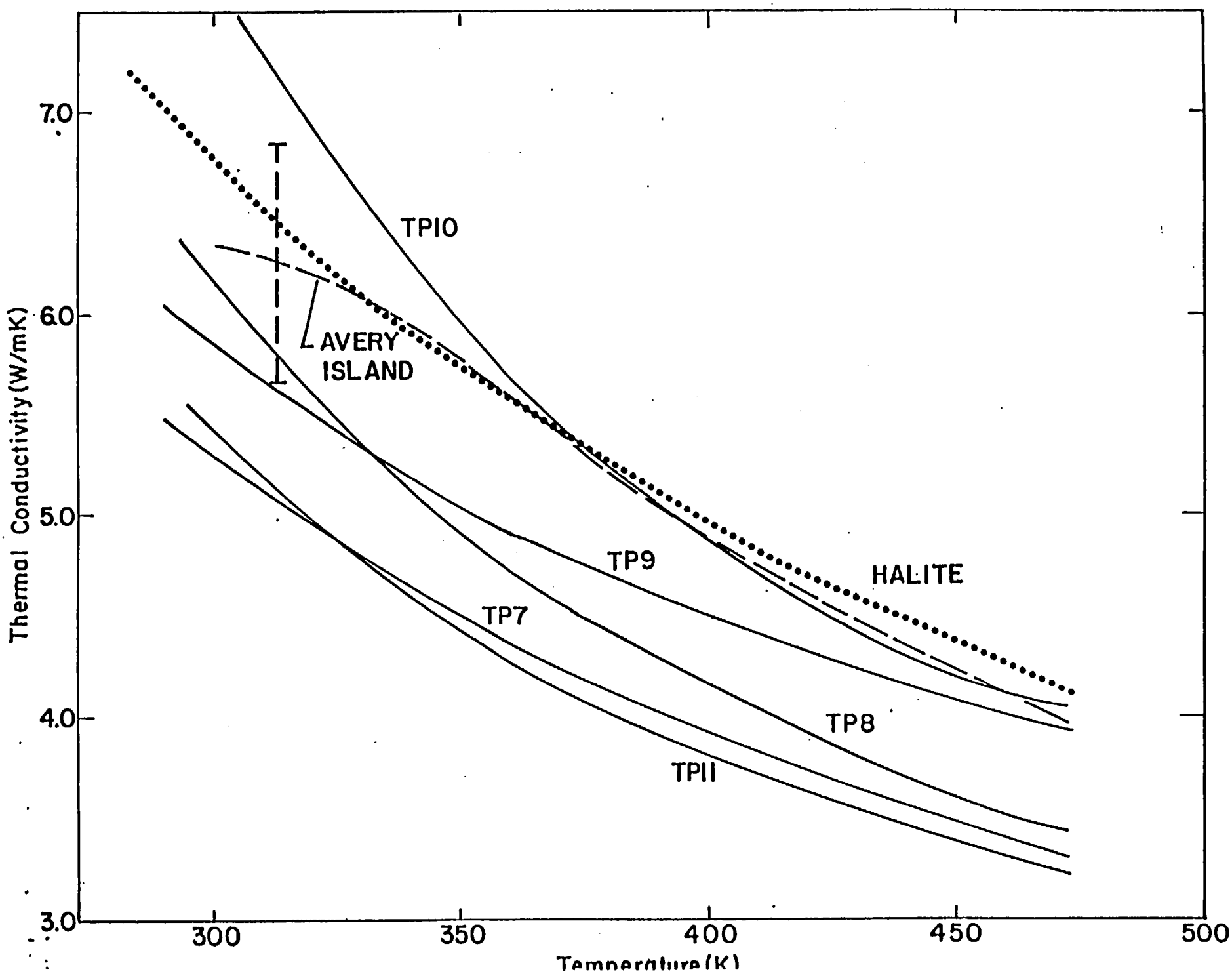


Figure 6. Continued.


Thermal Conductivity (W/mK)
7.0
6.0
5.0
4.0
3.0
300
350
400
450
500
Temperature (K)
TP10
AVERY
ISLAND
TP9
HALITE
TP7
TP8
TP11

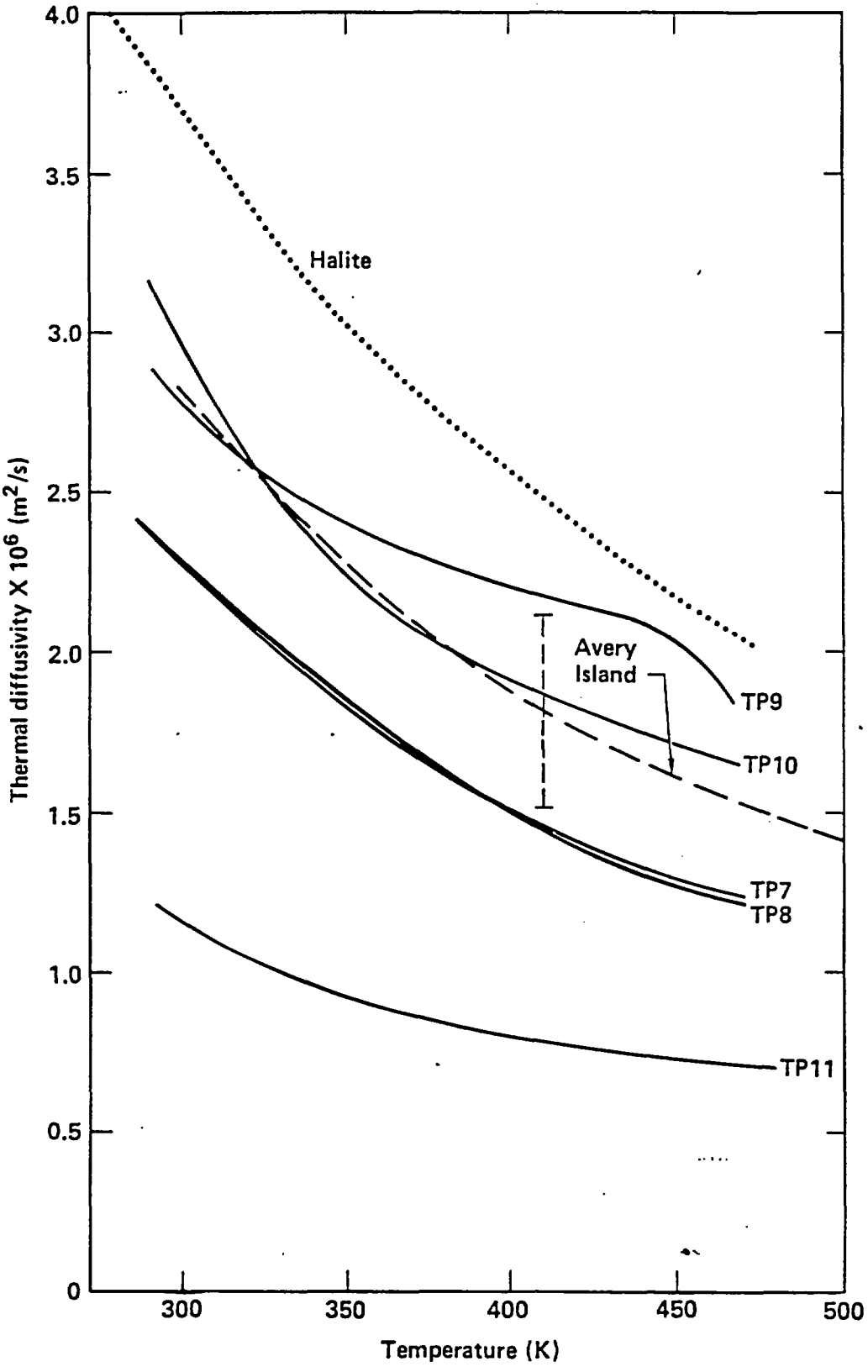


Figure 8. Summary of thermal diffusivity measurements for salt. The solid lines are estimated fits to the data in Fig. 6. The error bar shows the scatter in the Avery Island data, which are taken from Durham et al. (1981).

RE/SPEC LABORATORY TESTING

Triaxial Compression Creep

Triaxial Compression Constant Stress Rate

Triaxial Compression Constant Strain Rate

Brazilian

Brine Inclusion Motion

SPECIMEN PREPARATION

Core Sample Selection

- Thick Strata
- Sensitive Locations
- Representative Samples

Core Sample Inventory

- Identification Number
- Recovery Location
- Description
- Dimensions

Specimen Fabrication

- Coring, Sawing, Grinding
- ASTM Specifications

Post-Test Disposition

- Petrology/Petrofabric Analysis
- Label and Bag
- Return to Core Library

CALIBRATION

Written Procedures

NBS Traceability

Entire System Calibration

Acquisition/Reduction Program Input

QA Records Archive

Regular Intervals

TESTING

Written Procedures

Computer-Controlled Test Systems

Commercially-Available Transducers

Test Matrix

- Expected Variable Ranges
- Enough Tests To Characterize Variability

DATA

14-Bit A/D

Disk Storage

- Engineering Units
- Binary Units

Analysis (Fitting & Plotting)

- Data Acquisition Computer
- Mainframe Computer

Archive

- QA Vault (Disks)
- Computer Vault (Tapes)

PARADOX BASIN

GEOENGINEERING

INVESTIGATIONS

DATA RESOURCES - ALL FROM BOREHOLE GD-1

DRILLING PARAMETERS, INCLUDING RQD

ELECTRIC WIRELINE LOGS

IN SITU TESTING

LABORATORY TESTING OF CORE

INDEX TESTING OF CORE

BOREHOLE GD-1

SEVERAL MILES FROM A CANDIDATE GEOLOGIC REPOSITORY OPERATIONS AREA (GROA) IN DAVIS CANYON OR LAVENDAR CANYON.

TOTAL DRILLED DEPTH TO APPROXIMATELY 6000 FT, OR ABOUT 3000 FT BELOW REPOSITORY.

CONTINUOUSLY CORED, WITH 4-IN. DIAMETER CORE RECOVERY.

ALL CORE STORED IN DENVER FACILITY, AND SHIPPED TO VARIOUS ONWI-DESIGNATED LABORATORIES FROM THERE.

DURING DRILLING OPERATIONS, HYDROGEOLOGY AND GEOTECHNICAL IN SITU TESTING CONDUCTED AT DIFFERENT HOLD POINTS, BASED ON CORE LOGGING DESCRIPTIONS AND ELECTRIC LOG ANALYSIS.

ALL GEOTECHNICAL IN SITU TESTING WAS DONE IN SALT STRATA.

IN SITU TESTING IN GD-1

UNLOADING STRESS/STRAIN

- ROCK MASS DEFORMATION PROPERTIES (11-IN. DIAMETER X 100 TO 160 FT LENGTH)
- VIRGIN STRESS-STRAIN BEHAVIOR REPRESENTATIVE OF EXPECTED EXCAVATED OPENING PERFORMANCE

SHORT-TERM CREEP

- SHORT TERM CREEP BEHAVIOR AT CLOSE TO ATMOSPHERIC INTERNAL BOREHOLE PRESSURE
- MEASUREMENT DATA TAKEN OVER 24-HR. PERIOD
- DATA APPEAR TO COMPARE WITH BOREHOLE CLOSURE DATA FROM ASSE
- RELATIVE CREEP RATES BETWEEN DIFFERENT DEPTHS RELATE REASONABLY WELL TO PREDICTION OF WCC LABORATORY CREEP RATE MODEL

ELECTRIC LOGS

- DYNAMIC ~~ELECTRIC~~ ELASTIC PROPERTIES WERE COMPUTED FROM SONIC LOG PARAMETERS
- DYNAMIC YOUNG'S MODULUS APPROXIMATELY 30% HIGHER THAN STATIC VALUE FROM LABORATORY TESTS
- NEUTRON LOG MAY BE RELATED TO ROCK STRENGTH ACCORDING TO RESEARCH

HYDRAULIC FRACTURING TESTS

- IN SITU STRESS MEASUREMENT IN 5 DIFFERENT SALT CYCLES

LABORATORY TESTING OF GD-1 CORE

TRIAXIAL STRENGTH TESTS CONDUCTED

- VARIOUS STRESS PATHS
- ELEVATED TEMPERATURES (TO 150C)
- VARIOUS STRAIN RATES
- INFLUENCE OF ANHYDRITE LAMINAE

CREEP TESTING

- ALL TESTS IN EXTENSION UNLOADING
- ROOM TEMPERATURE AND 50C
- STAGED UNLOADING
- 1 WEEK/STAGE, FOR 1 MONTH TOTAL, APPROXIMATELY

PERMEABILITY

- REPRESENTATIVE SAMPLING OF ALL STRATIGRAPHIC UNITS
- TESTED PERMEABILITY ANISOTROPY (HORIZONTAL AND VERTICAL)
- TESTED TO MINIMUM OF 0.1 MICRODARCY
- TESTING FLUID WAS DISTILLED WATER FOR NON-SALT, AND SILICON OIL FOR SALT
- STEADY STATE TECHNIQUE

INDEX PROPERTIES

- COMPARED POINT LOAD, SCHMIDT HAMMER REBOUND, ABRASION HARDNESS AND TOTAL HARDNESS WITH LABORATORY UNIAXIAL COMPRESSIVE STRENGTH AND YOUNG'S MODULUS.
- STATISTICAL CORRELATIONS MADE

UNLOADING TESTS

WCC Technical Procedure

Equipment

- OIL FIELD EQUIPMENT
- Lynes heavy duty straddle packers
- REAL TIME DATA RECORDING WITH DOWNHOLE TRIPLE TRANSDUCERS CALIBRATED BY SUPPLIER AND CHECKED IN FIELD
- Volumetric displacement sensed by fluid level sensor
- Nitrogen gas tubing pressurization system

Types of Data

- Pressure vs. time (Downhole and Surface)
- Fluid level vs. time (Volume Displacement)

Data Interpretation

- Radial Strain from Volume Displacement

Conclusions

- Radial strain of salt increases with depth, as expected

References

- ONWI-400

SHORT TERM CREEP

WCC Technical Procedure

Equipment
- SAME AN UNLOADING TEST

Types of Data
- SAME AS UNLOADING TEST

Data Interpretation
- RADIAL STRAIN CREEP RATE FROM VOLUME DISPLACEMENT VS. TIME

Conclusions
- SHORT TERM (ONE DAY) CREEP RATE SHOWS DRAMATIC INCREASE WITH DEPTH (ORDER OF MAGNITUDE DIFFERENCE BETWEEN 3200 AND 4900 FT)

References
- ONWI-400

HYDRAULIC FRACTURING TESTS

PROCEDURE
- WCC TECHNICAL PROCEDURE

EQUIPMENT
- OIL FIELD EQUIPMENT
- LYNES HEAVY DUTY STRADDLE PACKER
- REAL TIME DATA RECORDING FROM SURFACE PRESSURE TRANSDUCER CALIBRATED BY SUPPLIER AND CHECKED IN FIELD
- CALIBRATED WATER SUPPLY TANK WITH SIGHT GLASS INDICATOR OF VOLUME

DATA TYPES
- PRESSURE VS. TIME
- FLUID SUPPLY VOLUME VS. TIME

DATA INTERPRETATION
- ANALYSIS OF PRESSURE-TIME CURVES USING CONVENTIONAL ELASTIC ANALYSIS TECHNIQUES

CONCLUSIONS
- MINIMUM HORIZONTAL STRESS EQUAL TO LITHOSTATIC PRESSURE
- MAXIMUM HORIZONTAL STRESS APPROXIMATELY 1.0 TO 1.6 TIMES LITHOSTATIC, DEPENDING ON ASSUMPTIONS REGARDING ELASTIC STRESS CONCENTRATIONS, AND PORE PRESSURES

REFERENCES
- ONWI-400

TRIAXIAL STRENGTH TESTING

PROCEDURE

- COMBINED ASTM-WCC TECHNICAL PROCEDURE

EQUIPMENT

- 100K LOADING APPARATUS
- 2 AXIAL AND 2 CIRCUMFERENTIAL BONDED STRAIN GAGES PER SAMPLE
- AXIAL LOAD CELL AND CONFINING PRESSURE TRANSDUCER
- LVDT TO MONITOR PLATEN-TO-PLATEN DISPLACEMENT
- 10,000 PSI TRIAXIAL CELL
- ALL EQUIPMENT CALIBRATED AGAINST LABORATORY STANDARDS

DATA ACQUISITION SYSTEM INCLUDED DATRONIX SIGNAL CONDITIONING AND SCANNING EQUIPMENT, ANALOG-DIGITAL CONVERTER AND HP-85 MICROCOMPUTER.

DATA TYPES

- ELAPSED TIME
- AXIAL AND CIRCUMFERENTIAL STRAIN ON SAMPLE
- AXIAL FORCE
- CELL PRESSURE
- PLATEN-TO-PLATEN DISPLACEMENT
- TEMPERATURE

DATA INTERPRETATION

- CONVENTIONAL STRESS-STRAIN PLOTS
- ELASTIC MODULI CHECKED WITH REBOUND LOOP LOADING ON SELECTED SAMPLES

CONCLUSIONS

STRENGTH ENVELOPES AND YOUNG'S MODULUS COMPARE WELL WITH RE/SPEC RESULTS ON PARADOX SALT

REFERENCES

- ONWI-400

CREEP TESTING

PROCEDURES
- WCC TECHNICAL PROCEDURE

EQUIPMENT
- 100K LOAD FRAME
- 50T HYDRAULIC JACK
- AIR-ACTUATED, HYDRAULIC POWER SYSTEM
- 10,000 PSI TRIAXIAL CELL
- STRAIN, DISPLACEMENT, FORCE AND PRESSURE TRANSDUCERS SAME AS FOR TRIAXIAL TEST
- DATA ACQUISITION SYSTEM INCLUDED AUTODATA-9 DATA LOGGER INTERFACED WITH HP-85 MICROCOMPUTER
- ALL EQUIPMENT CALIBRATED AGAINST LABORATORY STANDARDS

DATA TYPES
- SAME AS FOR TRIAXIAL STRENGTH TESTS

DATA INTERPRETATION
- STRESS AND STRAIN VS. TIME PLOTS
- EACH CREEP STAGE FIT TO A POWER LAW
- OTHER CREEP PARAMETER ANALYSES SIMILAR TO RE/SPEC

CONCLUSIONS
- STRESS EXPONENT SIMILAR TO OTHER PUBLISHED DATA
- Q/R APPEARS TO BE LOW

REFERENCE
- ONWI-400

PERMEABILITY

Procedure
- WCC Technical Procedure

Equipment
- 10,000 psi triaxial cell
- 2,500 psi rated inlet and outlet reservoirs
- LVDT-monitored floats in reservoirs
- reservoir pressure monitored by electric transducers
- sample cell pressure monitored by electric transducer
- vertical displacement sensor on sample top cap
- all equipment calibrated to laboratory standards

Data Types
- reservoir level vs. time
- test pressures monitored for constant value

Data Interpretation
- constant head permeability analysis

Conclusions
- salt permeability less than 0.1 microdarcy
- other lithologic units have permeabilities generally corresponding to in situ values

References
- ONWI-290

INDEX PROPERTY TESTING

PROCEDURE

- ASTM, AND PUBLISHED RESEARCH PROCEDURES

EQUIPMENT

- POINT LOAD TESTER, TERRAMETRICS
- SCHMIDT HAMMER, TYPE L
- MODIFIED TABOR ABRASION MACHINE
- UNCONFINED COMPRESSIVE STRENGTH
  EQUIPMENT SAME AS FOR TRIAXIAL STRENGTH TESTING
  MINUS TRIAXIAL CELL

DATA TYPES

- POINT LOAD INDEX
- SCHMIDT HAMMER REBOUND NUMBER
- ABRASION HARDNESS NUMBER
- TOTAL HARDNESS NUMBER
- STRESS/STRAIN CURVES FOR STRENGTH AND YOUNG'S MODULUS

DATA INTERPRETATION

STATISTICAL CORRELATIONS FOR LABORATORY-TESTED UNCONFINED COMPRESSIVE STRENGTH AND YOUNG'S MODULUS WITH VARIOUS INDEX PROPERTIES

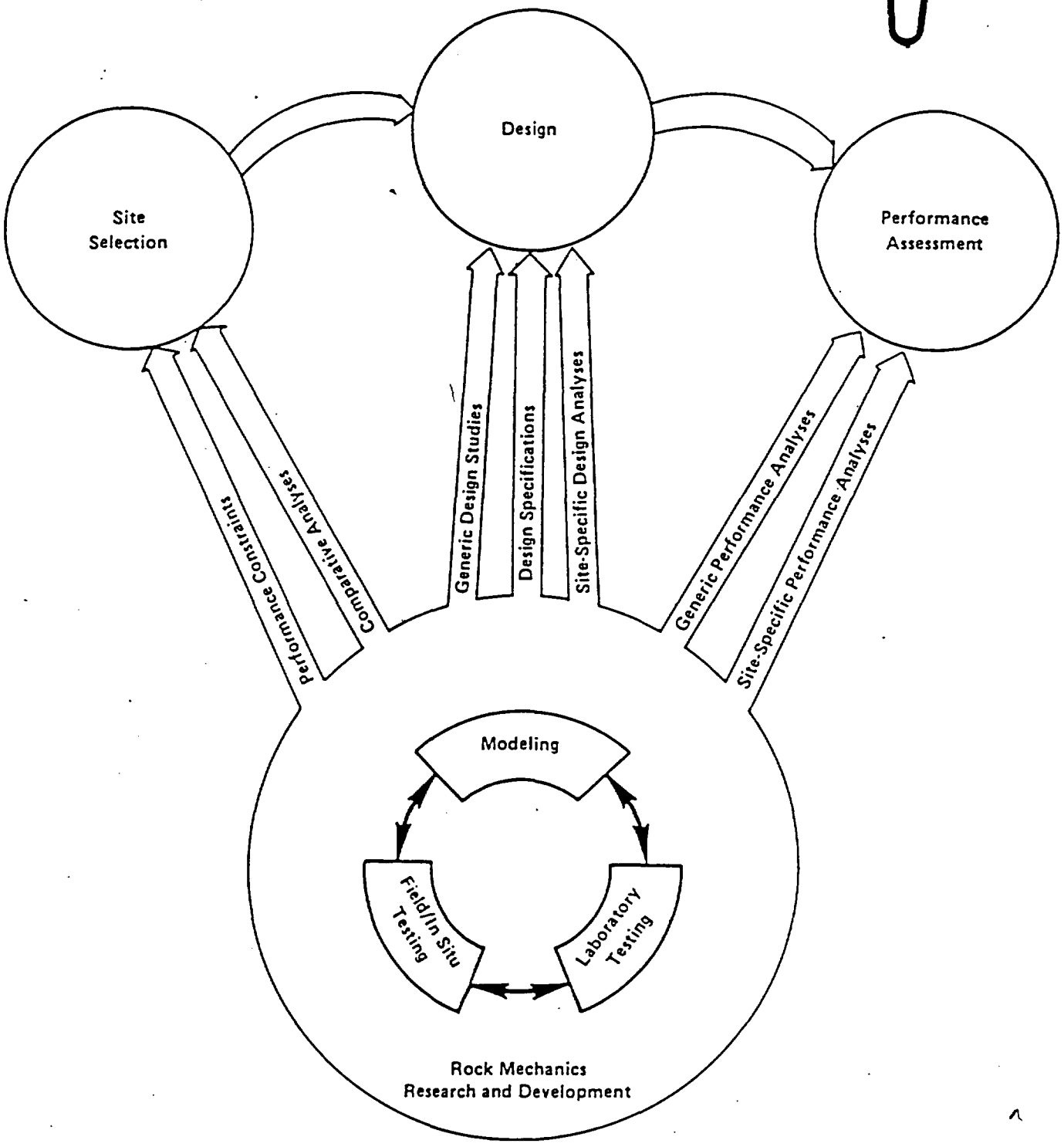
CONCLUSIONS

ROCK STRENGTHS VARY FROM LOW TO HIGH STRENGTH, AND A FAIR DEGREE OF CORRELATION EXISTS BETWEEN INDEX PROPERTIES AND STRENGTH OR MODULUS. A LARGER DATA BASE IS NEEDED.

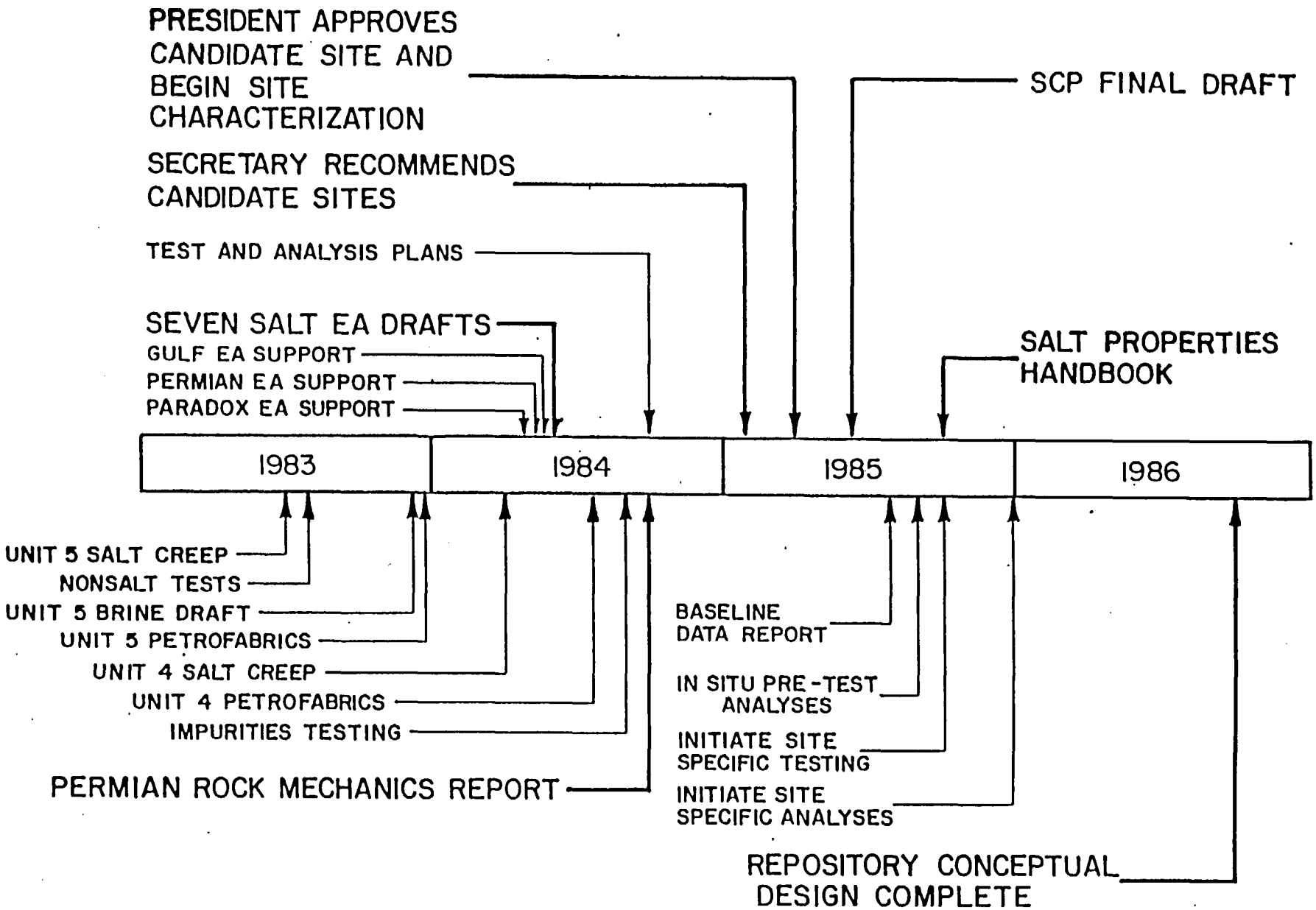
REFERENCES

TOPICAL REPORT IN PREPARATION

see folder for Mr. Polizhoff/Mr. Neff
9-6-84



ROCK MECHANICS TECHNICAL SUPPORT DURING REPOSITORY DEVELOPMENT (NWTS ROCK MECHANICS PLAN (DOE/NWTS-114))


PRESIDENT APPROVES CANDIDATE SITE AND BEGIN SITE CHARACTERIZATION
SCP FINAL DRAFT
SECRETARY RECOMMENDS CANDIDATE SITES
TEST AND ANALYSIS PLANS
SEVEN SALT EA DRAFTS
GULF EA SUPPORT
PERMIAN EA SUPPORT
PARADOX EA SUPPORT
SALT PROPERTIES HANDBOOK
1983
1984
1985
1986
UNIT 5 SALT CREEP
NONSALT TESTS
UNIT 5 BRINE DRAFT
UNIT 5 PETROFABRICS
UNIT 4 SALT CREEP
UNIT 4 PETROFABRICS
IMPURITIES TESTING
PERMIAN ROCK MECHANICS REPORT
BASELINE DATA REPORT
IN SITU PRE-TEST ANALYSES
INITIATE SITE SPECIFIC TESTING
INITIATE SITE SPECIFIC ANALYSES
REPOSITORY CONCEPTUAL DESIGN COMPLETE

MILESTONES

Materials Property Testing Accomplishments

Avery Island Testing

- *4 Additional Long-Term Tests*
- *Revised Creep Law*
- *Topical Report RSI-0243*

Palo Duro Unit 4 Testing

- *12 Test Matrix*
- *Creep Law Evaluation*
- *Topical Report RSI-0252*

Brine Motion Study

- *Palo Duro Unit 5 Salt Tests*
- *Single Crystal Fluid Inclusions*
- *Threshold Gradient Determination*
- *Topical Report RSI-0218*

Materials Property Testing Accomplishments

Deformation Mechanisms of Salina Salt

- *Post-Test Observation of 12 Tests*
- *Importance of Anhydrite Stringers*
- *Dislocation Climb at Higher Temperatures*
- *Topical Report RSI-0235*

Petrofabrics of Palo Duro Unit 5 Salt

- *Mineral Constituents (about 95 % Halite)*
- *Grain Size (about 7 mm)*
- *Dislocation Climb at Higher Temperatures*
- *Mechanism Not Discernible at Lower Temperatures*
- *Technical Memorandum (TLM-0104)*

Thermal Properties Measurement System

- *Design and Acquisition (January, 1984)*

Axial/Torsion Test System

- *Specifications and Bid Letting (Due 5/14)*

ROCK MECHANICS TESTING AND INSTRUMENTATION CONTRACTORS (DESIGN ANALYSIS GROUP)

RE/SPEC

- 'STANDARD' ROCK MECHANICS TESTS AT ELEVATED TEMP./PRESS.
- PETROFABRIC/GEOCHEMISTRY ANALYSES
- CREEP TESTING
- SPECIALIZED TEST SYSTEMS
  - HOLLOW CYLINDER TESTING
  - THERMAL PROPERTIES MEASUREMENT SYSTEM
  - AXIAL TORSION TEST SYSTEM
  - BRINE MIGRATION SYSTEM

LLNL/TBD

- THERMAL PROPERTIES MEASUREMENT OF CONDUCTIVITY, DIFFUSIVITY, EXPANSION, SPECIFIC HEAT

UNIVERSITY OF MINNESOTA

- GENERIC TEST CONCERNS SUCH AS LOAD-RATE INFLUENCES

WSV:8/21/84

ROCK MECHANICS TESTING & INSTRUMENTATION CONTRACTORS

(CONTINUED)

SWEC/ARA/WOODWARD-CLYDE (I.E., GPM'S)

- 'STANDARD' ROCK MECHANICS TESTS AT AMBIENT CONDITIONS
- HARDNESS, ABRASION, AND RELATED TESTS
- GEOCHEMISTRY/PETROFABRIC ANALYSES

S&RI

- HIGH TEMP./PRESS. ENVIRONMENTAL AND CALIBRATION TEST EQUIPMENT FOR
  - STRESS-CHANGE DEVICE
  - DISPLACEMENT MONITOR

WSV:8/21/84

ROCK MECHANICS TESTING CAPABILITIES

AT RE/SPEC

- (10) TRIAXIAL CREEP TEST MACHINES
- 1-MILLION POUND MTS TEST SYSTEM
- TWO-POST MTS TEST SYSTEM
- HOLLOW-CYLINDER TEST SYSTEM
- THERMAL PROPERTY MEASUREMENT SYSTEM*
- AXIAL TORSION TEST SYSTEM**
- COMPUTERIZED DATA REDUCTION/ANALYSIS SYSTEM

AT UNIVERSITY OF MINNESOTA

- (3) TRIAXIAL CREEP TEST MACHINES
- 1-MILLION POUND MTS TEST SYSTEM (RENTAL)

AT LAWRENCE LIVERMORE NATIONAL LABORATORY

- PRESSURIZED THERMAL PROPERTIES SYSTEM FOR CONDUCTIVITY & DIFFUSIVITY (4" DIAMETER x 10")
- PRESSURIZED THERMAL CONDUCTIVITY SYSTEM (3" DIAMETER x 6")
- PRESSURIZED THERMAL DIFFUSIVITY SYSTEM (3" DIAMETER x 6")
- PRESSURIZED THERMAL EXPANSION SYSTEM (RENTAL)

---

* IN DEVELOPMENT
**TO BE PROCURED IN FY 85

WSV:8/21/84

ONWI
BATTELLE Project Management Division

ROCK MECHANICS TESTING CAPABILITIES

(CONTINUED)

AT SOIL & ROCK INSTRUMENTATION

- BENCH SCALE TEST SYSTEM

AT GPM'S

- VARIOUS INDEX TESTING, SONIC & STRENGTH TESTS (E.G., ARA)

WSV:8/21/84

ONWI

BATTELLE Project Management Division

ROCK MECHANICS TESTING PLANS - FY 84/85

DESIGN ANALYSIS GROUP

- TEST MATRIX FOR FY 85/86 TESTING (ROCK MECHANICS PLAN)
- LONG-TERM TESTING OF HALITE (SECONDARY CREEP)
- DEVELOPMENT OF PROTOTYPE STRESS/CHANGE AND DISPLACEMENT MONITORING SYSTEMS
- IMPURITY INFLUENCE ON CREEP RESPONSE (SWEC & RE/SPEC)
- ESTABLISH THERMAL PROPERTIES MEASUREMENT SYSTEM
- PROCURE AXIAL/TORSION TEST SYSTEM
- IMPLEMENT HOLLOW CYLINDER TEST SYSTEM
- INFLUENCE OF LOAD RATE ON STRENGTH AND CREEP RESPONSE
- INFLUENCE OF PRE-PRESSURE ON THERMAL CONDUCTIVITY
- ESTABLISH THERMAL STANDARD FOR CONDUCTIVITY TESTING (BWIP)

WSV:8/21/84

ONWI

BATTELLE Project Management Division

CONCEPTUAL LEVELS OF ROCK MECHANICS DATA

1. BASELINE - REFERENCE MODELS AND PROPERTIES

MORE DETAIL

2. SALT PROPERTIES HANDBOOK**

3. DATA BASE MANAGEMENT

4. SEARCH LEVEL RECORD**

5. DETAILED DATA TAPES

6. RECORDS TURNOVER PACKAGE

**UNDER DEVELOPMENT

SALT PROPERTIES HANDBOOK

(MAY 1983)

CHAPTER 1 INTRODUCTION

CHAPTER 2 THERMOPHYSICAL PROPERTIES
— THERMAL CONDUCTIVITY, EXPANSION, SPECIFIC HEAT

CHAPTER 3 THERMOMECHANICAL PROPERTIES
— ELASTIC PARAMETERS, STRENGTH, SONIC VELOCITY, CREEP

CHAPTER 4 GEOPHYSICAL PROPERTIES
— PERMEABILITY, BRINE MIGRATION, MOISTURE CONTENT

CHAPTER 5 GEOCHEMISTRY AND PETROFABRIC ANALYSIS
— COMPOSITION, FABRIC, IMPURITIES

CHAPTER 6 RADIATION EFFECTS
— RADIOLYSIS OF BRINES AND SALT

CHAPTER 7 DESIGN ANALYSES
— APPROACHES, CODE DESCRIPTIONS

ONWI

SEARCH LEVEL RECORD

INPUT FORM

GENERAL

RECORD NUMBER (FROM CONTROL)

DATE

ORIGINATOR'S NAME (LAST/FIRST)

LOCATION

BOREHOLE NAME

SAMPLE DEPTH (m)

ROCK TYPE

FORMATION NAME & UNIT

TEST CONDITIONS

TEST TYPE(S)

TEST TEMPERATURE (°C)

CONFINING PRESSURE (MPa)

STRESS DIFFERENCE OR RATE (MPa)

SAMPLE DIAMETER (cm)

SAMPLE LENGTH (cm)

TEST I.D.

TEST ORGANIZATION/SAMPLE I.D.

DATE TESTED

REFERENCE

STORAGE

IF TAPE

TAPE NO./FORMAT

VOL. LABEL

FILE NAME

LINE NO./RECORDS

IF FICHE

LOCATION

FICHE I.D.

NO. OF PAGES

Rock Mechanics Data Summary - Permian Basin

Testing Laboratory (Contract No.)	Type of Test	Test Data Included in Laboratory Testing Reports	Test Data Not Included in Laboratory Testing Reports		
			Type of Data	Medium	Location
SWEC Geotechnical Laboratory, Boston	Water Content	Results for each sample	Lab Data Sheet (each specimen)	Paper	ONWI files in SWEC lab
	Density and Effective Porosity	Results for each sample	Lab Data Sheet (each specimen)	Paper	ONWI files in SWEC lab
	Rebound Hardness (Schmidt)	Hardness index (average of 10 highest readings) for each sample	Lab Data Sheet with individual readings (each specimen)	Paper	ONWI files in SWEC lab
	Brazilian Tensile Strength	Results for each sample	Lab Data Sheet (each specimen)	Paper	ONWI files in SWEC lab
	Slake Durability Index	Results of each cycle for each sample	Lab Data Sheet (each specimen)	Paper	ONWI files in SWEC lab
	Atterberg Limits	Results of each sample	Lab Data Sheet (each specimen)	Paper	ONWI files in SWEC lab
	Direct Shear on Discontinuities	Plot of shear stress vs horizontal displacement, Plot of stress ratio vs horizontal displacement Calculated peak and residual friction angle Photograph and cross section of shear surface	Lab Data Sheets (each specimen)	Paper	ONWI files in SWEC lab
	Liquid Permeability	Report has not been finished	-	-	-

Rock Mechanics Data Summary - Permian Basin (cont'd)

Testing Laboratory (Contract No.)	Type of Test	Test Data Included in Laboratory Testing Reports	Test Data Not Included in Laboratory Testing Reports: Type of Data	Medium	Location
	Unconfined Swell	Plot of swelling strain vs time	Lab Data Sheet (each specimen)	Paper	ONWI files in SWRC lab
	Swelling Pressure	Plot of pressure vs time	Lab Data Sheet (each specimen)	Paper	ONWI files in SWRC lab
Applied Research Assoc. Inc. S. Royalton, Vermont (G-110D)	Triaxial Compression and Sonic Velocity	Plots of: Displacement vs time Deviatoric Stress vs axial strain Radial strain vs axial strain Loading History Velocity traces (at progressively higher stresses) Vp vs stress Vs vs stress E(Dynamic) vs stress G(Dynamic) vs stress P.R.(Dynamic) vs stress Photos Specimen dimensions and index properties Bulk Modulus (dynamic) at various continuing pressures Fracture strength, or maximum stress Summary Data (picks from plots)	Digital data from load cell and strain gages and/or LVDTs	Floppy Disk	Vendor's lab
			Lab Data Sheet (each specimen)	Paper	Vendor's lab

Rock Mechanics Data Summary - Permian Basin (cont'd)

Testing Laboratory (Contract No.)	Type of Test	Test Data Included in Laboratory Testing Reports	Test Data Not Included in Laboratory Testing Reports: Type of Data	Medium	Location
Applied Research Assoc. Inc. S. Royalton, Vermont, (C-110D)	Unconfined Compression and Sonic Velocity	Plots of: Displacement vs time Stress vs strain Radial strain vs axial strain Velocity traces (typical) Vp vs stress Vs vs stress E(Dynamic) vs stress G(Dynamic) vs stress P.R.(Dynamic) vs stress Photos Summary Data (picks from plots) Specimen dimensions and index properties Fracture strength or maximum stress	Digital data from load cell and strain gages and/or LVDTs Lab Data Sheet (each specimen)	Floppy Disk Paper	Vendor's lab Vendor's lab
Resource Engineering Inc. Waltham, Mass (C-110M)	Bulk Density, Apparent Density, Specific Gravity, Effective Porosity, Total Porosity	Results for each sample, sample description,	Lab Data Sheet (each specimen)	Paper	Vendor's lab
Applied Research Assoc. Inc. S. Royalton, Vermont (C-110J)	Unconfined Compression Rebound hardness Abrasion hardness	Plots of: Displacement vs time Deviatoric stress vs axial strain Radial strain vs axial strain Specimen Summary Page containing: Density, Moisture Content, Specimen dimensions, Fracture Strength Taber abrasion hardness (avg. of two determinations) Rock abrasiveness (avg. of two determinations)	Digital data from load cell and LVDTs (each sample) Lab Data Sheet for abrasion hardness with individual readings (each sample) Lab Data Sheet for rebound hardness with individual readings (each sample)	Floppy Disk Paper Paper	Vendor's lab Vendor's lab Vendor's lab

Rock Mechanics Data Summary - Permian Basin (cont'd)

Testing Laboratory (Contract No.)	Type of Test	Test Data Included in Laboratory Testing Reports	Test Data Not Included in Laboratory Testing Reports		
			Type of Data	Medium	Location
		Total Hardness Schmidt rebound hardness (radial) (average and std. deviation of 10 highest readings) Schmidt rebound hardness (axial) (average and std. deviation of 10 highest readings)	Lab Data Sheet for density and moisture content (each sample)	Paper	Vendor's lab
Prof. R. C. Reynolds Dartmouth College Hanover, NH (G-111E)	Clay Mineralogy	Photos, Results for each sample, sample description, X-Ray diffraction charts, Data reduction program	None	-	-
Terra Tek Inc. Salt Lake City, Utah (G-110Y)	-Salt Index- Water content insoluble residue clay mineralogy Thermal fracture	Reports have not been recieved	-	-	-
Applied Research Assoc. Inc. S. Royalton, Vermont (G-111M)	Gas Permeability	Reports have not been recieved	-	-	-

Rock Mechanics Data Summary - Permian Basin (cont'd)

Testing Laboratory (Contract No.)	Type of Test	Test Data Included in Report of Geotechnical Borehole Testing	Test Data Not Included in Borehole Testing Report		
			Type of Data	Medium	Location
TerraTek Engineering Salt Lake City (G-111F)	Hydrofracture	Plots of surface and downhole data (pressure vs time) for each zone.	Flow vs time from flowmeter	Paper	Vendor's files
		Tabulated surface and downhole pressure and temperature data. Flow rates and volume injected for each zone.	Impression sleeves	Rubber	SWEC Field Office, Amarillo, TX
		Calculated stresses and tensile strength (each zone where adequate data was obtained).	Calculations	Paper	Vendor's files
		Fracture orientations. Sketch of each fracture impression.	Orientation Data Sheets	Paper	Vendor's files
Schlumberger of Canada Brooks, Alberta (G-105H)	Borehole televiewer	Printed televiewer Logs (microfiche)	Waveform records from televiewer Sonde	Video tape	SWEC Project files
Schlumberger, Inc. Dumas, TX (G-105B)	Geophysical Logs	Logs (Microfiche)	None	-	-
-	-	Daily Reports by SWEC	-	-	-

2912 LITERATURE REVIEW

- 2912.01 Subactivity Summary
- 2912.1 Lab Testing of Salt
  - 2912.1.1 Rock Mechanics Testing - Porosity and Permeability
  - 2912.1.2 Strength Testing
  - 2912.1.3 Stress-Strain Measurements
  - 2912.1.4 Miscellaneous
- 2912.2 Hydraulic Fracture Literature
  - 2912.2.1 Oilfield Hydraulic Fracture and DST
  - 2912.2.2 Hydraulic Fracture Articles by B. Haimson
  - 2912.2.3 Hydraulic Fracture Articles by Miscellaneous Authors
- 2912.3 Laboratory Testing and Properties of Salt
  - 2912.3.1 Repository/Salt Literature - Geologic
  - 2912.3.2 Numeric Analyses of Salt and Similar Materials
  - 2912.3.3 Laboratory Testing of Salt - Mechanical Properties
  - 2912.3.4 Laboratory Testing of Salt-Creep Properties

2913 PLAN IN SITU TESTING ACTIVITIES

- 2913.01 Subactivity Summary
- 2913.1 In Situ Elastic Properties
- 2913.2 Drill Stem Tests - Initial Planning
- 2913.3 Detailed Drill Stem Testing Plan
- 2913.4 Drill Stem Tests - Analytical Procedure

2913.5 Drill Stem Test - Dilatometer Instrumentation Plan

2913.6 Drilling Test Plans GD-1 Core Management Plan

2913.7 Drilling Test Plans - Kubat Well; Elk Ridge Well; Primary Borehole (PBH GD-2)

2914 PLAN LABORATORY TESTING PROGRAM

2914.01 Subactivity Summary

2914.1 Laboratory Testing - General Plans

2914.2 Laboratory Testing - Wave Velocity

2914.3 Laboratory Testing - Core Analysis

2914.4 Laboratory Testing - Permeability

2914.5 Laboratory Strength Testing - Deformability

2914.6 Laboratory Testing - Thermal Properties

2914.7 Geotech Lab Test - Paradox Salt Cycles (Other than Salt 6)

2915 MODIFICATIONS TO IN SITU TEST EQUIPMENT

2915.01 Subactivity Summary

2915.1 Plan for Dilatometer to Directly Measure Diameter Change during GDST

2915.2 Hydrogeology Modifications to Drill Stem Test Tool

2922 IN SITU GDST RECORDS AND DATA

2922.01 Subactivity Summary

2922.1 Testing in Borehole GD-1: August 1980

2922.1.1 Daily Diary

2922.1.2 Record of Computer Data Tapes

2922.1.2.1 Original GDST Computer Tapes Recorded in Field on HP-9825 (Quantity 24 tapes)

2922.1.2.2 Duplicate GDST Computer Tapes Compatible with HP-85 (Quantity 5 Tapes)

2922.1.2.3 Listings of Duplicate GDST Tapes

2922.1.3 Calibration Records for Pressure Transducers

2922.1.3.1 GDST Compliance Check in Cased Portion of GD-1

2922.1.3.2 GDST Compliance On-Line Computer Printout

2922.1.3.3 GDST Compliance Pressure vs Time Plots

2922.1.4 GDST-1 Field Records

2922.1.4.1 GDST-1 On-Line Computer Printout

2922.1.4.2 GDST-1 Pressure vs Time Plots

2922.1.5 GDST-2 and GDST-3 (Aborted) Field Records

2922.1.5.1 GDST-2 On-Line Computer Printout

2922.1.5.2 GDST-2 Pressure vs Time Plots

2922.1.5.3 GDST-3 On-Line Computer Printout

2922.1.5.4 GDST-3 Pressure vs Time Plots

2922.1.6 GDST-4 and GDST-4A Field Records

2922.1.6.1 GDST-4 and GDST-4A On-Line Computer Printout

2922.1.6.2 GDST-4 and GDST-4A Pressure vs Time Plots

2922.1.7 GDST-5 (Aborted) and GDST-3A (Aborted) Field Records

2922.1.7.1 GDST-5 and GDST-3A On-Line Computer Printout

2922.1.7.2 GDST-5 and GDST-3A Pressure vs Time Plots

2922.1.8 GDST-6 Field Records

2922.1.9 GDST-6A Field Records

2922.1.10 GDST-7 Field Records

2922.1.11 GDST-8 Field Records

2922.1.12 GDST-9 Field Records

2922.1.13 GDST-6, -6A, -7, -8, -9 Pressure vs Time Graphs

2922.2 Geophysical Logs for GD-1

2922.3 Geophysical Logs from Kubat Well

2922.4 Geophysical Logs from ER-1 Well

2931 GEOTECHNICAL TESTING OF CORE SAMPLES FROM SALT CYCLE 6 OF BOREHOLE GD-1

2931.01 Subactivity Summary

2931.1 Test Plan

2931.2 Test Procedures

2931.2.1 Calibration Records of Laboratory Test Equipment

2931.2.2 Test Procedures for Sample Preparation for High Pressure Triaxial Testing

2931.2.3 Special Laboratory Testing Procedures for Paradox Basin Project (Black Notebook)

2931.3 Chronological Files

2931.3.1 Summary Status and Schedules from Lab Mobilization

2931.3.2 Telecons Concerning Lab Mobilization

2931.3.3 Lab Testing Status Reports

2931.3.4 Lab Sample Shipping & Receiving Records (Black Notebook)

2931.4 Geotech Sample Selection and Shipment from Denver to Oakland

2931.5 Budgetary Planning

2931.6 Laboratory Test Results

2931.6.1 GD-1 and -3 Uniaxial

2931.6.2 GD-1, -5, and -7 Uniaxial

2931.6.3 GD1-14, -15, and -16 Triaxial Extension Unload Low Percent Anhydrite

2961.6.4 GD1-39, -40, and -41 Triaxial Extension Unload Base Case

2931.6.5 GD1-58, -59, and -61 Triaxial Compression Load

2931.6.6 GD1-62, -63, and -64 Triaxial Compression Unload

2931.6.7 GD1-65, -67, and -68 Triaxial Extension Load

2931.6.8 GD1-70, -71, and -72 Triaxial Extension Unload-Different Strain Rate

2931.6.9 GD1-36, -37, and -38 Triaxial Extension Unload-High Temperature

2931.6.10 GD1-78, -79, and -81 Anhydrite Room Temperature

2931.6.11 GD1-82, -83, and -116 Anhydrite High Temperature

2931.6.12 Effective Porosity

2931.6.12.1 Lab Files for Effective Porosity Measurements (Black Notebook)

2931.6.13 Wave Velocities

2931.6.14 Creep GD1-32

2931.6.15 Creep GD1-34

2931.6.16 Creep GD1-35

2931.6.17 Creep GD1-73

2931.6.18 Creep GD1-133 (3 folders)

2931.6.19 Creep GD1-132

2931.7 Computer Tape Data from Lab Testing

2931.7.1 Five HP-85 Data Tapes for Uniaxial, Triaxial, and Aluminum Calibration

2931.7.2 Six HP-85 Data Tapes for Creep Data

2931.8 Geotech Lab Computer Program Documentation (HP-85 Computer)

2931.9 Temperature Calibration and Post-Test Aluminum/Salt System Calibration Check

2932 ROCK INDEX PROPERTIES FOR GEOENGINEERING AT PARADOX BASIN, UTAH

2932.1 Test Plan; Laboratory Instructions; Sample Shipping & Receiving Forms (Black Notebook)

2932.2 Laboratory Test Results

2932.2.1 Uniaxial Compression GD1-333 to GD-361 (Black Notebook)

2932.2.2 Uniaxial Compression GD1-362 to GD1-391 (Black Notebook)

2932.2.3 Uniaxial Compression GD1-392 to GD1-417 (Black Notebook)

2932.2.4 Schmit Rebound Hardness GD-1 (Black Notebook)

2932.2.5 Abrasion Testing (Tarkoy) (Black Notebook)

2932.2.6 Pointload Strength Testing (Black Notebook)

2932.2.7 Swell/Classification Tests (Black Notebook)

2932.2.8 HP-85 Magnetic Data Tapes

2932.3 Preliminary Transmittal of Results to ONWI

2932.3.1 Test Planning and Computer Programs

2932.3.2 Initial Submittal of Results

2932.3.3 Final Submittal of Results from Lab to Kocherhans/PB-KBB

2932.3.4 Rough Drafts and Checking of Summary Table of Results

2932.4 Work Folder for Preparation of Topical Report

2932.5 Q-A Folder

2932.5.1 WCC Peer Review

2932.5.2 ONWI Review

2932.5.3 Project Management Approval

2932.6 Final Report

2941 ANALYSIS OF GDST TESTING

2941.01 Subactivity Summary

2941.1 Analysis of GDST Testing in Borehole GD-1

2941.1.1 Compliance of GDST Unloading and Loading System

2941.1.1.1 Theoretical Tubing Compliance

2941.1.2 Analysis GDST Unloading

2941.1.2.1 File Description Including Test Plan

2941.1.2.2 Analyses Calculation Sheets and Graphs

2941.1.2.3 Preliminary Results to ONWI, November 1980

2941.1.2.4 Event Summaries

2941.1.2.5 Xeroxes of Field Data

2941.1.2.6 Calculation of Young's Modulus

2941.1.3 Analysis of Short-Term Creep During GDST

2941.1.4 Analysis GDST Loading/Hydraulic Fracture Tests

2941.1.4.1 Summary Plots and Analyses

2941.1.4.2 Hydraulic Fracture Results sent to ONWI

2941.1.5 ONWI Presentation GDST Results, January 1981

2941.1.5.1 Rough Drafts for ONWI Presentation, January 1981

2941.1.6 Peer Review GDST Analysis by Dr. Neville G.W. Cook

2942 ANALYSES OF SALT LABORATORY TEST DATA

2942.1 Analysis of Lab Creep Data

2942.1.1 Computer Output: Creep Fit Analyses Routines plus Input Data

2942.1.2 Creep Fit Output: GD1-35

2942.1.3 Creep Fit Output: GD1-73

2942.1.4 Creep Fit Output: GD1-133

2942.1.5 Creep Analyses Compilations

2942.1.6 Triaxial Data Compilations

2970 REPORTS OF GDST RESULTS

2970.01 Subactivity Summary

2970.1 Preliminary Contribution to Area Characterization Report (ACR)

2970.1.1 ACR Guidelines

2970.1.2 ACR Initial Draft

2970.1.3 ACR Intermediate Drafts

2970.1.4 ACR Figure and Table Drafts

2970.2 Contribution for Penn State Conference on Mechanical Behavior of Salt

2970.2.1 Rough Drafts and Reviews of Penn State Paper

2970.3 Contribution for Hydraulic Fracture Conference in Monterey, California

2970.4 Draft Version Geotech Topical Report Main Text (1st Vol.) & Appendices (2nd Vol.)

2970.5 Draft Version of ONWI-400; Main Text Review Copies

2970.5.1 Draft ONWI-400; Initial Drafts and Outline

2970.5.2 Draft ONWI-400; Appendices

2970.6 Final Version ONWI-400; Main Text

2970.6.1 Final Version ONWI-400; Graphics Checking.

CREEP TEST DATA

Hansen, F.D., and K.D. Mellegard, 1980, Creep of 50-mm Diameter Specimens of Dome Salt from Avery Island, Louisiana, ONWI-104, prepared by RE/SPEC Inc. for Office of Nuclear Waste Isolation, Battelle Memorial Institute.

Type of Test: Triaxial creep tests

Format of Data: Graphs of stress-strain and strain-time

Location of Reference: Earth Technology Library - NTIS.ONWI-104
ONWI Library - EW-ONWI-RL-30

Carter, N.L., and F.D. Hansen, 1980, Mechanical Behavior of Avery Island Halite: A Preliminary Analysis, ONWI-100, prepared by RE/SPEC Inc. for Office of Nuclear Waste Isolation, Battelle Memorial Institute.

Type of Test: Creep tests

Format of Data: Graphs of strain-time, tables of strain-time (preliminary data)

Location of Reference: Earth Technology Library - NTIS.ONWI-100

Sambeek, L.L.V., R.G. Stickney, and K.B. DeJong, 1981, Avery Island Heater Tests and Stress Data for the First 300 days, ONWI-190(2), prepared by RE/SPEC Inc. for Office of Nuclear Waste Isolation, Battelle Memorial Institute.

Type of Test: In-situ heater tests with measurements of displacement and stress

Format of Data: Tabulations and graphs of displacement and stress data

Location of Reference: ONWI Library - EW-ONWI-RL-600

Sambeek, L.L.V., R.G. Stickney, and K.B. DeJong, 1981, Avery Island Heater Tests: Measured Data for 1000 Days of Heating, ONWI-190(5), prepared by RE/SPEC Inc. for Office of Nuclear Waste Isolation, Battelle Memorial Institute.

Type of Test: In-situ heater tests

Format of Data: Graphs and tabulations of displacement, floor expansion, floor heave, closure, pillar dilation, stress, strain

Location of Reference: Earth Technology Library - NTIS.ONWI-190(5)

Carter, N.L., 1983, Creep and Creep Rupture of Rock Salt, ONWI-224, prepared by RE/SPEC for Office of Nuclear Waste Isolation, Battelle Memorial Institute..

Type of Test: Creep tests

Format of Data: Data summary in text and graphs of existing creeptest results

Location of Reference: ONWI Library - EW-ONWI-RL-1812

Mellegard, K.D., P.E. Senseny, and F.D. Hansen, 1983, Quasi-static Strength and Creep Characteristics of 100-mm-Diameter Speciamens of Salt from Avery Island, Louisiana, ONWI-250, prepared by RE/SPEC Inc. for Office of Nuclear Waste Isolation, Battelle Memorial Institute.

Type of Test: Quasi-Static Strength, Creep

Format of Data: Graphs of strain/time
Tables of quasi-static strength

Location of Reference: ONWI Library - EW-ONWI-RL-1849

Sensery, P.E., K.D. Mellegard, and N.M. Eslinger, 1983, Statistical Analysis of Transient Creep Data from Laboratory Tests on Avery Island Dome Salt, ONWI-236, prepared by RE/SPEC Inc. for Office of Nuclear Waste Isolation, Battelle Memorial Institute.

Type of Test: Creep tests/Statistical data analysis

Format of Data: Graphs of Creep Strain/time, Strain/time for 50 and 100 mm samples

Location of Reference: ONWI Library - EW-ONWI-RL-1813

Mellegard, K.D., and P.E. Senseny, 1983, Exponential Time Creep Law for Avery Island Salt, ONWI-329, prepared by RE/SPEC Inc. for Office of Nuclear Waste Isolation, Battelle Memorial Institute.

Type of Test: Creep test with creep law curve fit

Format of Data: Graphs of creep law curve fits to experimental data

Location of Reference: ONWI Library - EW-ONWI-RL-1854

Hansen, F.D., and N.L. Carter, 1980, Creep of Rocksalt at Elevated Temperatures, Proc. of 21st U.S. Symp. on Rock Mech., pp. 217-226.

Type of Test: Creep test

Format of Data: Graphs of stress and strain vs. time and temperature

Location of Reference: ONWI Library - EW-ONWI-RL-905

Sambeek, L.L.V., R. G. Stickney, and R.A. Wagner, 1980, Thermomechanical Assessment of In Situ Heater Tests in Dome Salt at Avery Island, Louisiana, Proceedings of the 21st U.S. Symp. on Rock Mech., pp. 175-182.

Type of Test: In Situ heater tests

Format of Data: Graphs of displacment after 300 days (see ONWI-190(2) for details)

Location of Reference: ONWI Library - EW-ONWI-RL-905

Pfeifle, T.W., and P.E. Senseny, 1982, Steady-State Creep of Rock Salt in Geoengineering, 23rd Symp. on Rock Mech., pp. 307-314.

Type of Test: Creep test

Format of Data: Graph and/or Tables of axial strain vs. time and temperature, stress (see ONWI-104, ONWI-250)

Location of Reference: Personal libraries (Leif Eriksson or Brenda Meyer)

CREEP/CLOSURE/STRENGTH

Thoms, R.L., M. Mogharrebi, R.M. Gehle, 1982, Borehole Closure in the Vacherie and Rayburn's Salt Dome, prepared by the Institute of Environmental Studies, Louisiana State University, Baton Rouge, LA, for the U.S. Department of Energy.

Type of Test: Caliper logs

Format of Data: Borehole closure/depth graph

Location of Reference: ONWI Library - EW-ONWI-RL-1894

Hansen, F.D., 1977 (resubmitted 1978), Case History - Rock Mechanics Examination of the Jefferson Island Salt Mine: II. Laboratory Evaluation of Strength and Creep Deformation Characteristics of Dome Salt Under Confining Pressure, prepared by RE/SPEC Inc. for Office of Nuclear Waste Isolation, Battelle Memorial Institute.

Type of Test:	Triaxial compression, triaxial creep, indirect tension
Format of Data:	Tables and/or graphs of tensile strength, stress/strain, strain/time
Location of Reference:	Personal library (Leif Eriksson) Technical Memorandum Report RSI-0057

Hansen, F.D., and K.D. Mellegard, 1980, Quais-static Strength and Deformational Characteristics of Domal Salt from Avery Island, Louisiana, ONWI-116, prepared by RE/SPEC Inc. for Office of Nuclear Waste Isolation, Battelle Memorial Institute.

Type of Test:	Compressive and tensile strength, creep, velocity
Format of Data:	Graphs of stress/strain, Tables of tensile strength, compressive strength, moduli
Location of Reference:	ONWI Library - EW-ONWI-RL-609

Hansen, F.D., 1977, Quasi-static Strength and Deformation Characteristics of Salt from the Cote Blanche Mine, prepared by RE/SPEC Inc. for Office of Nuclear Waste Isolation, Battelle Memorial Institute.

Type of Test:	Compression, velocity
Format of Data:	Graph and/or tables of stress/strain, shear and normal stress, failure stresses, deformation moduli, elastic properties derived from velocities
Location of Reference:	Personal library (Leif Eriksson)

Tammemagi, H.Y., M.C. Loken, J.D. Osnes, and R.A. Wagner, 1981, Data Requirements for Site Characterization Repository Analyses Topical Report RSI-0181, ONWI-364 (Draft), prepared by RE/SPEC Inc. for Office of Nuclear Waste Isolation, Battelle Memorial Institute.

Type of Test:

Format of Data: Summaries Data from Previous Studies (References attached)

Tables of Thermal Properties (Lagedrost, and Capp and Lagedrost)

Tables of Mechanical Properties (i.e., elastic moduli, failure envelopes, creep parameters (Senseny, 1981)

Model-time deofrmation (Pfeifle et al, 1981)

Young Moduli (derived ν) from sonic and density logs (LETCo)

Tables of In Situ Temperature (Karably and White)

Location of Reference: ONWI Library - EW-ONWI-RL-2433

LIST OF REFERENCES FOR EW-ONWI-RL-2433

Birch, F., and H. Clark, 1940, "The Thermal Conductivity of Rocks and Its Dependence Upon Temperature and Composition, Part II", Am. J. Sci., 238, pp. 613-635.

Blankenship, D.A., and R. G. Stickney, 1981, "Nitrogen Gas Permeabilitiy Tests at Avery Island", RE/SPEC Inc., Rapid City, SD, RSI-0173, prepared for Office of Nuclear Waste Isolation, Battelle Memorial Institute, Columbus, OH, ONWI-...., October.

Callahan, G.D., 1979, "Inelastic Thermomechanical Analysis of a Generic Bedded Salt Repository", RE/SPEC Inc., Rapid City, SD, RSI-0087, prepared for Office of Nuclear Waste Isolation, Battelle Memorial Institute, Columbus, OH, ONWI-125, May.

Capps, W., and J.F. Lagedrost, 1981, "Thermal Property and Density Measurements of Samples Taken from Drilling Cores from Potential Geologic Media, Interim Reports (12) on Materials from the Gibson Salt Dome - 1, Paradox Basin, Utah", Fiber Materials, Inc., Biddeford, MN, prepared for Office of Nuclear Waste Isolation, Battelle Memorial Institute, Columbus, OH, ONWI/SUB/79/E-515-00800-35/046, September.

Cheverton, R.D., and W.D. Turner, 1972, "Thermal Analysis of the National Radioactive Waste Repository: Progress Through March 1972", Oak Ridge National Laboratory Report ORNL-4789, September.

Claiborne, H.C., L.D. Rickertsen, and R.F. Graham, 1980, "Expected Environments in a Nuclear Waste and Spent Fuel Repository in Salt", Oak Ridge National Laboratory ORNL/TM-7201, August.

Clark, S.P., 1966, "Handbook of Physical Constants", Geological Society of America, Inc.

Dames and Moore, 1978, "Technical Support for GEIS: Radioactive Waste Isolation in Geologic Formations - Ground Water Movement and Nuclide Transport", Y/OWI/TM-36/21, April.

Durham, W.B., and A.E. Abey, 1981, "Thermal Properties of Avery Island Salt to 573 K and 50-MPa Confining Pressure", Lawrence Livermore Laboratory, University of California, Livermore, CA, URCL-53128, March.

Dutton, S.P., 1980, "Depositional Systems and Hydrocarbon Resource Potential of the Pennsylvanian System, Palo Duro and Dalhart Basins, Texas Panhandle", Texas Bureau of Economic Geology, Geological Circular 80-8.

Fetter, C.W., 1980, Applied Hydrogeology, Charles E. Merrill Publishing Company, Columbus, OH, 1980.

LIST OF REFERENCES FOR EW-ONWI-RL-2433 (continued)

Fossum, A.F., and G.D. Callahan, 1981, "Material Properties Testing and Analysis for the National Waste Terminal Storage Program, Quarterly Progress for January 1, 1981 through March 31, 1981", RE/SPEC Inc., Rapid City, SD, RSI-0147, prepared for Office of Nuclear Waste Isolation, Battelle Memorial Institute, Columbus, OH, ONWI-...., April.

Gloyna, E.F., and T.D. Reynolds, "Permeability Measurements of Rock Salt", Journal of Geophysical Research, 66, pp. 3913-3921, November.

Goodman, R.E., 1980, Introduction to Rock Mechanics, John Wiley and Sons.

Holman, J.P., 1976, Heat Transfer, McGraw-Hill Book Co.

Hosman, R.L., 1978, "Geohydrology of the Northern Louisiana Salt-Dome Basin Pertinent to the Storage of Radioactive Wastes — A Progress Report", U.S. Geological Survey, Water-Resources Investigations 78-104, November.

Johnson, K.S., and S. Gonzales, 1978, "Salt Deposits in the United States and Regional Geologic Characteristics Important for Storage of Radioactive Waste", Earth Resource Associates, Athens, GA, prepared for the Office of Nuclear Waste Isolation, Union Carbide Corporation, Y/OWI/SUB-7414/1, March.

Kappelmeyer, O., and R. Haenel, 1974, Geothermics with Special Reference to Application, Geopublication Associates.

Karably, L.S., and R.M. White, 1981, "Geothermal Studies of Seven Interior Salt Domes", Law Engineering Testing Co., Marietta, GA, prepared for Office of Nuclear Waste Isolation, Battelle Memorial Institute, Columbus, OH, Job No. MV 9767.30, July.

Lagedrost, J.F., 1979, "Thermal Property and Density Measurements of Samples Taken from Drilling Cores from Potential Geologic Media, Interim Reports (4) on Materials from the Vacherie Salt Dome, Webster Parish, Louisiana", Fiber Materials Inc., Biddeford, MN, prepared for the Office of Nuclear Waste Isolation, Battelle Memorial Institute, Columbus, OH, ONWI/SUB/79/E515-00800-1 to 4, September.

Lagedrost, J.F., 1980, "Thermal Property and Density Measurements of Samples Taken from Drilling Cores from Potential Geologic Media, Interim Reports (8) on Materials from Randall and Swisher Counties, Texas", Fiber Materials Inc., Biddeford, MN, prepared for the Office of Nuclear Waste Isolation, Battelle Memorial Institute, Columbus, OH, ONWI/SUB/79/E515-00800-9 to 16, March.

Lagedrost, J.F., 1980a, "Thermal Property and Density Measurements of Samples Taken from Drilling Cores from Potential Geologic Media, Interim Reports ( ) on Materials from the Vacherie Dome, Louisiana", Fiber Materials Inc., Biddeford, MN, prepared for the Office of Nuclear Waste Isolation, Battelle Memorial Institute, Columbus, OH, ONWI/SUB/79/E515-00800-27 to 30, September.

Lagedrost, J.F., 1980b, "Thermal Property and Density Measurements of Samples Taken from Drilling Cores from Potential Geologic Media, Interim Reports (4) on Materials from Salt Valley DOE-3, No. 13827A", Fiber Materials Inc., Biddeford, MN, prepared for the Office of Nuclear Waste Isolation, Battelle Memorial Institute, Columbus, OH, ONWI/SUB/79/E515-00800 17 to 20, September.

Lagedrost, J.F., 1980c, "Thermal Property and Density Measurements of Samples Taken from Drilling Cores from Potential Geologic Media, Interim Reports (6) on Materials from Richton Salt Dome, MRIG-9, Mississippi", Fiber Materials Inc., Biddeford, MN, prepared for the Office of Nuclear Waste Isolation, Battelle Memorial Institute, Columbus, OH, ONWI/SUB/79/E515-00800-21 to 26, September.

Lagedrost, J.F., 1981, "Thermal Property and Density Measurements of Samples Taken from Drilling Cores from Potential Geologic Media, Interim Reports (4) on Materials from the Richton Salt Dome, MRIG-9, Mississippi, Fiber Materials Inc., Biddeford, MN, prepared for the Office of Nuclear Waste Isolation, Battelle Memorial Institute, Columbus, OH, ONWI/SUB/79/E515-00800-31 to 34, July.

Law Engineering Testing Co., 1980, "Area Characterization, Mississippi Study Area, Gulf Coast Salt Domes Project", prepared for Office of Nuclear Waste Isolation, Battelle Memorial Institute, Columbus, OH, MV9600, August.

Law Engineering Testing Co., 1981, "Area Characterization, North Louisiana Study Area, Gulf Coast Salt Domes Project", prepared for Office of Nuclear Waste Isolation, Battelle Memorial Institute, Columbus, OH, MV9700, February.

Loken, M.C., "Characterization of Potential Repository Sites-Scope", RE/SPEC Inc., Rapid City, SD, RSI-0169, prepared for Office of Nuclear Waste Isolation, Battelle Memorial Institute, Columbus, OH, ONWI-_____, November 30.

McClintock, F.A., and A.S. Argon, 1966, Mechanical Behavior of Materials, Addison-Wesley Publishing Co.

McVey, D.F., 1981, "Analysis of Data from Line Source Thermal Conductivity Measurements Taken In Situ in Dome Salt at the Avery Island Mine", Sandia National Laboratories, Albuquerque, NM, SAND81-1232, prepared for the U.S. Department of Energy, August.

Pfeifle, T.W., K.D. Mellegard, and P.E. Senseny, 1983, Preliminary Constitutive Properties for Salt and Nonsalt Rocks from Four Potential Repository Sites, ONWI-450, prepared by RE/SPEC Inc. for Office of Nuclear Waste Isolation, Battelle Memorial Institute.

Type of Test:	Strength, creep
Format of Data:	Tables and/or graphs of strength, strain/time, elastic constants
Location of Reference:	ONWI Library - EW-ONWI-RL-0387

Pfeifle, T.W., K.D. Mellegard, and P.E. Senseny, 1983, Preliminary Constitutive Properties for Salt Rocks from Four Potential Repository Sites, ONWI-314, prepared by RE/SPEC Inc. for Office of Nuclear Waste Isolation, Battelle Memorial Institute.

Type of Test:	Strength, creep
Format of Data:	Tables and/or graphs of strength, strain/time, elastic constants
Location of Reference:	ONWI Library - EW-ONWI-RL-1741

Lagedrost, J.F., and W. Capps, 1983, Thermal Property and Density Measurements of Samples Taken from Drilling Cores from Potential Geologic Media, BMI/ONWI-522, prepared by Energy Materials Testing Laboratory for Fiber Materials Inc. for Office of Nuclear Waste Isolation, Battelle Memorial Institute.

Type of Test:	Thermal properties, density
Format of Data:	Tables of thermal properties and density for various depths
Location of Reference:	ONWI Library - EW-ONWI-RL-2288

Gulf Interstate Engineering Company, 1977, National Strategic Oil Storage Program Weeks Island Mine Geotechnical Study, Vol. I.

Type of Test:	Compression, triaxial, sonic velocity
Format of Data:	Tables of cohesion, moduli, failure strain, triaxial compression, compressive and tensile strength
Location of Reference:	ONWI Library - EW-ONWI-RL-923

Ode, H., 1968, Review of Mechanical Properties of Salt Relating to Salt Dome Genesis, GSA Special Paper 88.

Type of Test: Unknown

Format of Data: Graph of depth/density relationship (from Nettleton, 1934, Am. Assoc. Petro Geol. Bull., Vol. 18)

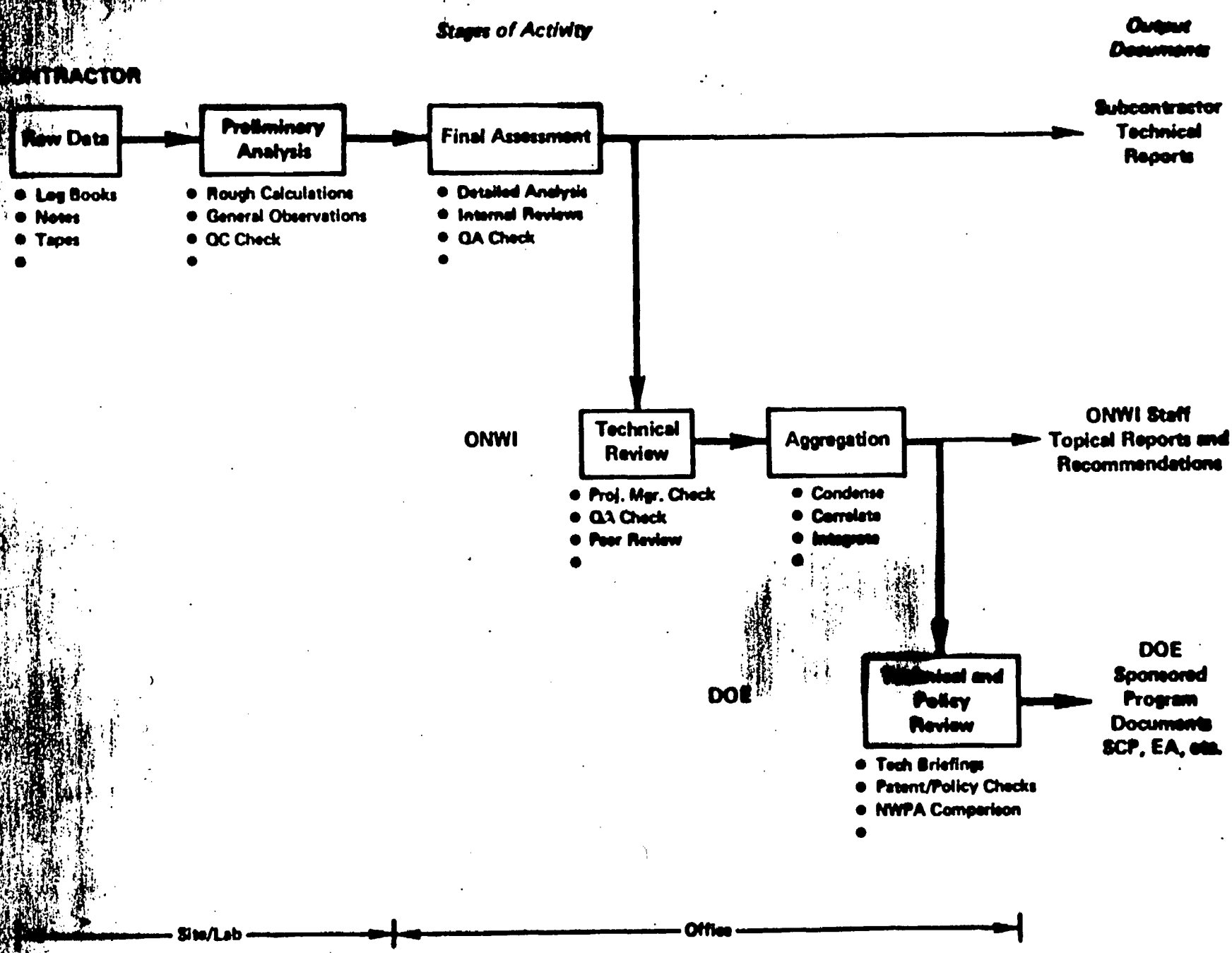
Location of Reference: ONWI Library - EW-ONWI-RL-1534

Serata, S., S. Sakurai, and T. Adachi, 1968, Theory of Aggregate Rock Behavior based on Absolute Three-Dimensional Testing (ATT) of Rock Salt, Proc. 10th Symp. of Rock Mech.

Type of Test: Triaxial compression

Format of Data: Graphs and/or tables of stress/strain, strain hardening, Poisson's ratio, Young's modulus, bulk modulus

Location of Reference: ONWI Library - EW-ONWI-RL-1569



A HISTORY OF TECHNICAL DATA

TECHNICAL DATA MANAGEMENT SYSTEM
(TDMS)

BIBLIOGRAPHIC SOURCES	-	RIS
PROJECT RECORDS	-	RTP
PROJECT DATA	-	SRP/TDB

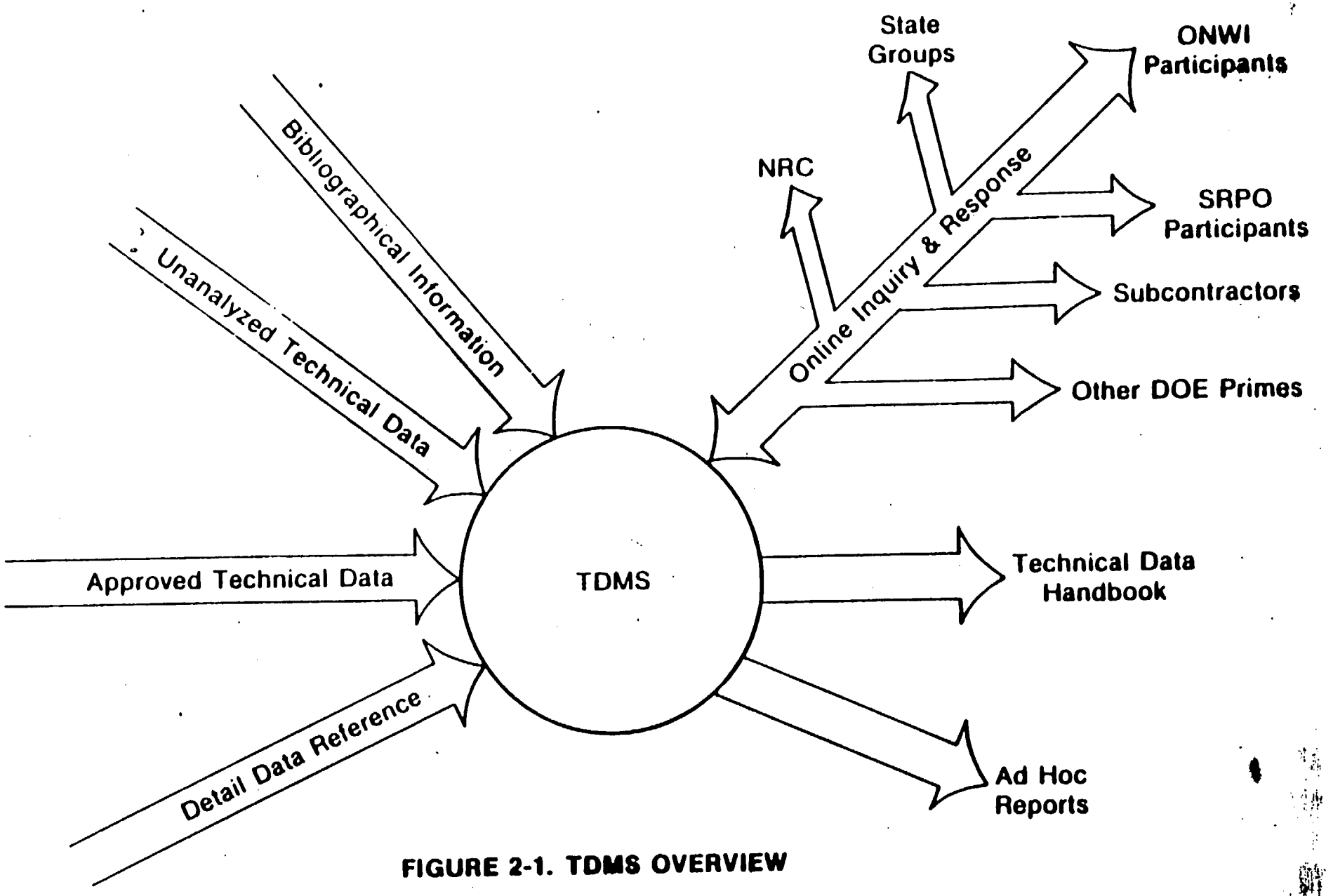


FIGURE 2-1. TDMS OVERVIEW

SRP TECHNICAL DATA BASE
DATA CATEGORIES, RECORD AND TOPIC TYPES

- MATERIAL PROPERTIES
- SITE DESCRIPTIONS
- DESIGNS
- IMPACTS/ASSESSMENTS
- AUXILLARY SUPPORT

SRP TECHNICAL DATA BASE
DATA CATEGORIES, RECORD AND TOPIC TYPES

MATERIAL PROPERTIES

- MATERIAL PROPERTIES
  - THERMAL
  - MECHANICAL
  - HYDROLOGY
  - CHEMICAL
  - RADIATION EFFECTS
  - INTERACTION

ITEM 1

ACCESSION NUMBER :2
RECORD TYPE :borehole results
WELL ID :, Gibson Dome #1
UNIT,SUBUNIT :, Cycle 6
BASIN,SUBBASIN :, Paradox, Gibson Dome
COUNTY,STATE :, San Juan, UT
TEST LAB :, RE/SPEC Inc
CORE SUPPLIER :, Woodward Clyde Consultants
MATERIALS ID :, salt
FORMATION :, PARADOX
HORIZON :, 1000 [illegible] (1000A) [illegible]/(feet)
CREEP LAW PARAMETER: A :, 6.33 x 10E-4 [illegible] per hour
CREEP LAW PARAMETER: n :, 1.06
CREEP LAW PARAMETER: Ea :, 11.9 x 10E-2
CREEP LAW PARAMETER: B :, 198
CREEP LAW PARAMETER: Ess* :, 5 x 10E-6 per sec
CREEP LAW PARAMETER: Q/R :, 6836 deg K
CREEP LAW PARAMETER: TEST CONDITIONS :, [illegible], (10 MPa, 100C) and [illegible] MPa, 200C)
CREEP LAW PARAMETER: METHODS/UNCERTAINTIES:
, three triaxial creep tests
FAILURE CRITERION: k :, 2.2 MPa
FAILURE CRITERION: ALPHA :, 40.2 MPa
FAILURE CRITERION: BETA :, 0.0129 1/MPa
FAILURE CRITERION: EQUATION :, Mises-Schleicher
FAILURE CRITERION: METHODS/UNCERTAINTIES:
, triaxial compression tests, indirect tension tests
YOUNGS MODULUS (STATIC): MIN :, 21.9 GPa
YOUNGS MODULUS (STATIC): MAX :, 32.6 GPa
YOUNGS MODULUS (STATIC): MEAN :, 26.9 GPa
YOUNGS MODULUS (STATIC): STD DEV :, 3.2 GPa
POISSONS RATIO (STATIC): MIN :, 0.17
POISSONS RATIO (STATIC): MAX :, 0.39
POISSONS RATIO (STATIC): MEAN :, 0.31
POISSONS RATIO (STATIC): STD DEV :, 0.06
SORT WELL NAME :, Gibson Dome #1
INITIALIZATION [date,authorities,field numbers,source] :
830825, S Versluis, MJ Gollis, BJM, 1-100,102-202, (1)
831114, S Versluis, KA St. John, CAB, 101, (2)
SOURCES:
, (1) Pfeifle, T.W. et al, 1983. Preliminary Constitutive Properties for Salt and Nonsalt Rocks from Four Potential Repository Sites, ONWI-450, RE/SPEC Inc.
, (2) Woodward Clyde Consultants, 1982. Well Completion Report for Gibson Dome #1 Borehole,

TABLE 4.3

SUMMARY OF EXPONENTIAL-TIME CREEP LAW PARAMETERS FOR FOUR SALTS

SITE	A ($MPa^{-n}s^{-1}$)	n	Q/R (K)	$\dot{\varepsilon}_{ss}$[a] (s^{-1})	ε_a	B
Richton [2]	2.60×10^{-2}	5.01	9,895	5×10^{-8}	4.22×10^{-2}	126
Vacherie [2]	8.71×10^{-3}	2.22	7,569	5×10^{-8}	5.03×10^{-2}	108
Permian [2] (Cycle 4)	4.66×10^{-3}	4.60	8,660	5×10^{-8}	3.97×10^{-2}	82
Permian (Cycle 5)	1.93×10^{-4}	4.15	7,154	5×10^{-8}	5.50×10^{-2}	108
Paradox [2] (Cycle 7)	1.52×10^{-7}	1.39	3,468	5×10^{-8}	14.1×10^{-2}	198
Paradox (Cycle 6)	6.33×10^{-4}	1.06	6,836	5×10^{-8}	11.9×10^{-2}	198

[a] Assumed value based on large Avery Island and S.E. New Mexico data sets.

TABLE 4.2

FAILURE CRITERIA SUMMARY[a]

SITE	k (MPa)	α (MPa)	β (MPa^{-1})
Richton	0.2	40.0	0.0180
Vacherie	0.7	46.4	0.0133
Permian			
Cycle 4	1.0	38.8	0.0174
Cycle 5	1.1	43.5	0.0151
Paradox			
Carnallite	1.5	47.1	0.0149
Cycle 6	2.2	40.2	0.0129
Cycle 7	1.6	51.4	0.0136

SUBJECT/DATE	ABBREVIATION	
Title	TI	
Abstract	ABS	
Descriptor	DE	
Date of Document	DTDOC	
PARTIES INVOLVED		
Author	SEN	e.g. J Doe
Corporate Author	COAU	e.g. XYZ Inc.
RETRIEVAL		
OMWI No.	OCN	e.g. OMWI - 522
External No.	ECN	e.g. INTERA - A796
Microfiche No.	MFCN	
-also-		
Controlled Library No.	LIBNO	
Reference in_____	DOCREF	e.g. EA, SCP
ADDITIONAL INFORMATION		
Prepared For	PREP	e.g. DOE, OMWI
Receiver	ADOR	
Date Entered	DTENT	
Date of Last Change	DTCHG	
Type of Document	TYPE	e.g. Report, Book, Speech
Access No.	ACC	

5/8/84

2/ find de=geochem*
* 12 2/ DE-GEOCHEM
3/ display rpt for 1-2

ITEM 1

ACC NO 60467
DOC DATE 790901
TITLE TECHNICAL REQUIREMENTS FOR QUALIFICATION OF A POTENTIAL NUCLEAR WASTE REPOSITORY SITE IN BASALT
SENDER JOHNSON RE;DEJU RA
CORP AUTH RHO;RHO
ABSTRACT
THIS DOCUMENT IS THE IDENTIFICATION AND DEFINITION OF THE REQUIREMENTS FOR LONG-TERM RADIOACTIVE WASTE STORAGE IN A REPOSITORY IN BASALT, WHICH ARE BASED ON RADIOLOGICAL STANDARDS, TECHNICAL, AND SOCIOECONOMIC SITE-SUITABILITY CONSIDERATIONS. THE PRINCIPAL REQUIREMENTS ARE CATEGORIZED BY DISCIPLINE AND INCLUDE RADIOLOGICAL ENGINEERING, HYDROLOGIC, GEOCHEMICAL, GEOLOGIC, AND SOCIOECONOMIC. EACH REQUIREMENT IS DEFINED AND BRIEFLY DISCUSSED IN THIS DOCUMENT. THE BASALT WASTE ISOLATION PROJECT ACTIVITIES NEEDED TO ASSURE THAT THE REQUIREMENTS CAN BE MET ARE ALSO NOTED.

ITEM 2

ACC NO 72926
DOC DATE 830101
TITLE SELECTED HYDROLOGIC AND GEOCHEMICAL ISSUES IN SITE CHARACTERIZATION FOR NUCLEAR WASTE DISPOSAL. FLOOD BASALTS AT THE HANFORD RESERVATION
SENDER CARNAHAN CL;DELANY JM;LONG JC;SILVA RJ;WATKINS DJ;WHITE AF;WILSON CR
CORP AUTH LBL;LBL;LBL;LBL;LBL
ABSTRACT
FOUR ISSUES ARE CONSIDERED THAT MUST BE ADDRESSED BY A SITE CHARACTERIZATION PROGRAM DESIGNED TO EVALUATE THE SUITABILITY OF THE FLOOD BASALTS OF THE PASCO BASIN IN CENTRAL WASHINGTON AS A SITE FOR THE CONSTRUCTION OF A REPOSITORY FOR THE DISPOSAL OF HIGH-LEVEL NUCLEAR WASTE. THE FOUR ISSUES ARE (1) IDENTIFICATION OF HYDROSTRATIGRAPHIC UNITS WITHIN A SEQUENCE OF FLOOD BASALTS, (2) MECHANISMS AND POINTS OF GROUNDWATER RECHARGE AND DISCHARGE, (3) SOLUBILITY OF RADIONUCLIDES, AND (4) PHASE TRANSFORMATION OF FRACTURE FILLING MATERIALS. EACH ISSUE IS DISCUSSED IN TERMS OF ITS SIGNIFICANCE TO WASTE ISOLATION. AVAILABLE APPROACHES FOR RESOLVING THE ISSUES ARE PRESENTED AND THEIR LIMITATIONS IDENTIFIED. WHERE APPROPRIATE, RESEARCH PROGRAMS FOR OVERCOMING THESE LIMITATIONS ARE INDICATED.
3/

16/ ?fields

FIELD NAME	NUMBER	TYPE	LABEL
ACC	1	I KEY	ACC NO
DTENT	2	I NP	DATE ENTERED
ID	5	I NN	ID
TI	6	S	TITLE
DTDOC	10	I	DOC DATE
CTR	12	S	CONTRACTOR
ADDR	14	S	ADDR
TYPE	15	S NN	DOC TYPE
DE	20	S	DESCRIP
CODE	24	S	CODE
DTCST	30	I	CTR ST DTE
DTCED	31	I	CTR END DTE
PM	32	S	PGM MGR
OPM	33	S	ONWI PGM MGR
SCTR	34	S	SUBCTR
STI	35	S	SHORT TITLE
MFN	51	I	MFLM FR NO.
OCN	52	S	ONWI CTL NOS.
ECN	53	S	EXT CTL NOS.
SEN	57	S	SENDER
DTCHG	60	I	DATE LAST CHG
SEC	96	I NP	SECURITY
RTP	98	MAP	
RTPP	100	MAP	

DETAILED DATA REPORTS
(DDR)

PURPOSE

- ACCESS TO DATA ON MAGNETIC TAPE
- ACCESS TO RECENT OR VALID DATA

TYPES OF DATA

- DOWNHOLE LABORATORY TESTS
- WELL LOGS
- SEISMIC, GRAVITY OR MAGNETIC SURVEYS
- ENVIRONMENTAL AND SOCIOECONOMIC
- METEROLOGIC AND GEOGRAPHIC

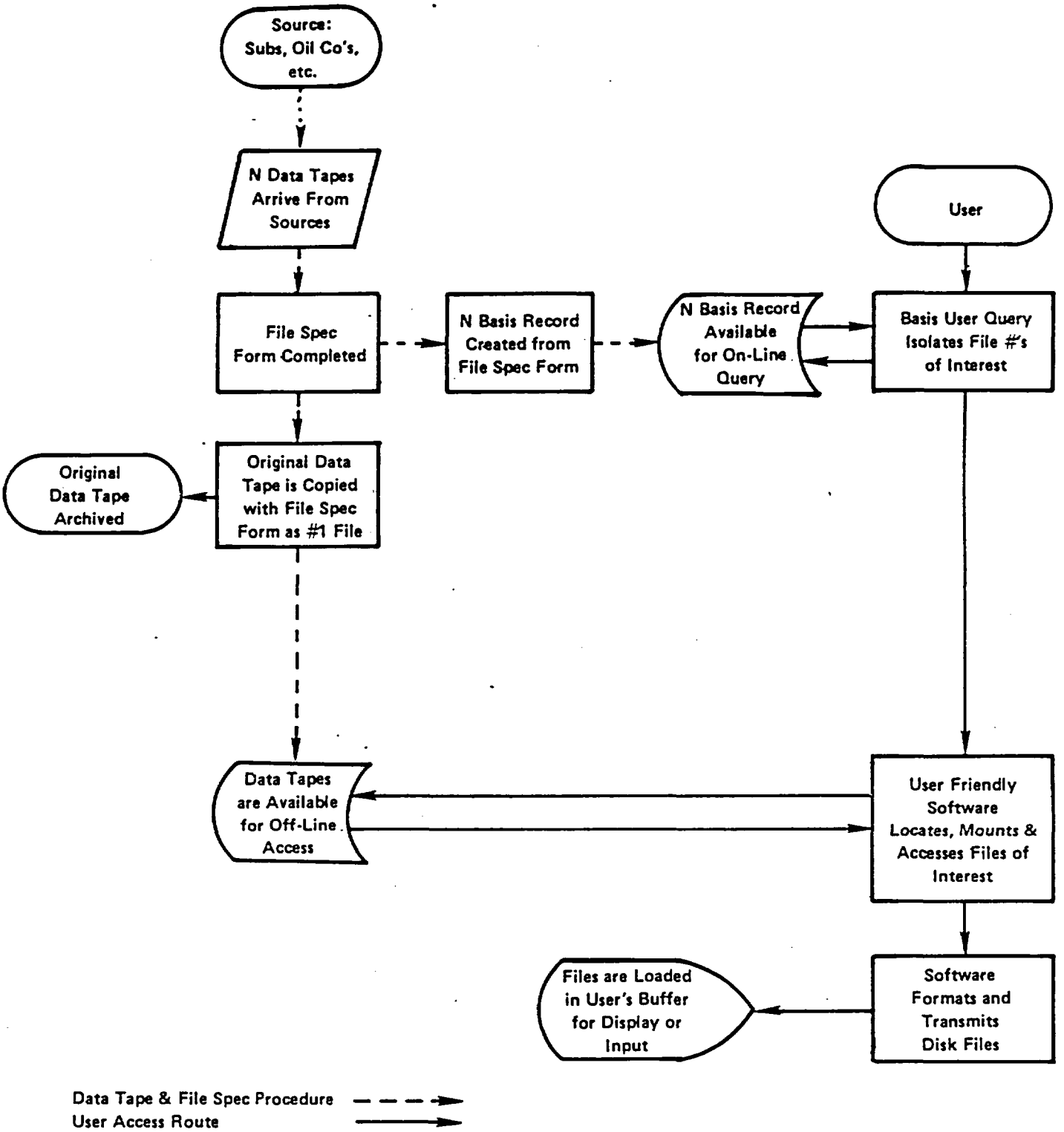
DETAILED DATA REPORTS
(DDR)

PURPOSE

- ACCESS TO DATA ON MAGNETIC TAPE
- ACCESS TO RECENT OR VALID DATA

TYPES OF DATA

- DOWNHOLE LABORATORY TESTS
- WELL LOGS
- SEISMIC, GRAVITY OR MAGNETIC SURVEYS
- ENVIRONMENTAL AND SOCIOECONOMIC
- METEROLOGIC AND GEOGRAPHIC



Data Tape & File Spec Procedure — — — →
User Access Route ——→

RAW DATA TAPE ACCESS SYSTEM – PHASE A

FILE SPECIFICATION & TAPE INFORMATION FORM

Record Type _____

Topic Type _____

Computer Program [] , Data Tape [] , Other _____

Availability: Unrestricted [], U.S. only [], Govt contract [],

other _____

Tape Short Title _____

_____

_____

Volume Serial Number _____,Version _____, Date _____

Tape Full Title _____

_____

_____

_____

_____

Reel # _____, # of Tapes _____

Status: New [], Replacement [], Revision [], Addition []

Previous ID _____

ONWI Project Manager _____

Functional Manager _____

Subcontractor _____

Subcontract # _____

Subcontract Project Manager _____

Subcontractor Tape # _____

NESC CIN _____

Unit 7-track [], 9-track []

Density 556 [], 800 [], 1600 [], 6250 [], bpi

Parity odd [], even [], NR []

Record Format _____

Character Code: ASCII [], EBCDIC [], BCD [], BINARY [],

other _____

Assigned Protection Key: write _____, read _____

Label: ANSI STD [], IBM STD [], Unlabeled [],

other _____

IBM Tape File Specifications

File #	RECFM	LRECL	BLKSIZE	# BLOCKS	contents
_____,	_____,	_____,	_____,	_____,	_____
_____					

Fixed Length File Specifications

File #	Logical Record Length	Blocking Factor	# Blocks	contents
_____,	_____,	_____,	_____,	_____
_____				

Variable Length Record File Specifications

File #	Max. Record Length	# Records	# Blocks	contents
_____,	_____,	_____,	_____,	_____
_____;				

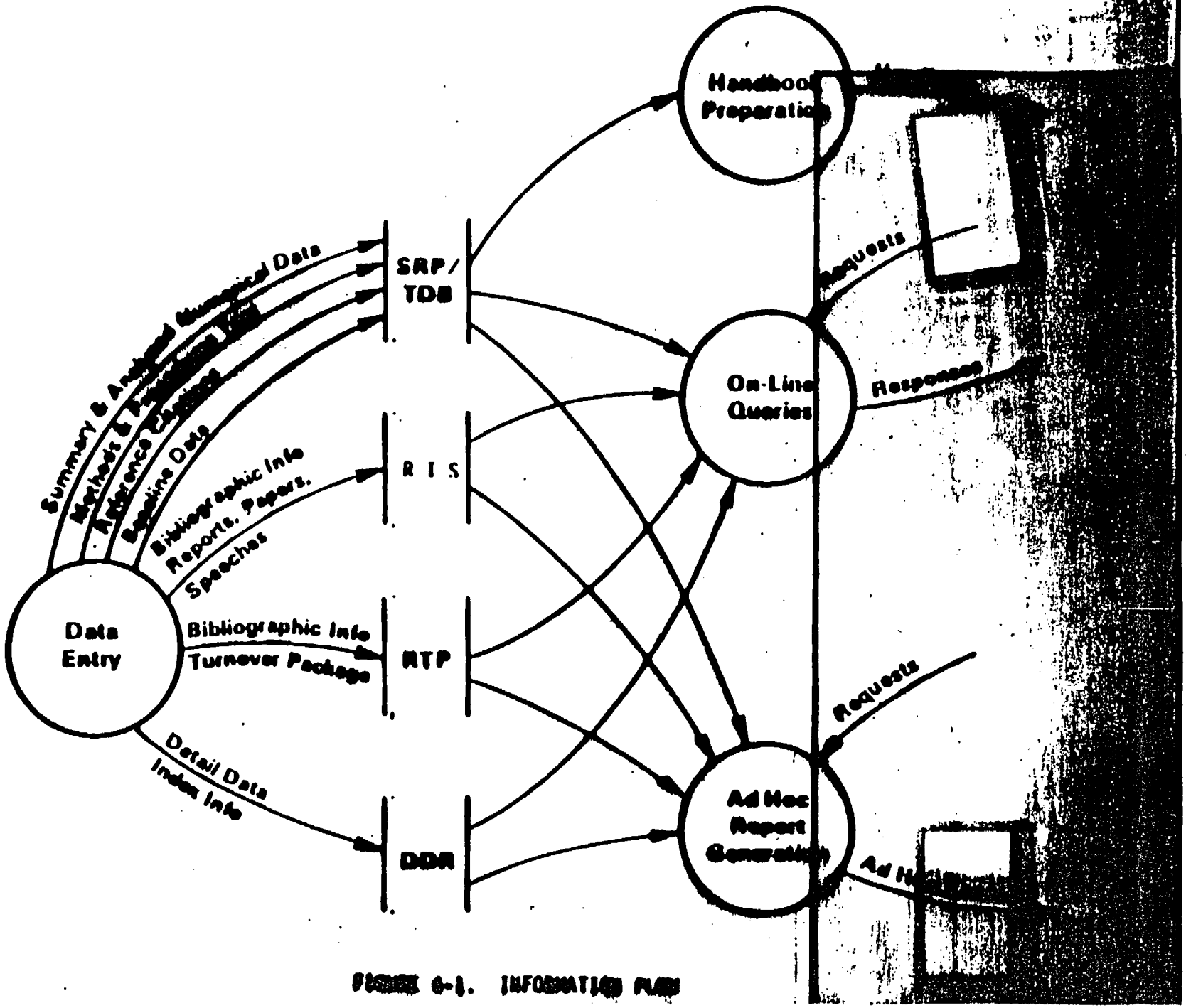
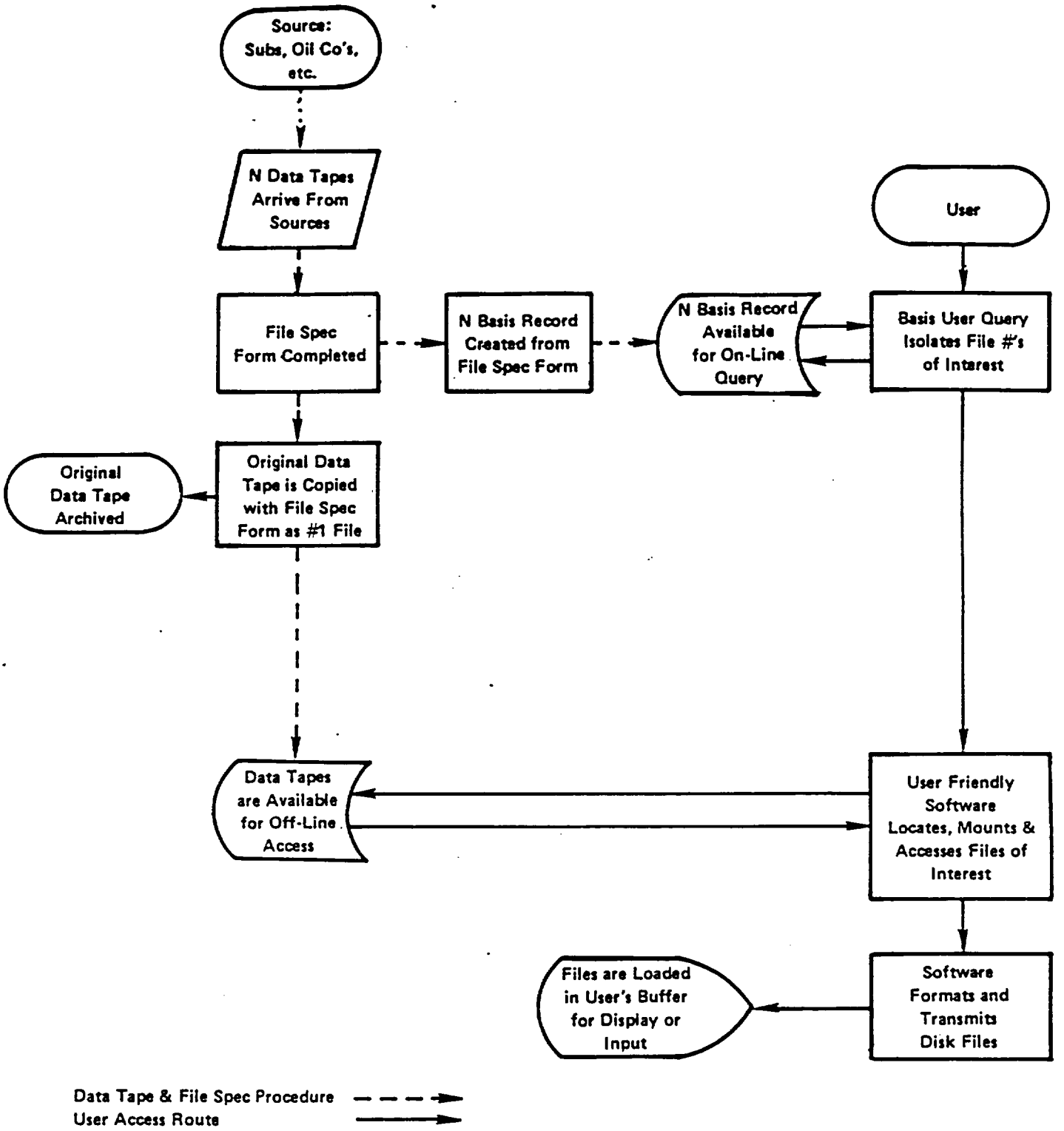


FIGURE 6-1. INFORMATION FLOW



RAW DATA TAPE ACCESS SYSTEM — PHASE A

FILE SPECIFICATION & TAPE INFORMATION FORM

Record Type _____

Topic Type _____

Computer Program [] , Data Tape [] , Other _____

Availability: Unrestricted [], U.S. only [], Govt contract [],

other _____

Tape Short Title _____

_____

_____

Volume Serial Number _____,Version _____, Date _____

Tape Full Title _____

_____

_____

_____

_____

Reel # _____, # of Tapes _____

Status: New [], Replacement [], Revision [], Addition []

Previous ID _____

ONWI Project Manager _____

Functional Manager _____

Subcontractor _____

Subcontract # _____

Subcontract Project Manager _____

Subcontractor Tape # _____

NESC CIN _____

Unit 7-track [], 9-track []

Density 556 [], 800 [], 1600 [], 6250 [], bpi

Parity odd [], even [], NR []

Record Format _____

Character Code: ASCII [], EBCDIC [], BCD [], BINARY [],

other _____

Assigned Protection Key: write _____, read _____

Label: ANSI STD [], IBM STD [], Unlabeled [],

other _____

IBM Tape File Specifications

File #	RECFM	LRECL	BLKSIZE	# BLOCKS	contents
_____,	_____,	_____,	_____,	_____,	_____
_____					

Fixed Length File Specifications

File #	Logical Record Length	Blocking Factor	# Blocks	contents
_____,	_____,	_____,	_____,	_____
_____				

Variable Length Record File Specifications

File #	Max. Record Length	# Records	# Blocks	contents
_____,	_____,	_____,	_____,	_____
_____;				

VIEWGRAPHS PROJECTED DURING DOE/ONWI PRESENTATION ON 8/21/84

ROCK MECHANICS STUDIES

ROCK MECHANICS STUDIES DIVIDED INTO:

- INDEX PROPERTIES
- THERMAL PROPERTIES
- THERMOMECHANICAL PROPERTIES
- MODELING STUDIES

HRH: 8/20/84

ONWI

BATTELLE Project Management Division

SCOPE OF MEETING

SCOPE OF ROCK MECHANICS DATA REVIEW IS TO PROVIDE A FORUM FOR THE FOLLOWING:

1. PRESENT EXISTING PUBLISHED ROCK MECHANICS DATA AS DEVELOPED BY THE ONWI PROGRAM.

2. PRESENT ROCK MECHANICS DATA DEVELOPED BY THE ONWI PROGRAM WHICH HAS NOT YET BEEN PUBLISHED I.E., UNANALYZED DATA REPORTS, REPORTS PRESENTLY IN REVIEW, ETC.

3. PRESENT EXAMPLES OF RAW DATA THAT FORM THE BASE FROM WHICH THE ROCK MECHANICS REPORTS (BOTH PUBLISHED AND UNPUBLISHED) WERE DERIVED.

4. PROVIDE A CATALOGUE OF EXISTING ROCK MECHANICS RAW DATA INDICATING:

   A) TYPE OF RAW DATA
   B) LOCATION OF RAW DATA
   C) FORMAT IN WHICH RAW DATA RESIDES

5. PROVIDE THE NRC ASSISTANCE AND FACILITIES TO EXAMINE THE DATA PRESENTED ITEMS 1 THRU 4.

HRH: 8/20/84

ONWI

BA111111 Project Management Division

SITE CONTRACTORS

GEOLOGIC PROJECT MANAGERS	SITE
STONE & WEBSTER ENGINEERING CORPORATION (SWEC)	PERMIAN BASIN, TEXAS
EARTH TECHNOLOGY CORPORATION (ETC)	GULF COAST SITES
WOODWARD-CLYDE CONSULTANTS (WCC)	PARADOX BASIN, UTAH

HRH: 8/20/84

ONWI

BATTELLE Project Management Division

CURRENT STATUS OF ROCK MECHANICS LABORATORY TESTING BEING CONDUCTED BY G.P.M.'s

BASIN	CONTRACTOR
GULF COAST BASIN	EARTH TECHNOLOGY CORPORATION (ETC)
TESTING COMPLETED AND NO FURTHER TESTING SCHEDULED AUGUST 20, 1984.	
PARADOX BASIN	WOODWARD-CLYDE CONSULTANTS (WCC)
TESTING COMPLETED AND NO FURTHER TESTING SCHEDULED AS OF AUGUST 20, 1984. GD-1 FINAL REPORT DUE.	
PERMIAN BASIN	STONE & WEBSTER ENGINEERING CORPORATION (SWEC)
EXTENSIVE TESTING PROGRAM IN PROGRESS.	SWEC's SUBCONTRACTORS: APPLIED RESEARCH ASSOCIATES RESOURCE ENGINEERING DARTMOUTH COLLEGE

HRH: 8/20/84

ONWI

BATTELLE Project Management Division

PERMIAN LABORATORY TESTING

INDEX TESTS	WATER CONTENT, DENSITY AND EFFECTIVE POROSITY, SCHMIDT HARDNESS, BRAZILIAN TENSILE STRENGTH, SLAKE DURABILITY ATTERBERG LIMITS.
SMALL SAMPLE UNCONFINED AND HARDNESS TESTS	SMALL UNCONFINED SAMPLES AND TABER ABRASION HARDNESS TESTS.
LARGE SAMPLE UNCONFINED, TRIAXIAL TESTING, VELOCITIES	UNCONFINED COMPRESSIVE STRENGTH OF 4" DIAMETER SAMPLES. TRIAXIAL SHEAR STRENGTH OF 4" DIAMETER SAMPLES. P AND S WAVE VELOCITIES ON THESE SAMPLES. STATIC AND DYNAMIC MODULI.
POROSITY AND SPECIFIC GRAVITY	TOTAL POROSITY, EFFECTIVE POROSITY AND SPECIFIC GRAVITY TESTS.
CLAY MINERALOGY	X-RAY ANALYSIS, DIFFERENTIAL THERMAL ANALYSIS, SCANNING ELECTRON MICROSCOPE, ETC.
LIQUID/GAS PERMEABILITY	PERMEABILITY USING A LIQUID/GAS AS A PERMEANT.
SPECIAL SALT INDEX PROPERTY	THERMAL FRACTURING ON SALT, INSOLUBLE RESIDUES AND WATER CONTENT/LOSS OF WEIGHT ON HEATING.

HRH: 8/20/84

ONWI

BATTELLE Project Management Division

PERMIAN BASIN ROCK MECHANICS TESTING

TESTING TYPE	WELL	CONTRACTOR	TESTING COMPLETE
INDEX	MANSFIELD	SWEC	YES
	DETTEN	SWEC	YES
	G. FRIEMEL	SWEC	YES
	UPPER J. FRIEMEL	SWEC	NO
	LOWER J. FRIEMEL	SWEC	NO
	ZEECK	SWEC	YES
	HARMAN	SWEC	NO
LARGE SAMPLES UNCONFINED TRIAXIAL TESTING AND VELOCITIES	MANSFIELD	ARA	YES
	G. FRIEMEL	ARA	YES
	DETTEN	ARA	YES
	ZEECK	ARA	YES
	J. FRIEMEL	ARA	NO
	HARMAN	ARA	NO
SMALL SAMPLES UNCONFINED AND HARDNESS TESTS	HARMAN	ARA	YES
	G. FRIEMEL	ARA	YES
	ZEECK	ARA	YES
	J. FRIEMEL	ARA	NO

HRH: 8/20/84

ONWI

BATTELLE Project Management Division

PERMIAN BASIN ROCK MECHANICS TESTING (CONT'D)

TESTING TYPE	WELL	CONTRACTOR	TESTING COMPLETE
POROSITY AND SPECIFIC GRAVITY	G. FRIEMEL	REI	YES
	J. FRIEMEL	REI	NO
	DETTEN	REI	YES
	ZEECK	REI	YES
CLAY MINERALOGY	G. FRIEMEL	DARTMOUTH	YES
	ZEECK	DARTMOUTH	YES
	J. FRIEMEL	DARTMOUTH	YES
SPECIAL SALT INDEX PROPERTIES	DETTEN	TERRATEK	NO
	MANSFIELD	TERRATEK	NO
	G. FRIEMEL	TERRATEK	NO
	J. FRIEMEL	TERRATEK	NO
	ZEECK	TERRATEK	NO
LIQUID PERMEABILITY TESTS	ALL WELLS	SWEC	NO
GAS PERMEABILITY TESTS	ZEECK	ARA	NO
	G. FRIEMEL	ARA	NO
	J. FRIEMEL	ARA	NO

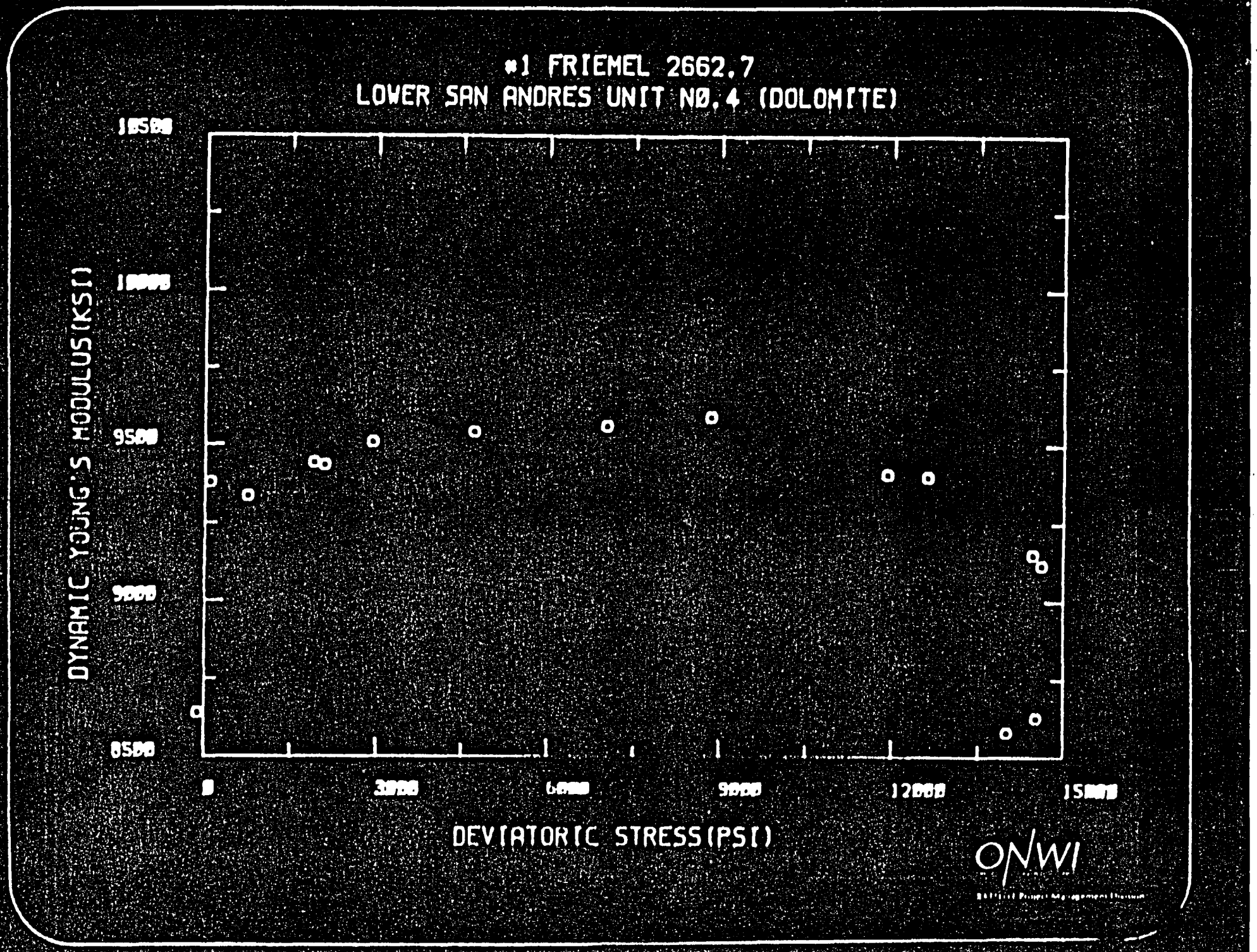
HRH: 8/20/84

ONWI

BATTELLE Project Management Division

Sample	Density g/cm^3	Water Content %	Young's Modulus x 10^6 psi (GPa)		Dynamic Shear Modulus 10^6 psi (GPa)	Poisson's Ratio		Fracture Strength psi (MPa)
			Static	Dynamic		Static	Dynamic	
No. 1 Friemel 1765.3 (salt) Upper San Andres	2.21	0.046	1.77 (12.20)	3.80 (26.20)	1.43 (9.86)	0.20	0.34	2643 (18.2)
No. 1 Friemel 2199.7 (anhydrite) Upper San Andres	2.94	0.014	13.26 (91.42)	13.15 (90.66)	5.08 (35.02)	0.33	0.27	17502 (120.7)
No. 1 Friemel 2362.7 (dolomite) Lower San Andres Unit No. 5	2.43	3.11	4.05 (27.92)	4.20 (28.96)	1.55 (6.89)	0.24 - 0.37	0.37	10030 (69.2)
No. 1 Friemel 2422.1 (anhydrite)	2.94	0.025	10.13 (69.84)	10.97 (75.63)	4.14 (28.54)	0.35	0.33	19535 (134.69)
No. 1 Friemel 2528.3 (salt) Unit No. 4	2.19	0.078	2.57 (17.71)	4.60 (31.72)	1.74 (12.00)	0.43	0.33	4222 (29.1)
No. 1 Friemel 2627.1 (dolomite) Lower San Andres Unit No. 4	2.47	0.625	5.83 (40.20)	6.80 (46.88)	2.57 (17.72)	0.30	0.35	19248 (132.7)
No. 1 Friemel 2658.6 (dolomite) Lower San Andres Unit No. 4	2.60	0.395	5.88 (40.54)	4.60 (31.72)	1.82 (12.55)	0.24	0.27	10826 (74.6)

ONWI


#1 FRIEMEL 2662.7
LOWER SAN ANDRES UNIT NO.4 (DOLOMITE)
DYNAMIC YOUNG'S MODULUS(KSI)
10500
10000
9500
9000
8500
0
3000
6000
9000
12000
15000
DEVIATORIC STRESS(PSI)
ONWI

LABORATORY TESTING FOR REBOUND HARDNESS, ABRASION HARDNESS,
AND CONFINED COMPRESSIVE STRENGTH
BY APPLIED RESEARCH ASSOCIATES
FROM J. FRIEMEL NO. 1 (DEEP)

FORMATION & LITHOLOGY	SAMPLE TOP	DEPTH BOTTOM	SAMPLE TYPE	TESTS
WOLFCAMP				
(SNALEY FOSSILIFEREOUS LIMESTONE)	5993.5	5994.2	SMALL DIA. CORE 8" LONG	UNCONFINED COMP. STRENGTH REBOUND HARDNESS, ABRASION HARDNESS
	5999.2	5999.9	SAME AS ABOVE	SAME AS ABOVE
PENNSYLVANIAN				
(ARKOSIC SANDSTONE)	7709.0	7709.7	SAME AS ABOVE	SAME AS ABOVE
(ARGILLACEOUS LIMESTONE)	7771.6	7772.7	SAME AS ABOVE	SAME AS ABOVE
(ARKOSIC SANDSTONE)	8312.0	8132.6	SAME AS ABOVE	SAME AS ABOVE

HRH: 8/20/84

ONWI
Office of Nuclear Waste Isolation
BATTELLE Project Management Division

PARADOX LABORATORY TESTING

TRIAXIAL EXTENSION UNLOADING AT SINGLE STRAIN RATE	FROM DIFFERENT INITIAL CONFINING STRESSES; STRAIN RATE = 10^{-5} TO 10^{-6} SEC^{-1}; TEST SPECIMENS HAVE AVERAGE PERCENTAGE ANHYDRITE LAMINATIONS.
TRIAXIAL EXTENSION - UNLOADING WITH LOW PERCENTAGE ANHYDRITE	3 SAMPLES UNDER SAM CONDITIONS AS ABOVE EXCEPT SAMPLES HAVE LOW PERCENTAGE ANHYDRITE.
TRIAXIAL EXTENSION - UNLOADING AT ELEVATED TEMPERATURES	3 SAMPLES UNDER SAME CONDITIONS AS ABOVE EXCEPT TEST AT TEMPERATURES OF 50°, 100°, AND $100^{o}C$.
TRIAXIAL COMPRESSION - UNLOADING OR LOADING	3 SAMPLES WITH COMPRESSION UNLOADING STRESS PATH WITH SAME TEST CONDITIONS AS ABOVE.
TRIAXIAL EXTENSION - LOADING	3 SAMPLES UNDER SAME TEST CONDITIONS AS ABOVE, EXCEPT LOADING STRESS PATH.
TRIAXIAL EXTENSION UNLOADING AT DIFFERENCE STRAIN RATES	3 SAMPLES UNDER SAME CONDITONS AS ABOVE, EXCEPT SLOWER AND FASTER STRAIN RATE.

HRH: 8/20/84

ONWI

BATTELLE Project Management Division

PARADOX LABORATORY TESTING (CONT'D)

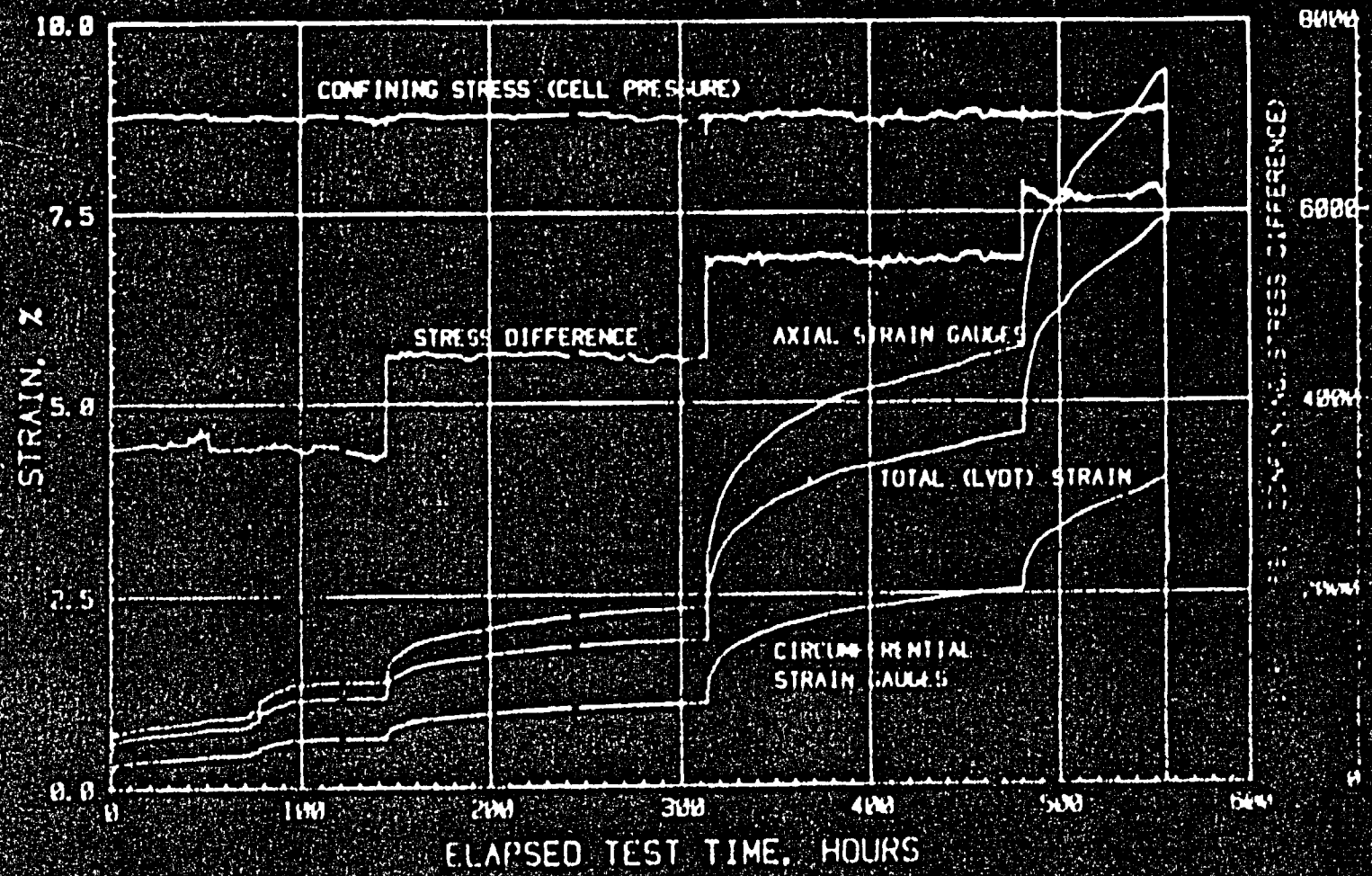
TRIAXIAL EXTENSION - UNLOADING ON PURE ANHYDRITE SAMPLES FROM IMMEDIATELY ABOVE OR BELOW SALT CYCLE 6.	3 SAMPLES UNDER SAME TEST CONDITIONS AS ABOVE; 3 SAMPLES UNDER ELEVATED TEMPERATURES AS IN THE THIRD TEST ITEM.
UNIAXIAL COMPRESSION	6 SAMPLES FROM PORTIONS OF SALT CYCLE 6 OTHER THAN THOSE TESTED ABOVE.
TRIAXIAL EXTENSION - UNLOADING CREEP	3 SAMPLES UNDER SAME GENERAL CONDITIONS AS TEST ITEM 1, EXCEPT TEST LONG-TERM CREEP PHENOMENA.
TRIAXIAL EXTENSION - UNLOADING CREEP AT ELEVATED TEMPERATURES	3 SAMPLES UNDER SAME CONDITIONS AS TEST ITEM 9, EXCEPT TEST ELEVATED TEMPERATURES CREEP PHENOMENA; SAME TEMPERATURES AS TEST ITEM 3.
BULK DENSITY AND POROSITY	ON ALL SAMPLES; TO BE DONE BEFORE THE TESTS LISTED ABOVE.

TESTS DONE MAINLY ON SALT 6 AND ANHYDRITE SAMPLES.

ONWI

BATTELLE Project Management Division

HRH: 8/20/84



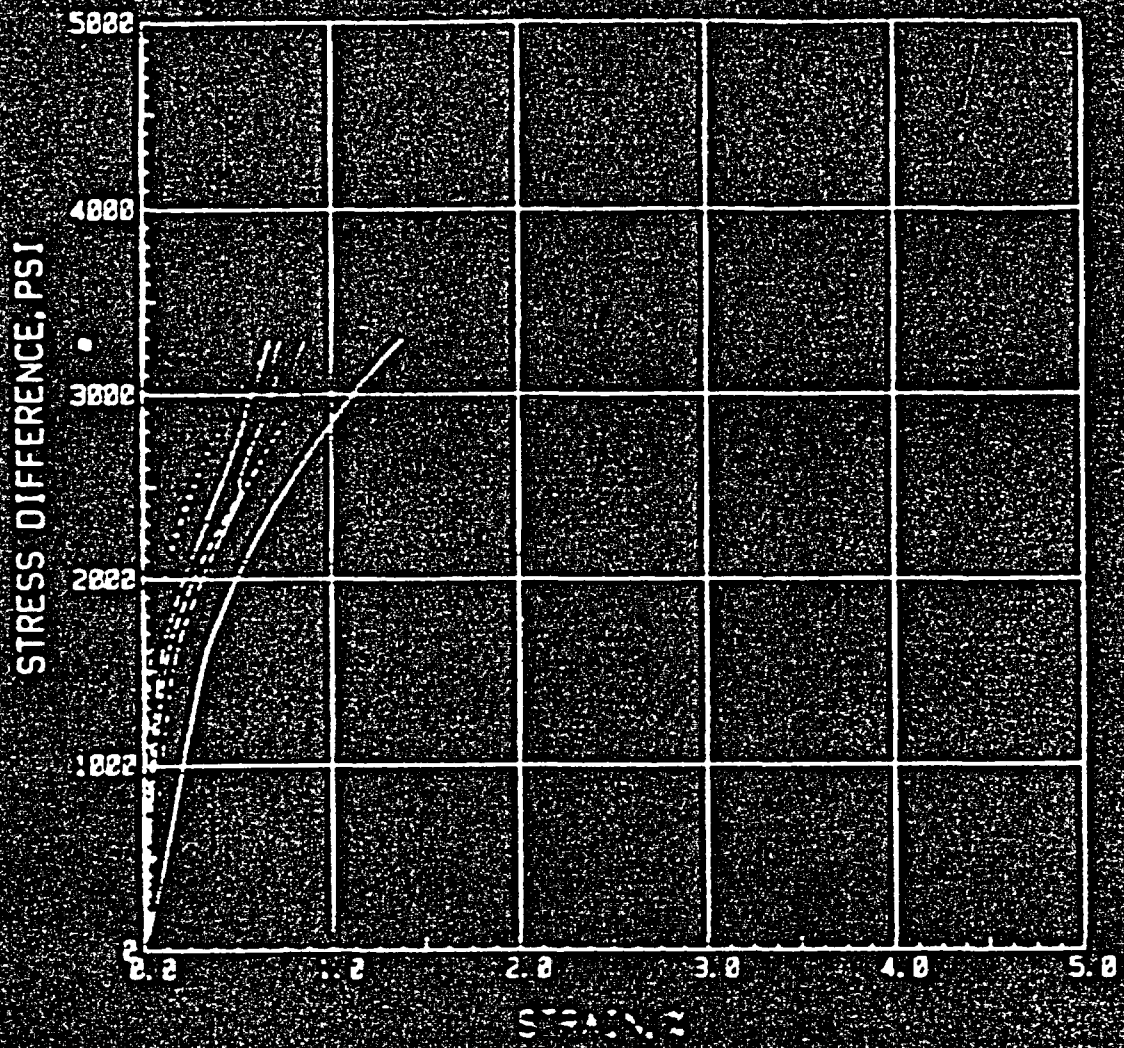
NOTES

1. TEST TEMPERATURE = 72 DEG F = 22 DEG C
2. SAMPLE TIP DEPTH = [illegible] FT BELOW RIG DATUM
3. METRIC CONVERSIONS: 1000 PSI = 6.9 MPA ; 1 FT = 0.305 M

SAMPLE GD1-73

LABORATORY CREEP TESTS
BOREHOLE GD-1

ONWI



NOTES

1. FIRST LOADING OF SAMPLE
2. AXIAL STRESS GRADUALLY INCREASED AT AXIAL STRAIN RATE APPROX. [illegible] SEC
3. STRESS DIFFERENCE = AXIAL STRESS
4. TEST TEMPERATURE = 72 DEG F = 22 DEG C
5. SAMPLE TOP DEPTH = 3387.8 FT BELOW RIG DATUM
6. METRIC CONVERSIONS: 1000 PSI = 6.9 MPA
   1 FT = 0.305 M

LEGEND

- CIRCUMFERENTIAL STRAIN GAUGES
- TOP AXIAL STRAIN GAUGES
- BOTTOM AXIAL STRAIN GAUGES
- MIDDLE AXIAL STRAIN GAUGES
- TOTAL (LVDT) STRAIN

UNIAXIAL COMPRESSION [illegible]

LABORATORY STRESS-STRAIN TEST
BORE-HOLE [illegible]

ONWI

STRUCTURAL GEOLOGIC MODELING

SALT DOME EVOLUTION STUDY	EARTH TECHNOLOGY CORPORATION (ETC)
PHYSICAL MODELING OF SALT DOME EVOLUTION	TEXAS BUREAU OF ECONOMIC GEOLOGY (TBEG)
RAYLEIGH-TAYLOR INSTABILITY STUDY OF PARADOX SALT BEDS	WOODWARD-CLYDE CONSULTANTS (WCC)

ONWI

BATTELLE Project Management Division

HRH: 8/20/84

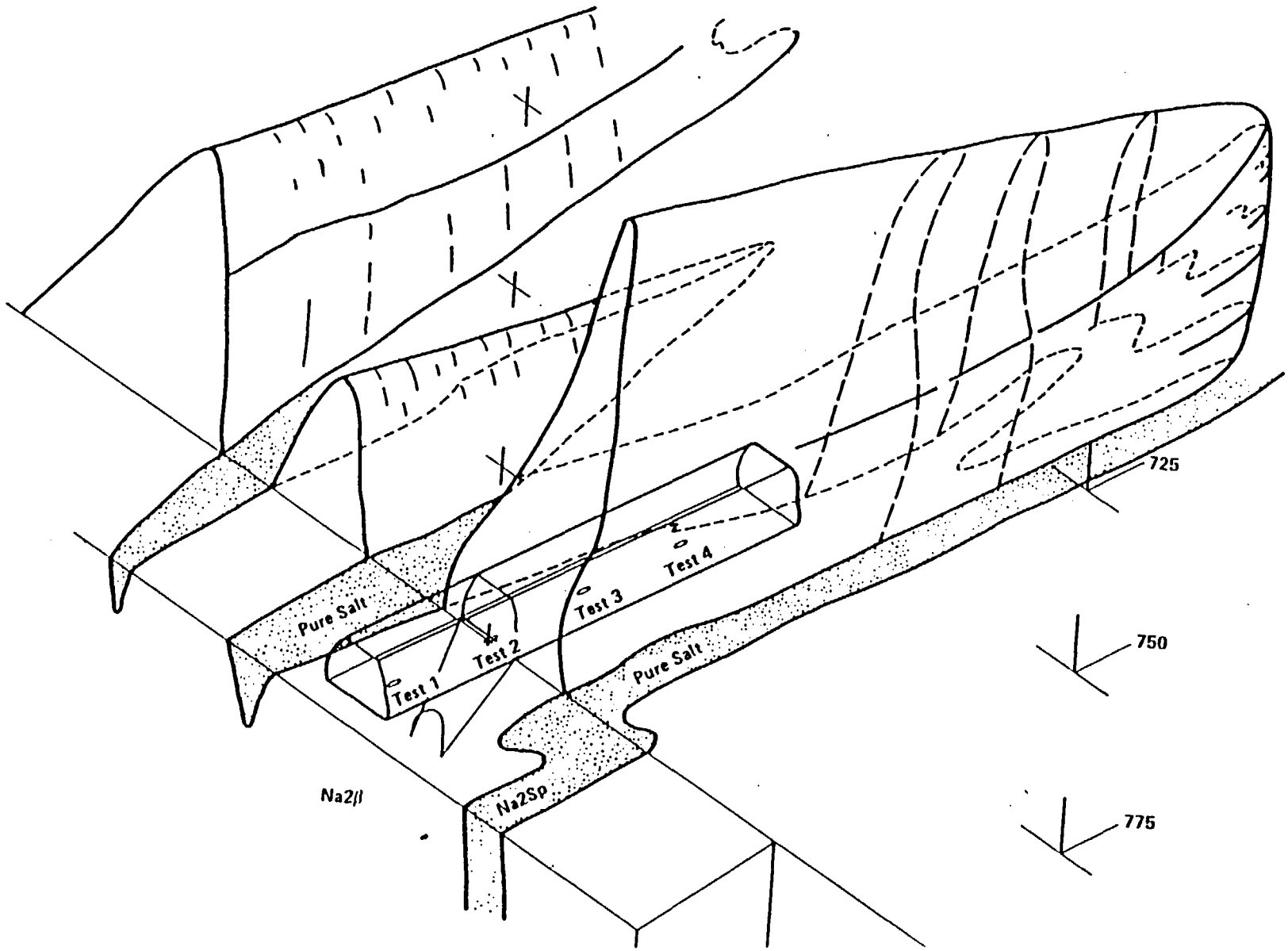
TESTING

IN-SITU ROCK MECHANICS TESTING	LOCATION
HYDROFRACTURING	GD-1 HOLE, UTAH
HYDROFRACTURING	HOLTZCLAW #1 HOLE, TEXAS
DOWNHOLE GEOPHYSICAL	
GEOPHYSICAL LOGGING	GD-1, UTAH
GEOPHYSICAL LOGGING	MRIG-9, RICHTON
GEOPHYSICAL LOGGING	MANSFIELD #1 DETTEN #1 G. FRIEMEL #1 J. FRIEMEL #1 ZEECK #1 HARMAN #1 HOLTZCLAW #1 SAWYER #1

HRH: 8/20/84

ONWI

BATTELLE Project Management Division


Pure Salt
Test 1
Test 2
Test 3
Test 4
Pure Salt
Na2SP
Na2β
725
750
775

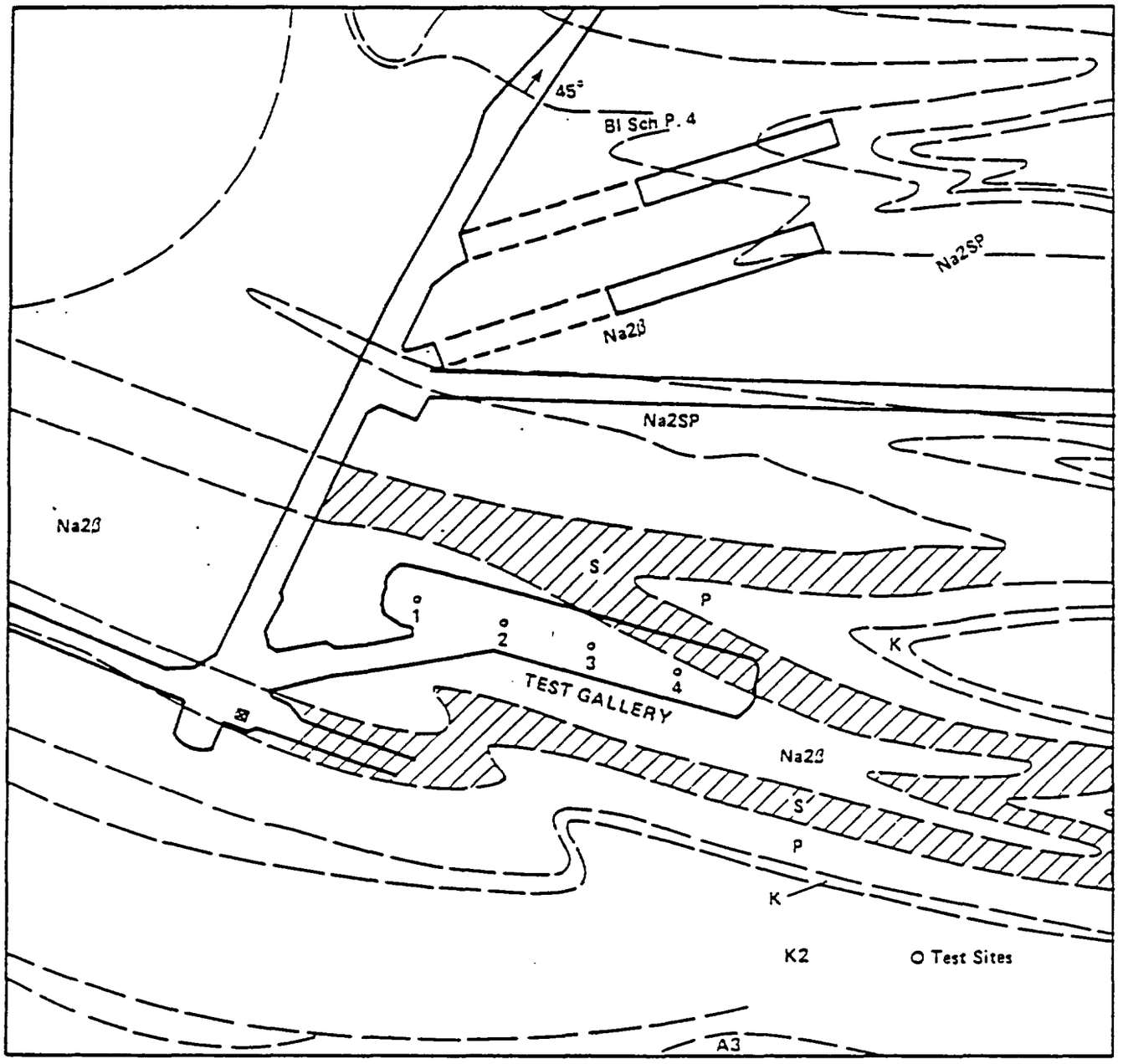


FIGURE 2-1. LOCATION OF 800 m BRINE MIGRATION TEST GALLERY AT ASSE MINE, HORIZONTAL GEOLOGICAL SECTION

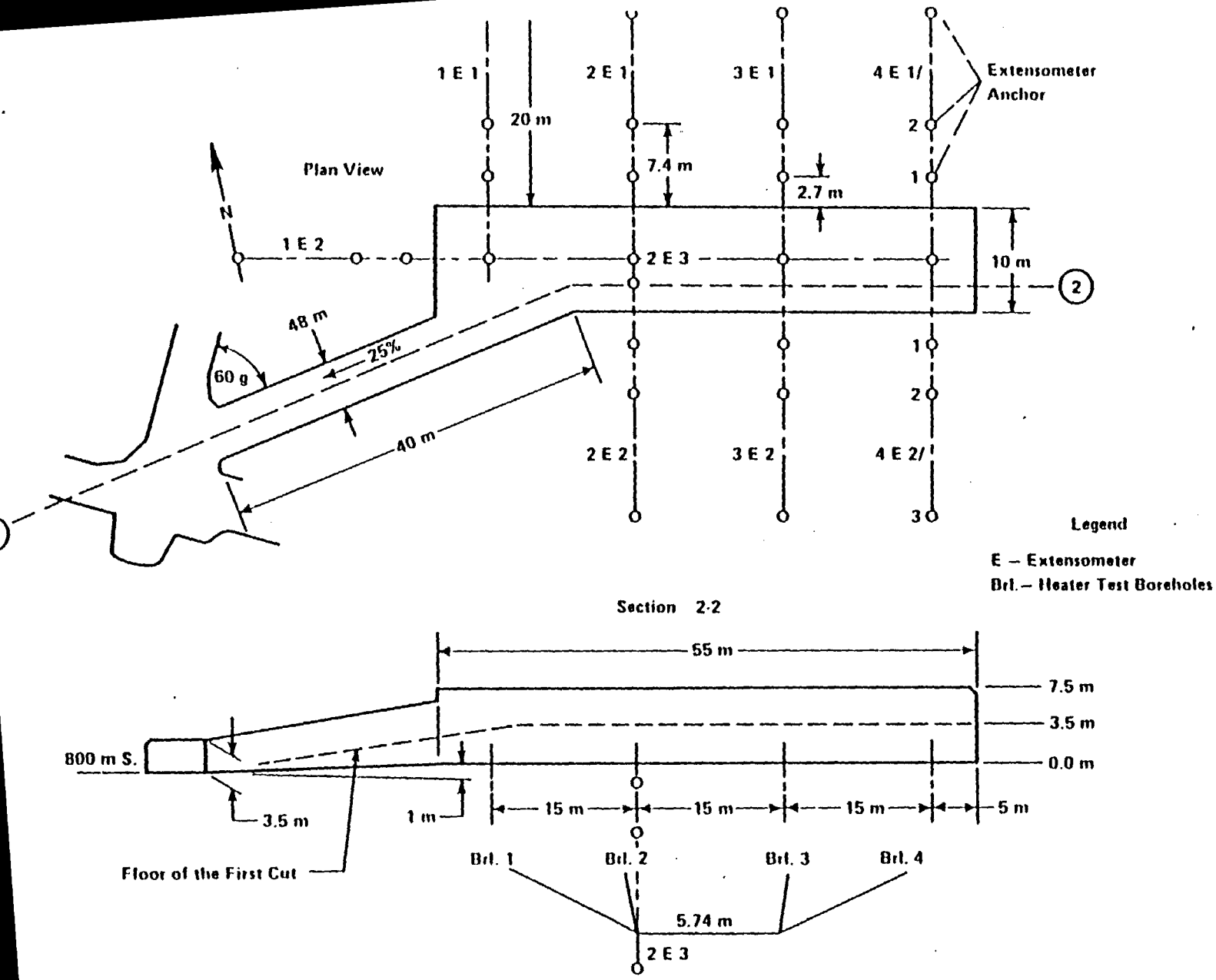


FIGURE 2-5. TEST SITE INSTRUMENTATION

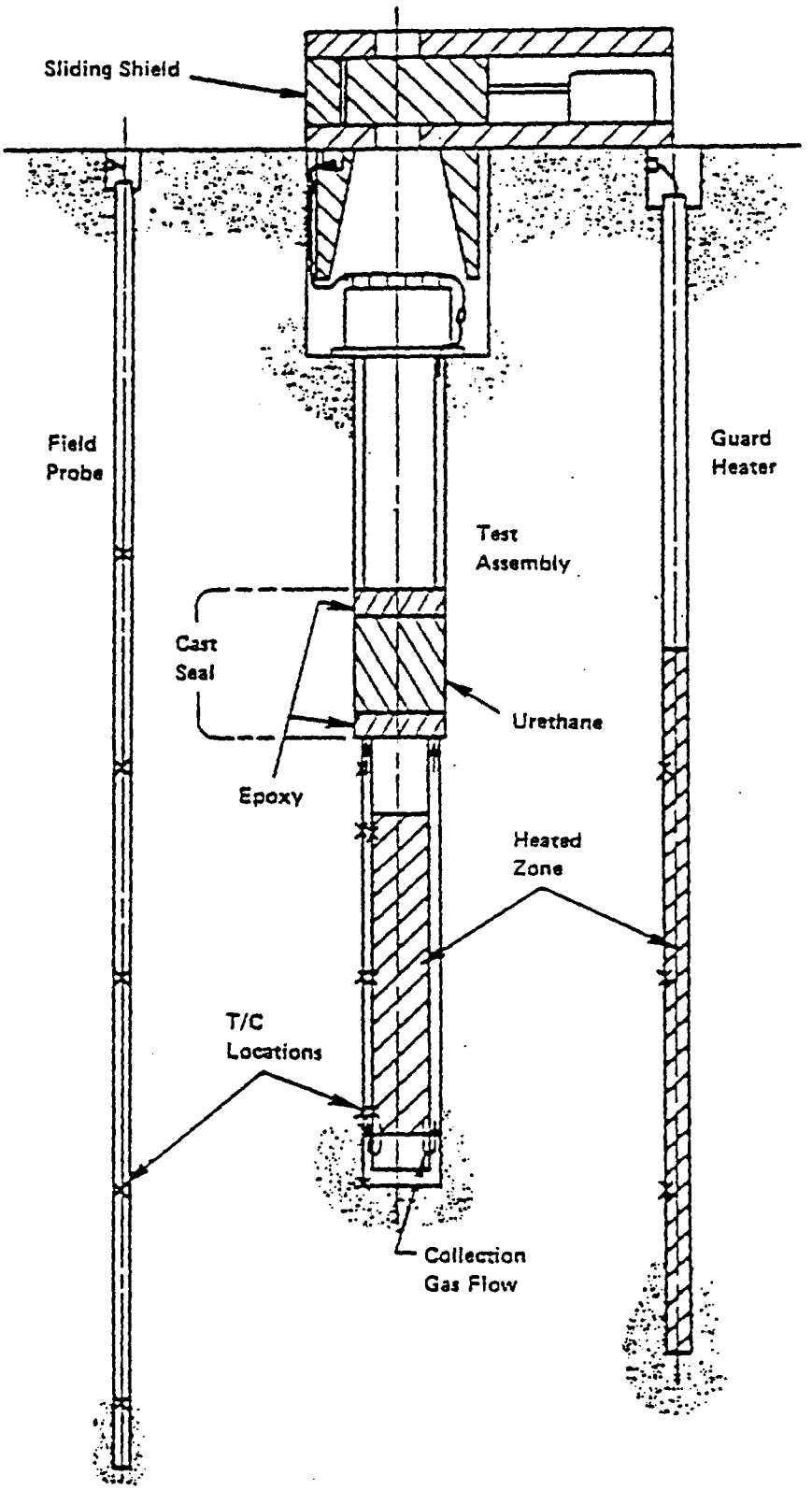


FIGURE 2-4. TEST SITE CROSS SECTI

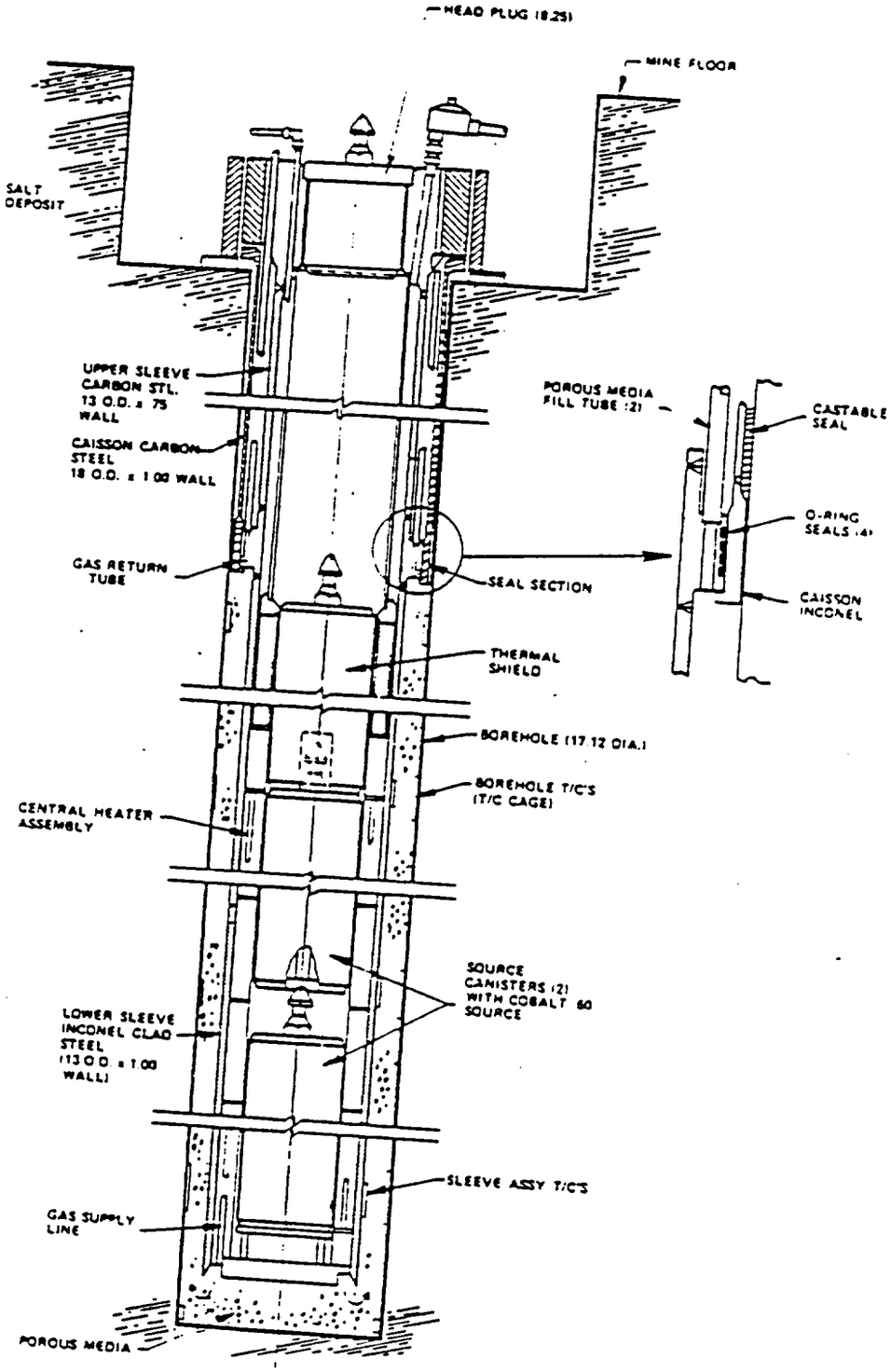


FIGURE 2-10. VERTICAL SECTION THROUGH CENTRAL BOREHOLE AND TEST ASSEMBLY

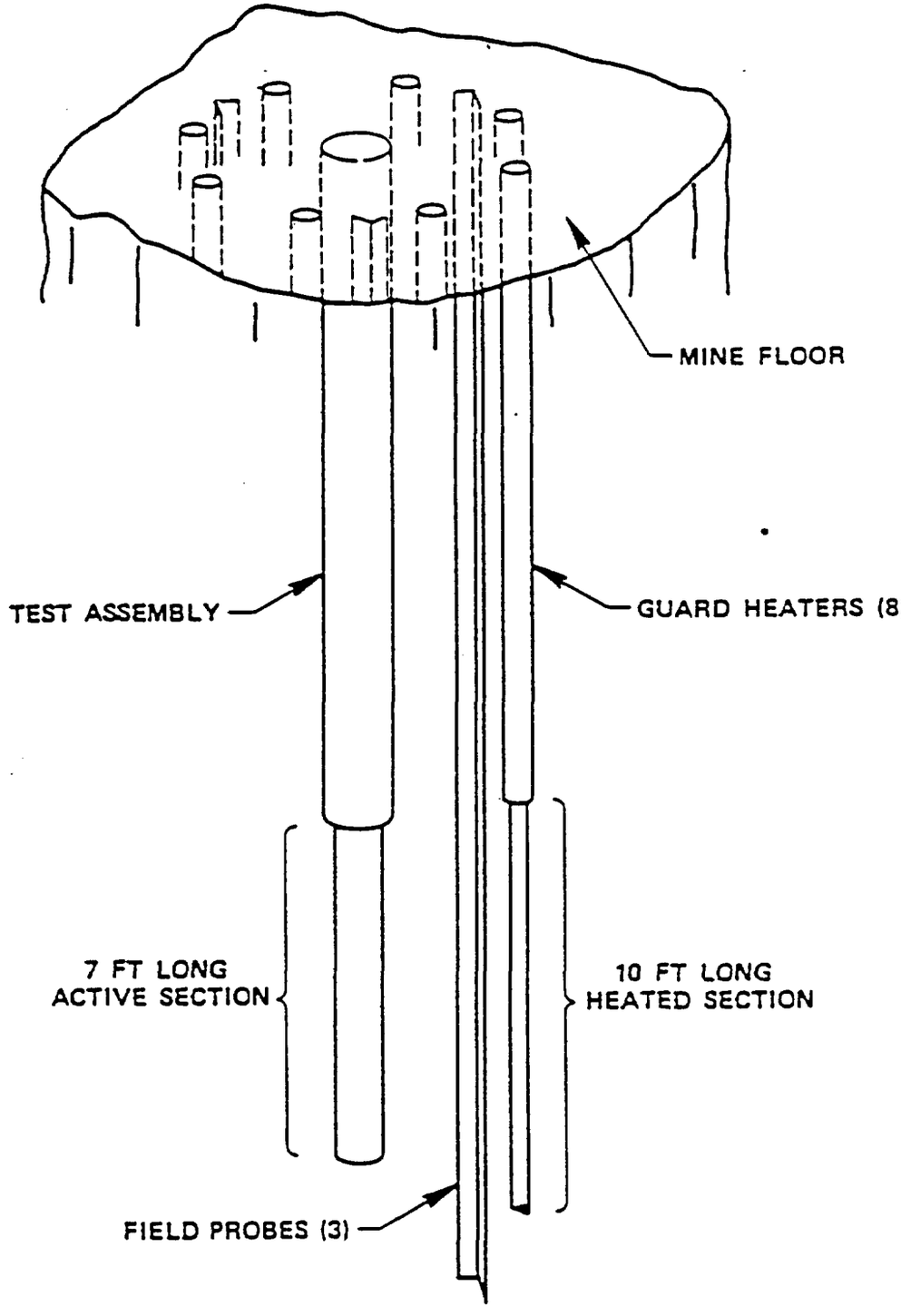
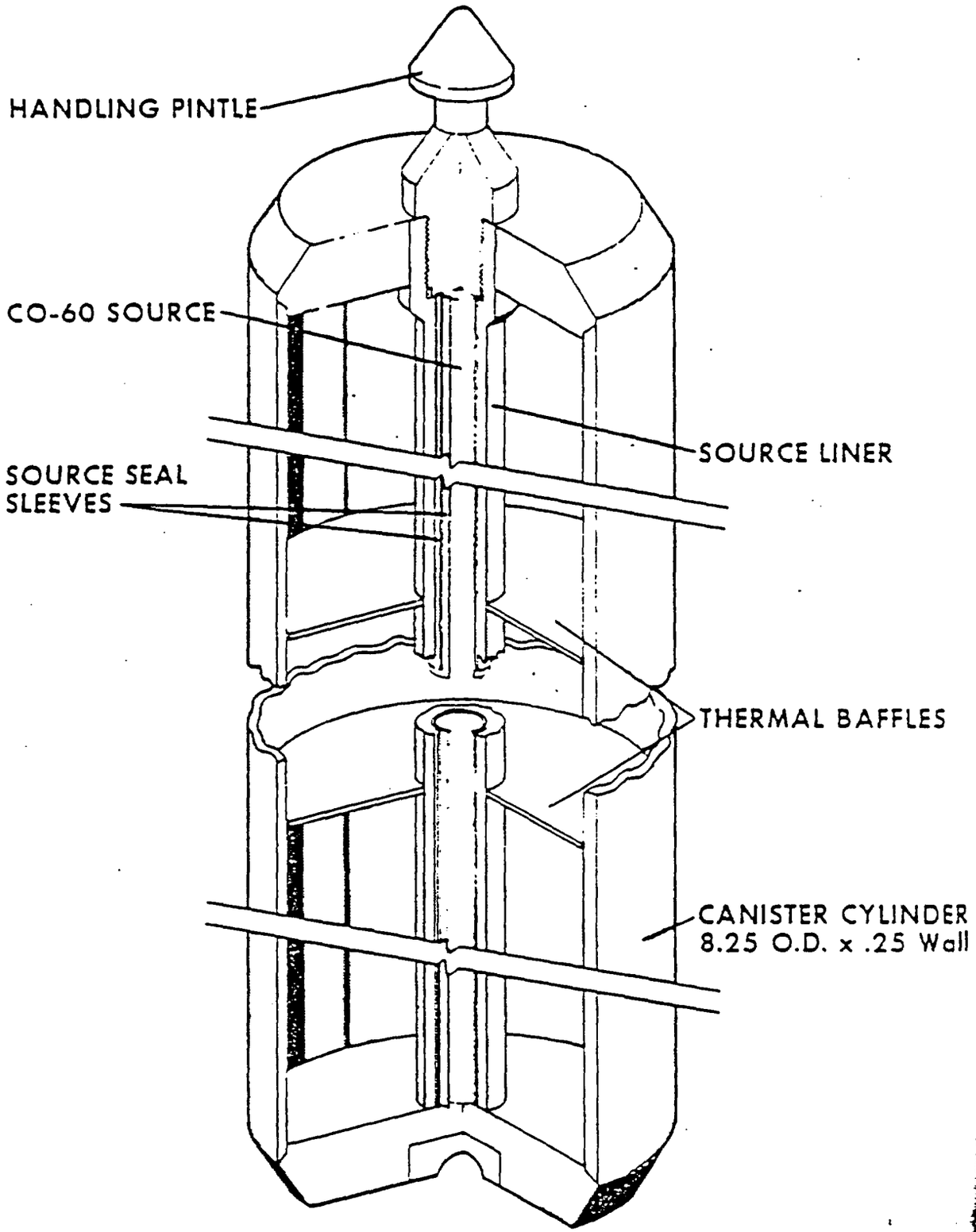


FIGURE 2-11. TEST SITE OVERVIEW SCHEMATIC


HANDLING PINTLE
CO-60 SOURCE
SOURCE LINER
SOURCE SEAL
SLEEVES
THERMAL BAFFLES
CANISTER CYLINDER
8.25 O.D. x .25 Wall

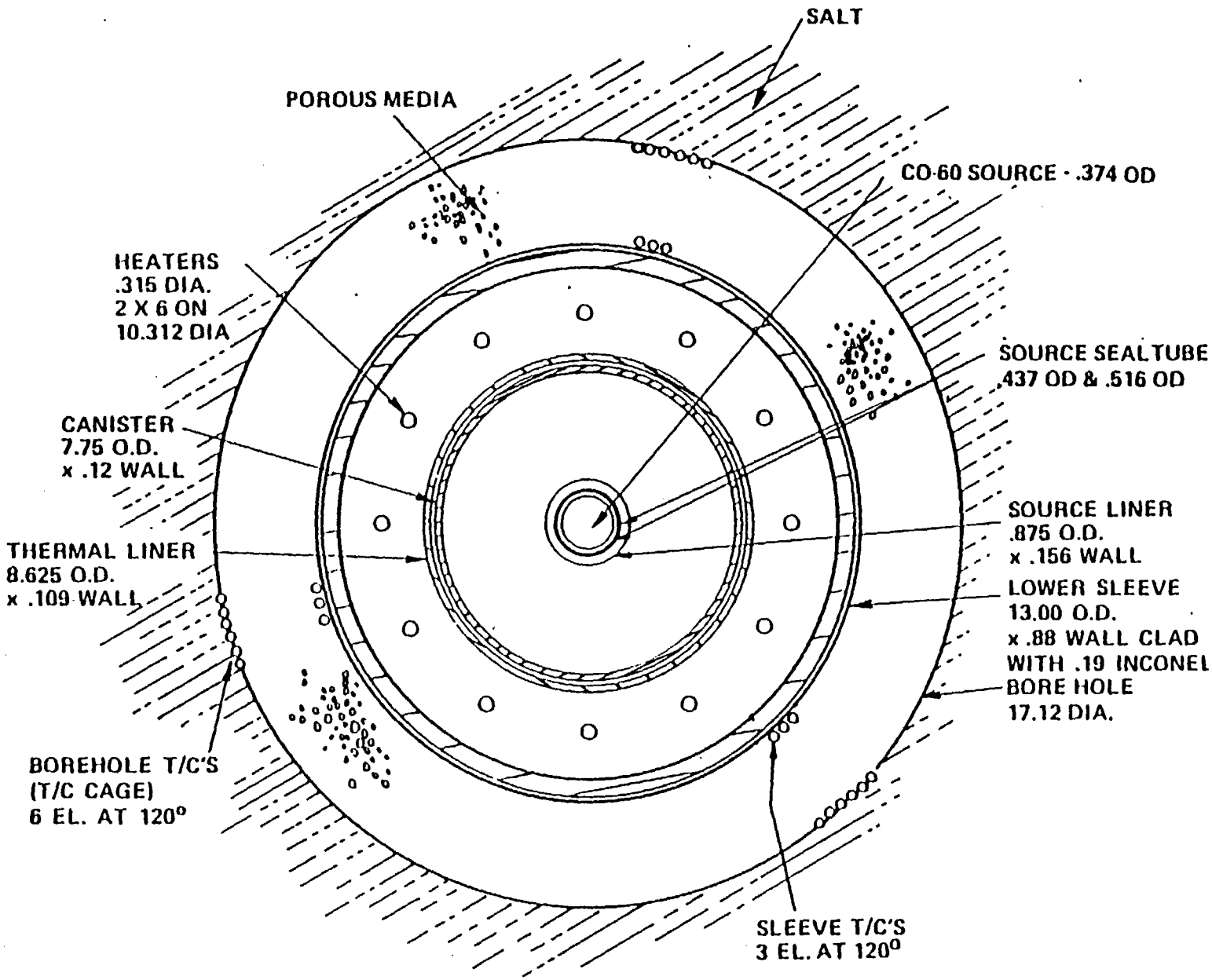


FIGURE 2-13. HORIZONTAL SECTION THROUGH TEST ASSEMBLY AND CENTRAL BOREHOLE NEAR HEATER MIDHEIGHT

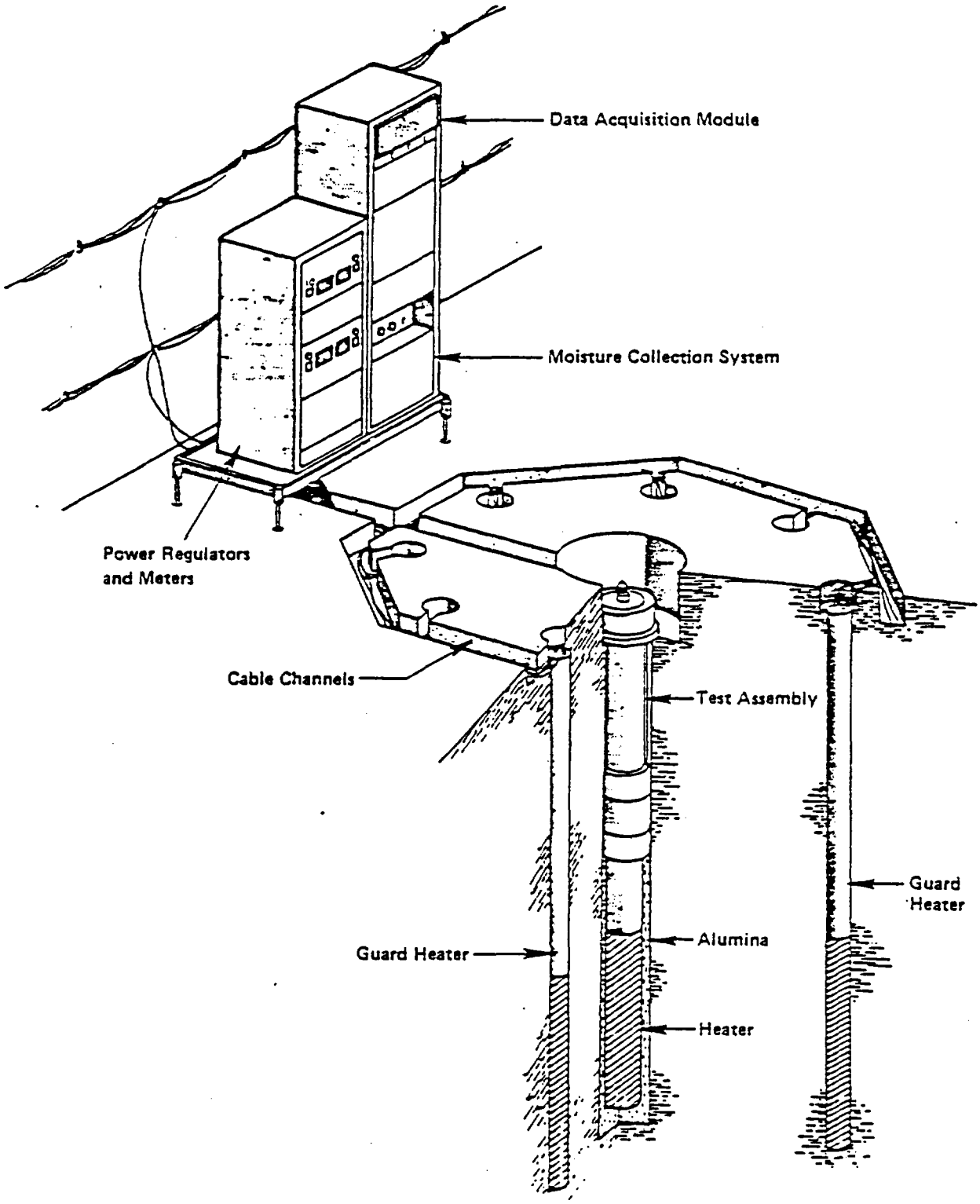


FIGURE 2-9. TYPICAL TEST SITE

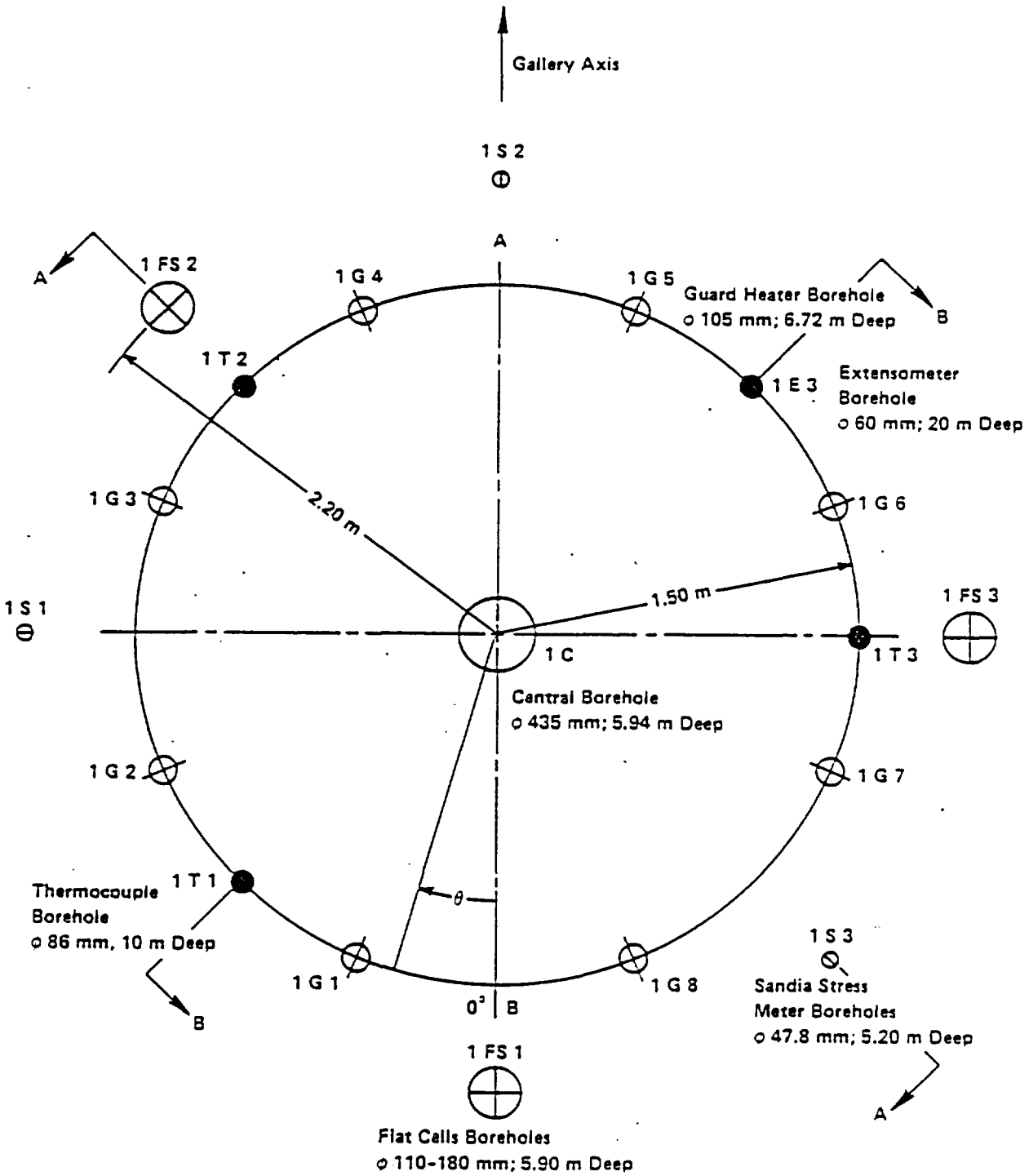


FIGURE 2-6. TEST SITE OVERVIEW OF THE BRINE MIGRATION TEST

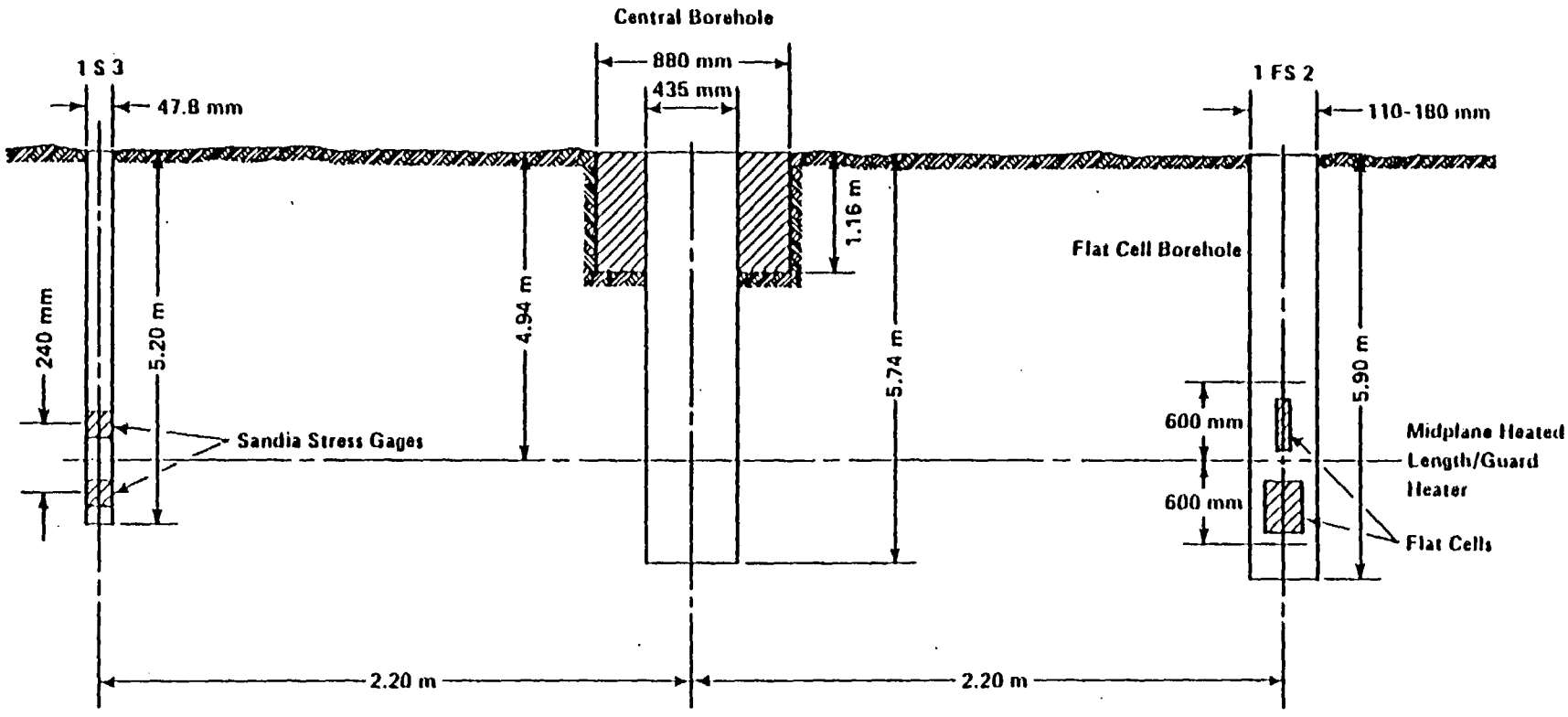


FIGURE 2-7. SECTION ACROSS BOREHOLE TEST FIELD AA

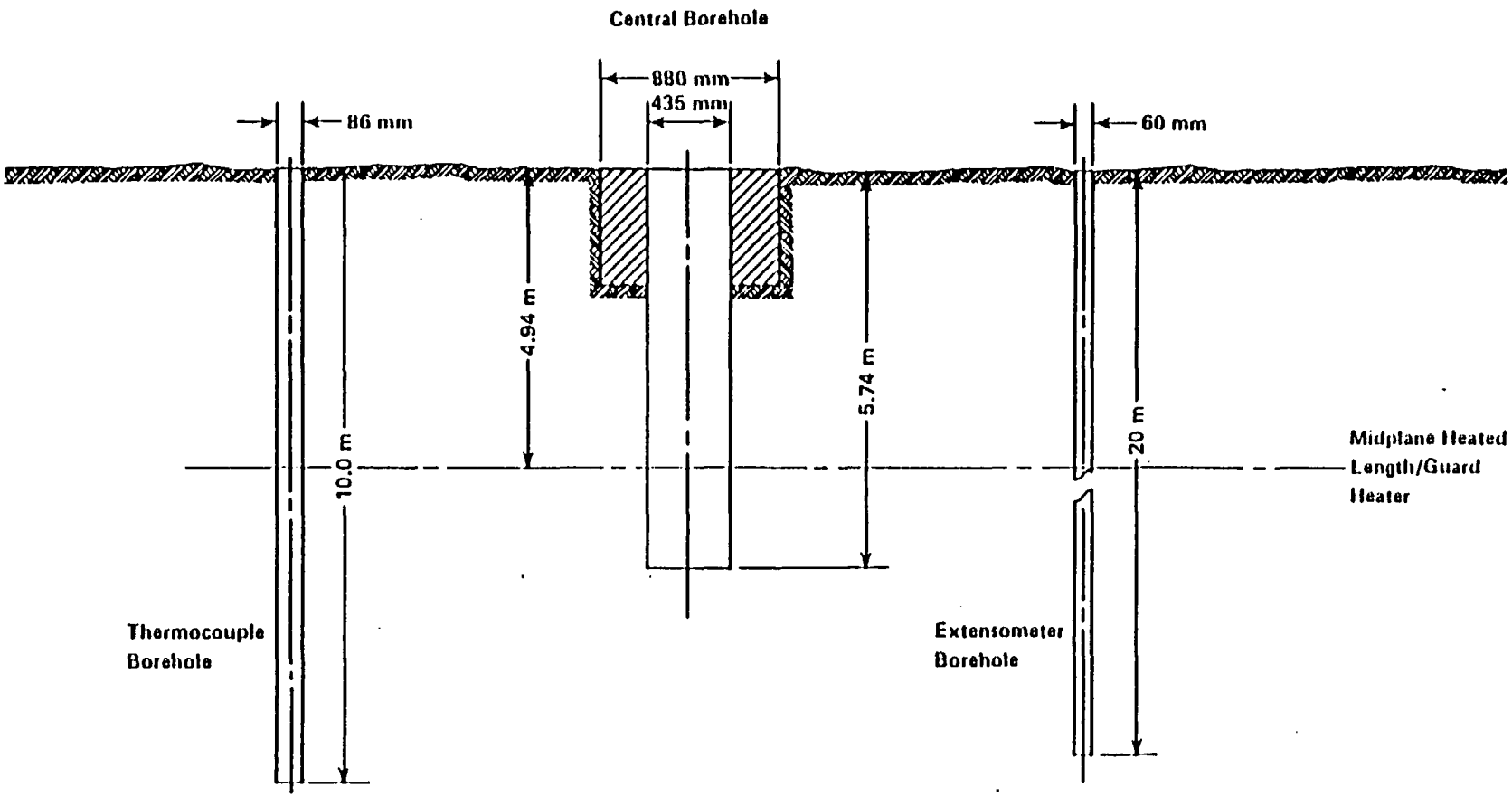


FIGURE 2-8. SECTION ACROSS BOREHOLE TEST FIELD BB

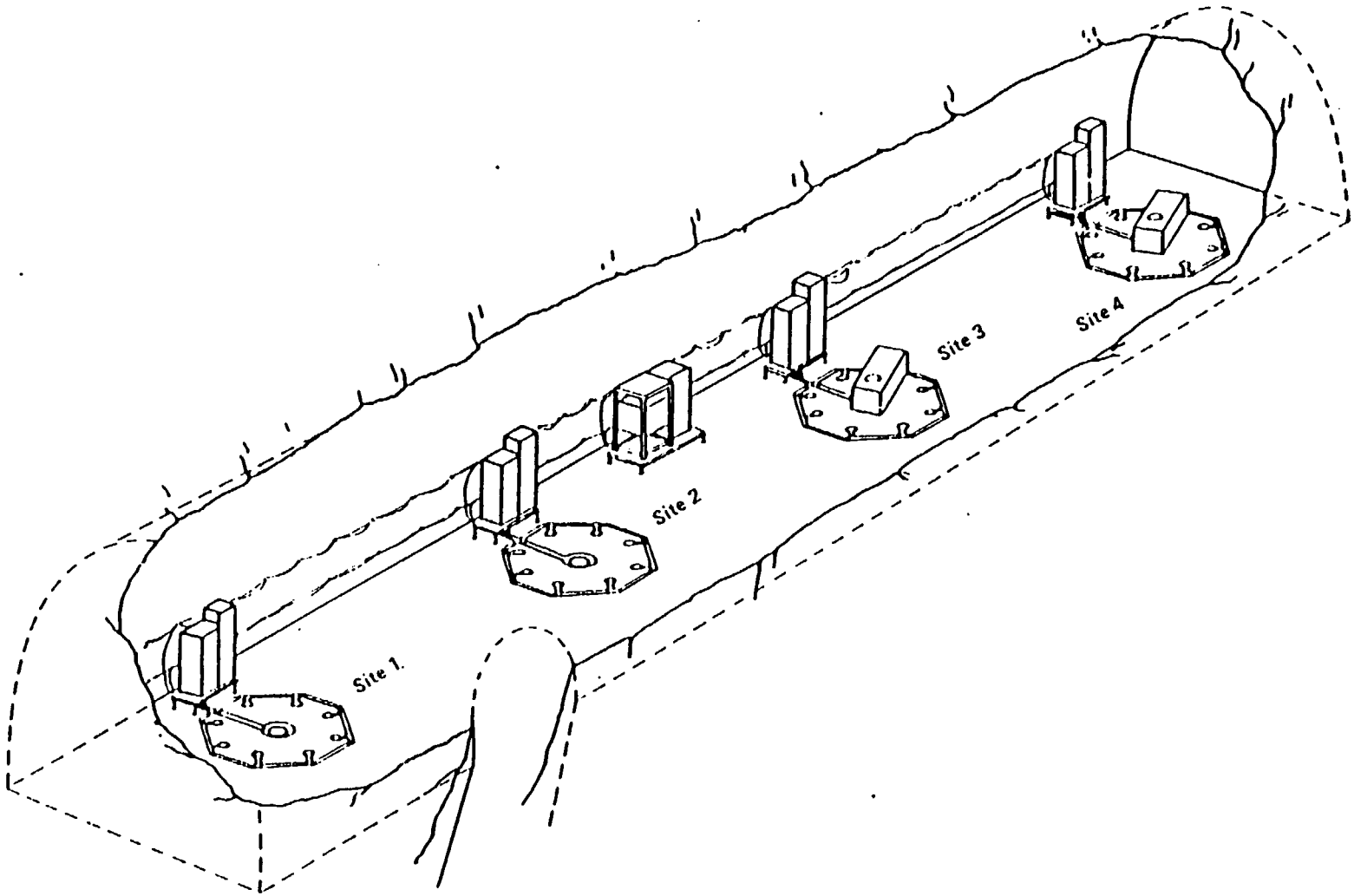
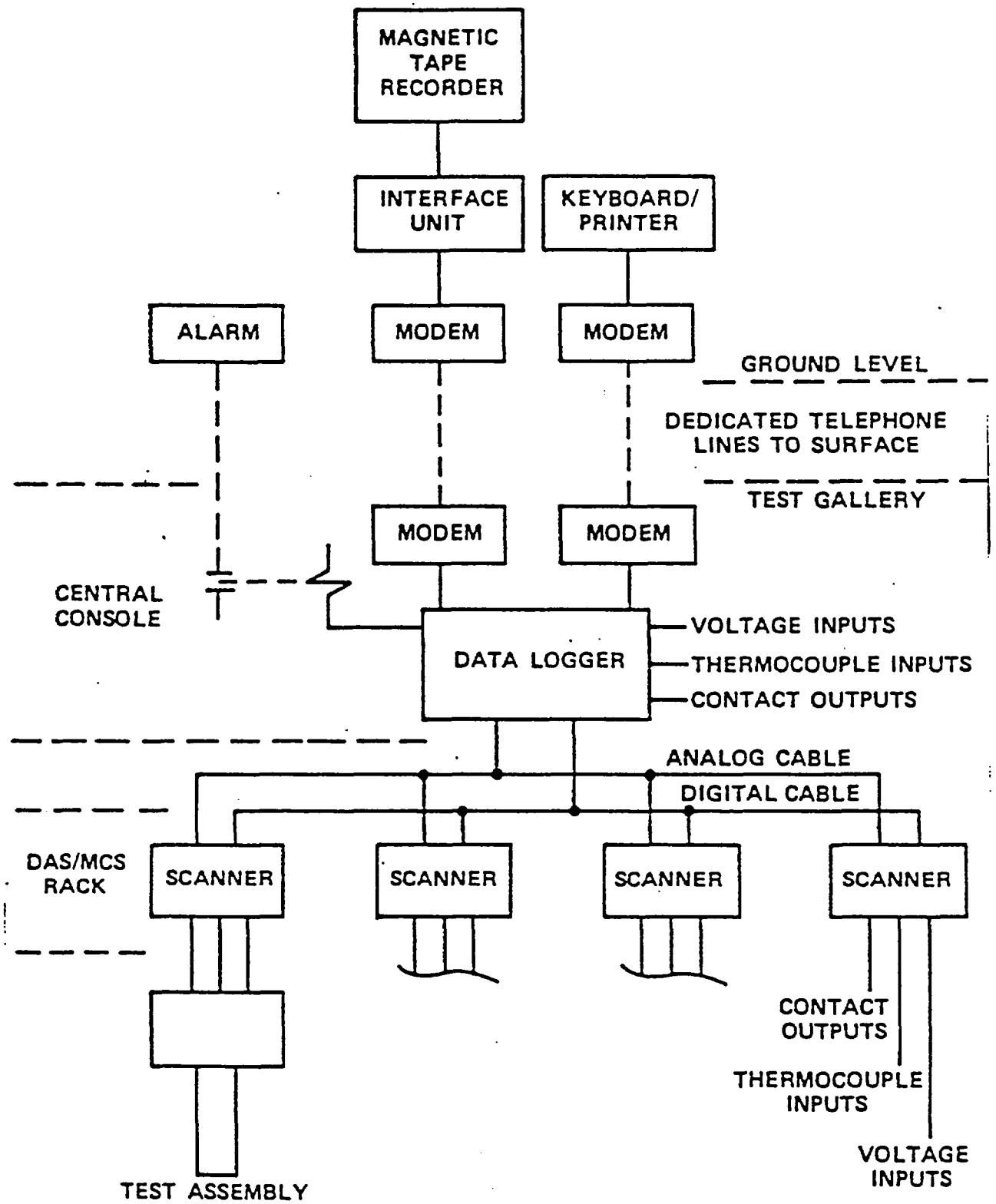
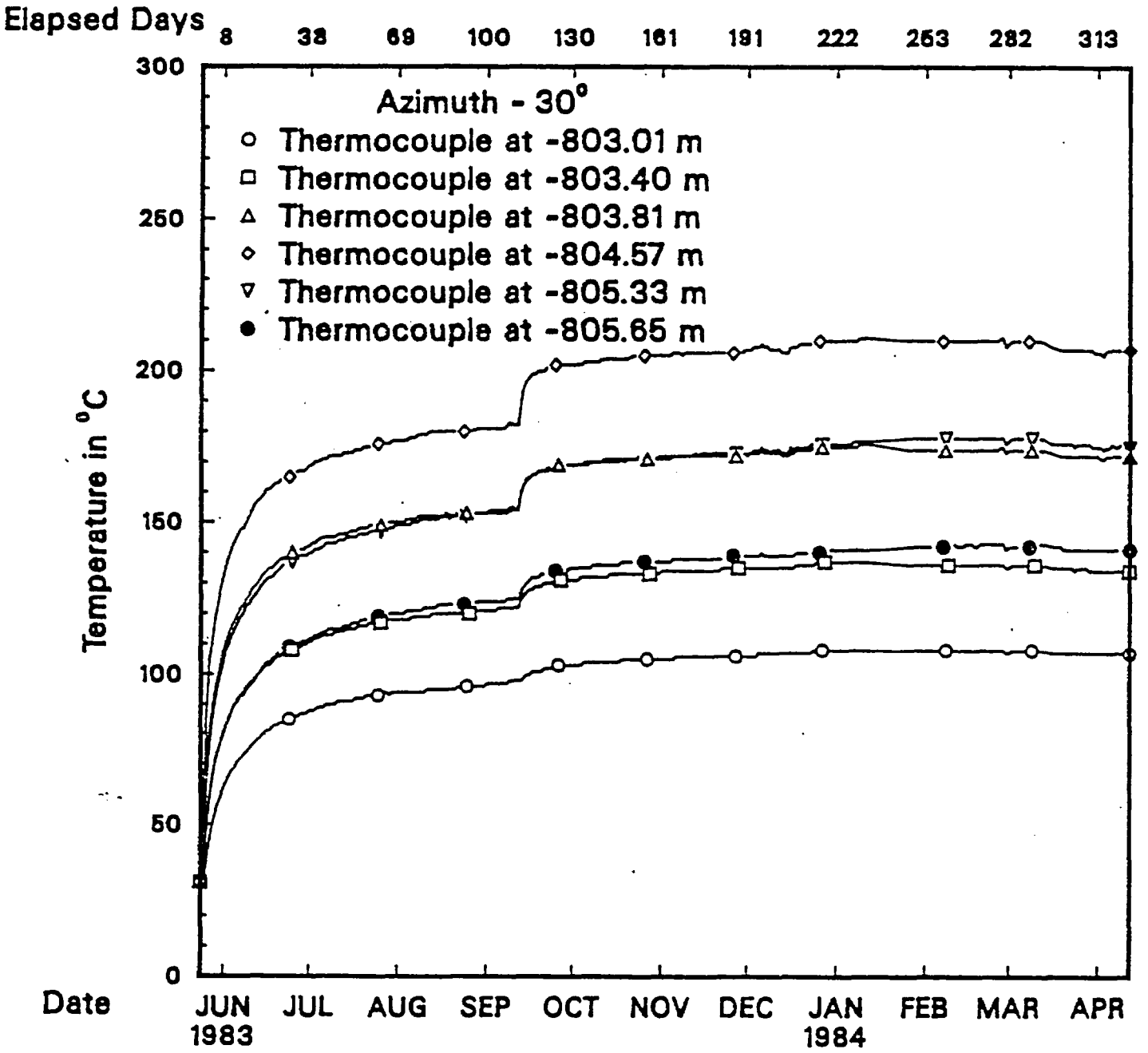
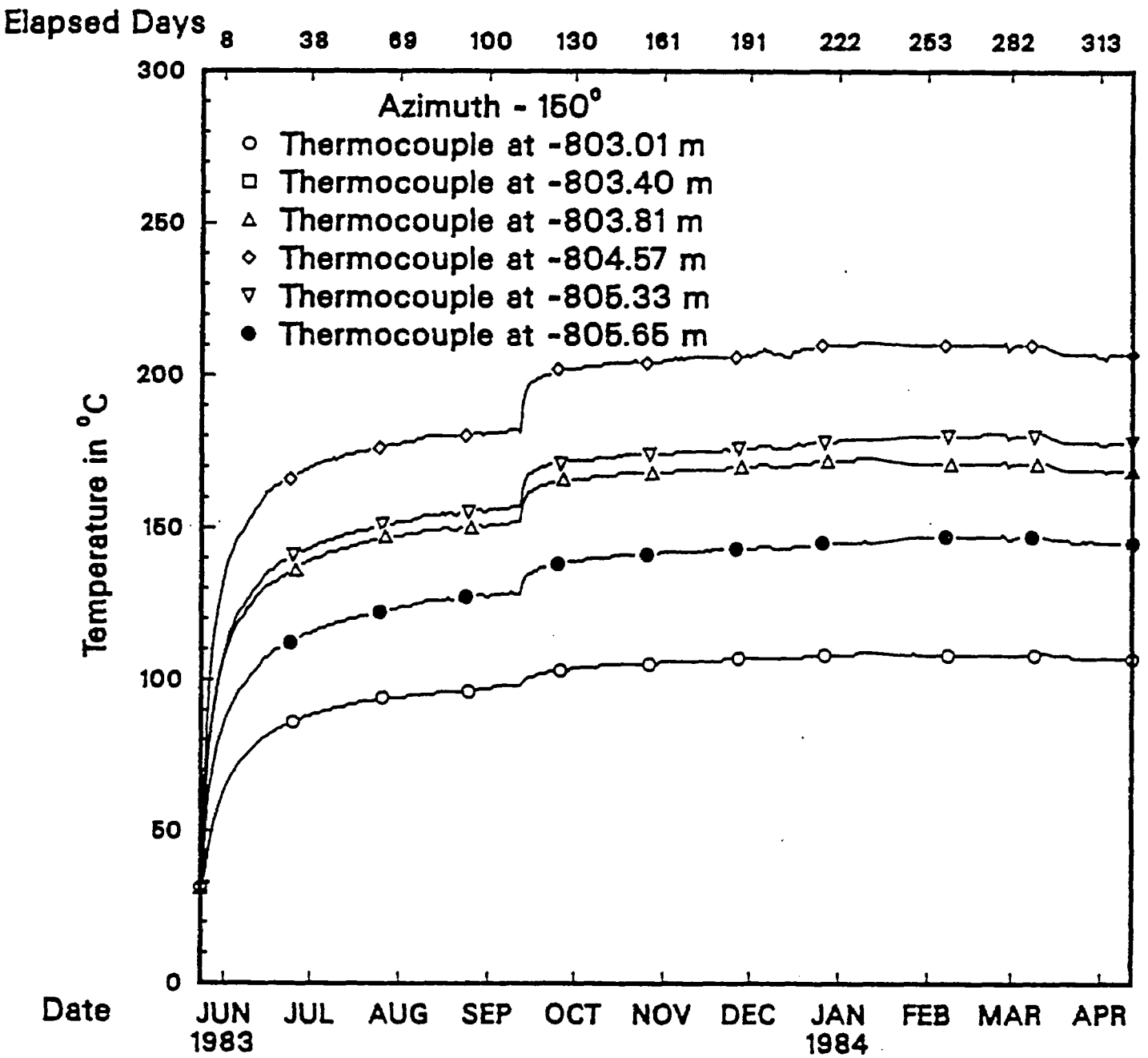


FIGURE 2-3. ASSE TEST GALLERY

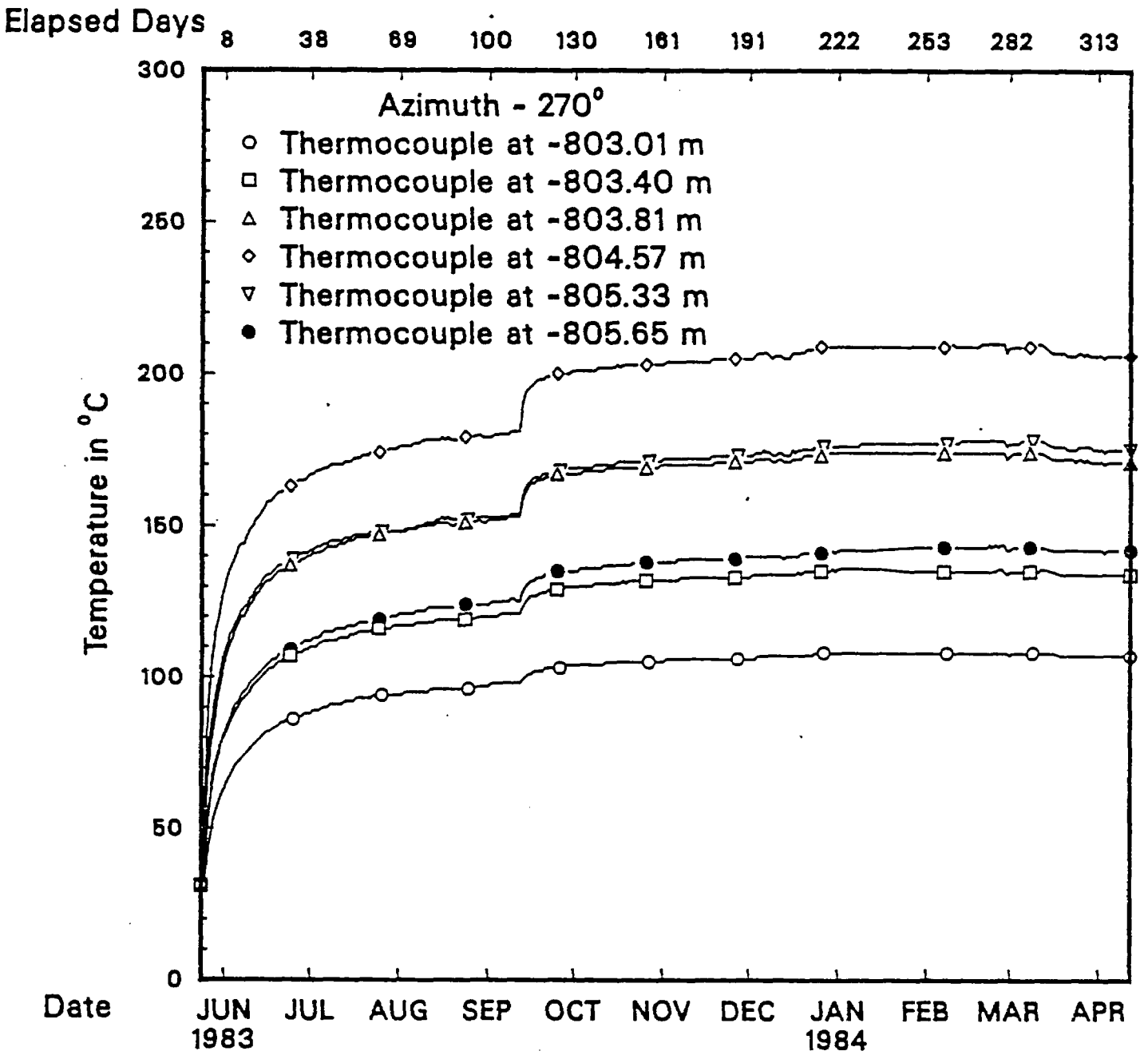

MAGNETIC TAPE RECORDER
INTERFACE UNIT
KEYBOARD/ PRINTER
ALARM
MODEM
MODEM
GROUND LEVEL
DEDICATED TELEPHONE LINES TO SURFACE
TEST GALLERY
MODEM
MODEM
CENTRAL CONSOLE
DATA LOGGER
VOLTAGE INPUTS
THERMOCOUPLE INPUTS
CONTACT OUTPUTS
ANALOG CABLE
DIGITAL CABLE
DAS/MCS RACK
SCANNER
SCANNER
SCANNER
SCANNER
CONTACT OUTPUTS
THERMOCOUPLE INPUTS
VOLTAGE INPUTS
TEST ASSEMBLY



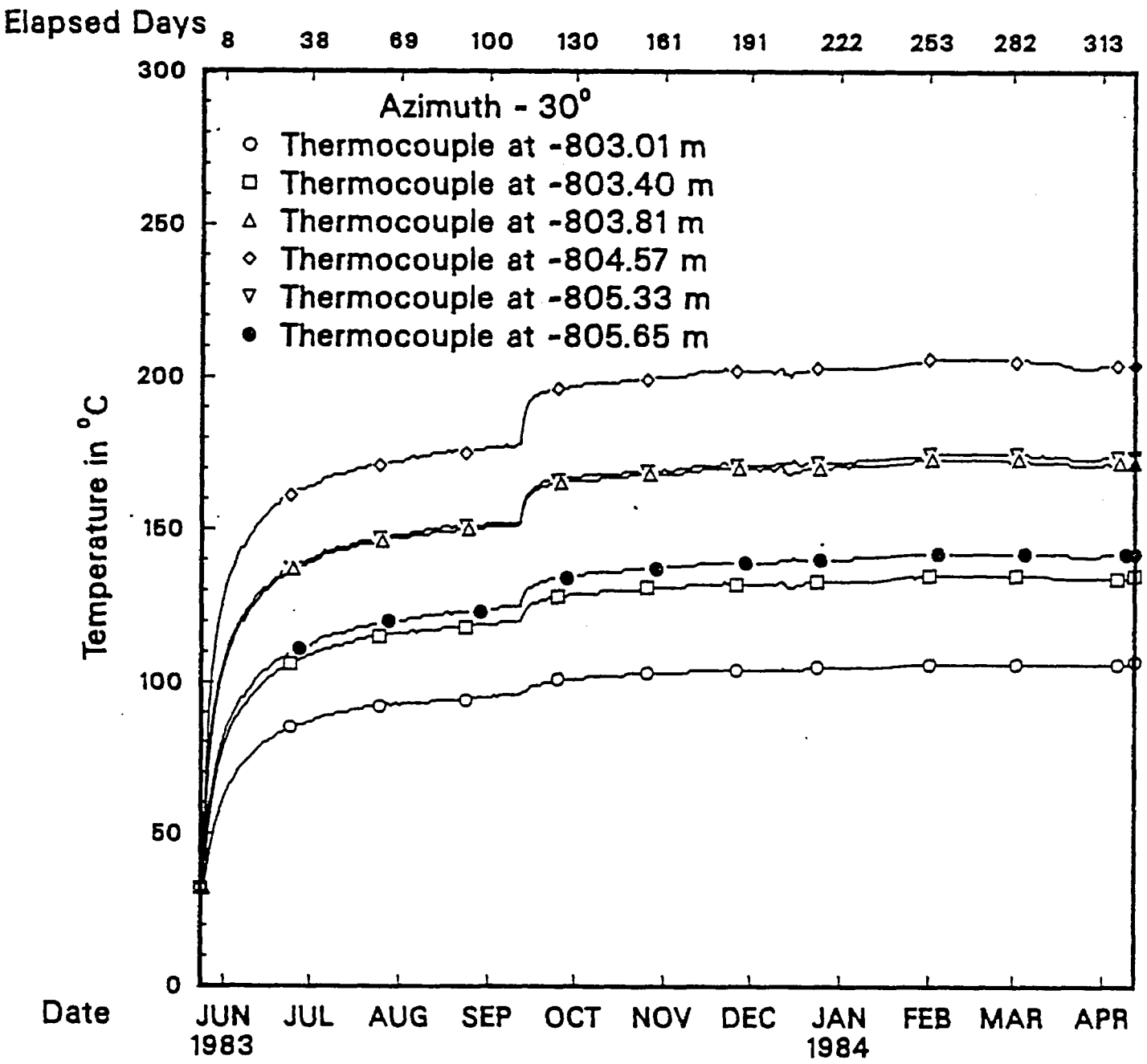
Borehole Salt Temperature vs. Time for Test #1



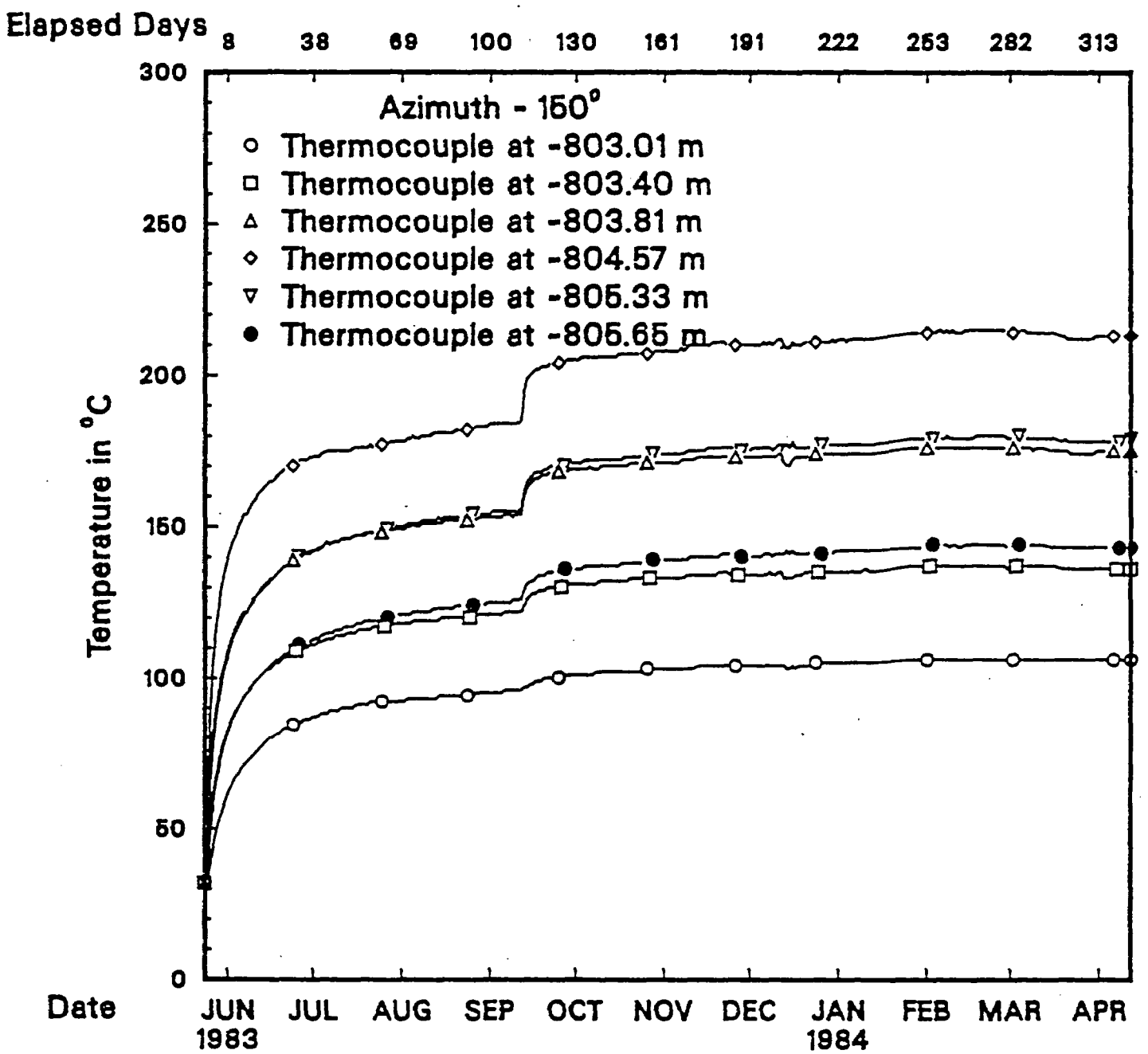
Borehole Salt Temperature vs. Time for Test #1



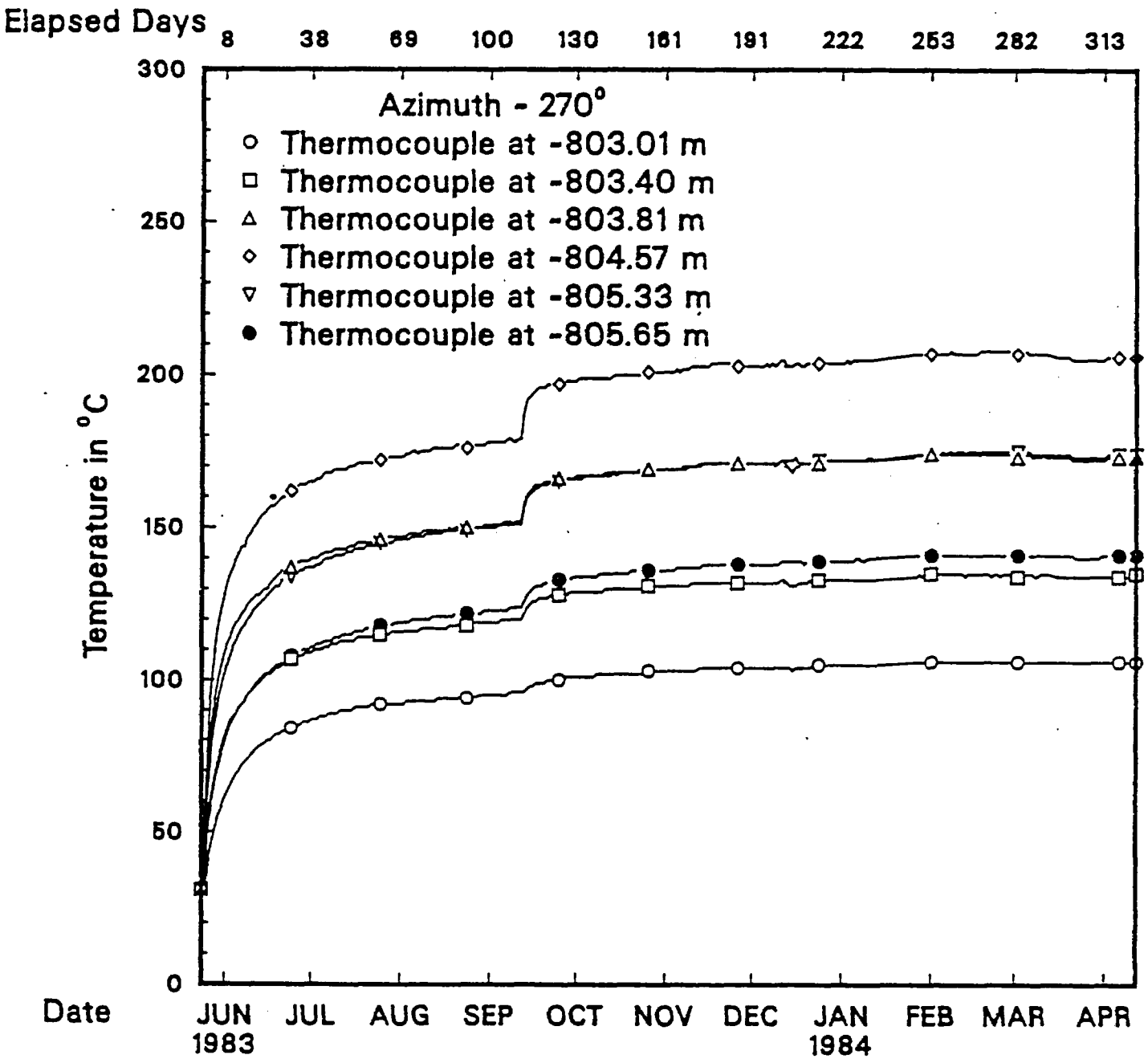
Borehole Salt Temperature vs. Time for Test #1



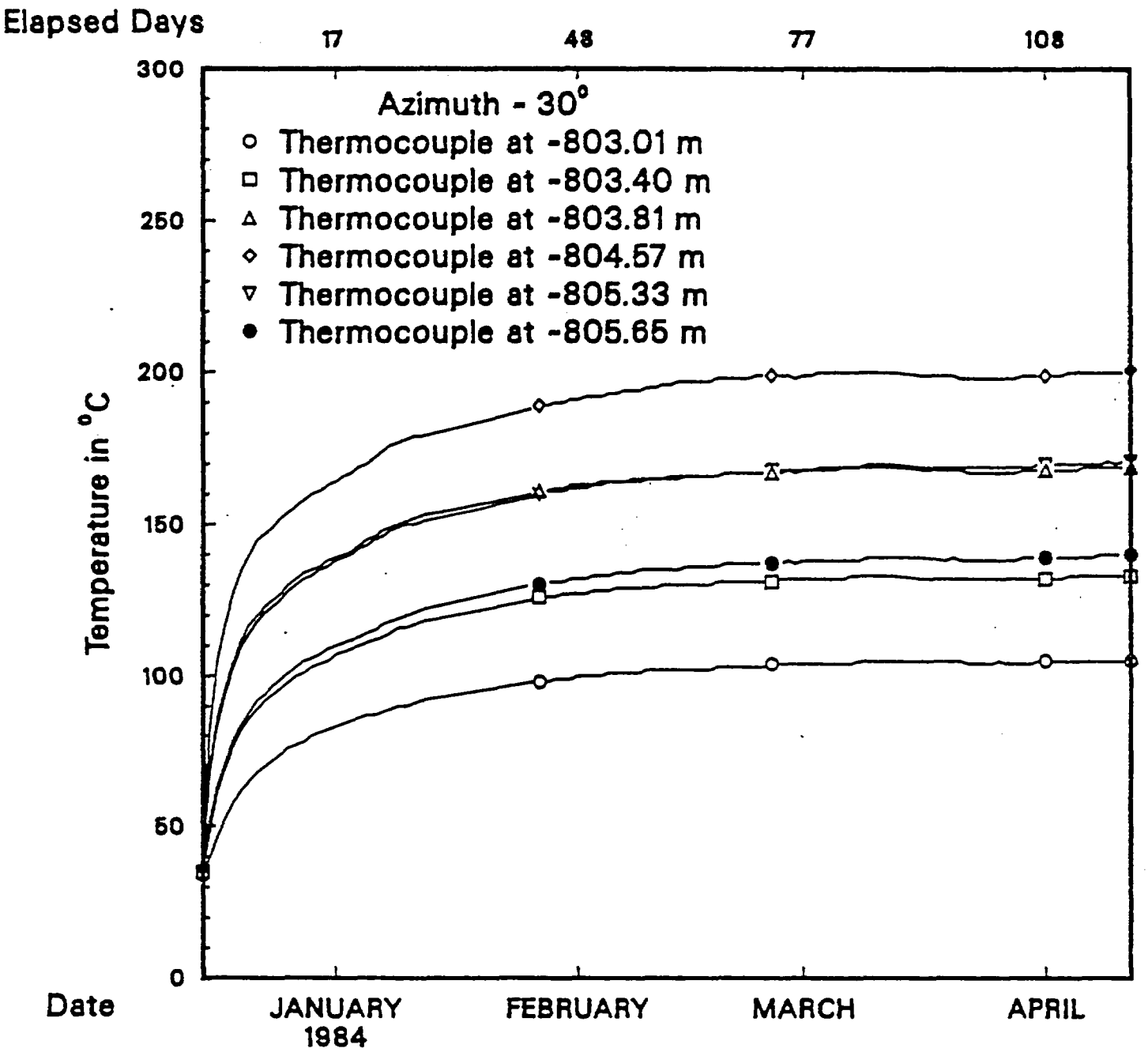
Borehole Salt Temperature vs. Time for Test #2



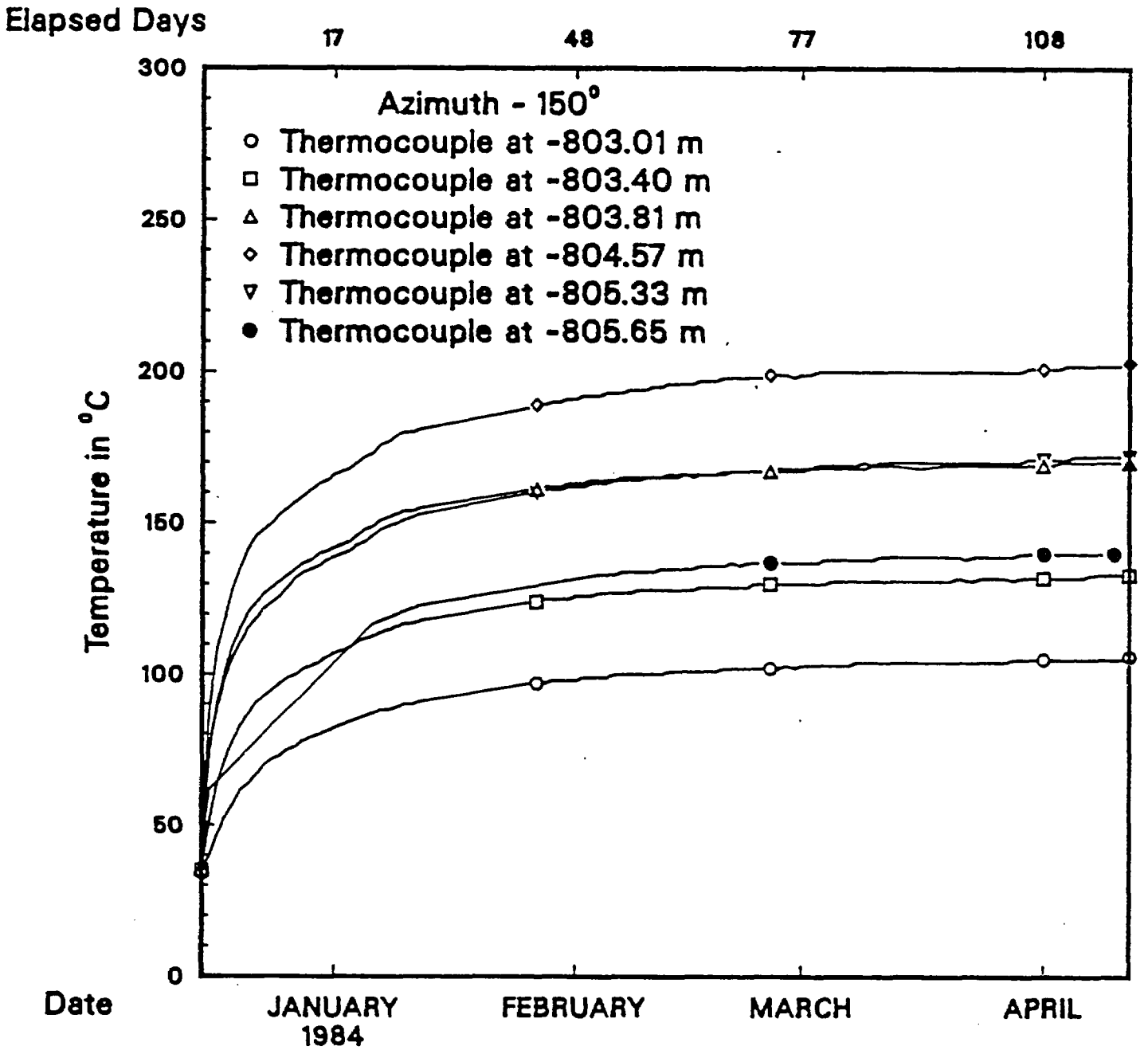
Borehole Salt Temperature vs. Time for Test #2



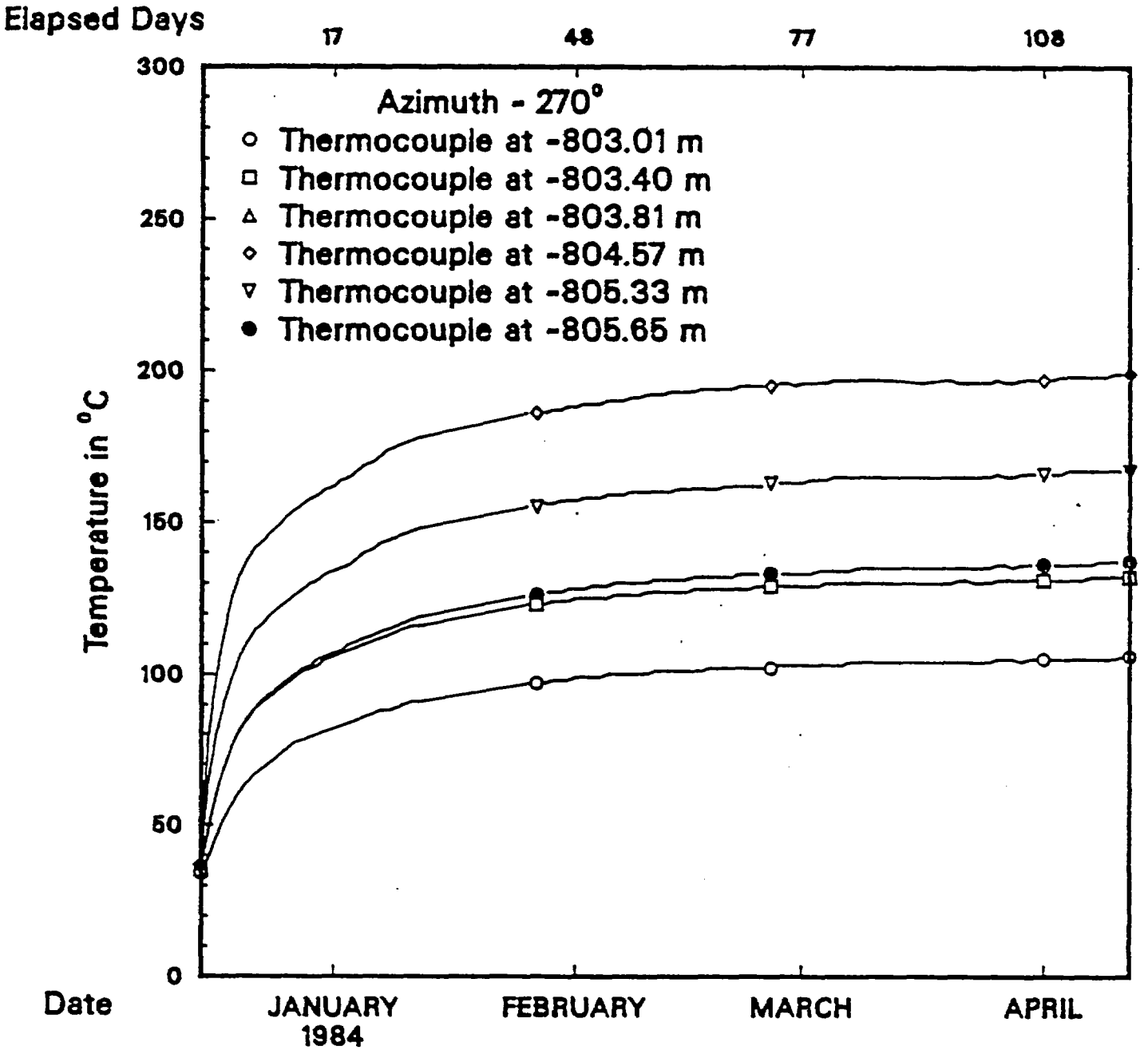
Borehole Salt Temperature vs. Time for Test #2



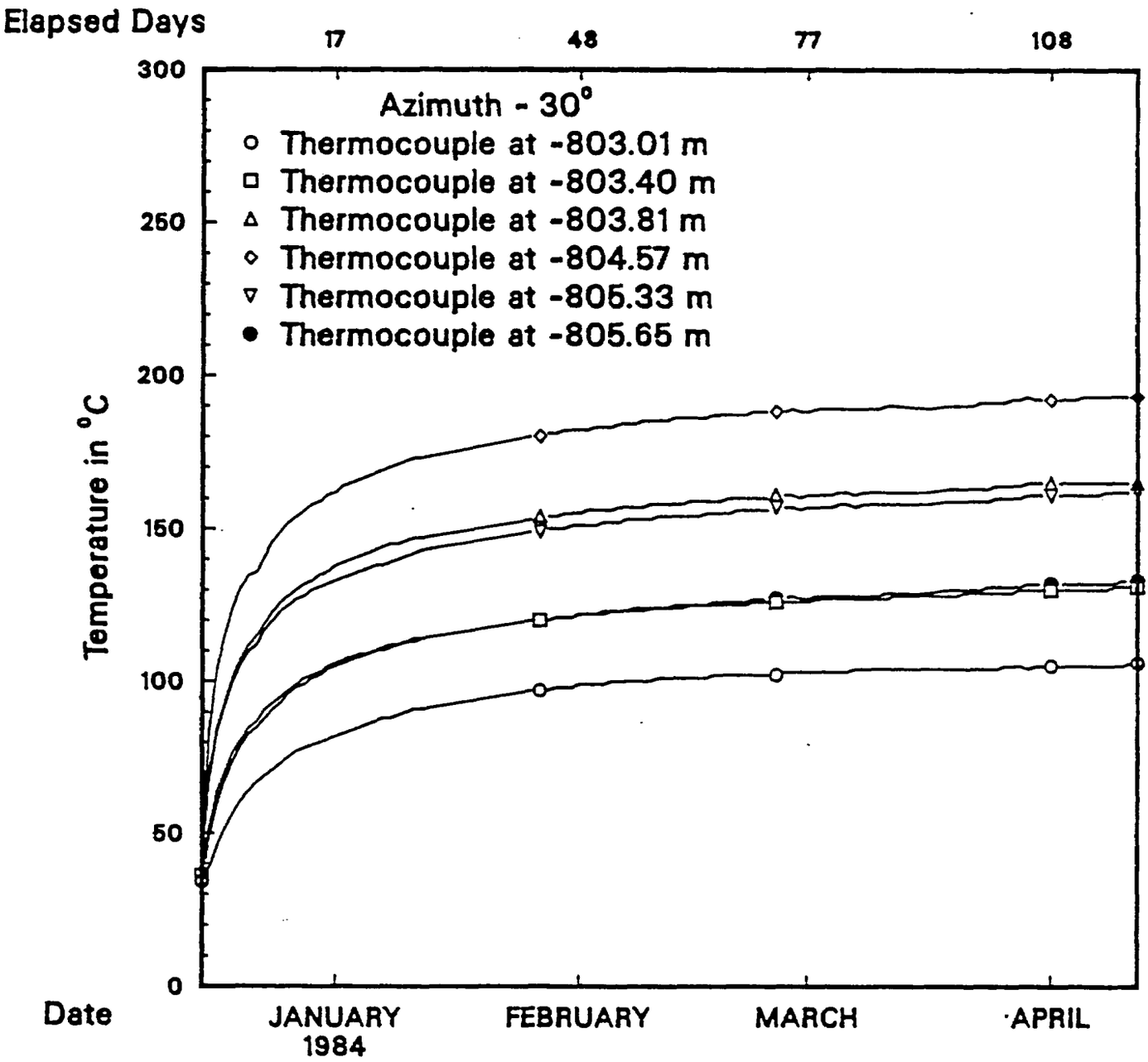
Borehole Salt Temperature vs. Time for Test #3



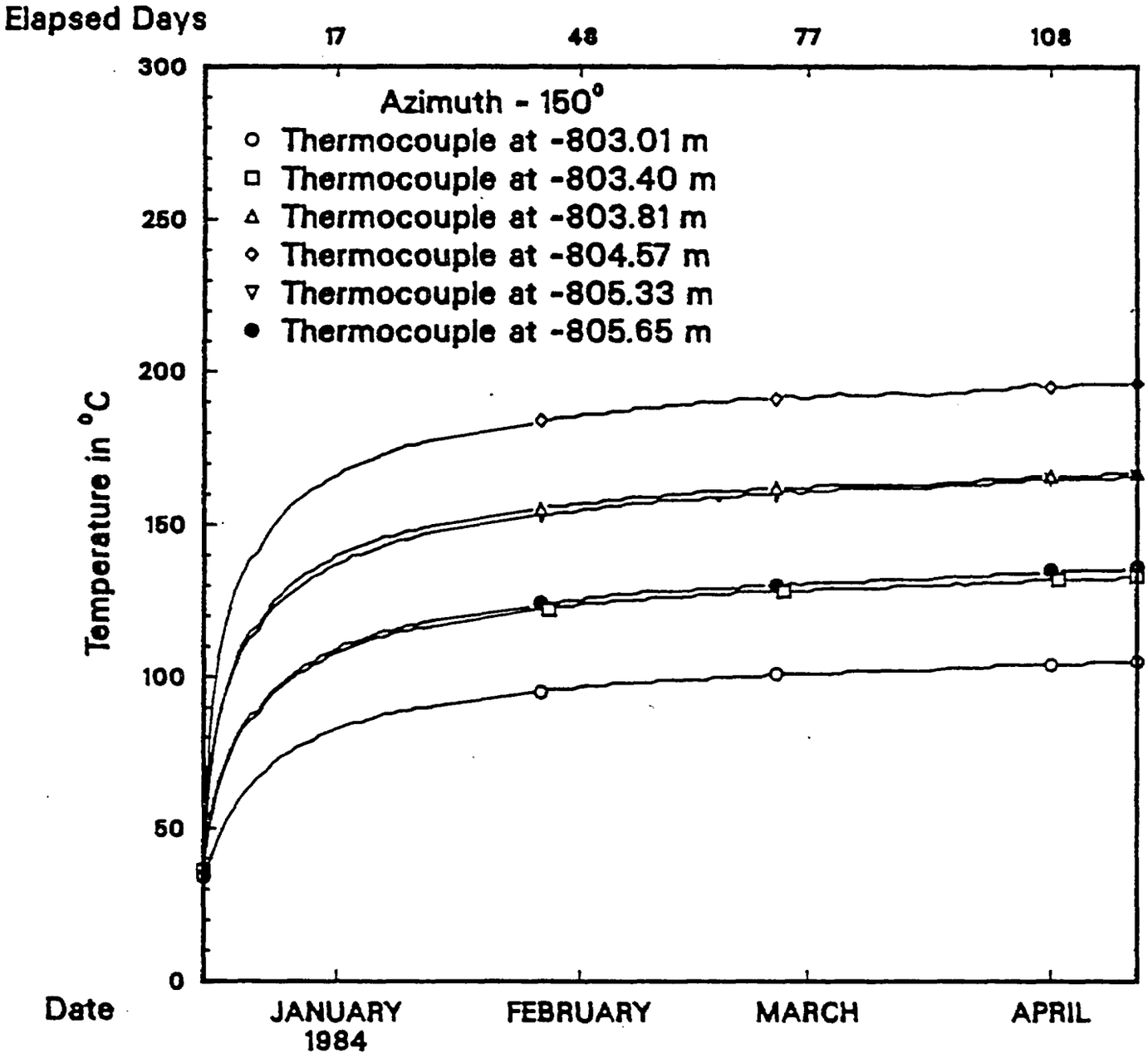
Borehole Salt Temperature vs. Time for Test #3



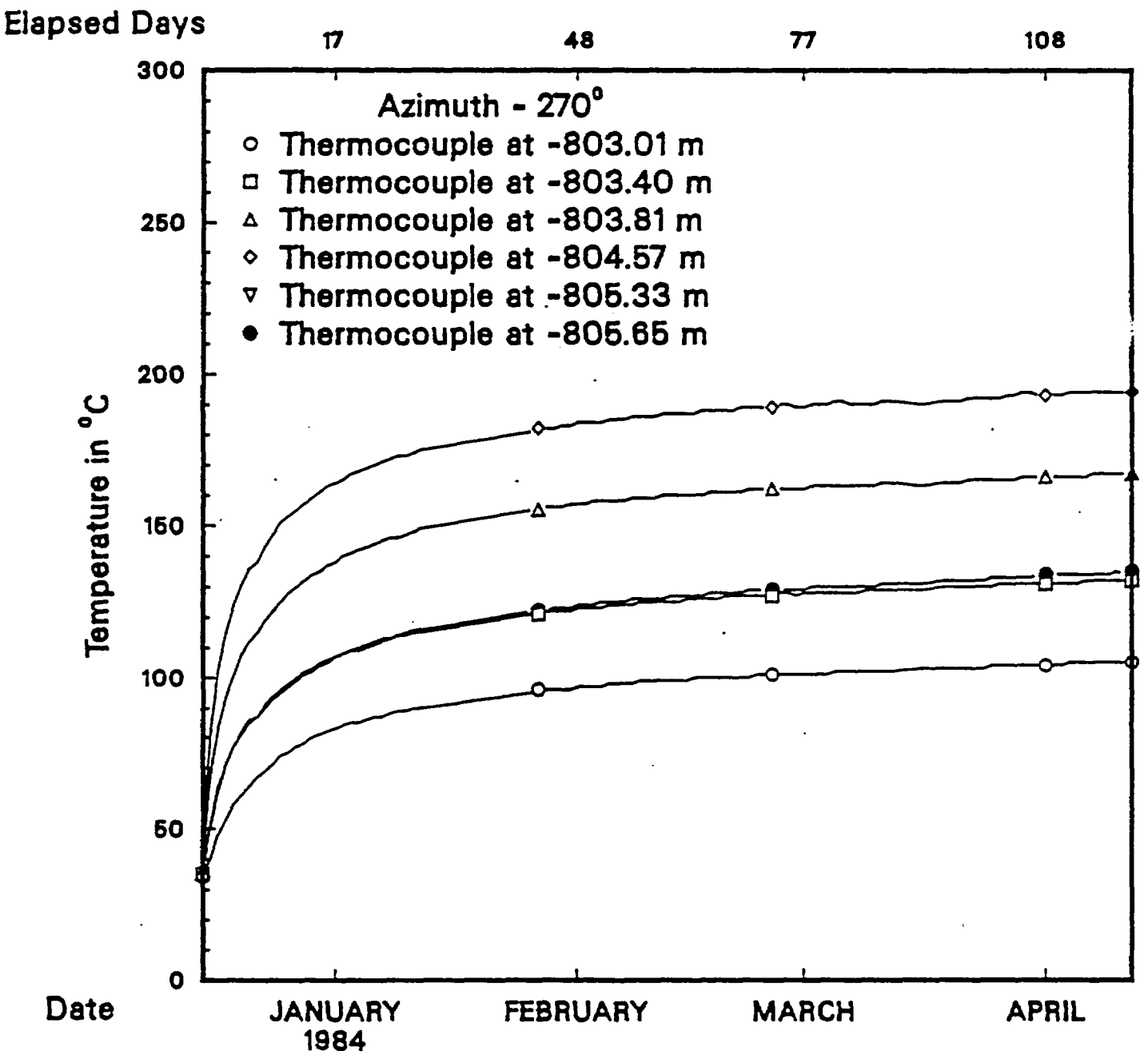
Borehole Salt Temperature vs. Time for Test #3



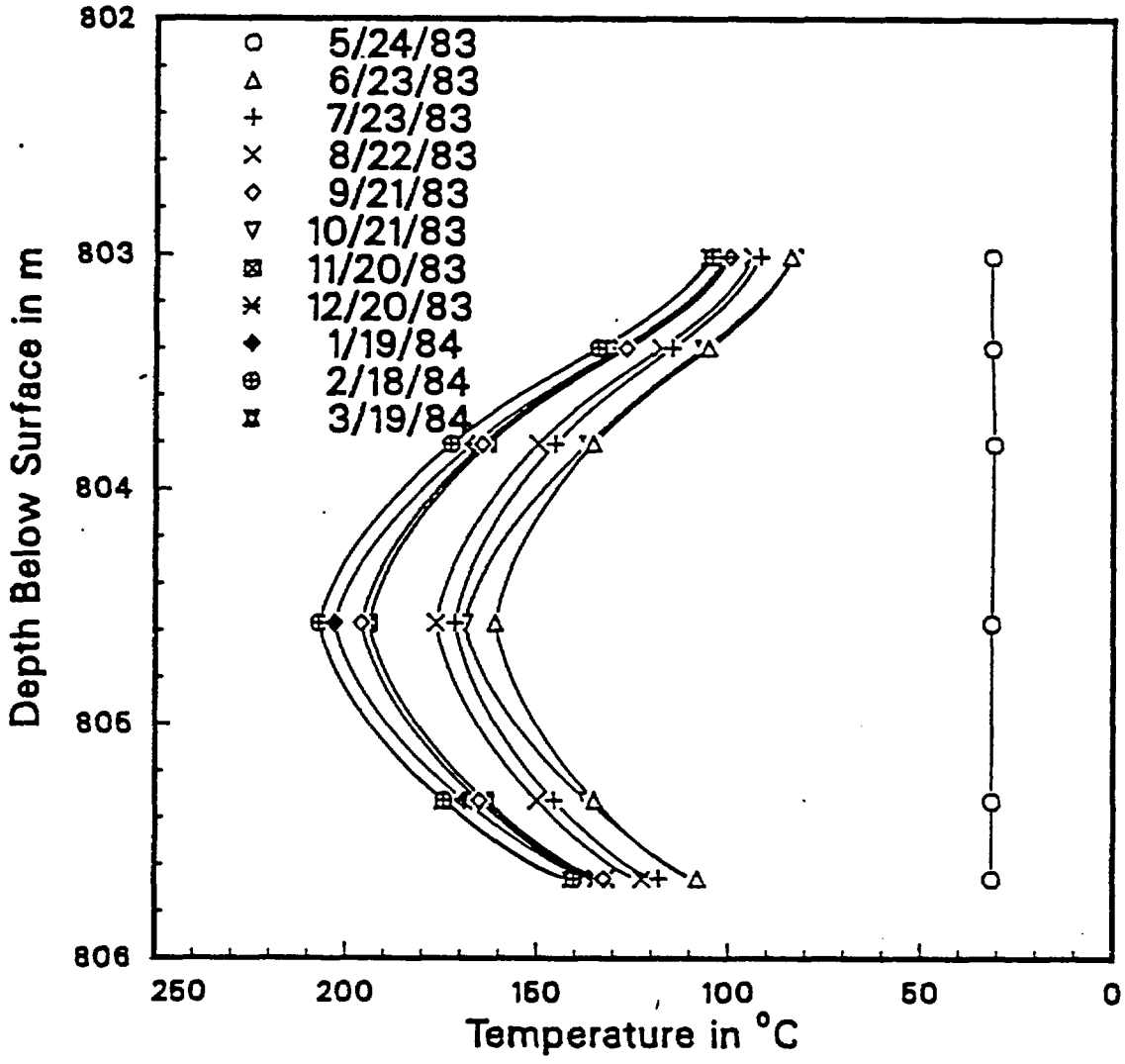
Borehole Salt Temperature vs. Time for Test #4



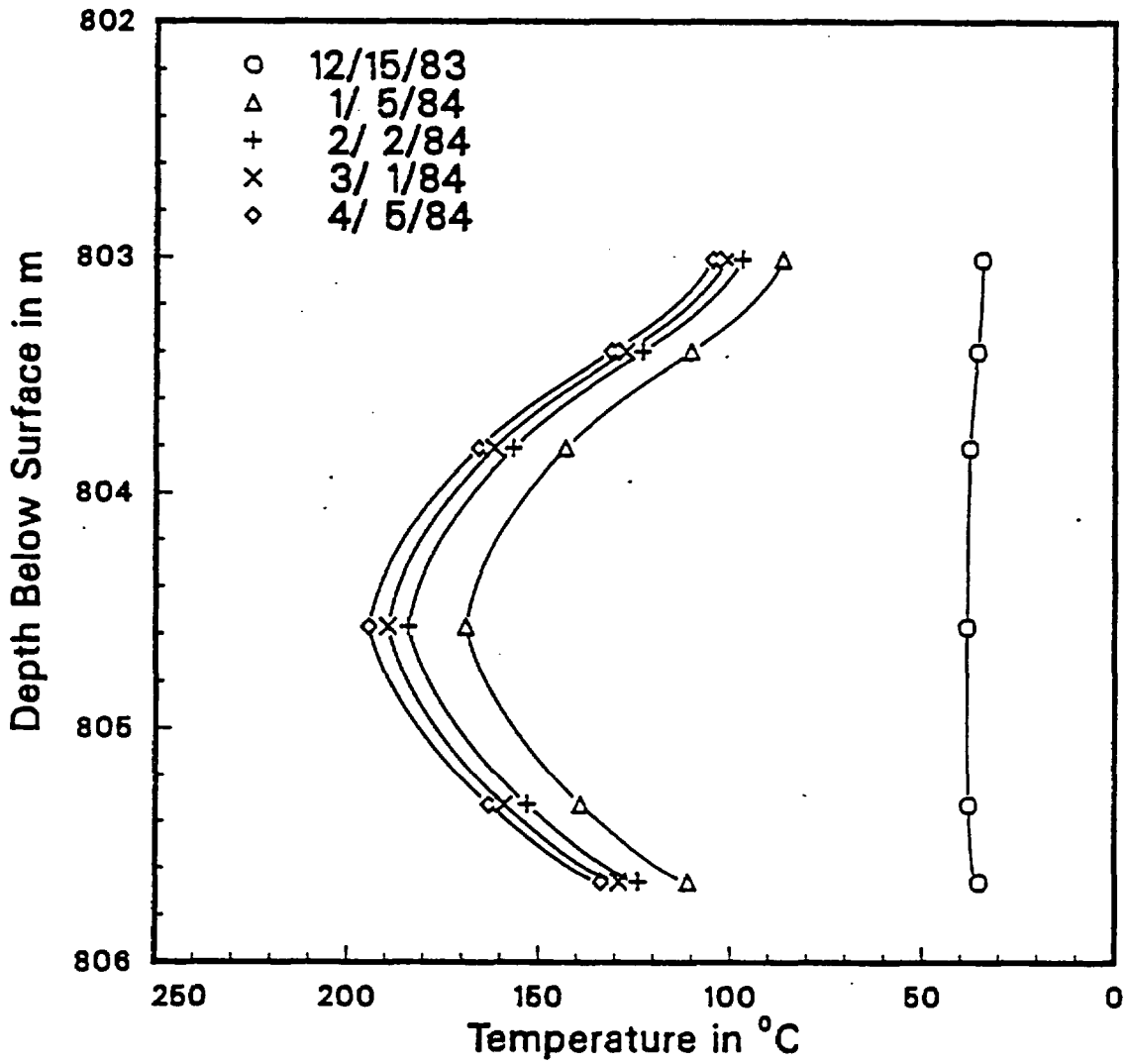
Borehole Salt Temperature vs. Time for Test #4



Borehole Salt Temperature vs. Time for Test #4



Depth Below Surface vs.
Average Borehole Wall Temperature
for Test #2



Depth Below Surface vs.
Average Borehole Wall Temperature
for Test #4

Borehole Salt Temperatures C for Test #1
Azimuth - 30 Degrees

Date	Elapsed Days	Thermocouple Elevation in meters 803.01	803.40	803.81	804.57	805.33	805.66
5/24/83	0	31.00	31.00	31.00	31.00	31.00	31.00
6/23/83	30	85.00	107.00	139.00	165.00	136.00	108.00
7/23/83	60	93.00	117.00	149.00	175.00	147.00	118.00
8/22/83	90	96.00	120.00	153.00	180.00	152.00	123.00
9/21/83	120	102.00	130.00	167.00	200.00	167.00	133.00
10/21/83	150	---	---	---	---	---	---
11/20/83	180	106.00	134.00	172.00	206.00	173.00	138.00
12/20/83	210	107.00	136.00	174.00	209.00	175.00	140.00
1/19/84	240	---	---	---	---	---	---
2/18/84	270	108.00	136.00	174.00	210.00	178.00	142.00
3/19/84	300	107.00	135.00	172.00	207.00	176.00	142.00

Borehole Salt Temperatures C for Test #1
Azimuth - 150 Degrees

Date	Elapsed Days	Thermocouple Elevation in meters 803.01	803.40	803.81	804.57	805.33	805.66
5/24/83	0	31.00	---	31.00	31.00	---	31.00
6/23/83	30	85.00	---	135.00	166.00	140.00	112.00
7/23/83	60	93.00	---	146.00	176.00	150.00	122.00
8/22/83	90	96.00	---	150.00	180.00	155.00	127.00
9/21/83	120	102.00	---	164.00	200.00	170.00	137.00
10/21/83	150	---	---	---	---	---	---
11/20/83	180	106.00	---	169.00	206.00	175.00	143.00
12/20/83	210	108.00	---	171.00	209.00	177.00	144.00
1/19/84	240	---	---	---	---	---	---
2/18/84	270	108.00	---	171.00	210.00	180.00	147.00
3/19/84	300	108.00	---	169.00	207.00	178.00	146.00

Borehole Salt Temperatures C for Test #1
Azimuth - 270 Degrees

Date	Elapsed Days	Thermocouple Elevation in meters 803.01	803.40	803.81	804.57	805.33	805.66
5/24/83	0	31.00	31.00	31.00	31.00	31.00	31.00
6/23/83	30	86.00	106.00	137.00	162.00	138.00	109.00
7/23/83	60	94.00	116.00	147.00	174.00	148.00	119.00
8/22/83	90	96.00	119.00	151.00	178.00	152.00	123.00
9/21/83	120	103.00	128.00	166.00	199.00	167.00	134.00
10/21/83	150	---	---	---	---	---	---
11/20/83	180	106.00	133.00	171.00	205.00	173.00	139.00
12/20/83	210	107.00	135.00	173.00	207.00	175.00	141.00
1/19/84	240	---	---	---	---	---	---
2/18/84	270	108.00	135.00	174.00	209.00	178.00	143.00
3/19/84	300	107.00	134.00	172.00	207.00	176.00	142.00

Borehole Salt Temperatures C for Test #2
Azimuth - 30 Degrees

Date	Elapsed Days	Thermocouple Elevation in meters 803.01	803.40	803.81	804.57	805.33	805.66
5/24/83	0	32.00	32.00	---	32.00	32.00	32.00
6/23/83	30	84.00	105.00	135.00	161.00	136.00	109.00
7/23/83	60	92.00	115.00	145.00	171.00	147.00	119.00
8/22/83	90	94.00	118.00	150.00	176.00	151.00	123.00
9/21/83	120	100.00	127.00	164.00	195.00	166.00	133.00
10/21/83	150	---	---	---	---	---	---
11/20/83	180	104.00	132.00	170.00	202.00	171.00	139.00
12/20/83	210	105.00	133.00	170.00	202.00	172.00	140.00
1/19/84	240	---	---	---	---	---	---
2/18/84	270	106.00	135.00	173.00	206.00	175.00	142.00
3/19/84	300	106.00	134.00	172.00	204.00	174.00	142.00

Borehole Salt Temperatures C for Test #2
Azimuth - 150 Degrees

Date	Elapsed Days	Thermocouple Elevation in meters 803.01	803.40	803.81	804.57	805.33	805.66
1/24/83	0	---	---	---	---	---	---
2/23/83	30	---	---	---	---	---	---
3/24/83	60	---	---	---	---	---	---
4/23/83	90	---	---	---	---	---	---
5/23/83	120	---	---	---	---	---	---
6/22/83	150	83.00	107.00	137.00	169.00	137.00	108.00
7/22/83	180	92.00	117.00	148.00	176.00	148.00	119.00
8/21/83	210	94.00	120.00	152.00	182.00	153.00	124.00
9/20/83	240	100.00	129.00	167.00	203.00	169.00	134.00
10/20/83	270	102.00	133.00	171.00	207.00	173.00	138.00
11/19/83	300	104.00	134.00	173.00	211.00	176.00	140.00
12/19/83	330	104.00	134.00	173.00	210.00	176.00	141.00
1/18/84	360	---	---	---	---	---	---
2/17/84	390	106.00	137.00	176.00	215.00	179.00	144.00
3/18/84	420	---	---	---	---	---	---

Borehole Salt Temperatures C for Test #2
Azimuth - 270 Degrees

Date	Elapsed Days	Thermocouple Elevation in meters 803.01	803.40	803.81	804.57	805.33	805.66
5/24/83	0	31.00	31.00	31.00	31.00	31.00	31.00
6/23/83	30	84.00	106.00	136.00	161.00	134.00	107.00
7/23/83	60	92.00	115.00	146.00	172.00	144.00	117.00
8/22/83	90	94.00	118.00	150.00	177.00	149.00	122.00
9/21/83	120	100.00	127.00	165.00	197.00	164.00	132.00
10/21/83	150	---	---	---	---	---	---
11/20/83	180	104.00	132.00	171.00	204.00	171.00	138.00
12/20/83	210	104.00	132.00	171.00	204.00	171.00	139.00
1/19/84	240	---	---	---	---	---	---
2/18/84	270	106.00	135.00	174.00	208.00	175.00	141.00
3/19/84	300	106.00	134.00	173.00	206.00	174.00	141.00

Borehole Salt Temperatures C for Test #3
Azimuth - 30 Degrees

Date	Elapsed Days	Thermocouple Elevation in meters 803.01	803.40	803.81	804.57	805.33	805.66
12/15/83	0	34.00	35.00	37.00	37.00	37.00	36.00
12/22/83	7	68.00	89.00	120.00	145.00	118.00	92.00
12/29/83	14	80.00	103.00	135.00	160.00	133.00	106.00
1/ 5/84	21	87.00	111.00	145.00	170.00	143.00	114.00
1/12/84	28	92.00	118.00	153.00	179.00	151.00	122.00
1/19/84	35	---	---	---	---	---	---
1/26/84	42	98.00	125.00	160.00	188.00	159.00	130.00
2/ 2/84	49	100.00	127.00	163.00	192.00	162.00	132.00
2/ 9/84	56	101.00	129.00	165.00	194.00	164.00	135.00
2/16/84	63	102.00	130.00	166.00	197.00	166.00	136.00
2/23/84	70	103.00	131.00	167.00	198.00	167.00	137.00
3/ 1/84	77	104.00	132.00	168.00	199.00	168.00	138.00
3/ 8/84	84	105.00	133.00	169.00	200.00	169.00	138.00
3/15/84	91	---	---	---	---	---	---
3/22/84	98	104.00	132.00	167.00	198.00	169.00	138.00
3/29/84	105	104.00	132.00	168.00	199.00	169.00	139.00
4/ 5/84	112	105.00	133.00	168.00	200.00	170.00	139.00
4/12/84	119	105.00	133.00	169.00	201.00	171.00	140.00

Borehole Salt Temperatures C for Test #3
Azimuth - 150 Degrees

Date	Elapsed Days	Thermocouple Elevation in meters 803.01	803.40	803.81	804.57	805.33	805.66
12/15/83	0	34.00	35.00	37.00	38.00	37.00	37.00
12/22/83	7	67.00	91.00	124.00	146.00	119.00	---
12/29/83	14	79.00	103.00	138.00	161.00	135.00	---
1/ 5/84	21	86.00	112.00	148.00	172.00	144.00	---
1/12/84	28	91.00	118.00	155.00	181.00	153.00	123.00
1/19/84	35	---	---	---	---	---	---
1/26/84	42	97.00	124.00	161.00	188.00	160.00	---
2/ 2/84	49	99.00	126.00	163.00	192.00	162.00	---
2/ 9/84	56	100.00	128.00	165.00	194.00	164.00	134.00
2/16/84	63	101.00	128.00	166.00	196.00	165.00	135.00
2/23/84	70	102.00	129.00	167.00	198.00	167.00	137.00
3/ 1/84	77	103.00	130.00	167.00	199.00	168.00	137.00
3/ 8/84	84	104.00	131.00	168.00	200.00	169.00	138.00
3/15/84	91	---	---	---	---	---	---
3/22/84	98	104.00	131.00	169.00	200.00	170.00	138.00
3/29/84	105	105.00	132.00	169.00	200.00	170.00	140.00
4/ 5/84	112	105.00	132.00	170.00	202.00	172.00	140.00
4/12/84	119	106.00	133.00	170.00	203.00	172.00	---

Borehole Salt Temperatures C for Test #3
Azimuth - 270 Degrees

		Thermocouple Elevation in meters					
Date	Elapsed Days	803.01	803.40	803.81	804.57	805.33	805.66
12/15/83	0	34.00	35.00	---	37.00	36.00	35.00
12/22/83	7	67.00	89.00	---	142.00	115.00	89.00
12/29/83	14	79.00	102.00	---	158.00	130.00	103.00
1/ 5/84	21	86.00	110.00	---	169.00	140.00	112.00
1/12/84	28	91.00	116.00	---	178.00	148.00	119.00
1/19/84	35	---	---	---	---	---	---
1/26/84	42	97.00	123.00	---	186.00	155.00	126.00
2/ 2/84	49	99.00	125.00	---	189.00	158.00	128.00
2/ 9/84	56	100.00	126.00	---	191.00	160.00	130.00
2/16/84	63	101.00	128.00	---	193.00	161.00	132.00
2/23/84	70	102.00	128.00	---	195.00	162.00	133.00
3/ 1/84	77	103.00	129.00	---	196.00	163.00	133.00
3/ 8/84	84	104.00	130.00	---	197.00	165.00	135.00
3/15/84	91	---	---	---	---	---	---
3/22/84	98	104.00	131.00	---	196.00	165.00	135.00
3/29/84	105	104.00	131.00	---	197.00	166.00	136.00
4/ 5/84	112	105.00	131.00	---	198.00	167.00	136.00
4/12/84	119	106.00	132.00	---	199.00	167.00	137.00

Borehole Salt Temperatures C for Test #4
Azimuth - 30 Degrees

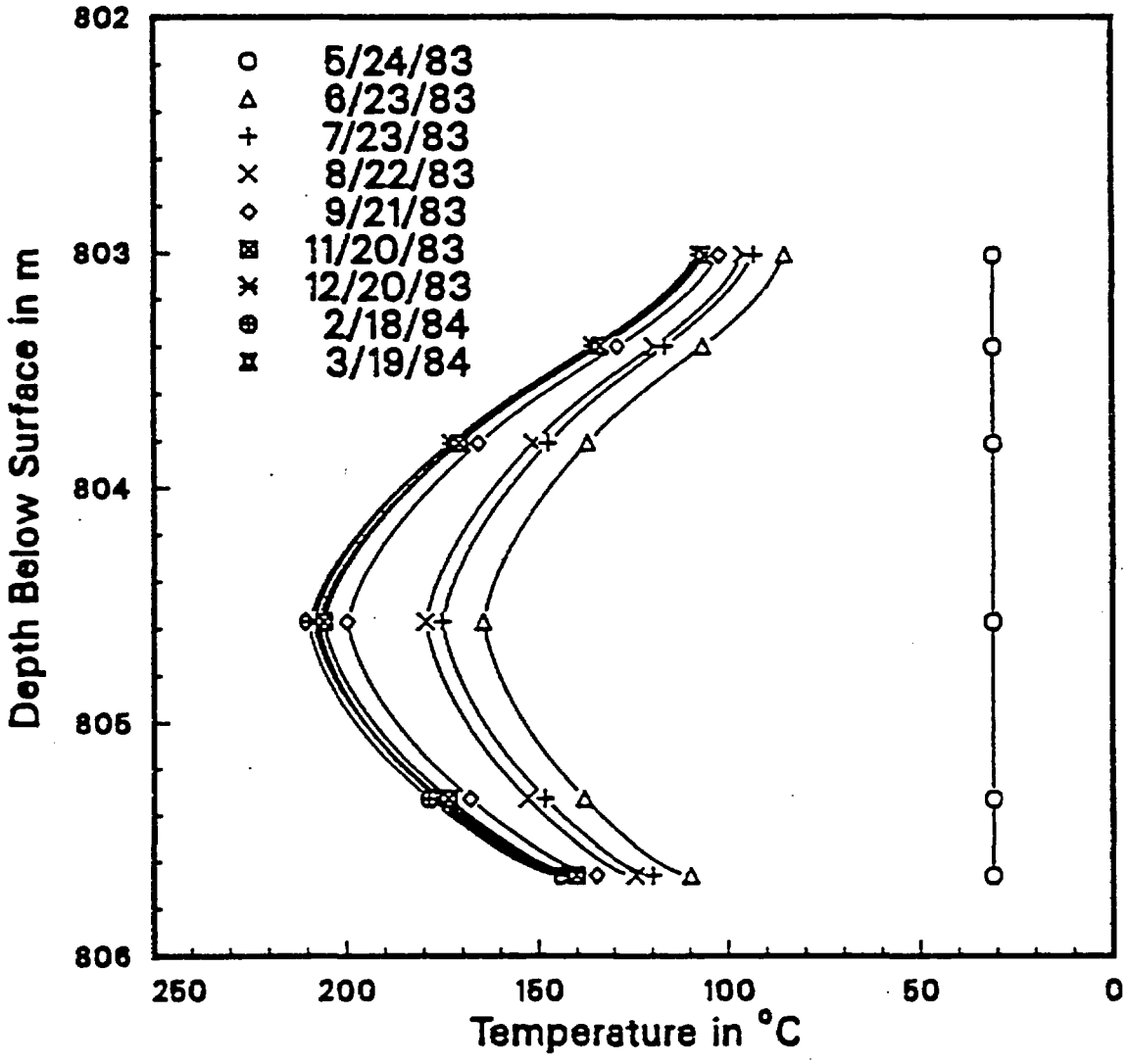
Date	Elapsed Days	Thermocouple Elevation in meters 803.01	803.40	803.81	804.57	805.33	805.66
12/15/83	0	35.00	36.00	38.00	39.00	38.00	35.00
12/22/83	7	67.00	87.00	115.00	136.00	112.00	85.00
12/29/83	14	80.00	102.00	133.00	158.00	130.00	101.00
1/ 5/84	21	87.00	109.00	142.00	167.00	137.00	109.00
1/12/84	28	91.00	114.00	147.00	173.00	143.00	114.00
1/19/84	35	---	---	---	---	---	---
1/26/84	42	96.00	120.00	153.00	180.00	149.00	120.00
2/ 2/84	49	97.00	122.00	156.00	182.00	151.00	122.00
2/ 9/84	56	99.00	123.00	157.00	185.00	153.00	124.00
2/16/84	63	100.00	125.00	159.00	186.00	154.00	125.00
2/23/84	70	101.00	126.00	160.00	188.00	156.00	127.00
3/ 1/84	77	101.00	126.00	161.00	188.00	157.00	127.00
3/ 8/84	84	102.00	127.00	162.00	189.00	158.00	128.00
3/15/84	91	---	---	---	---	---	---
3/22/84	98	104.00	129.00	163.00	190.00	159.00	130.00
3/29/84	105	104.00	130.00	165.00	193.00	161.00	132.00
4/ 5/84	112	105.00	130.00	165.00	193.00	161.00	132.00
4/12/84	119	105.00	131.00	165.00	193.00	162.00	133.00

Borehole Salt Temperatures C for Test #4
Azimuth - 150 Degrees

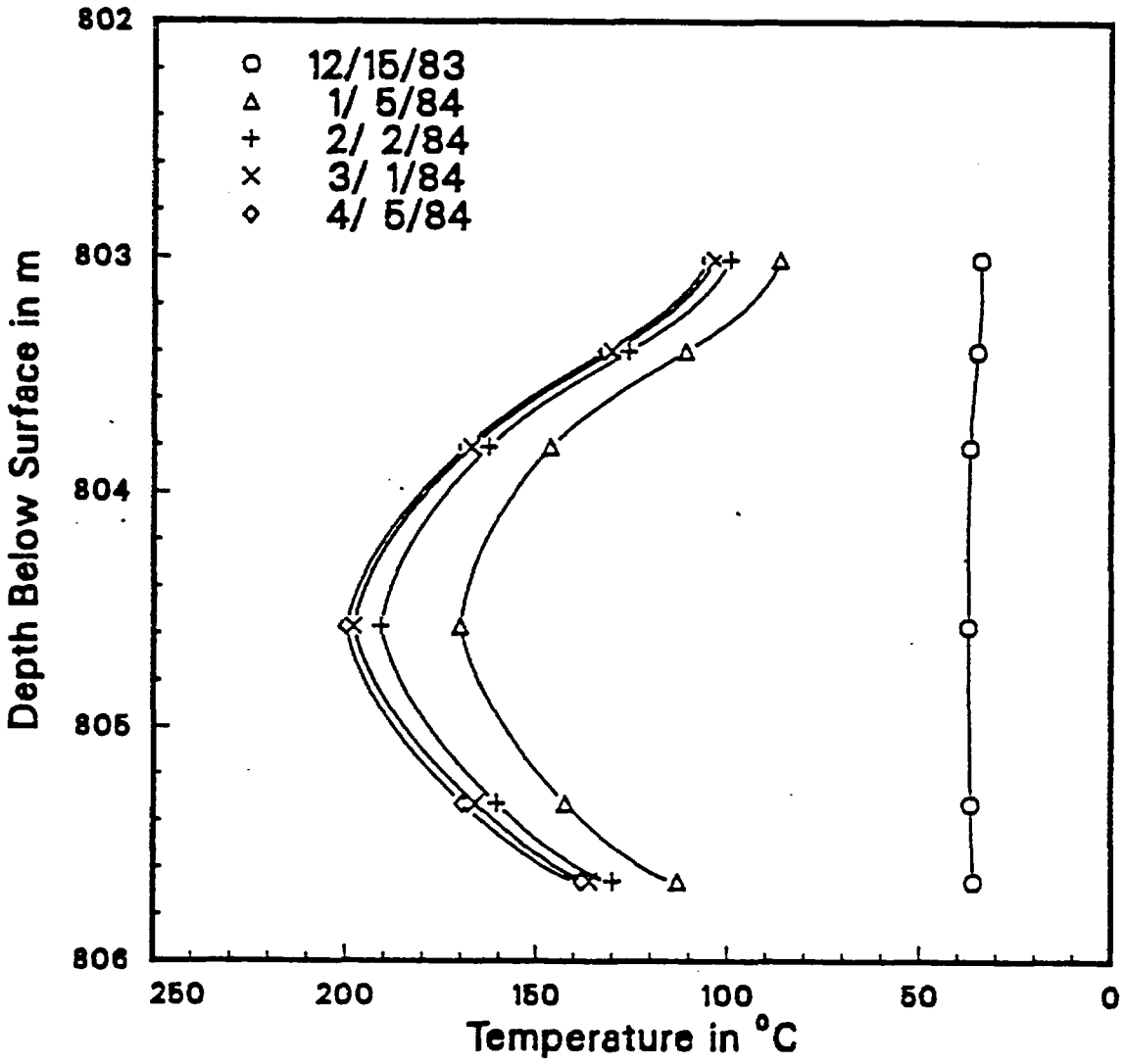
Date	Elapsed Days	Thermocouple Elevation in meters 803.01	803.40	803.81	804.57	805.33	805.66
12/15/83	0	34.00	36.00	38.00	38.00	38.00	36.00
12/22/83	7	67.00	88.00	117.00	141.00	115.00	89.00
12/29/83	14	79.00	104.00	135.00	162.00	133.00	105.00
1/ 5/84	21	86.00	112.00	144.00	171.00	141.00	113.00
1/12/84	28	90.00	116.00	149.00	177.00	147.00	118.00
1/19/84	35	---	---	---	---	---	---
1/26/84	42	95.00	122.00	155.00	183.00	153.00	123.00
2/ 2/84	49	97.00	124.00	157.00	186.00	155.00	126.00
2/ 9/84	56	98.00	125.00	159.00	188.00	157.00	128.00
2/16/84	63	99.00	127.00	161.00	190.00	158.00	129.00
2/23/84	70	100.00	128.00	162.00	191.00	160.00	130.00
3/ 1/84	77	101.00	128.00	162.00	191.00	161.00	131.00
3/ 8/84	84	102.00	129.00	163.00	192.00	162.00	131.00
3/15/84	91	---	---	---	---	---	---
3/22/84	98	103.00	131.00	164.00	194.00	163.00	133.00
3/29/84	105	104.00	132.00	166.00	196.00	165.00	134.00
4/ 5/84	112	104.00	132.00	166.00	196.00	165.00	135.00
4/12/84	119	105.00	133.00	167.00	196.00	166.00	136.00

Borehole Salt Temperatures C for Test #4
Azimuth - 270 Degrees

Date	Elapsed Days	Thermocouple Elevation in meters 803.01	803.40	803.81	804.57	805.33	805.66
12/15/83	0	34.00	35.00	37.00	38.00	---	35.00
12/22/83	7	67.00	87.00	115.00	138.00	---	87.00
12/29/83	14	80.00	102.00	134.00	159.00	---	103.00
1/ 5/84	21	86.00	110.00	143.00	169.00	---	111.00
1/12/84	28	90.00	115.00	149.00	175.00	---	116.00
1/19/84	35	---	---	---	---	---	---
1/26/84	42	95.00	121.00	155.00	181.00	---	122.00
2/ 2/84	49	97.00	123.00	157.00	184.00	---	124.00
2/ 9/84	56	99.00	125.00	159.00	186.00	---	126.00
2/16/84	63	100.00	126.00	160.00	187.00	---	127.00
2/23/84	70	100.00	127.00	162.00	189.00	---	129.00
3/ 1/84	77	101.00	128.00	162.00	189.00	---	129.00
3/ 8/84	84	102.00	128.00	163.00	190.00	---	130.00
3/15/84	91	---	---	---	---	---	---
3/22/84	98	103.00	130.00	165.00	192.00	---	132.00
3/29/84	105	104.00	131.00	166.00	194.00	---	133.00
4/ 5/84	112	105.00	131.00	166.00	194.00	---	134.00
4/12/84	119	105.00	132.00	167.00	194.00	---	135.00



Depth Below Surface vs.
Average Borehole Wall Temperature
for Test #1



Depth Below Surface vs.
Average Borehole Wall Temperature
for Test #3

Average Borehole Wall Temperature C for Test #1

Date	Depth 803.01	803.40	803.81	804.57	805.33	805.66
5/24/83	31.00	31.00	31.00	31.00	31.00	31.00
6/23/83	85.33	106.50	137.00	164.33	138.00	109.67
7/23/83	93.33	116.50	147.33	175.00	148.33	119.67
8/22/83	96.00	119.50	151.33	179.33	153.00	124.33
9/21/83	102.33	129.00	165.67	199.67	168.00	134.67
10/21/83	---	---	---	---	---	---
11/20/83	106.00	133.50	170.67	205.67	173.67	140.00
12/20/83	107.33	135.50	172.67	208.33	175.67	141.67
1/19/84	---	---	---	---	---	---
2/18/84	108.00	135.50	173.00	209.67	178.67	144.00
3/19/84	107.33	134.50	171.00	207.00	176.67	143.33

Average Borehole Wall Temperature C for Test #2

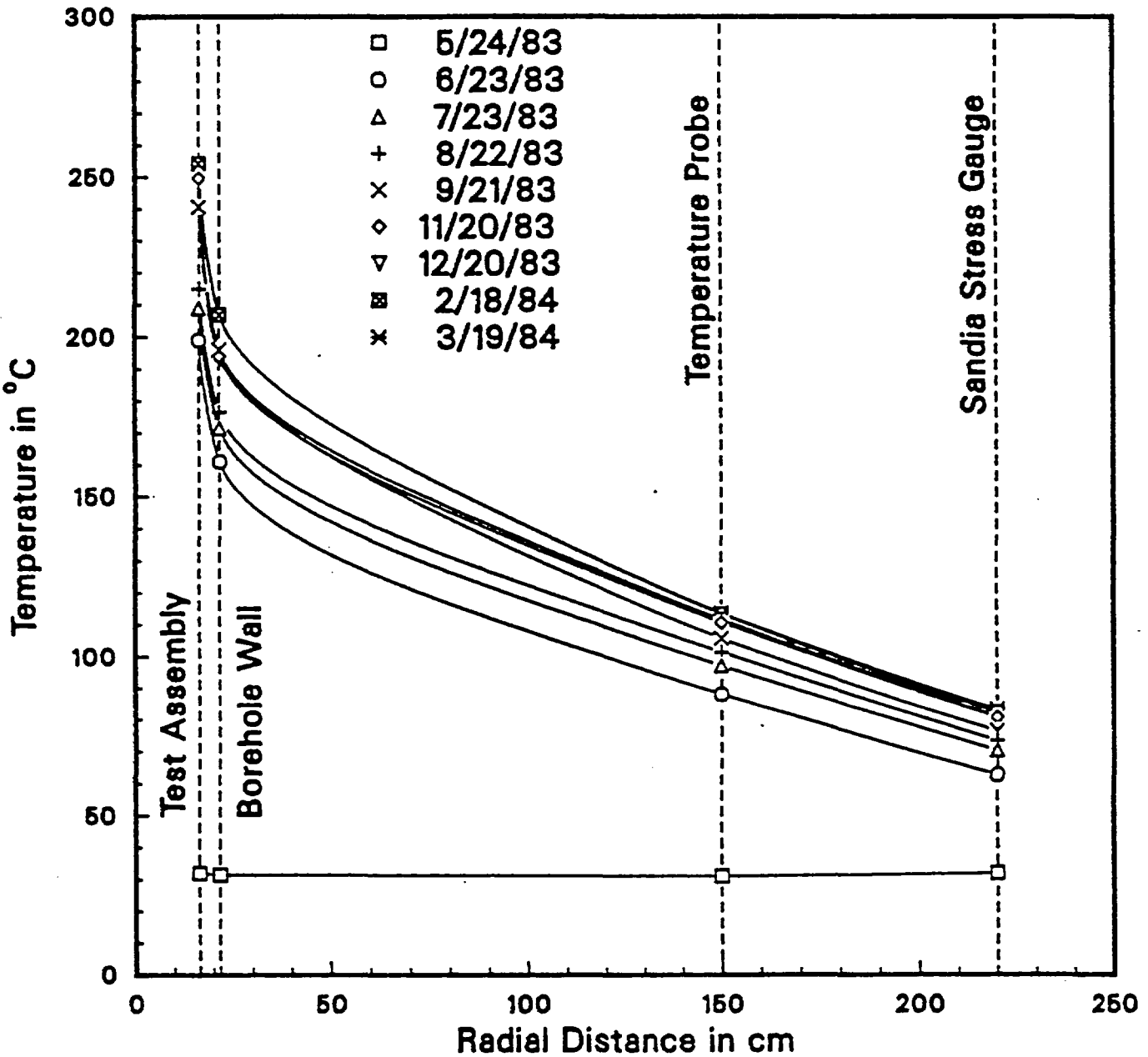
Date	Depth 803.01	803.40	803.81	804.57	805.33	805.66
5/24/83	31.50	31.50	31.00	31.50	31.50	31.50
6/23/83	84.00	105.50	135.50	161.00	135.00	108.00
7/23/83	92.00	115.00	145.50	171.50	145.50	118.00
8/22/83	94.00	118.00	150.00	176.50	150.00	122.50
9/21/83	100.00	127.00	164.50	196.00	165.00	132.50
10/21/83	83.00	107.00	137.00	169.00	137.00	108.00
11/20/83	100.00	127.00	163.00	194.00	163.33	132.00
12/20/83	101.00	128.33	164.33	196.00	165.33	134.33
1/19/84	100.00	129.00	167.00	203.00	169.00	134.00
2/18/84	104.67	134.33	172.67	207.00	174.33	140.33
3/19/84	105.33	134.00	172.67	207.00	174.67	141.00

Average Borehole Wall Temperature C for Test #3

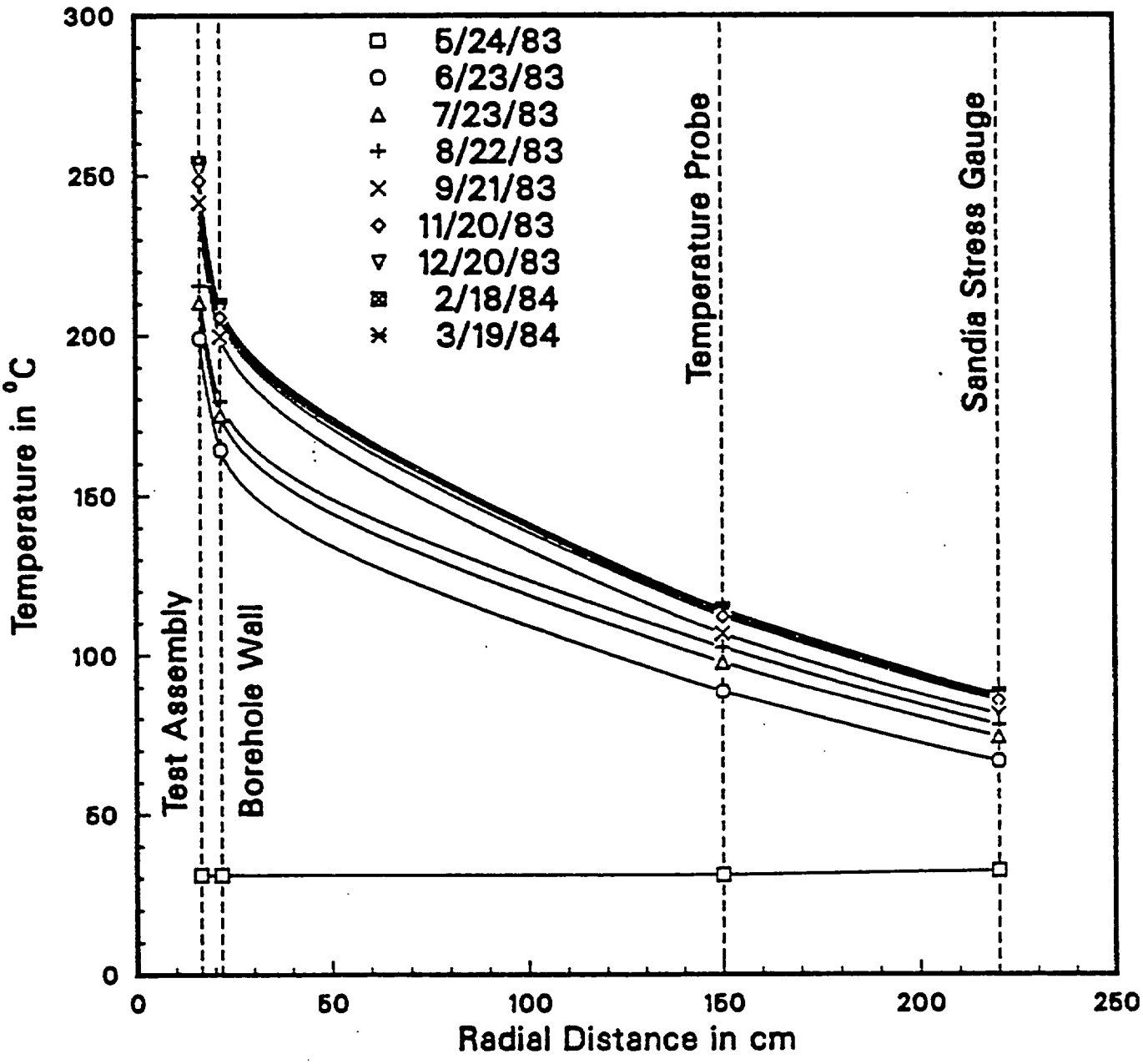
Date	Depth 803.01	803.40	803.81	804.57	805.33	805.66
12/15/83	34.00	35.00	37.00	37.33	36.67	36.00
1/ 5/84	86.33	111.00	146.50	170.33	142.33	113.00
2/ 2/84	99.33	126.00	163.00	191.00	160.67	130.00
3/ 1/84	103.33	130.33	167.50	198.00	166.33	136.00
4/ 5/84	105.00	132.00	169.00	200.00	169.67	138.33

Average Borehole Wall Temperature C for Test #4

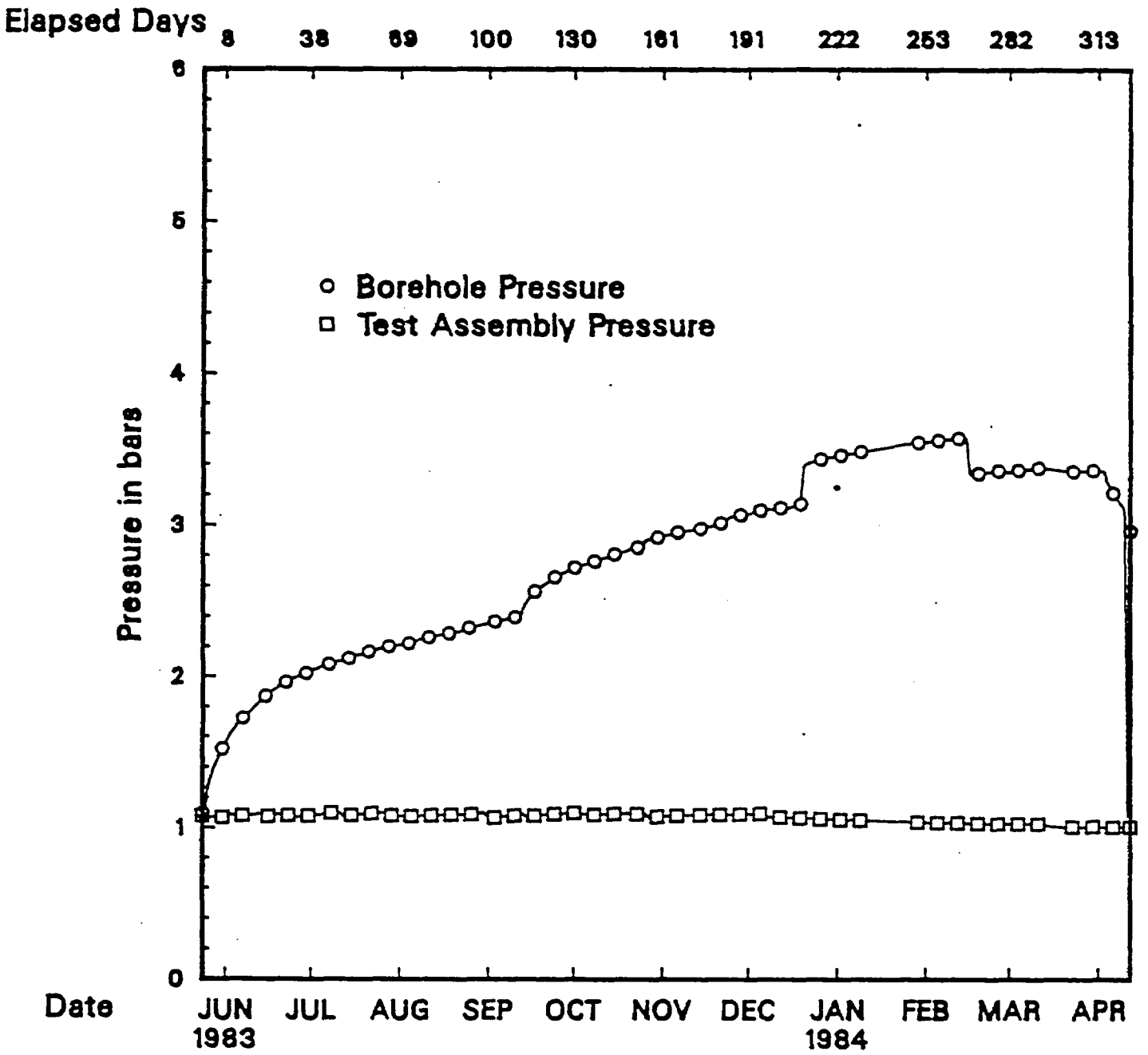
Date	Depth 803.01	803.40	803.81	804.57	805.33	805.66
12/15/83	34.33	35.67	37.67	38.33	38.00	35.33
1/ 5/84	86.33	110.33	143.00	169.00	139.00	111.00
2/ 2/84	97.00	123.00	156.67	184.00	153.00	124.00
3/ 1/84	101.00	127.33	161.67	189.33	159.00	129.00
4/ 5/84	104.67	131.00	165.67	194.33	163.00	133.67



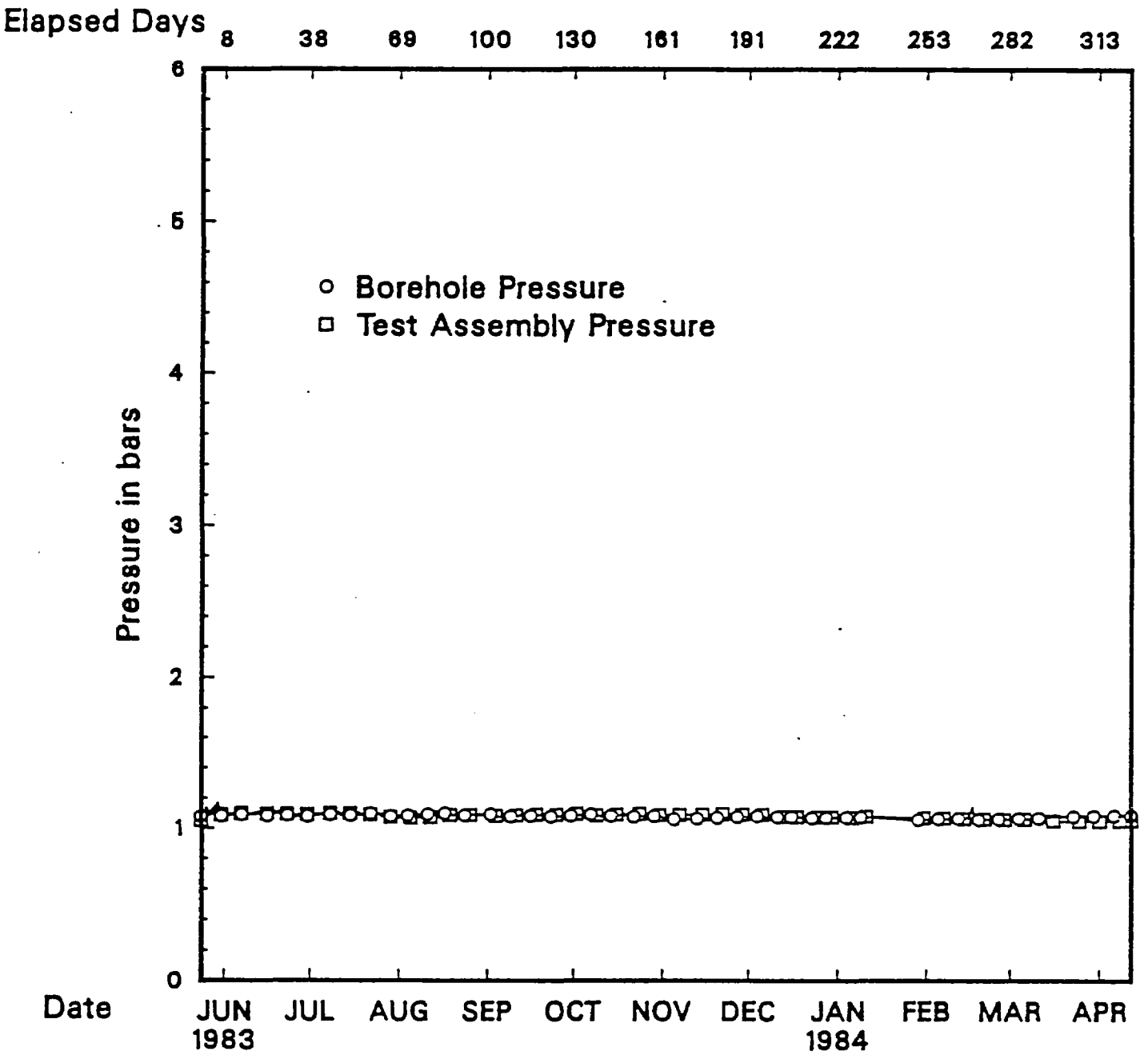
Radial Temperature at 804.57 m from Surface for Test #2



Radial Temperature at 804.57 m from Surface for Test #1



Test Assembly and Borehole Pressure vs. Time for Test #1



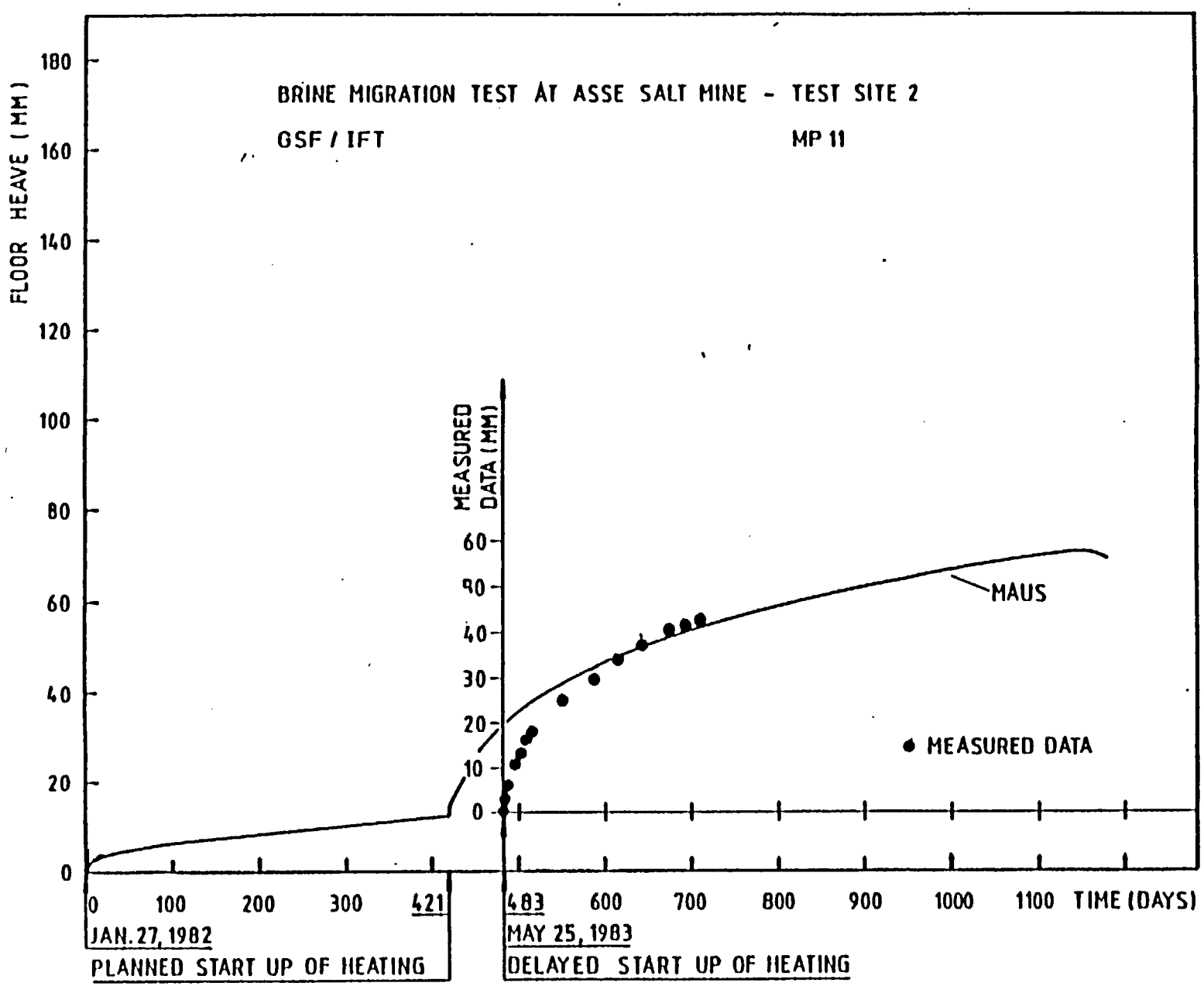
Test Assembly and Borehole Pressure vs. Time for Test #2

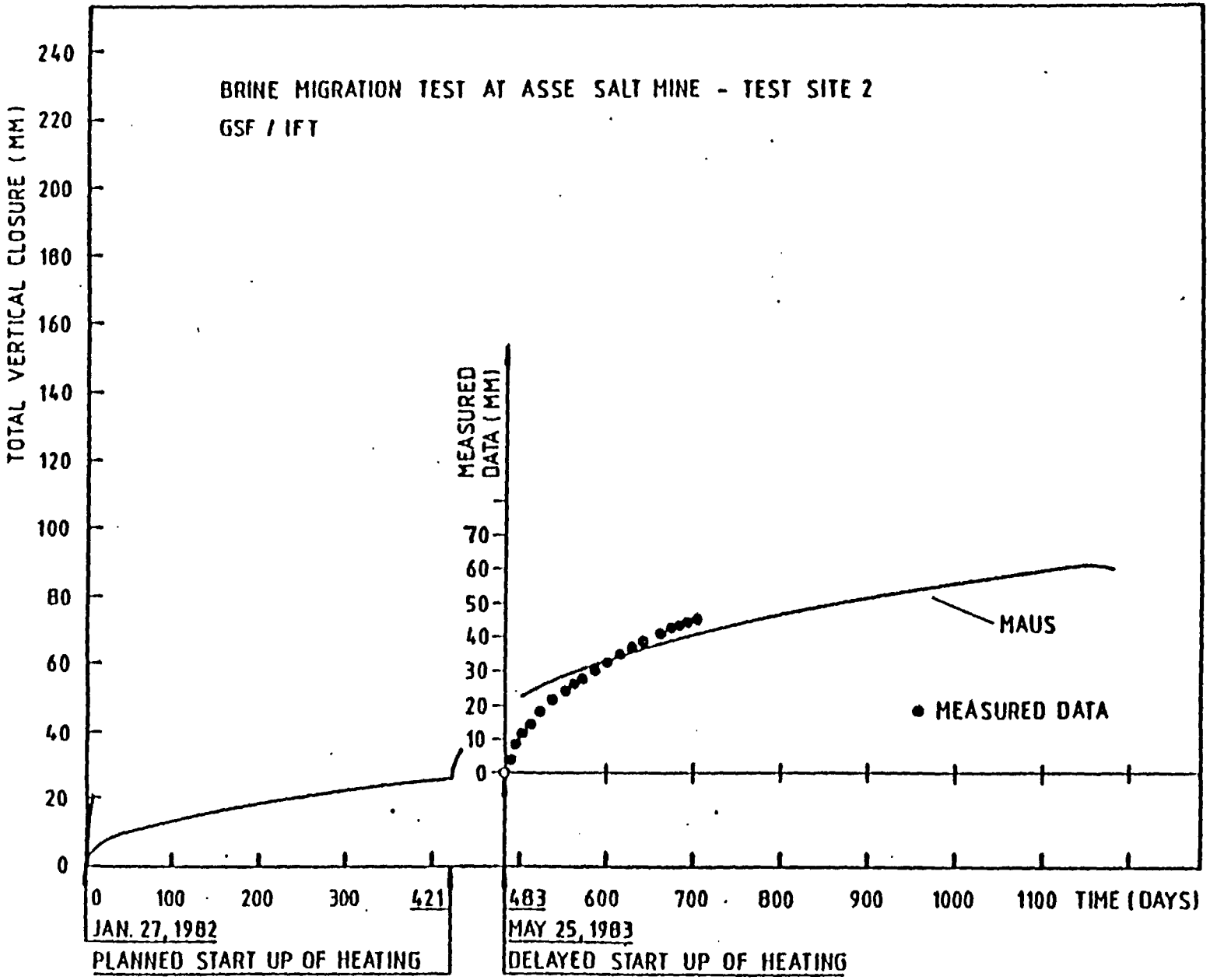
Test Assembly and Borehole Pressure for Test #1

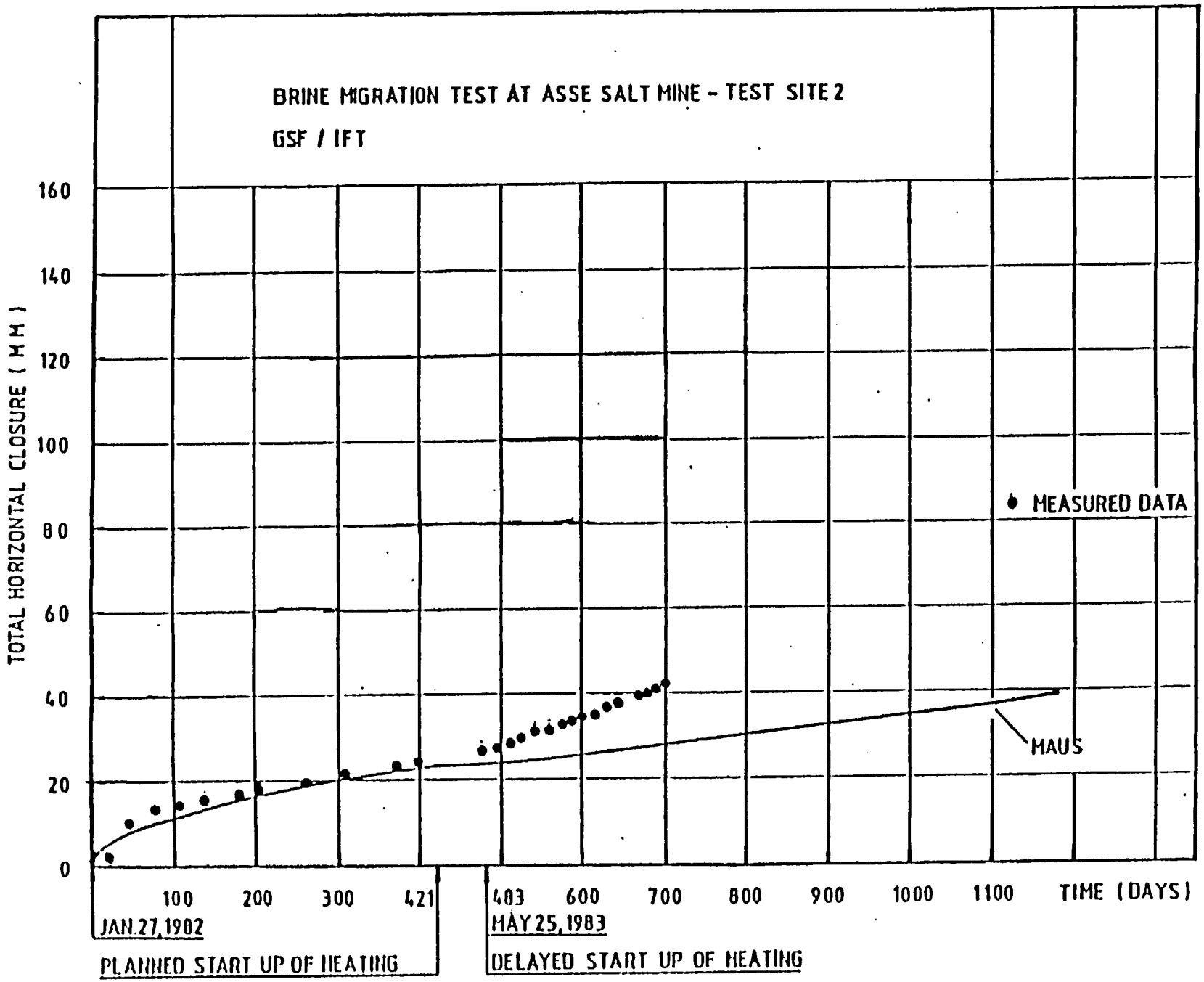
Date	Elapsed Days	Pressure in bars Borehole	Test Assembly
5/24/83	0	1.10	1.08
6/23/83	30	1.97	1.08
7/23/83	60	2.17	1.09
8/22/83	90	2.30	1.08
9/21/83	120	2.61	1.08
10/21/83	150	---	---
11/20/83	180	3.01	1.09
12/20/83	210	3.38	1.06
1/19/84	240	---	---
2/18/84	270	3.34	1.03
3/19/84	300	3.36	1.01

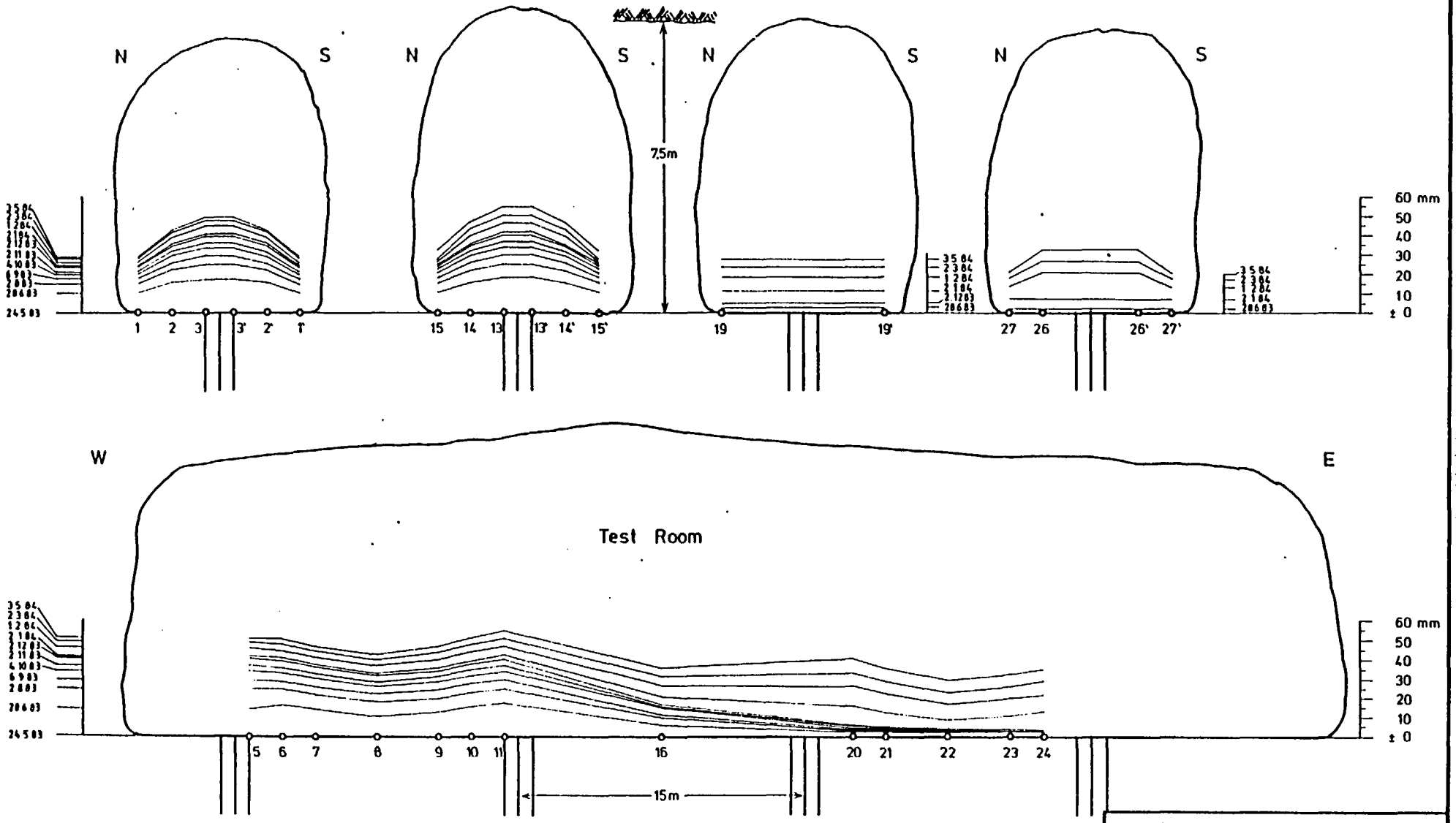
Test Assembly and Borehole Pressure for Test #2

Date	Elapsed Days	Pressure in bars Borehole	Test Assembly
5/24/83	0	1.08	1.05
6/23/83	30	1.09	1.09
7/23/83	60	1.10	1.09
8/22/83	90	1.09	1.09
9/21/83	120	1.09	1.09
10/21/83	150	---	---
11/20/83	180	1.07	1.09
12/20/83	210	1.07	1.08
1/19/84	240	---	---
2/18/84	270	1.06	1.06
3/19/84	300	1.08	1.05


BRINE MIGRATION TEST AT ASSE SALT MINE - TEST SITE 2
GSF / IFT
MP 11
FLOOR HEAVE (MM)
180
160
140
120
100
80
60
40
20
0
MEASURED DATA (MM)
60
50
40
30
20
10
0
MAUS
MEASURED DATA
0
100
200
300
421
483
600
700
800
900
1000
1100
TIME (DAYS)
JAN. 27, 1982
PLANNED START UP OF HEATING
MAY 25, 1983
DELAYED START UP OF HEATING


BRINE MIGRATION TEST AT ASSE SALT MINE - TEST SITE 2
GSF / IFT
TOTAL VERTICAL CLOSURE (MM)
240
220
200
180
160
140
120
100
80
60
40
20
0
MEASURED DATA (MM)
70
60
50
40
30
20
10
0
MAUS
MEASURED DATA
0
100
200
300
421
483
600
700
800
900
1000
1100
TIME (DAYS)
JAN. 27, 1982
PLANNED START UP OF HEATING
MAY 25, 1983
DELAYED START UP OF HEATING


BRINE MIGRATION TEST AT ASSE SALT MINE - TEST SITE 2
GSF / IFT
TOTAL HORIZONTAL CLOSURE (M M)
160
140
120
100
80
60
40
20
0
MEASURED DATA
MAUS
100
200
300
421
483
600
700
800
900
1000
1100
TIME (DAYS)
JAN.27,1982
PLANNED START UP OF HEATING
MAY 25,1983
DELAYED START UP OF HEATING



ASSE SALT MINE

Brine Migration Test

Floor Heave Profiles

Gezeichnet	gsf Institut für Tieflagerung	Schrank
		Fach
Geprüft	Remlingen im Januar 1984	Zeichnung
		Nr.

TABLE 3-2. BRINE MIGRATION FOR TEST #2 (NONRADIOACTIVE)

Date	Brine Migration in cc
05/26/83	0.0
07/28/83	30.0
08/15/83	48.0
08/25/83	55.0
09/06/83	57.0
09/15/83	57.0
09/26/83	58.0
10/10/83	58.0
11/02/83	60.0
11/17/83	70.0
11/28/83	75.0
12/07/83	75.0
12/16/83	77.5
12/29/83	77.6
01/05/84	80
01/16/84	80
01/27/84	85
02/08/84	87.5
02/16/84	87.5
02/29/84	88
03/16/84	89.5
03/20/84	90
03/21/84	95
03/30/84	95

TABLE 3-2a. BRINE MIGRATION FOR TEST #4 (RADIOACTIVE)

Date	Brine Migration in cc
12/16/83	0.0
12/19/83	0.0
12/20/83	0.0
12/21/83	0.0
12/22/83	0.0
12/27/83	0.0
12/28/83	0.0
12/29/83	0.0
12/30/83	0.0
01/06/84	55
01/16/84	50
01/27/84	55
02/08/84	60
02/16/84	65
02/29/84	68
03/16/84	70
03/20/84	77.5
03/21/84	79
03/30/84	79

Gasanalysis - Test Site 4 (radioactive)

Date of Sampling	Test Day	Sample No.	Component (Vo. %)								
			H_2	O_2	N_2	HCl	CO_2	CO	CH_4	C_2H_6	C_3H_8
Dec. 12, 83	-	4/1*	-	16.8	80.0	-	0,03	-	0.0031	<0.0001	<0.0001
Dec. 15, 83	0	4/2**	-	2.1	97.8	-	0,009	-	0.00045	<0.0001	<0.0001
Jan. 17, 84	33	4/3	0.02	8.0	90.3		0.75	0.06	0.008	0.002	0.0016
Feb. 15, 84	62	4/4	0.02	12.6	85.5	-	2.1	0.03	0.005	-	-
March 14, 84	90	4/5	<0.01	14.5	83.4	-	2.5	0.045	0.0015	-	-
April 17, 84	124	4/6	<0.01	14.22	83.5	-	2.8	0.04	0.0017	-	-
May 15, 84	153	4/7	0.004	15.5	81.2	-	3.15	0.005	0.001	0.0005	0.0005
June 16, 84	182	4/8	0.006	14.8	81.4	-	3.0	-	0.0008	0.0005	0.0005

*) before
purging with nitrogen
**) after

Gasanalysis - Test Site 3 (radioactive)

Date of Sampling	Test Day	Sample No.	Component (Vol. %)								
			H_2	O_2	N_2	HCl	CO_2	CO	CH_4	C_2H_6	C_3H_8
Dec. 12, 83	-	3/1*	-	9.1	67.8	-	0.022	-	0.0025	0.0001	<0.0001
Dec. 15, 83	0	3/2**	-	1.6	98.3	-	0.009	-	0.00015	<0.0001	<0.0001
Jan. 17, 84	33	3/3	0.45	1.03	98.2		0.47	0.17	0.083	0.006	0.008
Feb. 15, 84	62	3/4	0.52	0.59	96.8	-	2.2	0.21	0.12	0.03	0.025
March 14, 84	90	3/5	0.61	0.64	94.7	-	3.5	0.34	0.19	0.04	0.027
April 17, 84	124	3/6	0.70	0.28	92.9	-	4.05	0.36	0.23	0.048	0.03
May 15, 84	153	3/7	0.55	0.51	94.0	-	4.0	0.33	0.23	0.047	0.029
June 16, 84	182	3/8	0.68	0.35	91.5	-	6.0	0.35	0.22	0.045	0.028

*) before purging with nitrogen

**) after

Gasanalysis - Test Site 1 (non-radioactive)

Date of Sampling	Test Day	Sample No.	Component (Vol. %)								
			H_2	O_2	N_2	HCl	CO_2	CO	CH_4	C_2H_6	C_3H_8
May 25, 1983	0	1/1	-	0,9	98,9	-	0,034	-	0,0005	-	-
June 15, 1983	21	1/3	-	0,4	99,3	-	0,69	-	0,02	0,005	0,0063
July 20, 1983	56	1/4	< 0,01	1,04		0,0006	1,5	0,096	0,033	0,0027	
Aug. 23, 1983	90	1/5	0,45	2,8	94	0,0004	3,1	0,052	0,06	0,0287	0,164
Sept. 23, 1983	121	1/6	0,6	0,74	93,6	0,0002	4,04	0,32	0,0678	0,04	0,195
* Oct. 25, 1983	153	1/7	0,72	2,06	94,0	-	2,8	0,06	0,09	0,0079	0,0053
Nov. 23, 1983	182	1/8	1,34	1,1	89,9	-	7,0	0,27	0,123	0,073	0,163
Dec. 19, 1983	208	1/9	1,94	1,1	89,8	-	6,8	0,31	0,167	0,0715	0,159
Jan. 17, 1984	237	1/10	1,47	0,84	93,1	-	4,1	0,30	0,152	0,058	0,125
Feb. 15, 1984	266	1/11	1,40	0,51	93,8	-	4,7	0,26	0,167	0,027	0,13
March 14, 1984	294	1/12	1,72	0,59	90,6	-	6,0	0,40	0,18	0,015	0,072
April 17, 1984	328	1/13	2,21	0,24	91,4	-	5,46	0,39	0,22	0,03	0,10
May 15, 1984	357	1/14	1,84	0,72	92,7	-	4,30	0,24	0,185	0,024	0,075
June 16, 1984	386	1/15	2,31	0,28	91,8	-	4,95	0,29	0,18	0,024	0,075

* possibly exchanged for test site 2

Gasanalysis - Test Site 2 (non-radioactive)

Date of Sampling	Test Day	Sample No.	Component (Vol. %)								
			H_2	O_2	N_2	HCl	CO_2	CO	CH_4	C_2H_6	C_3H_8
May 25, 1983	0	2/1	-	0,8	98,6	-	0,021	-	0,0005	-	-
June 15, 1983	21	2/3	-	0,8	99,0	-	0,27	-	0,022	0,0015	0,0003
July 20, 1983	56	2/4	< 0,01	1,0		-	1,0	0,074	0,05	0,004	0,001
Aug. 23, 1983	90	2/5	0,76	1,06	95,0	-	1,5	-	0,079	0,0074	0,003
Sept. 23, 1983	121	2/6	0,68	1,22	94,4	-	1,8	0,043	0,076	0,008	0,0042
*Oct. 25, 1983	153	2/7	1,43	0,56	91,4	< 0,0001	7.1	0,51	0,1140	0,00495	0,216
Nov. 23, 1983	182	2/8	0,11	3,9	92,8	-	3,4	0,05	0,084	0,0082	0,0051
Dec. 19, 1983	208	2/9	0,79	2,5	93,0	-	3,0	0,04	0,0917	0,0087	0,0054
Jan. 17, 1984	237	2/10	0,92	3,3	94,8	-	2,3	0,08	0,111	0,0085	0,006
Feb. 15, 1984	266	2/11	0,97	3,5	93,2	-	2,8	0,075	0,104	0,006	0,007
March 14, 1984	294	2/12	1,0	2,2	93,1	-	2,6	0,06	0,065	0,008	0,003
April 17, 1984	328	2/13	1,49	1,53	94,0	-	2,38	0,06	0,06	0,0084	0,009
May 15, 1984	357	2/14	1,61	1,5	95,2	-	1,70	0,005	0,074	0,004	0,004
June 16, 1984	386	2/15	1,91	0,91	94,1	-	2,87	0,005	0,071	0,004	0,004

*

possibly exchanged for test site 1

①

List of Documents Requested by NRC.

	Number	Title
1	BMI/ONWI-522	Thermal Property and Density Measurements of Samples Taken from Drilling Cores from Potential Geologic Media
2	USGS O.F. 83-476	Thermal Data From Well GD-1, Gibson Dome, Paradox Valley, Utah
3	ONWI-450	Preliminary Constitutive Properties for Salt and Nonsalt Rocks From Four Potential Repository Sites
	~~ONWI-400~~	~~In Situ and Laboratory Geotechnical Test Results from Borehole GD-1 in Southeast Utah~~
	~~ONWI-400~~	~~In Situ and Laboratory Geotechnical Test Results from Borehole GD-1 in Southeast Utah~~
4	ORNL/TM-7052	Thermal Conductivity of the Rocks in the Bureau of Mines Standard Rock Suite
5	USGS O.F. 83-455	Temperature Profiles from Salt Valley, Utah, Thermal Conductivity of 10 Samples from Drill Hole DOE3, and Preliminary Estimates of Heat Flow
6	Y/DA-7013	Thermal Conductivity of Halite Using a Pulsed Laser
7	UCRL-53128	Thermal Properties of Avery Island Salt to 573 K and 50 MPa Confining Pressure
8	UCRL-83789	Thermal Conductivity, Diffusivity and Expansion of Avery Island Salt at Pressure and Temperature
9	ORNL/TM-6809	Thermal Conductivity of Rock Salt from Louisiana Salt Domes
10	ONWI-104	Creep of 50-mm Diameter Specimens of Dome Salt from Avery Island, Louisiana
11	ONWI-250	Quasi-Static Strength and Creep Characteristics of 100-mm Diameter Specimens of Salt from Avery Island, Louisiana
12	Y/OWI/SUB-78/22303/13	Quasi-Static Strength and Creep Deformational Characteristics of Bedded Salt from the Carey Mine near Lyons, Kansas
13	Y/OWI/SUB-78/22303/9	Petrofabric Analysis of the Deformational Behavior of Lyons, Kansas, and Jefferson Island, Louisiana Rock Salt

	Number	Title
14	Y/OWI/SUB-77/22303/7	Case History Rock Mechanics Examination of the Jefferson Island Salt Mine: III. Evaluation of Laboratory Specimen Dimensions on the Uniaxial Strength and Deformational Characteristics of Dome Salt
15	Y/OWI/SUB-77/22303/5	Case History Rock Mechanics Examination of the Jefferson Island Salt Mine: II. Laboratory Evaluation of Strength and Creep Deformation Characteristics of Dome Salt Under Confining Pressure
16	ORNL/SUB-4269-10	Design Aspects of the Alpha Repository: III. Uniaxial Quasi Static and Creep Properties of the Site Rock
17	ONWI-224	Creep and Creep-Rupture of Rock Salt
18	ONWI-116	Quasi-Static Strength and Deformational Characteristics of Domal Salt from Avery Island, Louisiana
19	ORNL-4555	Project Salt Vault: A Demonstration of the Disposal of High Activity Solidified Wastes in Underground Salt Mines
20	ONWI-100	Mechanical Behavior of Avery Island Halite: A Preliminary Analysis
21	ONWI-190(1)	Avery Island Heater Tests: Temperature Measurements for the First 300 Days
22	ONWI-190(2)	Avery Island Heater Tests: Displacement and Stress Data for the First 300 Days
23	ONWI-190(3)	Nitrogen Gas Permeability Tests at Avery Island
24	ONWI-190(5)	Avery Island Heater Tests: Measured Data for 1000 Days of Heating
	~~ORNL-4555~~	~~Project Salt Vault: A Demonstration of the Disposal of High Activity Solidified Wastes in Underground Salt Mines~~
25	K-0143	Thermal Conductivity and Diffusivity of Permian Basin Bedded Salt at Elevated Pressure and Temperature

	Number	Title	
26	K-0178	Thermal Conductivity and Diffusivity of Permian Anhydrite and Dolomite at Elevated Pressure and Temperature	
27	0-1140 (RSI-0221)	Constitutive Parameters for Salt and Nonsalt Rocks From The Betten, G. Friemel, and Zeeck Wells in the Palo Duro Basin	
28	0-1318 (RSI-0252)	Exponential-Time Constitutive Law for Palo Duro Unit 4 Salt From The J. Friemel No. 1 Well	
	~~0-1449 (RSI-0259)~~	~~Influence of Impurities on the Creep of Salt From The Palo Duro Basin~~	
29	0-1261, 0-1263, 0-1266, (BMI/SRP-5015) 0-1268 8 Volumes	Laboratory Testing of Rock and Salt Samples for Static Moduli, Dynamic Moduli, and Uniaxial and Triaxial Compressive Strength from the Detten No. 1 (PD-6 Well, G. Friemel No. 1 (PD-5) Well, Mansfield No. 1 (PD-4), and Zeeck No. 1 (PD-7_ Well - Palo Duro Basin, Texas: Unanalyzed Data	
30	0-1267	Harman Unconfined, Triaxial and Velocity Tests Report	X
31	0-1269	J. Friemel In-House Tests Report	X
32	0-1450	Salt Index Properties	X
33	0-1270 (Part A)	In Situ Stress Determination by Hydraulic Fracturing, Holtzclaw #1 Well	
34	0-1270 (Part B)	Report on the Borehole Televiewer Used At Holtzclaw No. 1 Well, Permian Basin	
35	0-1354 (RSI-0243)	Exponential-Time Creep Law for Avery Island Salt: First Revision	
36	0-1141	Transient Creep of Repository Rocks, Mehcanistic Creep Laws for Rock Salt	
37	0-1355 (RSI-0235)	Deformation Mechanisms of Experimentally Deformed Cleveland Bedded Salt	
38	0-1445	Assessment of Crushed Salt Consolidation and Fracture Healing Laboratory Test Results	X

	Number	Title
39	K-0179	Laboratory Simulation of Hydraulic Fracturing Stress Measurements in Salt
40	0-1452	A Constitutive and Experimental Investigation of Load History Influences on the Creep Behavior of Salt
41	0-1276 (RSI-0240)	Measured Data From The Avery Island Site C Heater Test
42	0-1306	Annual Report on Asse Mine
43	0-1255	Brine Migration Test Equipment Final Report - Asse Salt Mine
44	0-1454	Quarterly Brine Migration Data Report, Third Quarter, 1983: Brine Migration Investigation at Asse Mine in the Federal Republic of Germany
45	0-1455	Quarterly Brine Migration Data Report, Last Quarter, 1983: Brine Migration Investigation at Asse Mine in Federal Republic of Germany
46	0-1451	Results of Phase II Accelerated Borehole Testing Program at Avery Island
47	ORNL-SUB-4269-21	Experimental Consolidation of Granulated Rock Salt with Application to Sleeve Buckling.
48	ORNL-SUB-3706-2	Analysis and Evaluation of the Rock Mechanics Aspects of the Proposed Salt Mine Repository.
49	ORNL/TM-2102	Temperature and Pressure and its Implication for High level Waste Disposal.
50	ORNL/SUB-3706/1	Analysis and Evaluation of the Rock Mechanics Aspects of the Proposed Salt Mine Repository.

NOTE: THE ABOVE DOCUMENTS, EXCEPT NOS. 30, 31, 32, 38, 39 AND 40 (~~MARKED~~ INDICATE BY X), WERE FURNISHED TO NRC.

SRP GEOCHEMISTRY PROGRAM OVERVIEW FOR NRC

Columbus, Ohio

August 22, 1984

Members of the NRC Salt Project attended a geochemistry meeting on August 22, 1984. The objectives of this meeting were to obtain an overview of the SRPO/ONWI geochemistry program and review selected geochemistry and waste package documents requested by NRC.

Summary of Activities

1. NRC began the meeting by discussing the objectives of this meeting and related it to NRC's EA preparations (Enclosure 1). ONWI staff members then made overview presentations following the topics on the enclosed agenda and viewgraphs (Enclosures 2 and 3). The list of attendees is enclosed (Enclosure 4) and includes NRC staff in the areas of geochemistry, waste package, and performance assessment. Representatives from Louisiana and Mississippi also attended.
2. During the afternoon of August 22, 1984, per a discussion between R. Johnson and L. Casey, a few of the documents requested by NRC in the August 17, 1984, letter from J. Linehan to J. Neff were made available for review only and not retention (Enclosure 5). Copies of additional documents were given to the NRC for retention (Enclosure 5). The status of each of the requested documents was summarized by N. Hubbard.
3. As a supplemental item G. Jansen reviewed with the NRC the content of item 5 on Enclosure 5.

Observations

1. The presentations by ONWI were very informative and gave NRC staff a perspective that will be useful for planning future meetings around topics which were mentioned by both groups. Some of these topics are identified below.

SRPO GEOCHEMISTRY PROGRAM OVERVIEW FOR NRC

2. NRC anticipates that plans for investigating retardation in the far field and the rationale (data and assumptions) supporting these plans will be topics of multidisciplinary review and a potential workshop.
3. The current understanding by ONWI concerning preliminary waste package performance as affected by geochemistry-related factors is that the waste package can last a very long time (i.e., perhaps over 10,000 years) under postulated expected conditions. NRC anticipates that the assumptions underlying DOE's choice of expected conditions will be a major topic of review and a potential workshop.
4. NRC recognized, as a result of the rock mechanics data review and the geochemistry meeting, that investigations of brine migration and presentations are divided up within SRPO/ONWI into geochemistry, rock mechanics and performance assessment groups. Future meetings between SRPO and NRC that might be planned for discussing brine migration would benefit from including an integrated effort by all those SRPO/ONWI groups involved.
5. No observations were provided for this meeting summary by the representatives of Louisiana and Mississippi.

Action Items

1. SRPO agreed to provide a copy as soon as convenient of those EA references requested in the August 17, 1984 letter from J. Linehan to J. Neff.
2. NRC would like SRPO to identify for NRC those documents supporting the waste package leaching tests referred to in D. Clark's presentation. NRC would also like to receive a copy of these documents (those not published) as soon as convenient.

SRPO GEOCHEMISTRY PROGRAM OVERVIEW FOR NRC

The above items were discussed and the above action items agreed to. The draft of this summary was signed by ~~J. Neff of~~ DOE/SRPO and ~~R. Johnson of~~ NRC on August 24, 1984.

Jo-Ann Sherwin, DOE

Leslie A. Gray, SRPO

Robert J. Johnson 8/24/

SRPO GEOCHEMISTRY PROGRAM OVERVIEW FOR NRC

The above items were discussed and the above action items agreed to. The draft of this summary was signed by DOE/SRPO and NRC on August 24, 1984.

Jo-Ann Sherwin, DOE

Leslie A. Gray, SRPO

Robert T. Johnson 8/24/84

Enclosure 1

NRC REVIEW OF DRAFT EA'S

- DRAFT EA REVIEW
  - 60 day comment period
  - 30 day staff review
  - Simultaneous review of up to 9 draft EA's
  - Separate comments for each draft EA
  - Transmittal letter with major and specific comments attached, 40-80 pages
- PREPARATIONS PRIOR TO EA RELEASE
  - Inventory of documents and data
  - Conduct document and data reviews
  - Develop preliminary scenarios and conceptual models
  - Conduct sensitivity calculations in selected areas
  - Develop preliminary list of issues
  - Review early draft EA's
- SALT PROJECT ORGANIZATION

DIVISION OF WASTE MANAGEMENT

4

Director (Browning) (2)
Deputy (Bell) (2)

On-Site Licensing Representative 4
BWIP (Cook) (2)
NTS (Prestholt) (1)
SALT (Verma) (1)

REPOSITORY PROJECTS BRANCH (5) (Miller)	ENGINEERING BRANCH (2) (Barrett)	GEOTECHNICAL BRANCH (2) (Knapp)	POLICY AND PROGRAM CONTROL BRANCH (2) (Bunting)	LOW-LEVEL & URANIUM PROJECTS BRANCH (3) (Higginbotham)
BWIP Projects Section (5) (Kennedy)	Materials Engineering Section (8) (Johnson)	Hydrology Section (13) (Fliegel)	Policy Section (7) (Surmeier)	Low-Level Projects Section (8) (Jackson)
NTS Project Section (4) (Coplan)	Mining, Geoengineering Facility Design Section (7) (Greeves)	Geology/ Geophysics Section (7). (Justus)	Program Planning Section (4) (Altomare)	Uranium Recovery Projects Section (8) (Martin)
SALT Project Section (6) (Linehan)	Rock Mechanics Section (5) (Nataraja)	Geochemistry Section (4) (Starmer)	Integration Section (6) (Kearney)	
Regulation & Environmental Section (5) (Boyle)			Program Control and Analysis Section (7) (Mattson) Docket Control Center [(3)]	
25	22	26	26	18

TOTAL - 125

ORGANIZATIONAL CHART

84/07/26

NRC SALT PROJECT ORGANIZATION

	NRC STAFF		TECHNICAL ASSISTANCE CONTRACTS		
REVIEW TEAM	SALT PROJECT SECTION John Linehan	ON-SITE REPRESENTATIVE Teek Verma			
	PROJECT MANAGEMENT Robert Johnson				
	PERFORMANCE ASSESSMENT Mark Logsdon		PERFORMANCE ASSESSMENT Sandia		
	HYDROLOGY Fred Ross		HYDROGEOLOGY/CONCEPTUAL MODELS Golder Associates	HYDROGEOLOGY/TESTING Williams + Associates	
	GEOLOGY/GEOPHYSICS John Trapp		SEISMOTECTONICS/STRUCTURE Livermore EXPLORATION GEOPHYSICS Weston Geophysical	GROUNDWATER GEOLOGY Golder + Williams ENGINEERING GEOLOGY Engineers International	GENERAL GEOLOGY Army Corps of Engineers ENERGY + MINERAL RESOURCES TBD
	ROCK MECHANICS Jerry Pearring		INSITU TESTING Engineers International	THERMOMECHANICAL ANALYSIS Sandia	
	FACILITY DESIGN Jerry Pearring		FACILITY DESIGN Engineers International	MINING Bureau of Mines	
	GEOCHEMISTRY Walt Kelly		GEOCHEMISTRY Oak Ridge	GEOCHEMISTRY SENSITIVITY STUDIES Sandia	
	MATERIALS ENGINEERING Mike Tokar		WASTE PACKAGE/GENERAL Brookhaven	WASTE PACKAGE ANALYSIS Aerospace Corp.	
	ENVIRONMENT Ed Regnier		ENVIRONMENT/SOCIOECONOMICS TBD		
SUPPORT	STATE INTERACTIONS Donna Mattson				
	INFORMATION MANAGEMENT Nancy Still				
	RESEARCH				

Enclosure 2

GEOCHEMISTRY OVERVIEW

- Salt Repository Project -

August 22, 1984

Conference Room "C"

8:30am	Introduction	J. Sherwin/SRPO
8:40am	Introductory Comments	R. Johnson/NRC
9:00am	Site Characterization	N. Hubbard/ONWI

- Geological and Hydrological Settings:
  Palo Duro, Paradox, Gulf Coast
  - location and sizes of aquifers
  - water chemistry
  - origin of water chemistry
  - residence time (groundwater age)
  - radionuclide retardation
- Chemical Composition and Amounts of Brine
  - fluid inclusion brines:
    Palo Duro, Paradox, Gulf Coast
  - brines produced should external ground water intrude the host rock:
    Palo Duro, Paradox, Gulf Coast

10:00am	Laboratory Testing of Waste Package Components and Radiation Effects	D. Clark/ONWI

- Corrosion Rates of Mild Cast Steel in brines, with and without radiation
- Effects of Radiolysis on Brines and Salt
- Radionuclide Release in the Brine - Overpack - Waste Form System

10:30am	Performance Assessment	J. Kircher/ONWI

- Waste Package Lifetimes
  - expected conditions
    - brine migration
    - brine chemistry
    - radiolysis
  - breached by groundwater external to the salt
    - brine chemistry
    - radiolysis

11:30am	Natural Analogs • Salton Sea • Oklo • Morro to Ferro	N. Hubbard/ONWI
11:35am	Closing Summary Major Points: • Amounts of brine that migrate to waste package are inadequate to breach it; • Waste package dominates near-field chemistry; • Brines resulting from breaching are less corrosive than fluid inclusion brines, except perhaps at Paradox; • No exit from salt under expected conditions; • Extremely long travel times outside salt, especially at Palo Duro.	N. Hubbard/ONWI
12:00	Lunch	

Enclosure 3

GEOCHEMISTRY OVERVIEW
PERFORMANCE ASSESSMENT

AUGUST 22, 1984

JFK/8/22/84

ONWI
Office of Nuclear Waste Isolation
BATTELLE Project Management Division

BRINE MIGRATION CODES

MIGRAIN - EMPIRICAL

SPECTROM-58 - COMPREHENSIVE, THEORETICAL BASIS

BRINEMIG - EMPIRICAL; RESEMBLES MIGRAIN

ONWI

BATTELLE Project Management Division

VSM: 10/14/83

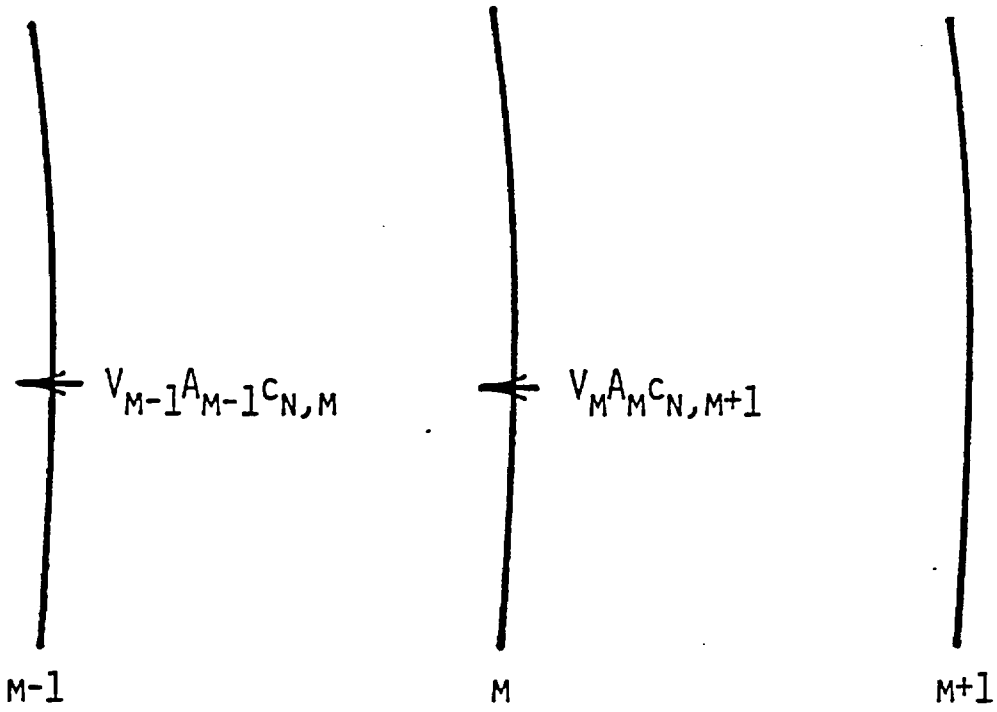
BRINEMIG

FINITE DIFFERENCE CODE BASED ON RADIAL INCREMENTS AND TIME INCREMENTS.

- USES JENKS EQUATION TO CALCULATE VELOCITIES
- CALCULATES TEMPERATURES FROM TABLES SUPPLIED BY TEMPV5
  - --USES LARGEST TEMPERATURE GRADIENTS
  - --PERFORMS SEMILOGARITHMIC INTERPOLATIONS
  - --NEGLECTS END EFFECTS
- ALLOWS USE OF A THRESHOLD GRADIENT

ONWI

VSM: 10/14/83



IN = OUT + ACCUMULATION

$$V_M A_M C_{N,M+1} = V_{M-1} A_{M-1} C_{N,M} + (C_{N+1,M} - C_{N,M}) \frac{\Delta V_M}{\Delta T}$$

WHERE M = RADIAL INCREMENT NUMBER

N = TIME INCREMENT NUMBER

V = VELOCITY

A = AREA

C = CONCENTRATION

ΔV = VOLUME OF INCREMENT

ΔT = TIME INCREMENT

ONWI

BATTELLE Project Management Division

VSM: 10/14/83

JENKS EQUATION

$$\text{LOG}\ (V/G) = 0.00656T - 0.6036$$

WHERE V = VELOCITY OF FLUID INCLUSION, CM/YR

G = TEMPERATURE GRADIENT IN SALT, $^{o}C/CM$

T = TEMPERATURE, ^{o}C

ONWI

VSM: 10/14/83

THRESHOLD GRADIENT

- MINIMUM TEMPERATURE GRADIENT WHICH WILL GIVE BRINE MIGRATION.

- ESTIMATED IN LITERATURE TO EQUAL 0.125°C/CM.

ONWI
Office of Nuclear Waste Isolation
Battelle

VSM:7-9-84

SALT BLOCK II

THERMAL GRADIENTS APPLIED TO A SALT CYLINDER

- CYLINDER FROM A SALT BED

  OUTSIDE RADIUS = 0.5 M
  INSIDE RADIUS = 0.05 M
  HEIGHT = 1 M

- VARIABLE HEAT SOURCE INSIDE

- CONSTANT TEMPERATURE CONTROL OUTSIDE

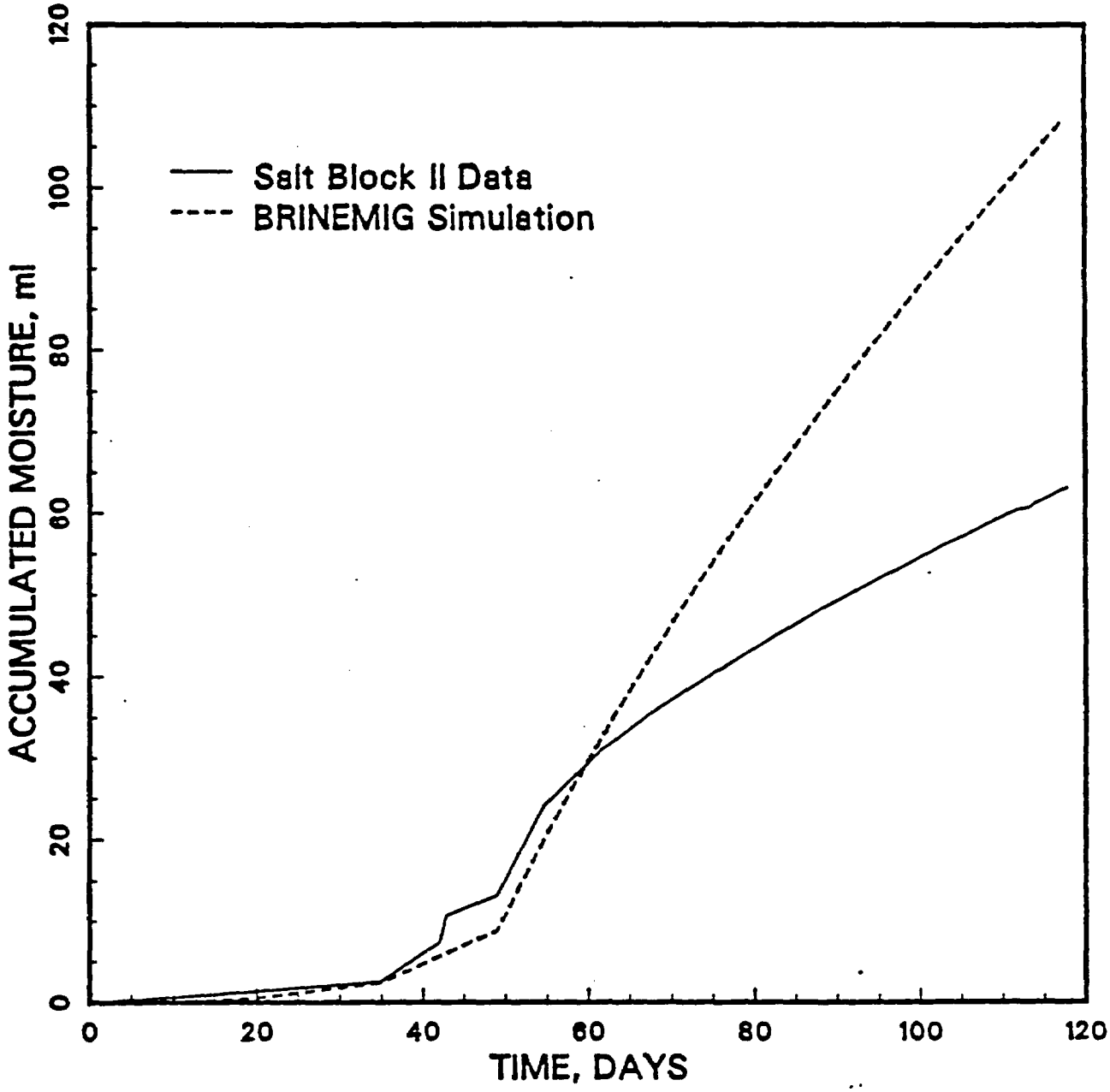
VSM: 10/14/83

ASSUMPTIONS

- ALL MIGRATION WAS INTRACRYSTALLINE.
- MOST CONSERVATIVE TEMPERATURE PROFILE WAS APPLIED THROUGHOUT.
- END EFFECTS WERE CONSIDERED FOR SALT BLOCK II SIMULATION.
- END EFFECTS WERE NEGLECTED FOR WASTE PACKAGES.
- INITIAL MOISTURE CONTENT WAS 5 VOLUME PERCENT FOR BEDDED SALTS.
- INITIAL MOISTURE CONTENT WAS 0.5 VOLUME PERCENT FOR DOMAL SALT.

VSM:7-9-84

ONWI
Office of Nuclear Waste Isolation
Battelle



Accumulated Moisture vs. Time
Simulation of Salt Block II Data

VSM:7-9-84

INPUT TO BRINEMIG

INITIAL CONCENTRATIONS OF BRINE IN SALT

- BEDDED = 0.05 ML/CM^3
  - GIBSON DOME
  - PALO DURO
- DOME = 0.005 ML/CM^3
  - RICHTON

EFFECTIVE PACKAGE LENGTH

- CHLW = 367.9 CM
- SF = 385.0 CM

PACKAGE RADIUS

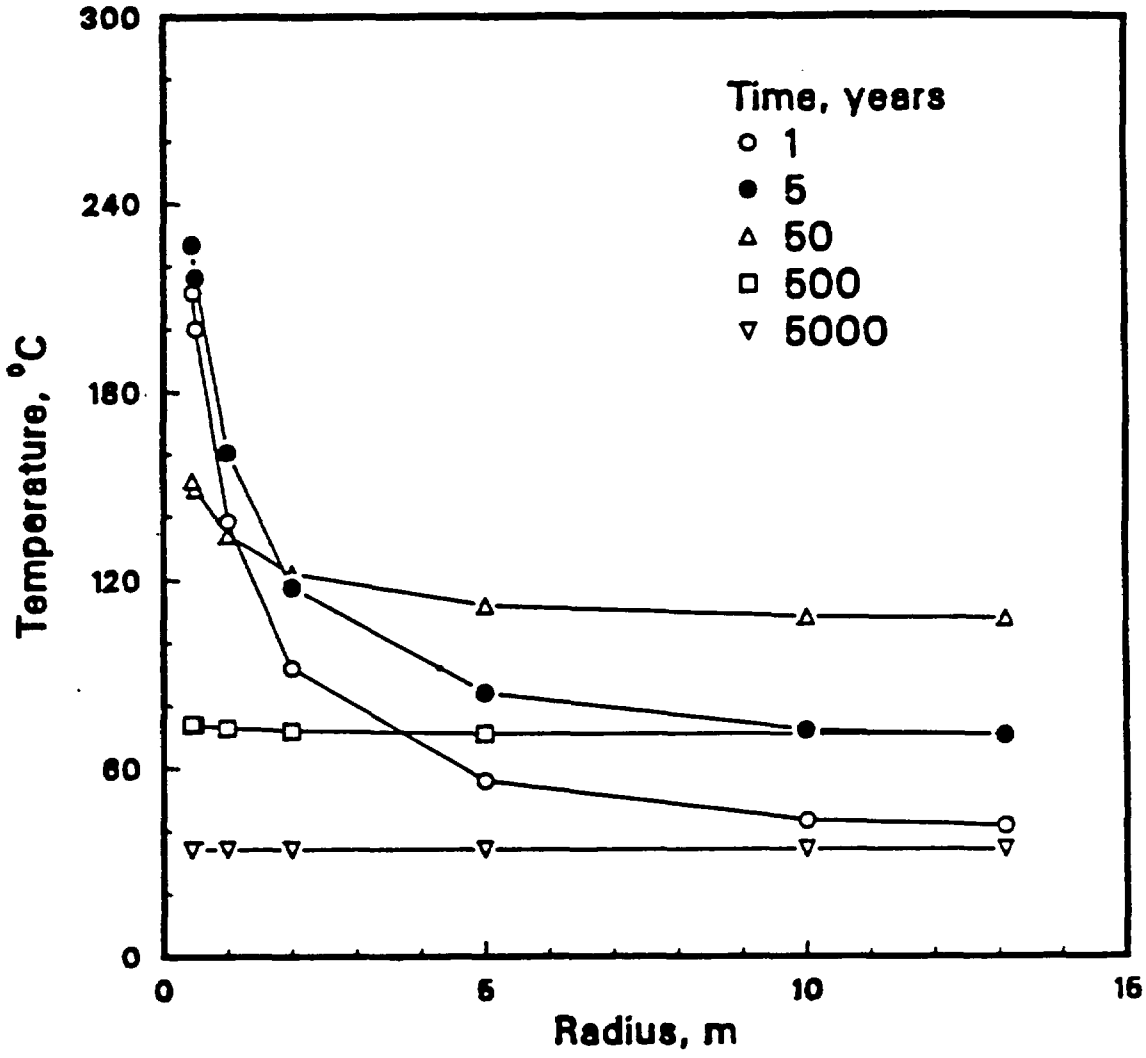
- CHLW = 44.5 CM
- SF = 41.7581 CM

DISTANCE BETWEEN PACKAGES

- CHLW = 1310 CM
- SF = 1005 CM

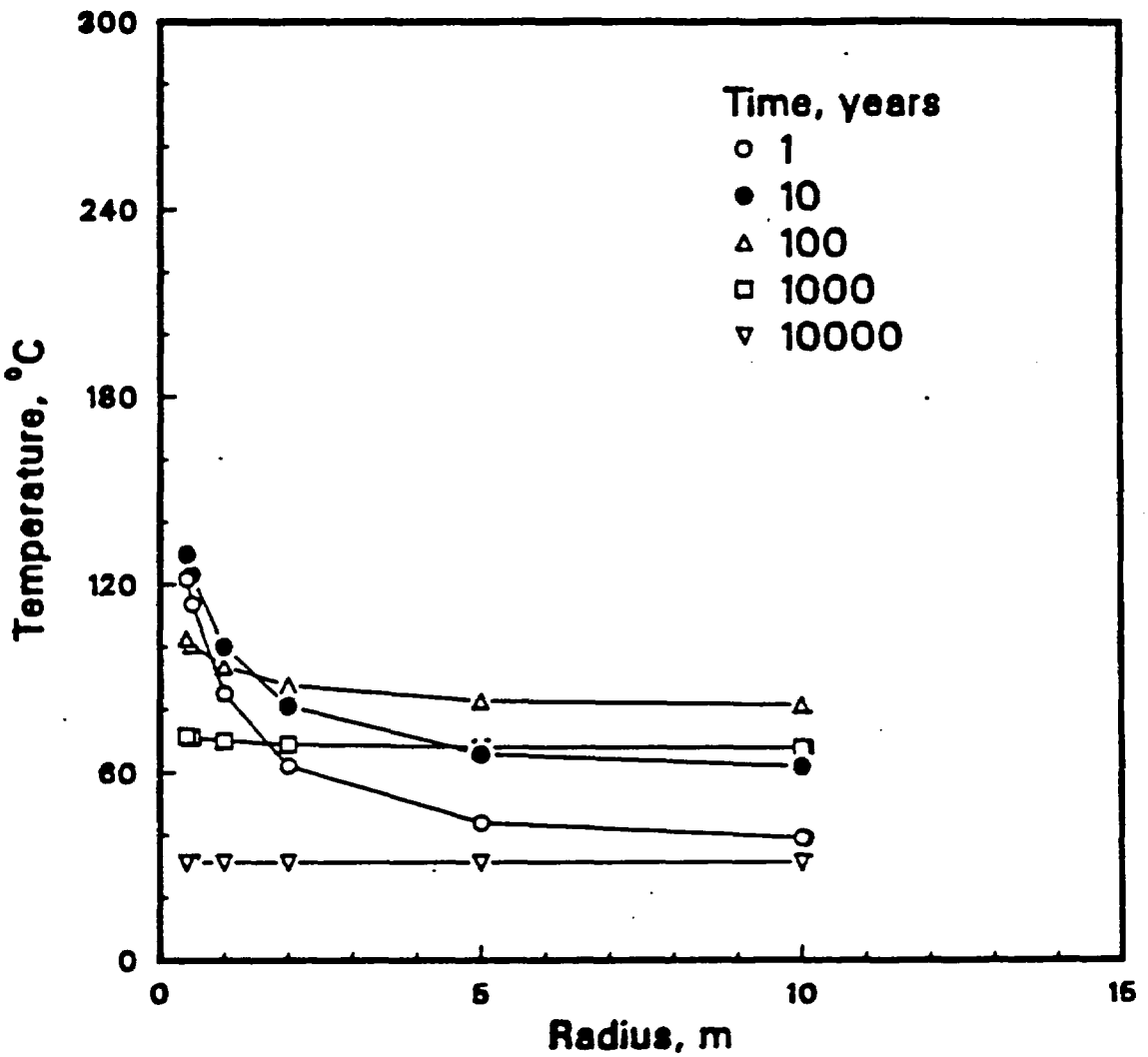
ONWI

VSM: 10/14/83



TEMPERATURES AROUND CHLW
WASTE PACKAGE AT DEAF SMITH

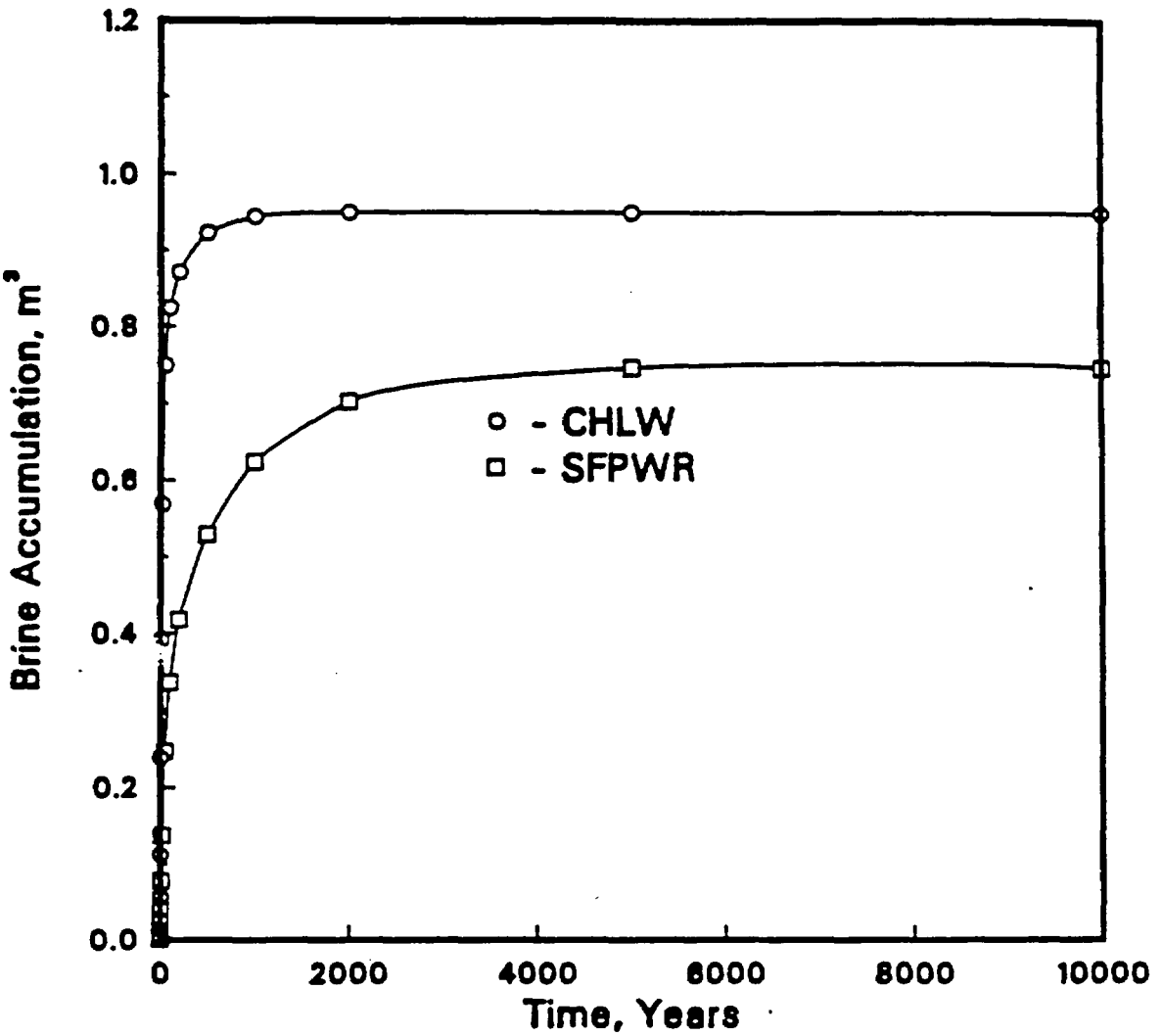
VSM:7-9-84



TEMPERATURES AROUND SFPWR
WASTE PACKAGE AT DEAF SMITH

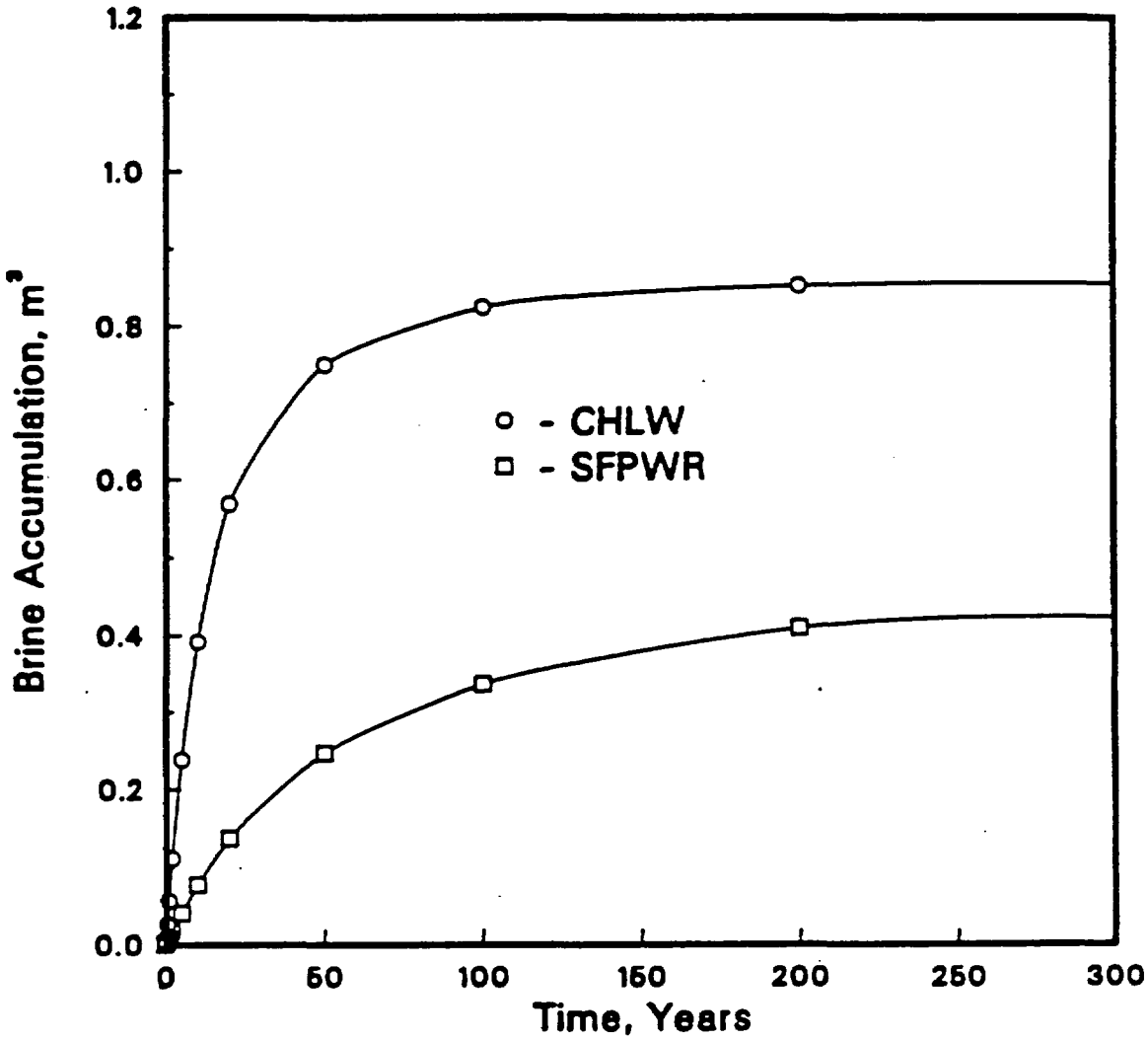
ONWI
Office of Nuclear Waste Isolation
Battelle

VSM:7-9-84



BRINE ACCUMULATION AT WASTE PACKAGE
WITH TIME AND ZERO THRESHOLD GRADIENT
FOR DEAF SMITH

VSM:7-9-84



BRINE ACCUMULATION AT WASTE PACKAGE
WITH TIME AND THRESHOLD GRADIENT OF
0.125°C/CM FOR DEAF SMITH

ONWI

VSM:7-9-84

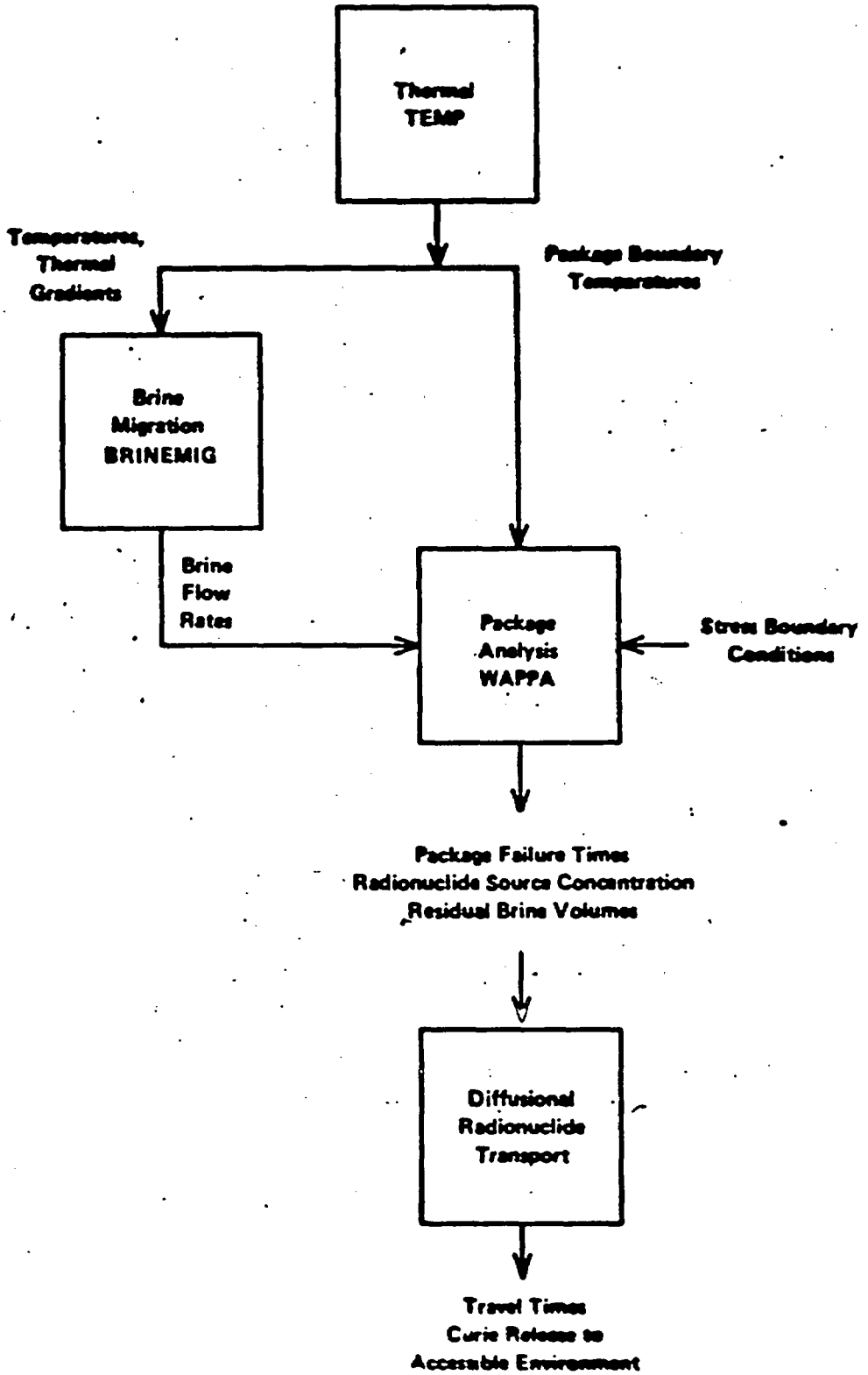
CONCLUSIONS

- ONLY A SMALL FRACTION OF THE AFFECTED MOISTURE LEAVES THE SALT.
- THE THRESHOLD GRADIENT HAS A SIGNIFICANT EFFECT ON THE RESULTS FOR SPENT FUEL.
- RICHTON DOME SHOWS THE SMALLEST BRINE ACCUMULATION.
- MORE WORK MUST BE DONE TO ESTABLISH CONSERVATISM.

ONWI

BATTELLE Project Management Division

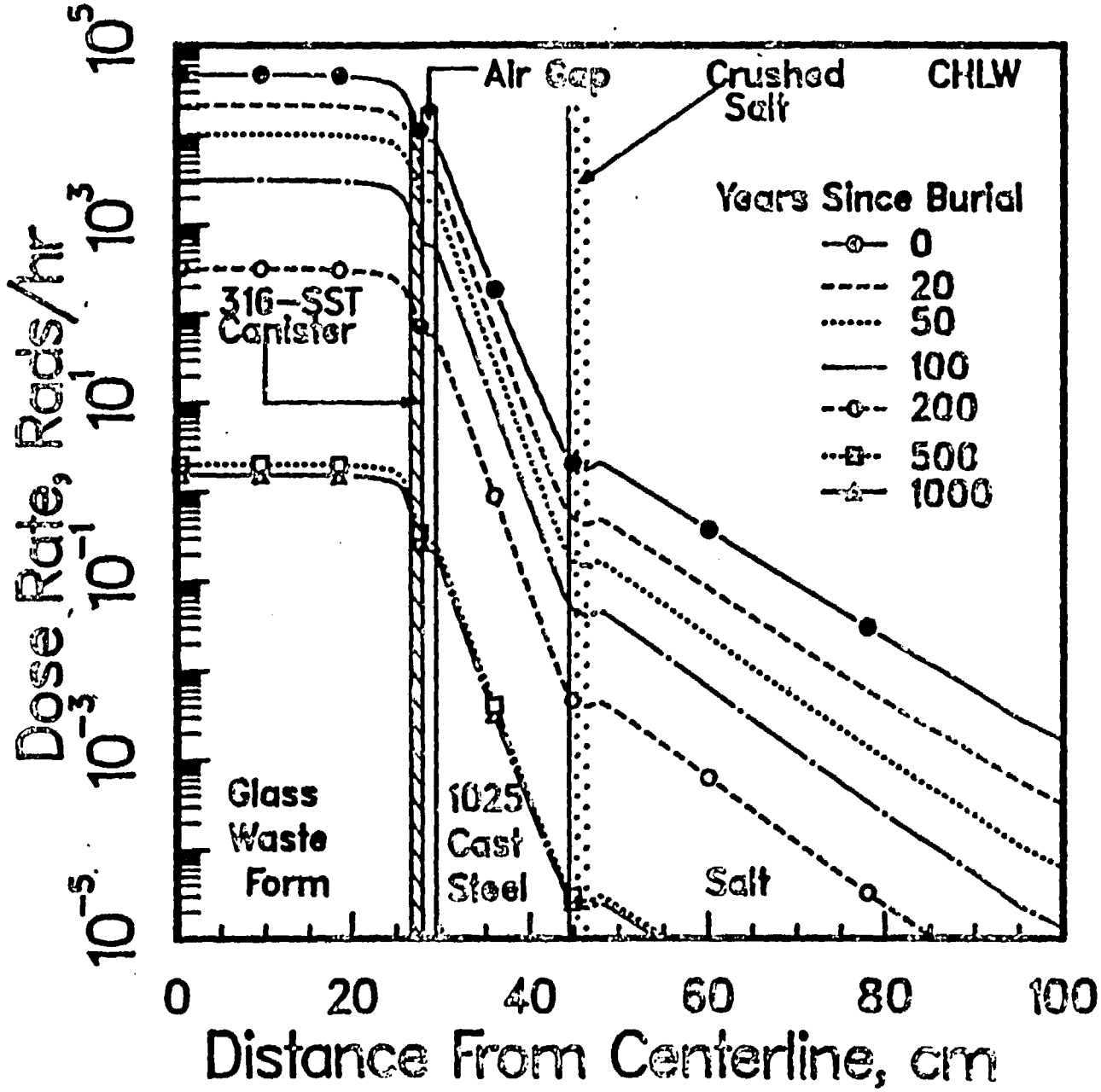
VSM: 10/14/83

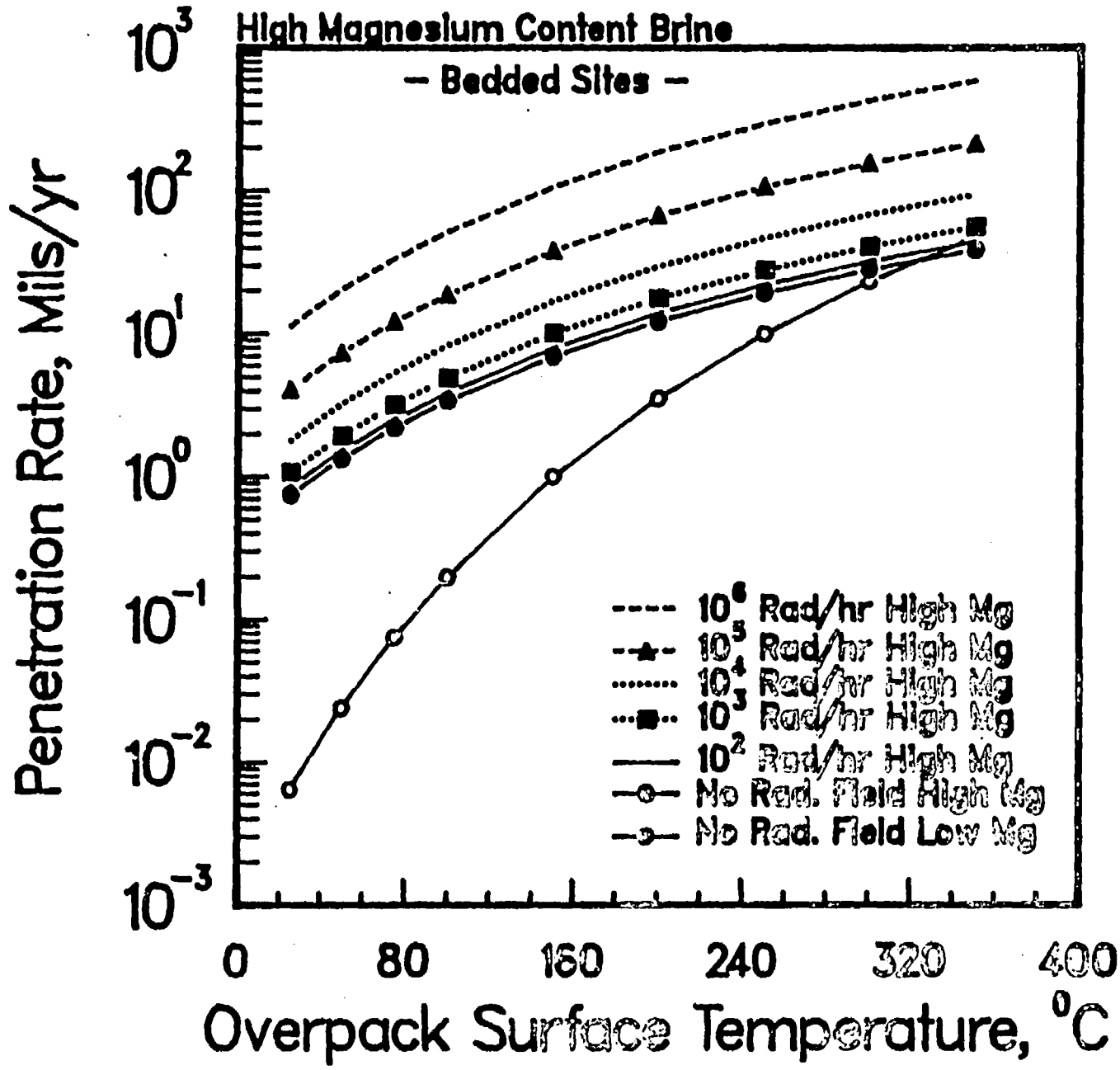


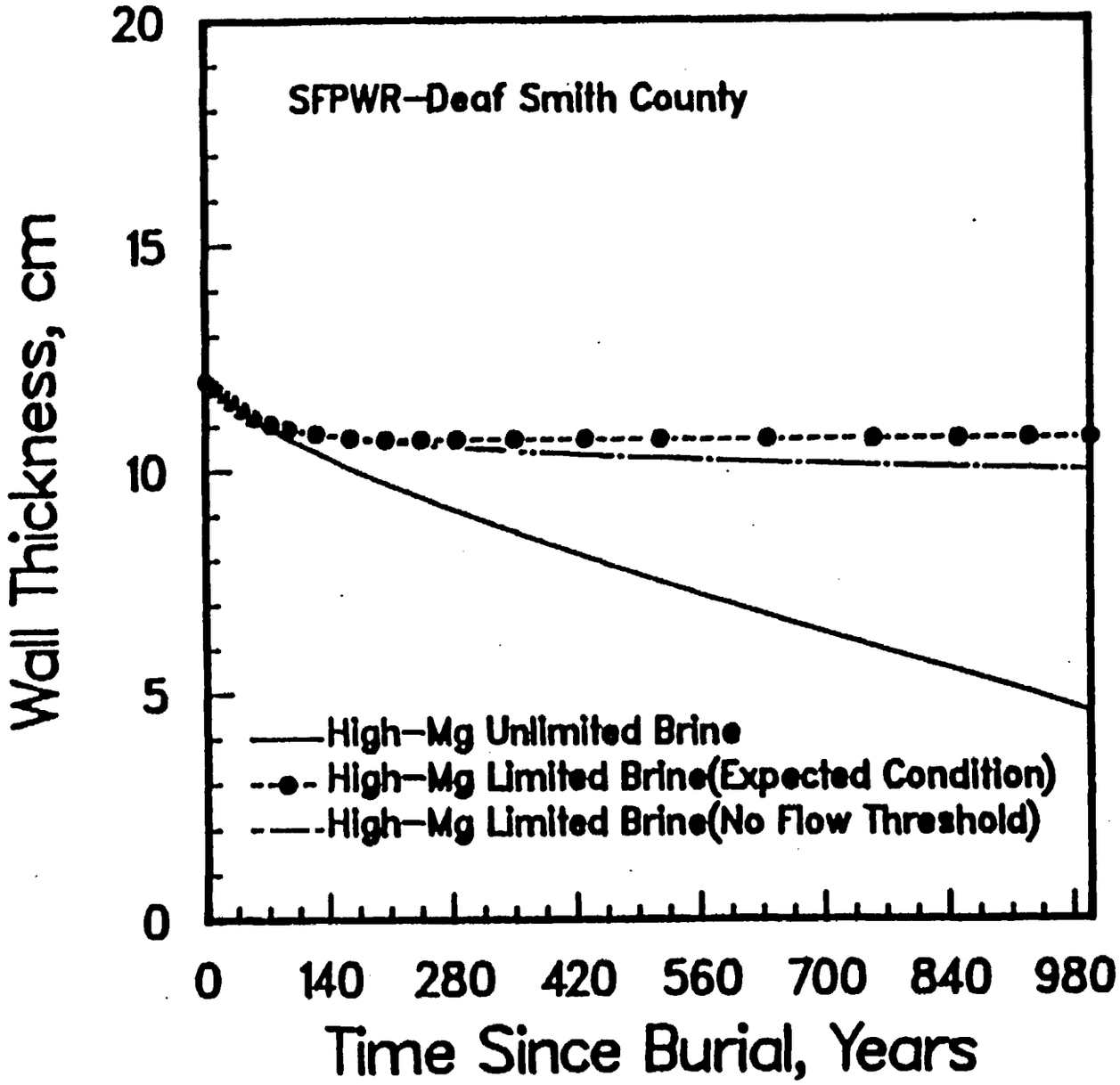
ONWI

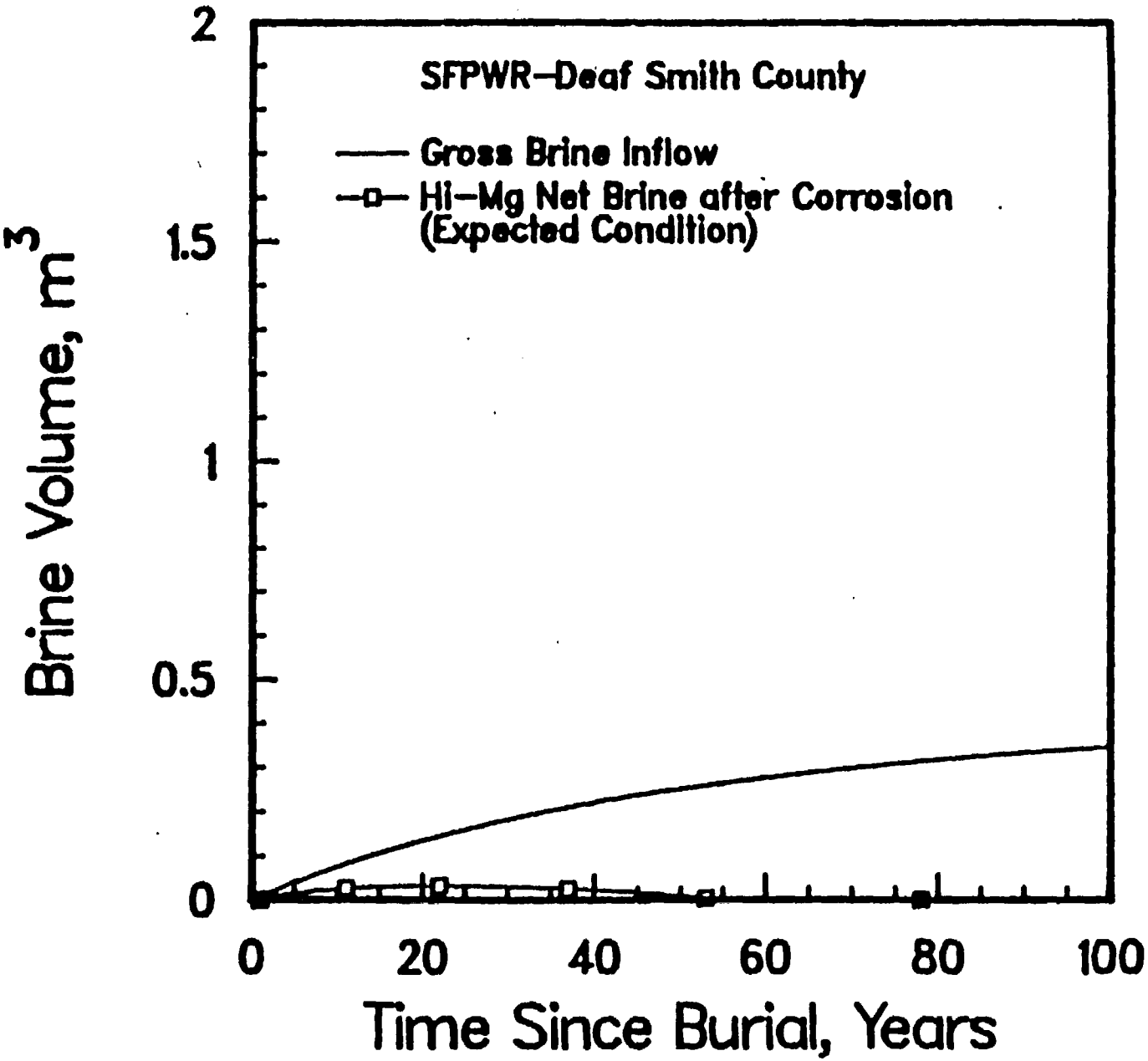
BATTELLE Project Management Division

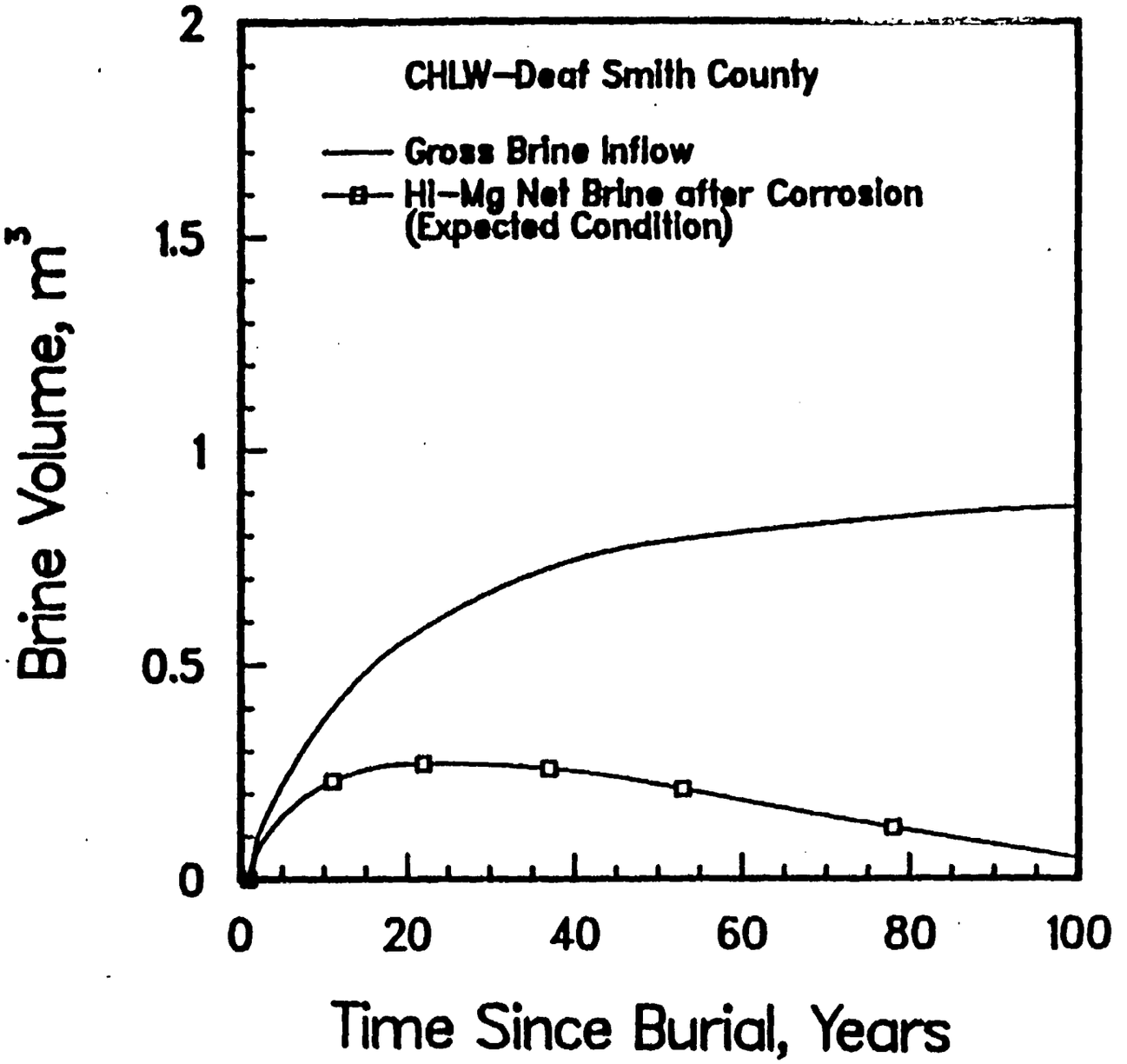
System Analyses for Assessment
of Performance of Engineered Barriers


Air Gap
Crushed Salt
CHLW
Years Since Burial
0
20
50
100
200
500
1000
316-SST Canister
Glass Waste Form
1025 Cast Steel
Salt
Dose Rate, Rads/hr
10^5
10^3
10^1
10^{-1}
10^{-3}
10^{-5}
0
20
40
60
80
100
Distance From Centerline, cm


High Magnesium Content Brine
— Bedded Sites —
Penetration Rate, Mils/yr
10^3
10^2
10^1
10^0
10^{-1}
10^{-2}
10^{-3}
0
80
160
240
320
400
Overpack Surface Temperature, °C
10^6 Rad/hr High Mg
10^5 Rad/hr High Mg
10^4 Rad/hr High Mg
10^3 Rad/hr High Mg
10^2 Rad/hr High Mg
No Rad. Field High Mg
No Rad. Field Low Mg


SFPWR–Deaf Smith County
Wall Thickness, cm
20
15
10
5
0
High–Mg Unlimited Brine
High–Mg Limited Brine(Expected Condition)
High–Mg Limited Brine(No Flow Threshold)
0
140
280
420
560
700
840
980
Time Since Burial, Years


SFPWR–Deaf Smith County
Gross Brine Inflow
Hi–Mg Net Brine after Corrosion
(Expected Condition)
Brine Volume, m3
2
1.5
1
0.5
0
0
20
40
60
80
100
Time Since Burial, Years


CHLW–Deaf Smith County
Gross Brine Inflow
Hi–Mg Net Brine after Corrosion
(Expected Condition)
Brine Volume, m3
2
1.5
1
0.5
0
0
20
40
60
80
100
Time Since Burial, Years

Deaf Smith County SFPWR Package. Comparison of Solubility and Maximum Brine Volume Limited Release at a Failed Waste Package Boundary with EPA Discharge Limits to the Accessible Environment

The volume of brine is 0.41 m^3 made available by brine thermal migration with a threshold thermal gradient.

Element	Solubility,[a] grams/m^3	Package Inventory,[b] grams	Dissolved in Brine, grams	Nuclide	EPA Limit,[c] Curies per 1000 MTIHM	Ratio of Radioactivity[b] in Brine to EPA Limit	Total Volume of Saturated Brine to Reach EPA Limit, m^3
Carbon	400.	831.	164.	C-14	200	1.2	0.35
Selenium	0.001	279.	4.1E-4	Se-79	500	0.12E-5	3.4E+5
Strontium	0.8	1,750.	0.33	Sr-90	80	0.11	3.9
Technetium	0.001	3,813.	4.1E-4	Tc-99	10,000	0.14E-6	2.9E+6
Tin	0.0001	6,752.	4.1E-5	Sn-126	80	0.58E-7	7.0E+6
Iodine	600,000.	1,157.	1,157.	I-129	500	0.063	Not saturated
Cesium	600,000.	7,077.	7,077.	Cs-135	2,000	0.17	Not saturated
				Cs-137	500	159. (meets limit by decay at 520 years)	
Radium	0.00042	0.67	1.7E-4	Ra-226	3	0.19E-4	2.1E+4
Thorium	0.001	50.	4.1E-4	Th-230	10	0.34E-5	1.2E+5
Uranium	0.001	4,800,000.	4.1E-4	U-234	10	0.16E-7	2.5E+7
Neptunium	0.001	8,245.	4.1E-4	Np-237	20	0.15E-5	2.7E+5
Plutonium	0.001	38,394.	4.1E-4	Pu-238	400	0.57E-5	7.2E+4
				Pu-239	100	0.33E-4	1.2E+4
				Pu-240	100	0.55E-4	7.5E+3
				Pu-241	500	0.41E-7	1.0E+7
				Pu-242	100	0.18E-06	2.3E+6
Americium	0.0001	4,304.	4.1E-5	Am-241	10	0.26E-2	1.6E+2
				Am-243	4	0.38E-4	1.1E+4
Curium	0.001	4.4	4.1E-4	Cm-244	10	0.13E-3	3.3E+3

(a) Various other solubility data exist, some with higher and some with lower values for various nuclides. These other data may be no more or no less applicable for this preliminary analyses.
(b) Maximum value during the period 300 years to 10,000 years.
(c) U.S. EPA, 1982, p. 58206.

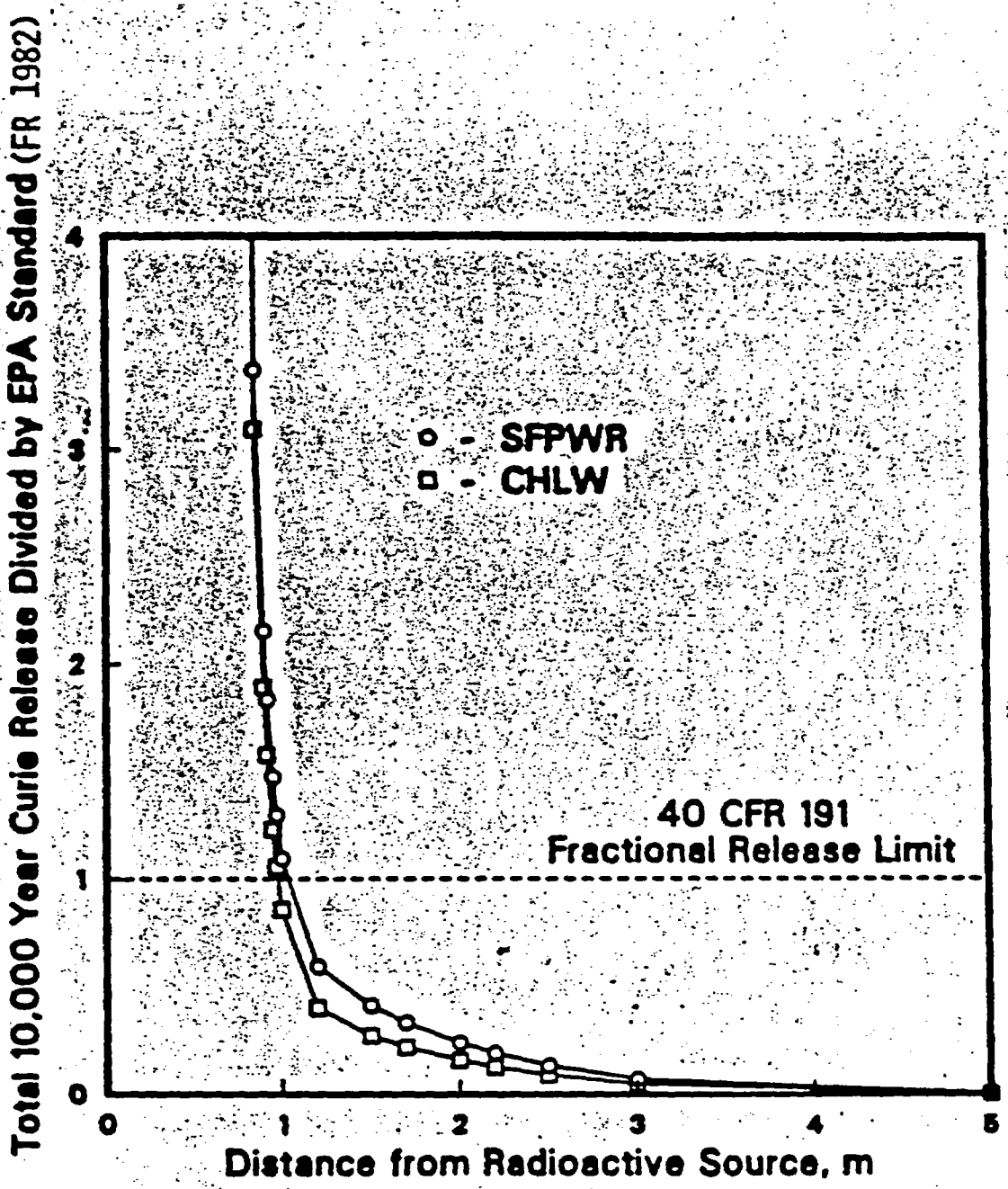
Deaf Smith County SFPWR Package. Comparison of Package Release Rates to Saturate Incoming Brine at 300 Years at the Waste Package Boundary with NRC Engineered System Release Rate Limits in 10 CFR 60

The final gross volume of incoming brine will be 0.75 m^3, made available by brine migration without a threshold thermal gradient.

The gross brine inflow rate is 4.2E-4 m^3 per year at 300 years after burial.

Element	Solubility,(a) grams/m^3	300 yr Package Inventory,(b) grams	Quantity Required to Saturate Incoming Brines, grams/yr	Nuclide	Activity From Package to Brine, Curies/yr	Ratio to 1000yr Nuclide Activity/ (1E-5 per yr)	Ratio to 1000yr Total Activity/ (1E-8 per yr)
Carbon	400.	831.	0.17	C-14	0.0012	22.	14.
Selenium	0.001	279.	4.2E-07	Se-79	3.0E-9	1.5E-04	(c)
Strontium	0.8	1,750.	3.4E-04	Sr-90	4.3E-5	330,000.	0.52
Technetium	0.001	3,813.	4.2E-07	Tc-99	7.1E-09	1.1E-5	(c)
Tin	0.0001	6,752.	4.2E-08	Sn-126	2.4E-11	6.3E-7	(c)
Iodine	600,000.	1,157.	250.	I-129	0.034	22,000.	410.
Cesium	600,000.	7,077.	250.	Cs-135	0.060	3,600.	710.
				Cs-137	14.	3.8E+10	170,000.
Radium	0.00042	1.1E-03	1.8E-7	Ra-226	1.7E-07	1.1	0.0021
Thorium	0.001	1.2	4.2E-7	Th-230	7.3E-09	0.086	(c)
Uranium	0.001	4,800,000.	4.2E-7	U-234	8.3E-13	8.3E-9	(c)
Neptunium	0.001	4,250.	4.2E-7	Np-237	3.0E-10	6.0E-6	(c)
Plutonium	0.001	38,394.	4.2E-7	Pu-238	1.2E-8	2.4E-4	(c)
				Pu-239	1.7E-08	1.1E-6	(c)
				Pu-240	2.8E-8	1.2E-6	(c)
				Pu-241	1.0E-10	1.6E-5	(c)
				Pu-242	9.3E-11	1.1E-6	(c)
Americium	0.0001	4,304.	4.2E-08	Am-241	1.3E-7	3.0E-6	(c)
				Am-243	7.8E-10	1.0E-6	(c)
Curium	0.001	4.4	4.2E-07	Cm-244	6.4E-09	3.1E+06	7.7E-05

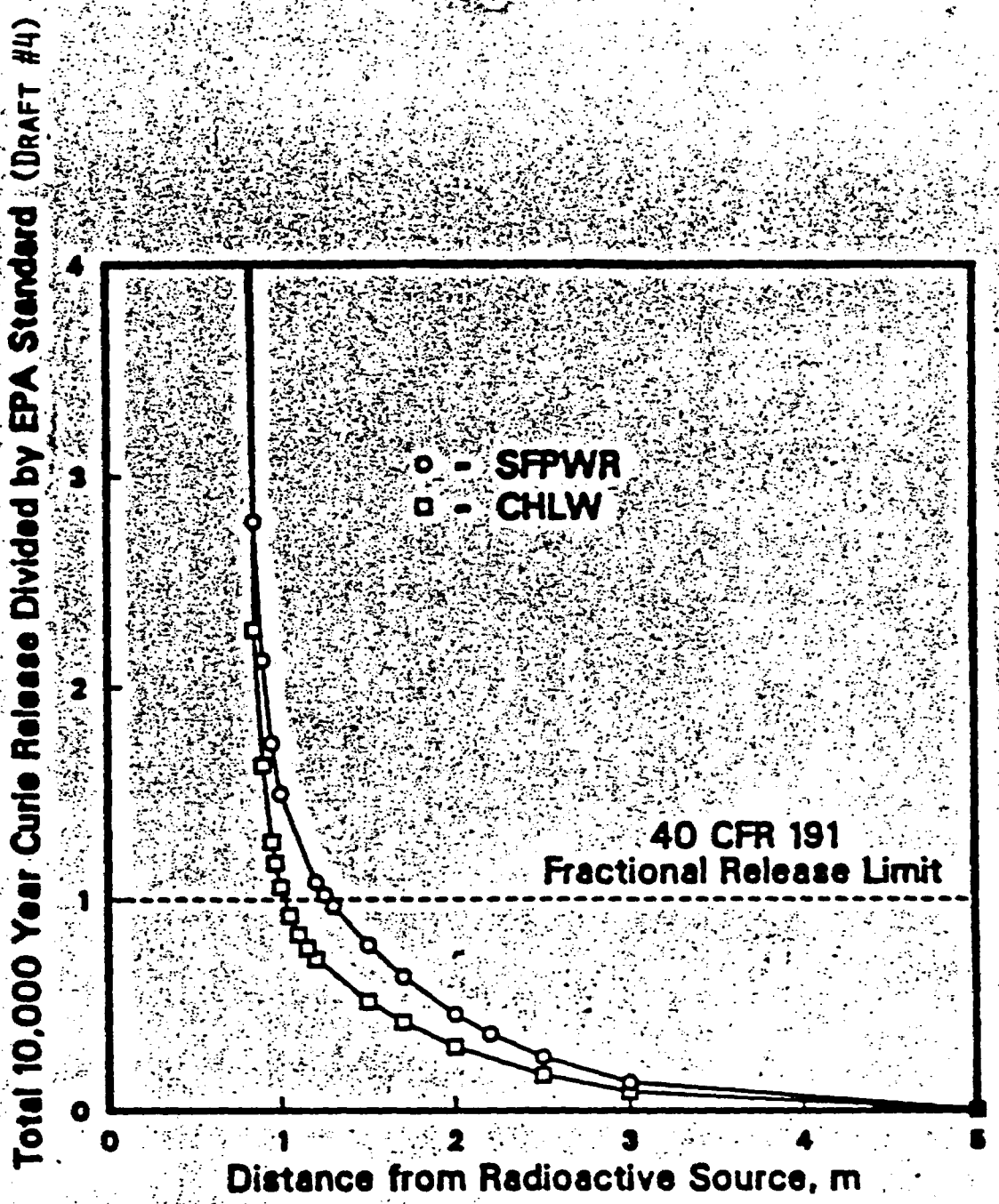
(a) Various other solubility data exist, some with higher and some with lower values for various nuclides. These other data may be no more or no less applicable for this preliminary analyses.
(b) The radium, thorium, and neptunium grow larger with time, so that at 10,000 years these inventories are 6.7E-01, 49.5, and 8,243 grams per package, respectively.
(c) This value is not computed unless the primary (10^{-5}) standard is not met indicated by a value greater than one in the preceding column.



TOTAL 10,000 YEAR CURIE RELEASE DIVIDED BY EPA STANDARD FOR VARIOUS DISTANCES TO HYPOTHETICAL ACCESSIBLE ENVIRONMENT FOR DEAF SMITH

ONWI

SB:7-9-84



Total 10,000 Year Curie Release Divided by EPA Standard for Various Distances to Hypothetical Accessible Environment for Deaf Smith

ONWI

SB:7-9-84

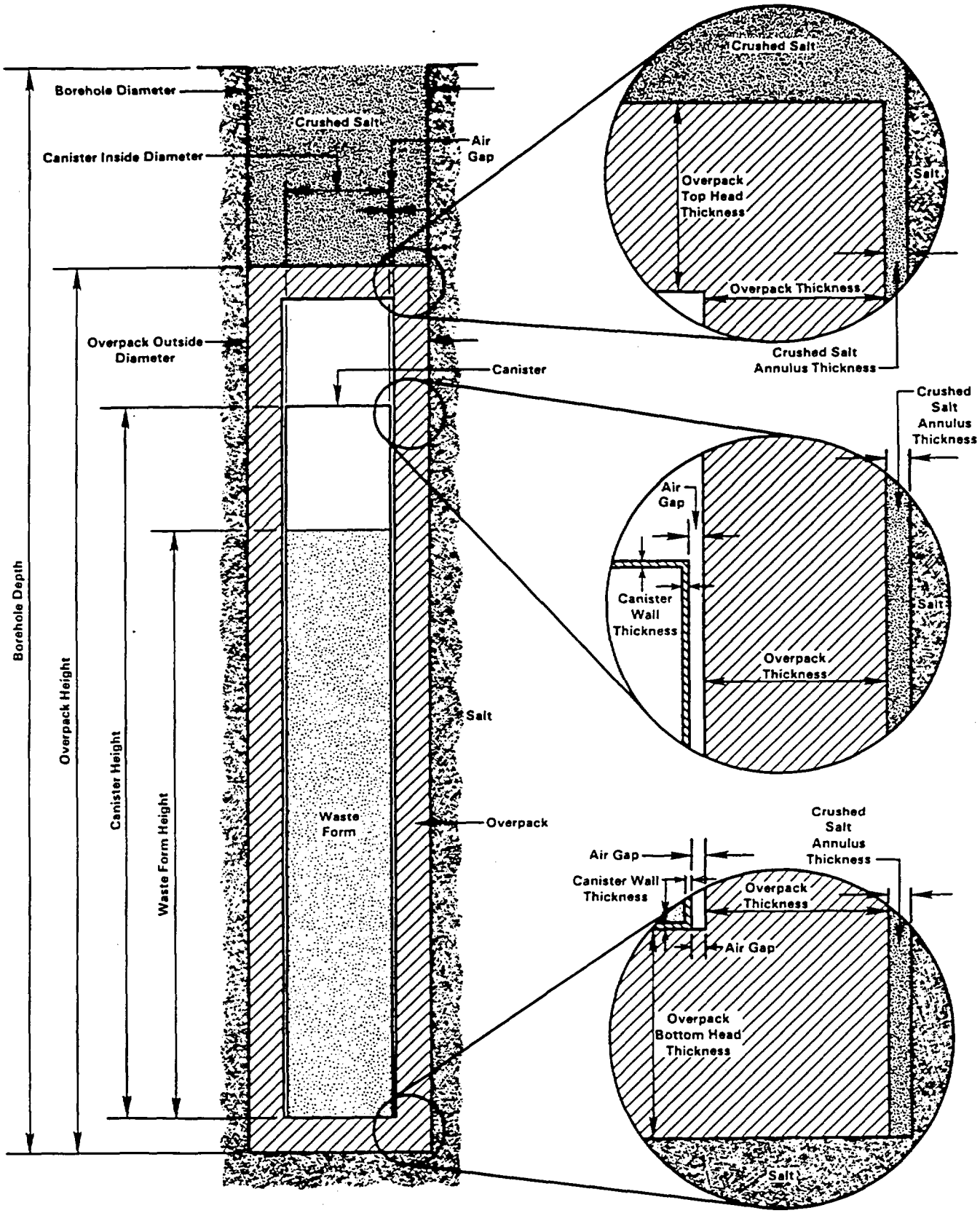
DISCUSSION TOPICS
FOR
SRPO SALT GEOCHEMISTRY MEETING
AUGUST 22, 1984

1. CORROSION OF LOW-CARBON STEEL
2. RADIOLYSIS EFFECTS IN SALT AND BRINES
3. WASTE PACKAGE LEACHING TESTS

DON CLARK
ENGINEERING DEVELOPMENT SECTION

DEC: 08/22/84

ONWI
Office of Nuclear Waste Isolation
BATTELLE Project Management Division



SCHEMATIC DRAWING OF GENERIC WASTE PACKAGES
EMPLACED IN BOREHOLE IN A SALT REPOSITORY

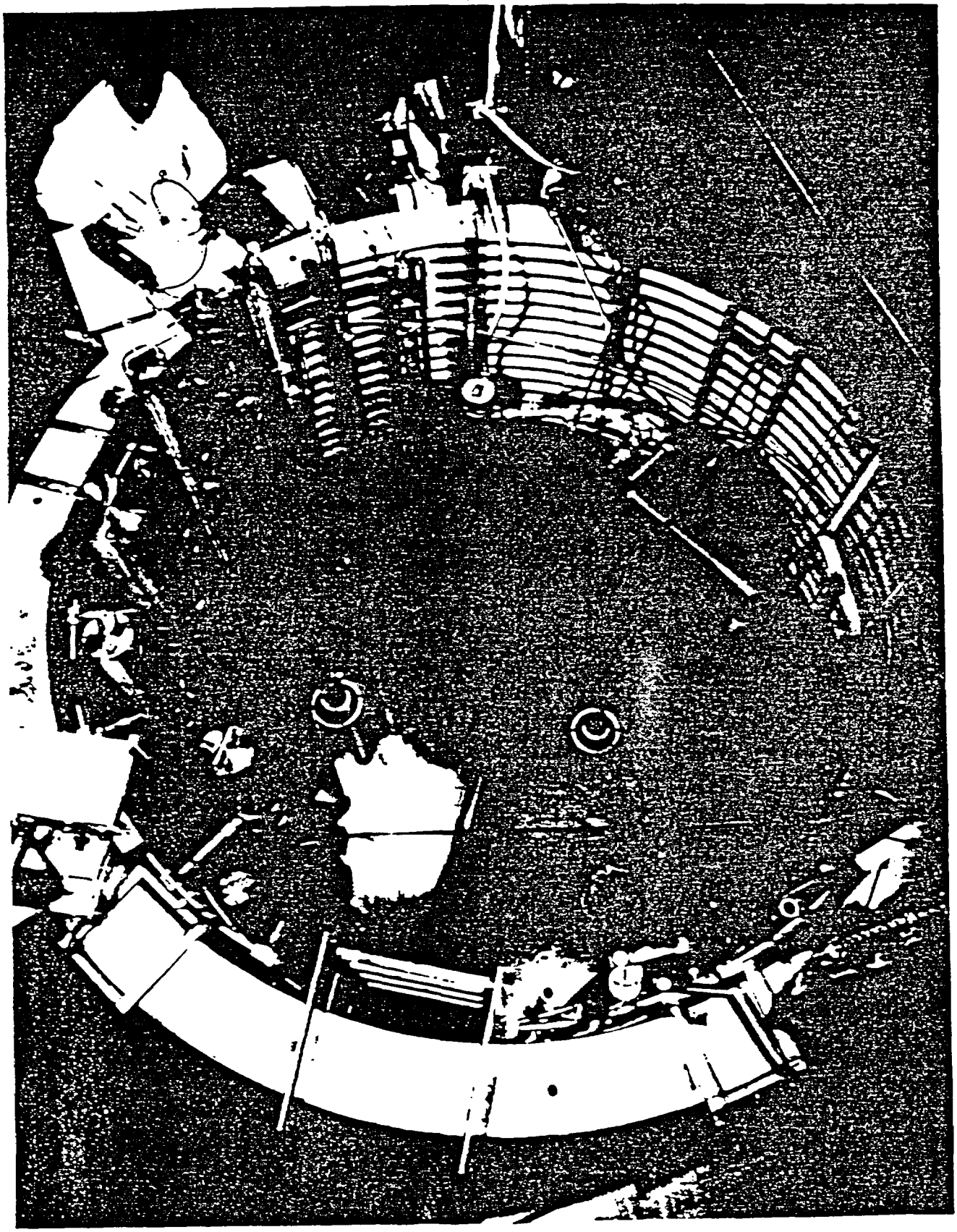
MK
7/25/84
Rev. 1

IMPACT OF RADIATION ON THE PERFORMANCE OF WASTE PACKAGE MATERIALS

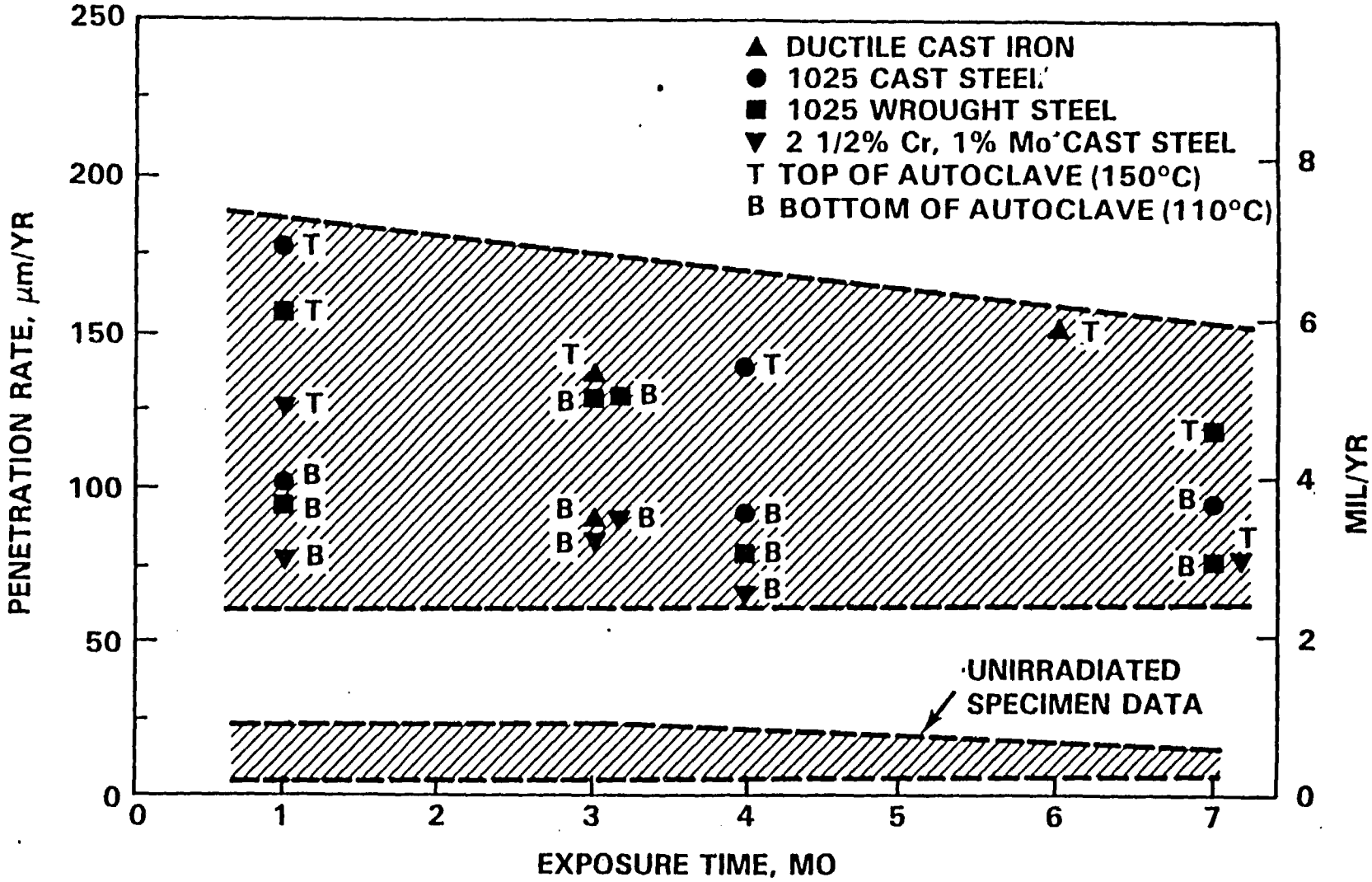
- SALT IRRADIATION EFFECTS (PRODUCTION OF COLLOIDAL, SODIUM, CHLORINE GAS)
- BRINE RADIOLYSIS EFFECTS
- BRINE MIGRATION
- RADIATION-ASSISTED CORROSION
- OTHER EFFECTS (CURRENTLY UNKNOWN)

DEC: 7/17/84

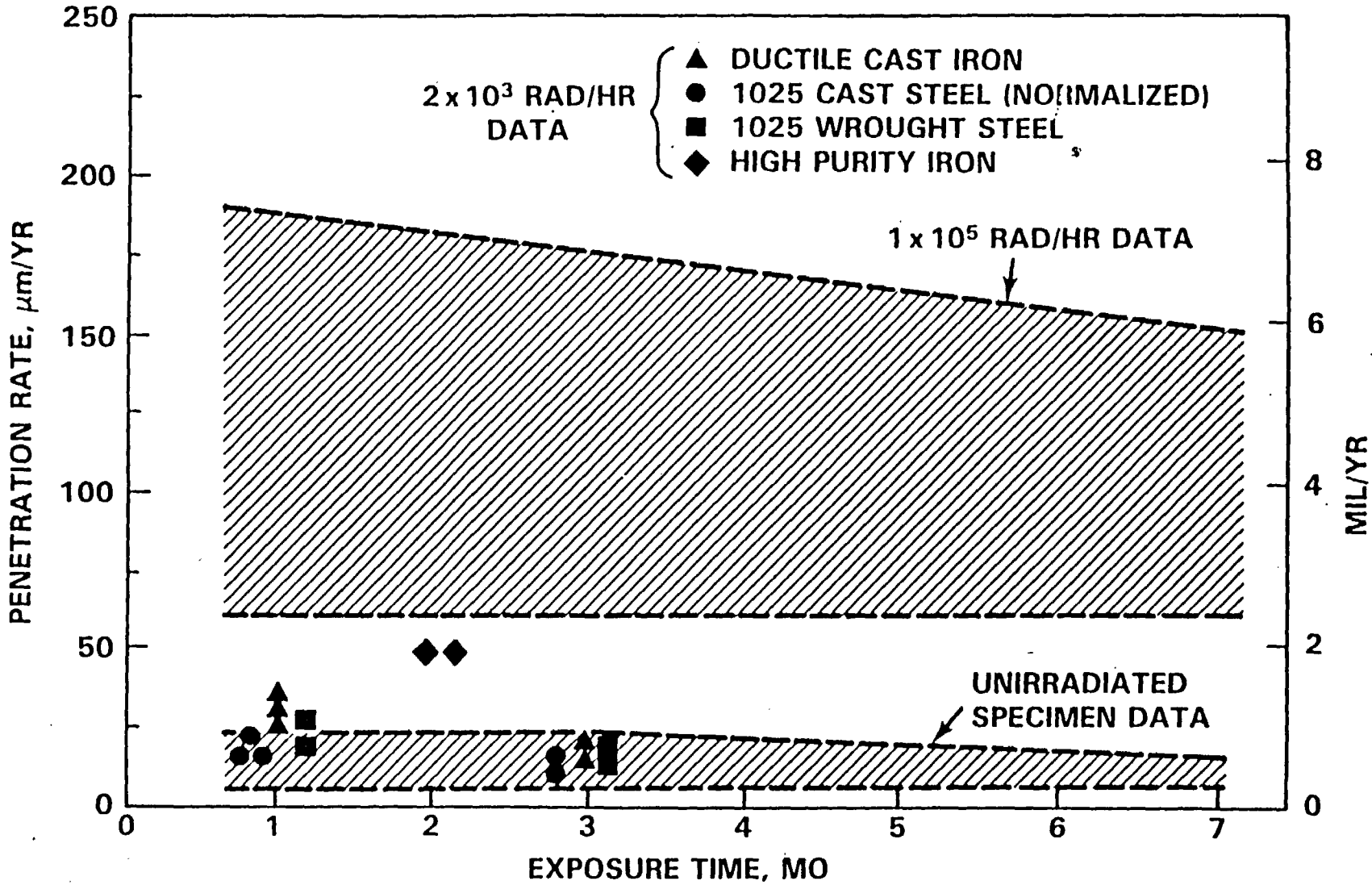
ONWI
BATTELLE Project Management Division



Gamma Irradiation Facility (Cobalt-60) used for Waste Form, Corrosion, Slow Strain Rate, Solution and Salt Irradiation Studies



Irradiation-Corrosion of Ferrous Materials in Permian Basin Brine No. 2 at 1×10^5 rad/hr and a Maximum Temperature of 150°C



Irradiation-Corrosion of Ferrous Materials in Permian Basin Brine No. 2 at $2x10^3$ rad/hr and a Maximum Temperature of 150°C

WASTE PACKAGE TESTING PROGRAM

STUDIES OF NEAR-FIELD ENVIRONENT - INTENDED TO PROVIDE DEFINITION OF THE ENVIRONMENTAL CONDITIONS TO WHICH WASTE PACKAGES WILL BE EXPOSED FOLLOWING EMPLACEMENT:

(A) SALT RADIOLYSIS EFFECTS

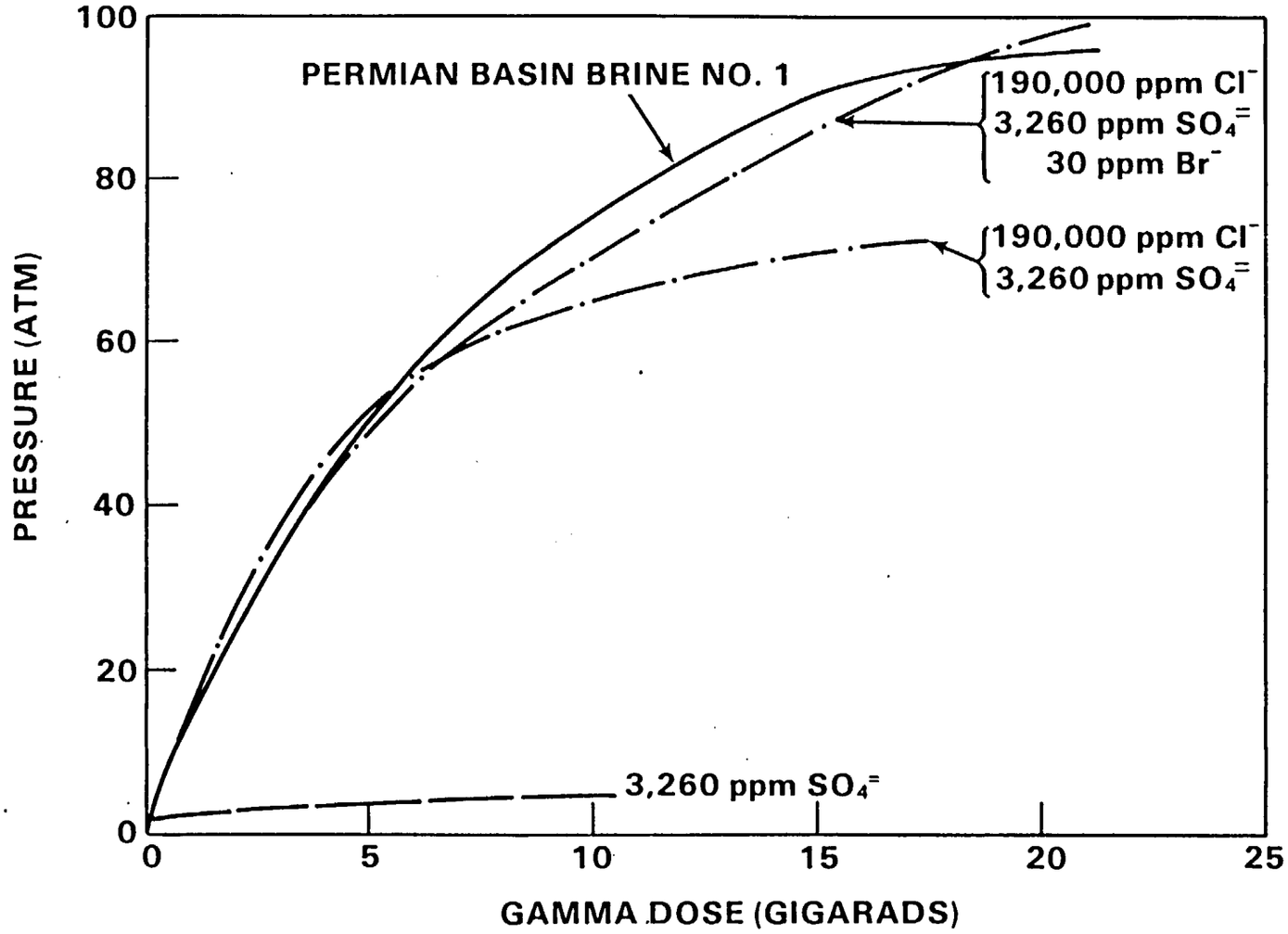
(B) BRINE RADIOLYSIS

(C) COMPOSITIONAL AND OTHER CHANGES IN HOST ROCK AND BRINES

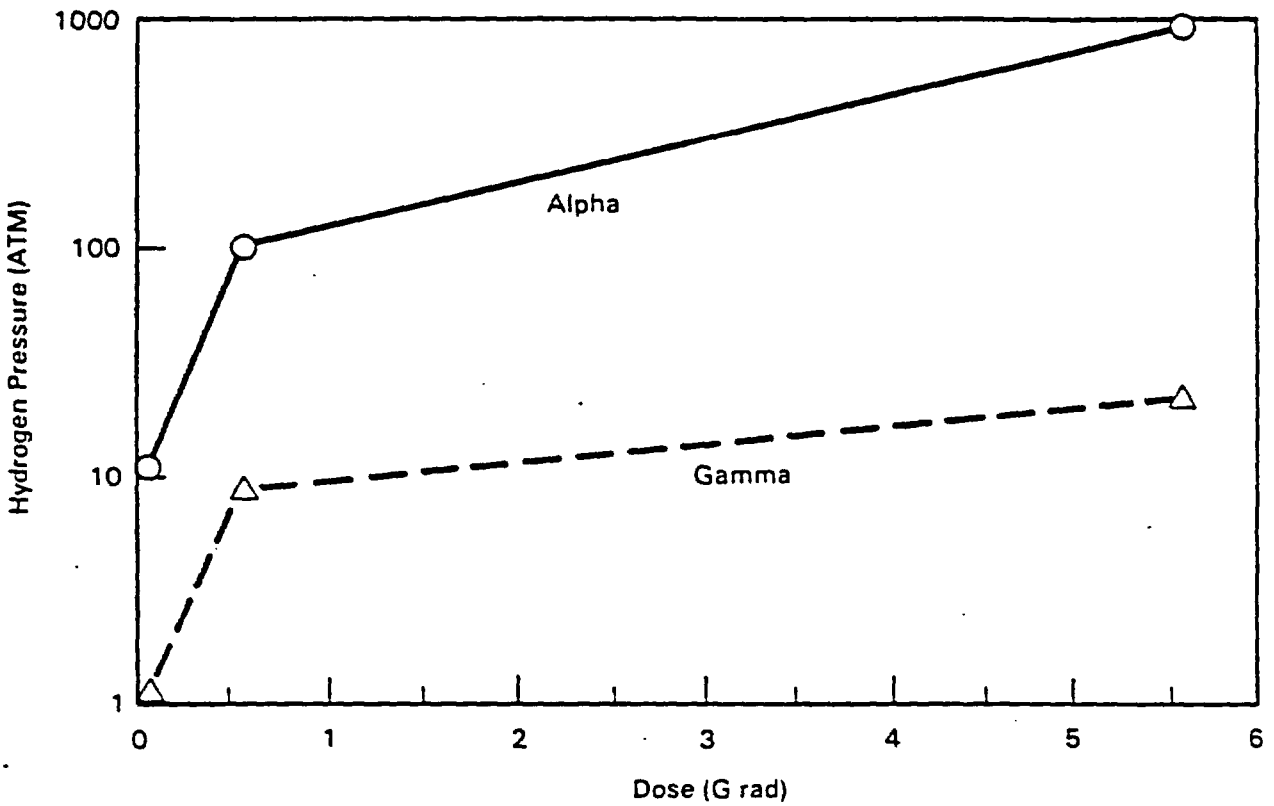
DEC: 7/17/84

ONWI

BATTELLE Project Management Division



Gamma Radiolysis Gas Pressure Generation From Various Salt Solutions as a Function of Dose



CALCULATED HYDROGEN PRESSURE GENERATED BY GAMMA OR ALPHA RADIOLYSIS OF NaCl BRINE

REACTION SCHEME FOR IRRADIATED SALT

$$Na^{+}Cl^{-} \xrightarrow{h\nu} Na^{o} + Cl^{o} \qquad (0)$$

$$Na^{o} + H_2O \longrightarrow 1/2\ H_2 + Na^{+} + OH^{-} \qquad (1)$$

$$Cl^{o} + 1/2\ H_2O \longrightarrow 1/2\ Cl^{-} + 1/2\ H^{+} + 1/2\ HOCl \qquad (2)$$

$$HOCl \rightleftharpoons H^{+} + OCl^{-}\ (K=3\times10^{-8}) \qquad (3)$$

$$3\ OCl^{-} \underset{}{\overset{k_1}{\rightleftharpoons}} 2\ Cl^{-} + ClO_3^{-}\ (K=10^{27}) \qquad (4)$$

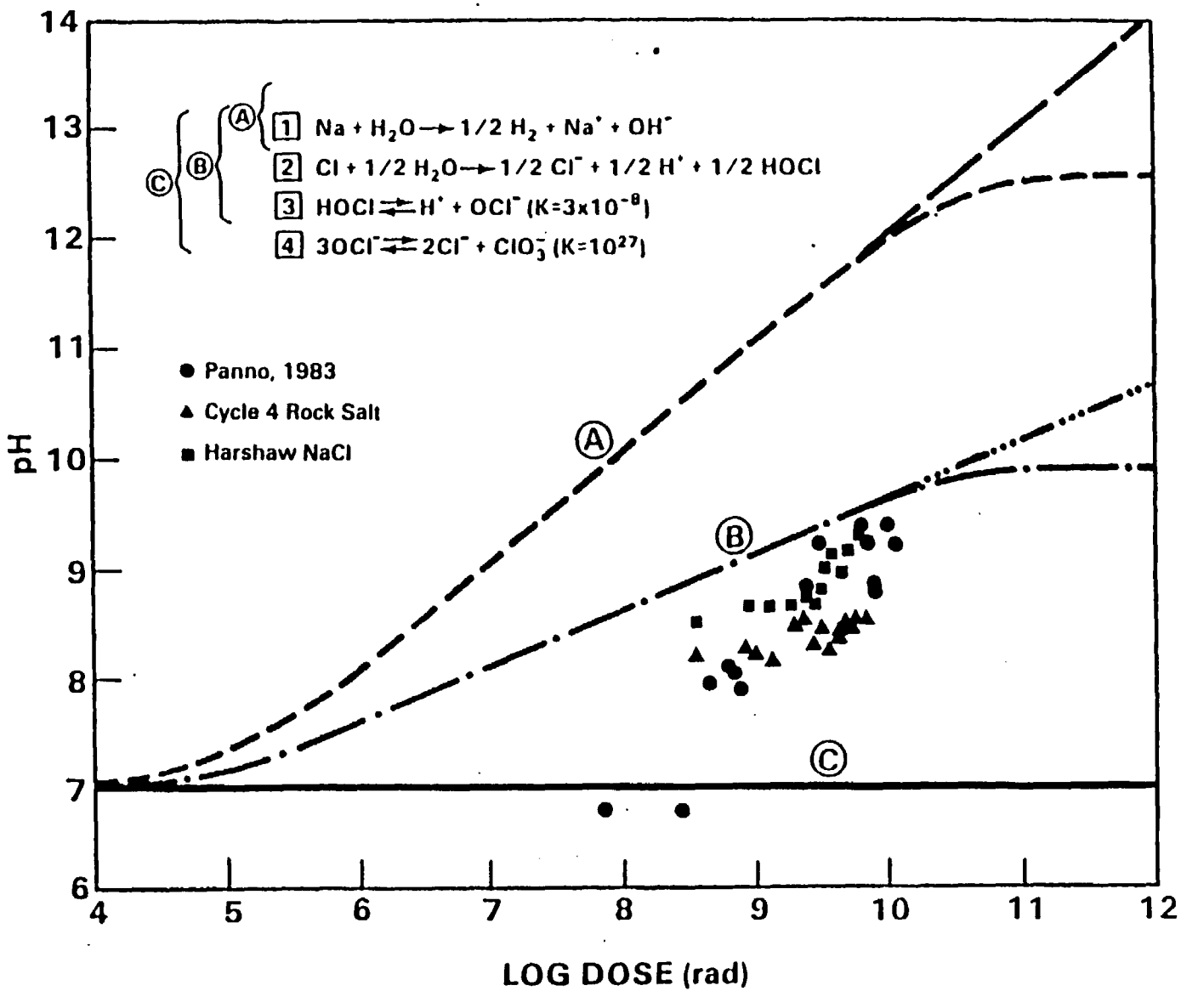
k_1(25°C) SLOW

k_1(75°C) MODERATE

$$4\ ClO_3^{-} \overset{k_1'}{\rightleftharpoons} Cl^{-} + 3\ ClO_4^{-}\ (K=10^{29}) \qquad (5)$$

k_1'(100°C) VERY SLOW

Solution pH vs Dose



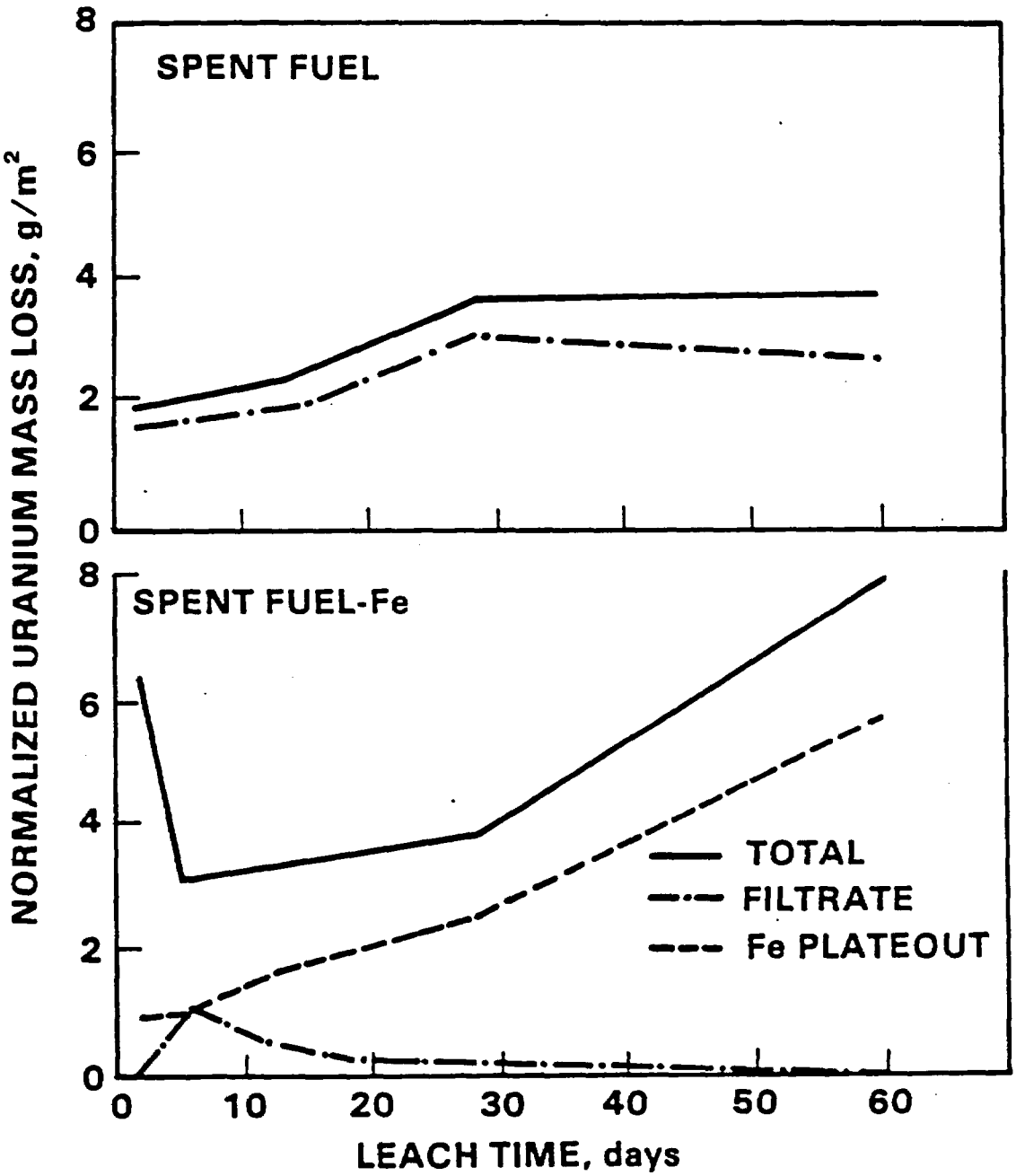
WASTE PACKAGE LEACHING TESTS

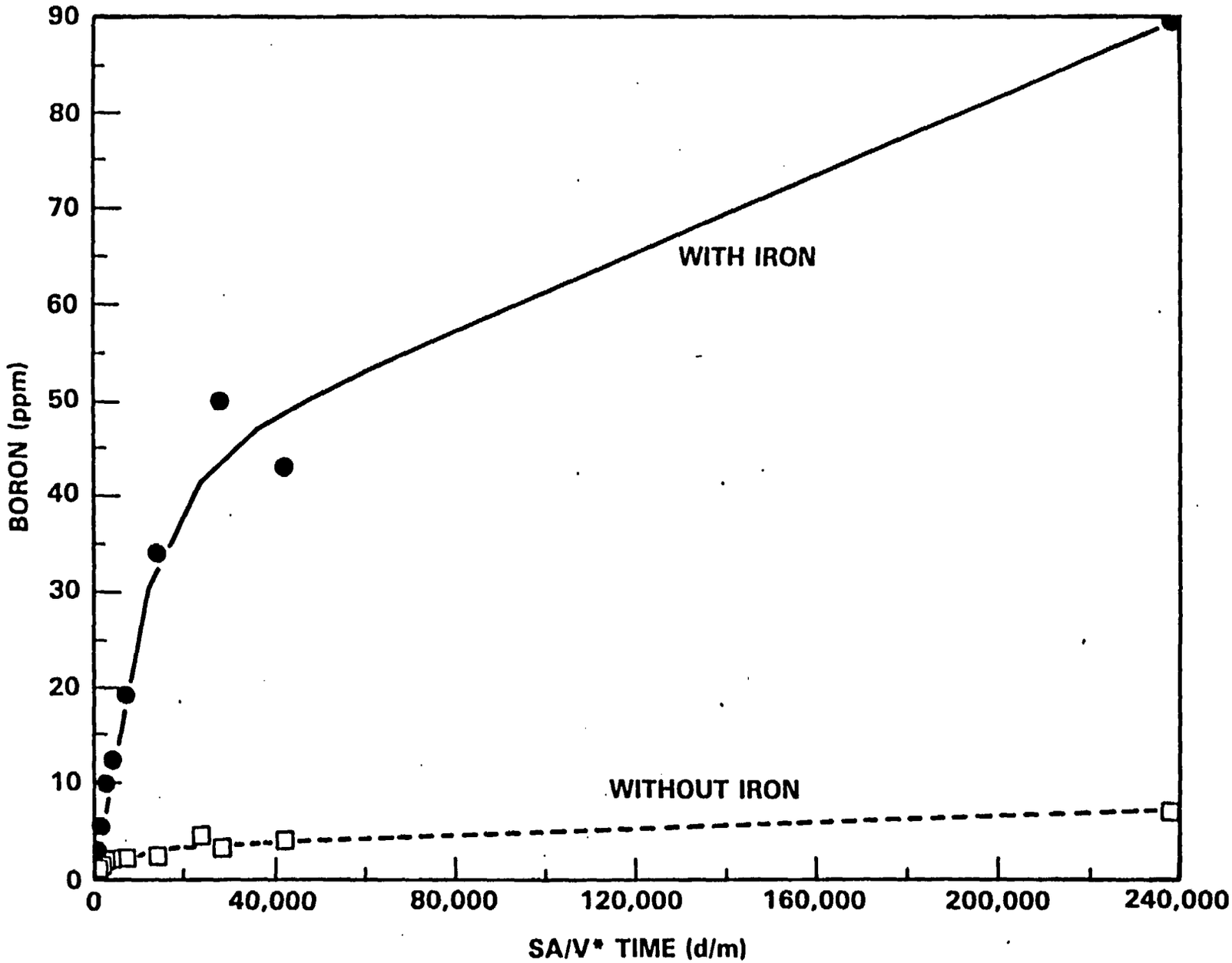
- ALPHA RADIOLYSIS RESULTS IN VERY OXIDIZING BRINE SOLUTIONS AND IN ENHANCED SOLUBILITIES OF MOST ACTINIDES

- THE PRESENCE OF IRON IN BRINES CAN RESULT IN REDUCING CONDITIONS THAT LOWER ACTINIDE SOLUBILITY

- SOLUTION EFFECTS (E.G., SOLUBILITIES) ARE CONTROLLING WITH RESPECT TO RADIONUCLIDE RELEASES FROM THE WASTE PACKAGE

COMPARISON OF URANIUM RELEASED IN SYSTEMS INCORPORATING SPENT FUEL AT 25 °C IN BRINE





Boron Release From 76-68 Glass vs. SA/V* Time in Permian Basin brine No. 1 at a Temperature of 70°C, With and Without Iron

WASTE PACKAGE TESTING

FOR PURPOSES OF QUALIFYING THE WASTE PACKAGE AND PREDICTING LONG-TERM PERFORMANCE, IT IS REQUIRED THAT WASTE PACKAGE TESTING BE DONE UNDER REPOSITORY-RELEVANT CONDITIONS. THUS, IT IS VITALLY IMPORTANT TO OBTAIN A PRECISE DEFINITION OF THE NEAR-FIELD ENVIRONMENT AND GEOCHEMICAL CONDITIONS TO WHICH EMPLACED WASTE PACKAGES WILL BE EXPOSED.

SUMMARY COMMENTS

GEOCHEMISTRY OVERVIEW MEETING
WITH
NUCLEAR REGULATORY COMMISSION

22 AUGUST 1984

PRESENTER: NORMAN HUBBARD

ONWI

BATTELLE Project Management Division

NH:8/22/84

WASTE PACKAGE DOMINATES NEAR-FIELD CHEMISTRY

- source of heat and radiation
- insufficient brine
  - corrosion rate not important
  - radiolysis not important
- virtually no redox controlling minerals in salt
  - Fe metal and radiolysis are controlling

NH:8/22/84

ONWI
Office of Nuclear Waste Isolation
Battelle

BRINE AMOUNTS INADEQUATE TO BREACH WASTE PACKAGE

- expected conditions -

- performance assessment calc. assume 2x to 10x more brine in salt than found
- all brine is reacted
  - no dependence on corrosion rate date
- more than 10cm of Fe overpack mutual remains
- overpack lifetimes always greater than 1,000 years

ONWI
Office of Nuclear Waste Isolation
Battelle

NH:8/22/84

NO EXIT FROM SALT

- expected conditions -

- No known natural exits
- Very slow flow/diffussion rates in salt
- impermeable rocks protecting salt

NH:8/22/84

ONWI
Office of Nuclear Waste Isolation
Battelle

BRINES RESULTING FROM

BREACHING REPOSITORY

- unexpected conditions -

- potentially unlimited volume of brine
- NaCl brines, sat. with $CaSO_4$, at Palo Duro and Gulf, rather than Mg-rich brines
- potentially large volumes of high-Mg brine at Paradox
- corrosion rate and radionuclide solubility data are more crutial

NH:8/22/84

ONWI
Office of Nuclear Waste Isolation
Battelle

TRAVEL TIMES IN FAR-FIELD AQUIFERS

Site	Outside Host Rock to 10km
Richton	>100,000 years
Palo Duro (Wolfcamp)	>500,000 years
Paradox (interbed below salt 6)	>1,000,000 years

NH:8/22/84

ONWI
Office of Nuclear Waste Isolation
BATTELLE Project Management Division

Enclosure 4

Organization	Name	Phone Number
DOE/CH	J. Sherwin	(614)424-5916
ONWI	N. Hubbard	(614)424-5242
ONWI	J. Parry	(614)424-5090
ONWI	P. Chen	(614)424-6498
ONWI	J. Kircher	(614)424-4871
ONWI	C. Kuntz	(614)424-5282
ONWI	R. Helgerson	(614)424-4290
USGS	A. LaSala	(614)424-5916
Weston	J. Nelson	(301)963-6800
LA Geological Survey	J. Holmes	(504)342-7466
MS Bureau of Geology	C. Stover	(601)354-6228
NRC/WMRP	L. Peeters	FTS (301)427-4653
NRC/WMGT	J. Starmer	FTS (301)427-4541
NRC/ORNL	G. Jacobs	FTS 626-0567
NRC/WMEG	M. Tokar	FTS 427-4748
NRC/WMGT	W. Kelly	FTS 427-4571
NRC/WMRP	R. Johnson	FTS 427-4785
DOE	W. Sidle	(614)424-5916
Earth Technology	F. Donath	(213)595-6611
NRC/WMRP	S. Grace	FTS 427-4686

Enclosure 5

Documents Provided to NRC

For NRC review, but not retention:

1. Knauth, L.P. and M.A. Beevnas, 1984. Origin of Fluid Inclusion Water in Bedded Salt Deposits, Palo Duro Basin, TX, March 1984, ONWI.

2. Fukui, L.M., 1983. Summary of Petrographic and Chemical Data for Palo Duro Basin Samples Examined by Bendix Field Engineering Corporation, Grand Junction, CO, as of April 29, 1983. May 2, 1983, ONWI.

3. McCulley, B.L., J.W. Thackston, and L.W. Preslo, 1984. Status Report: Geochemical Interactions Between Ground Water and Paleozoic Strata, Gibson Dome Area, Southeastern Utah, Feb. 1984, Woodward-Clyde.

4. Expected Nuclear Waste Repository Near-Field Performance at Potential Salt Sites, August, 1984. Part 1: Thermal Conditions; Part 2: Brine Migration; Part 3: Diffusional Radionuclide Transport.

5. Jansen, G., 1984. Expected Waste Package Performance for Nuclear Waste Repositories in Three Salt Formations.

For NRC Retention:

1. Hydrochemical and Isotope Hydrology Results for the Palo Duro Basin, TX Pandhandle: A summary Report of Material Presented at the June 5, 1984 Discussion Meeting, Columbus, OH. Prepared by Norman Hubbard/ONWI, July 20, 1984.

2. Curtis, D.B., T.M. Benjamin, and A.J. Gancosz. The Oklo Reactors: Natural Analogs to Nuclear Waste Repositories. Los Alamos Report LA-UR-81-3783.

3. Olander, D.R., A.J. Machiels, and S. Vagnik, 1980. Thermal Gradient Migration of Brine Inclusions in Salt, ONWI-208.

RSI DWG 025-80-69

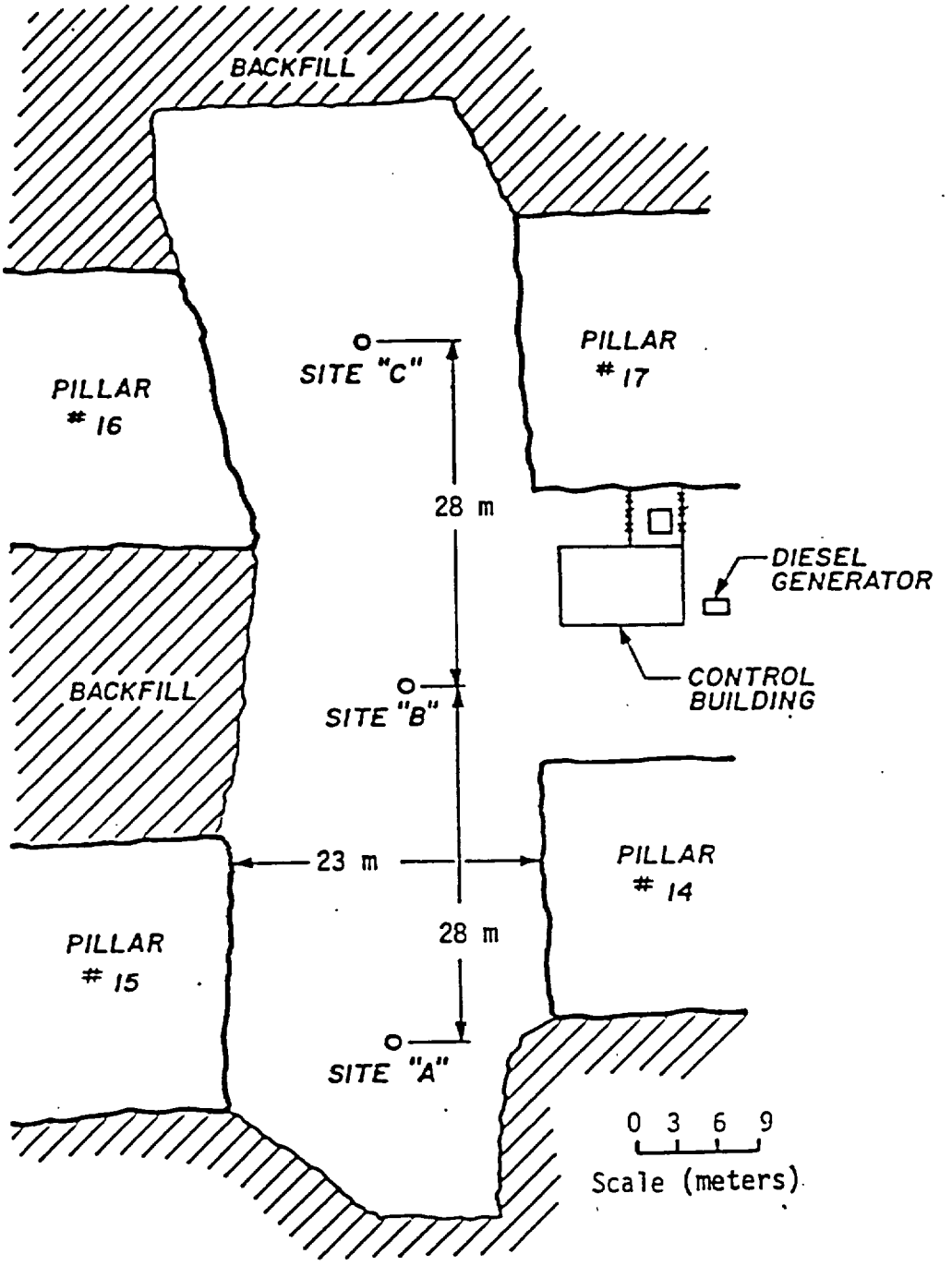


Figure 1-1. Heater Test Area Layout at Avery Island.

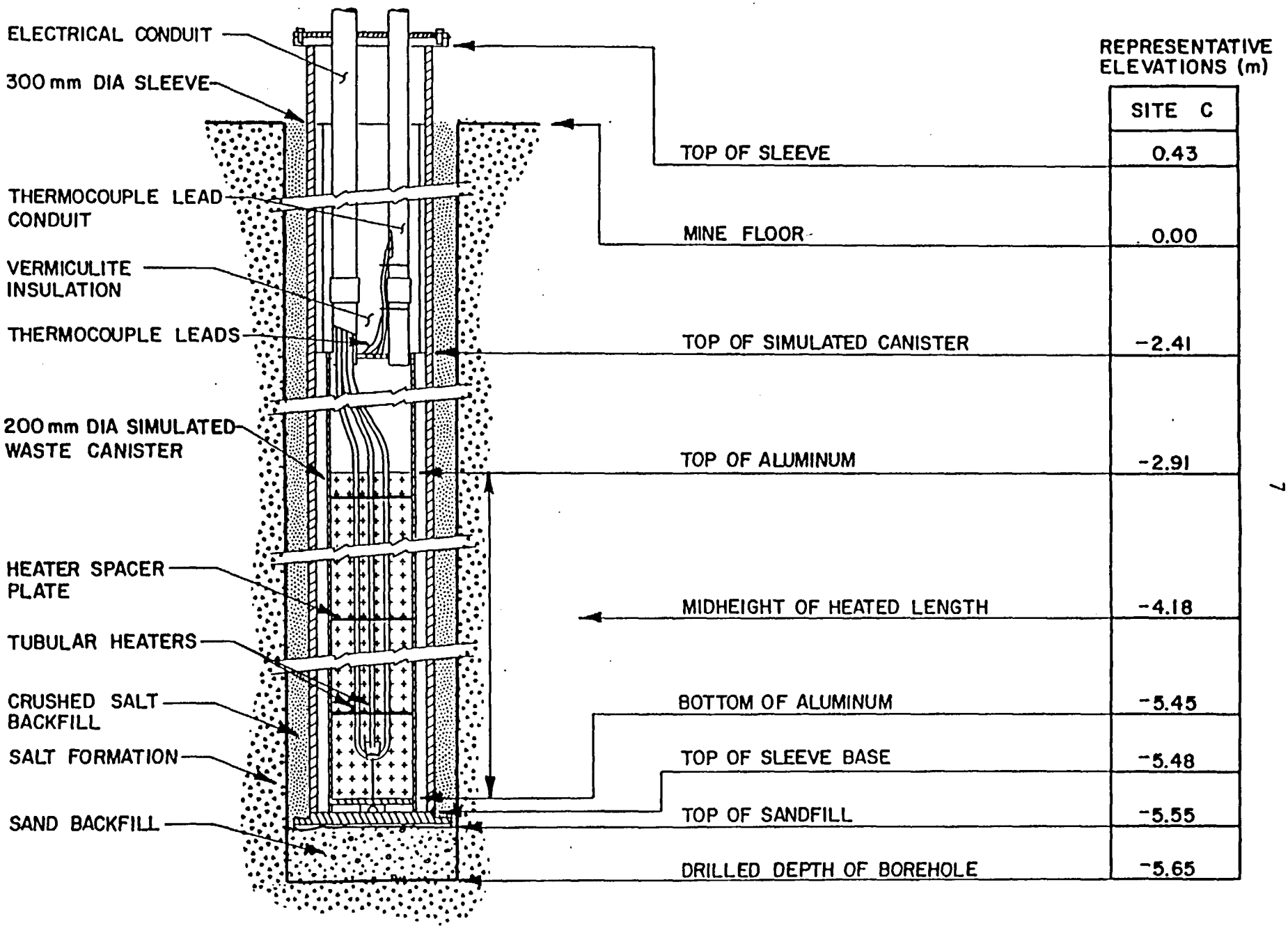
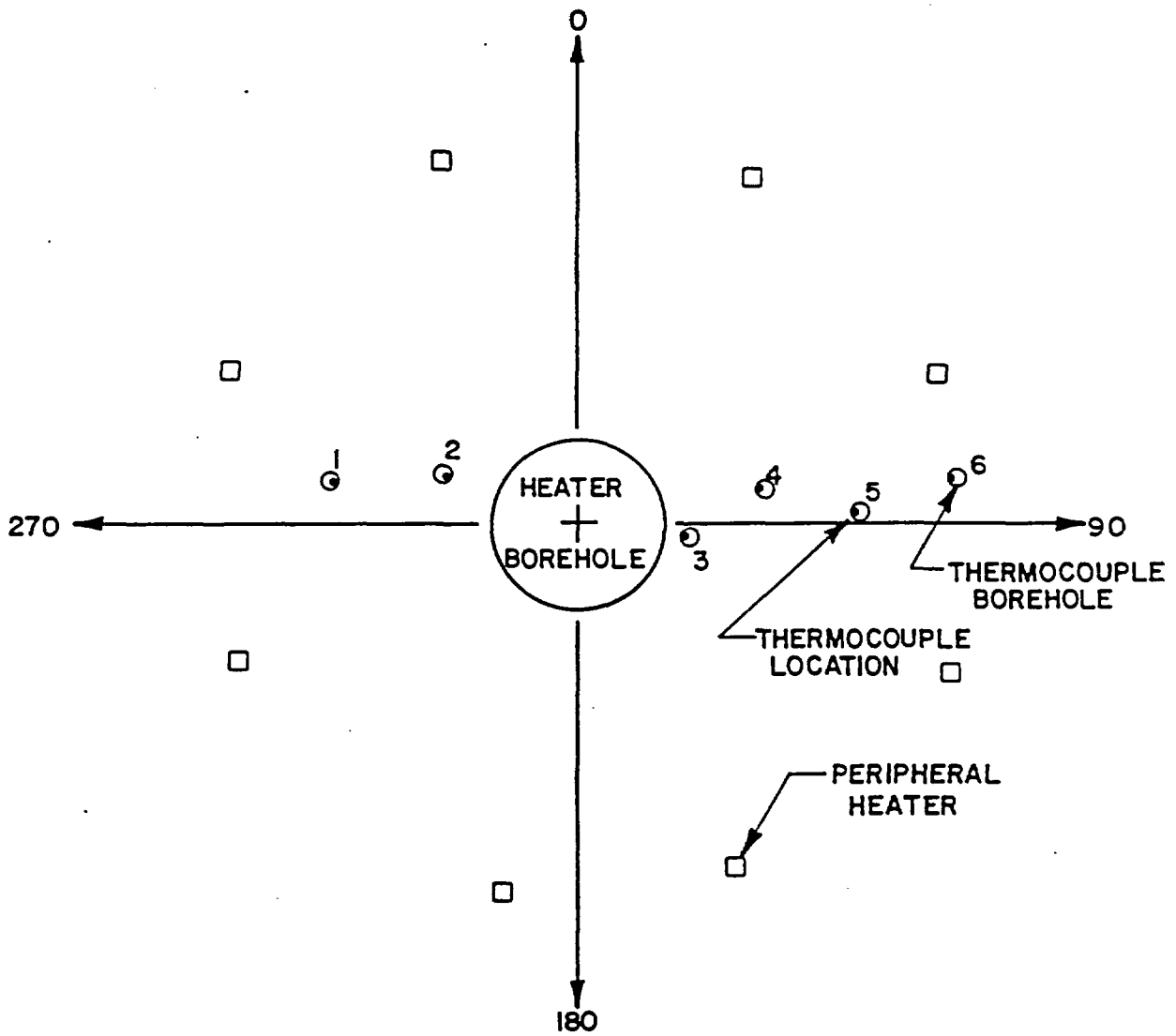


Figure 2-1. Cross-Section and Representative Elevations of the Site C Heater Assembly.

Table 2-1. Characteristics of the Avery Island Heater Tests

Characteristics	Site A	Site B	Site C
Heater Power Level	6 kW	3 kW	4 kW
Peripheral Heater Power Level (Total)	0	0	5.6 kW
Diameter of Heater Borehole	0.44 m	0.41 m	0.41 m
Sleeve Diameter/Schedule Number	0.3 m/Sch. 80	0.3 m/Standard Weight	0.3 m/Standard Weight
Backfill Type	None (Air)	None (Air)	Crushed Salt
Borehole Annulus Enclosure	Rock Wool	Butyl Rubber	Backfill
Number of T/C (Thermocouples) on Heater	3	3	3
Number of T/C on Sleeve	14	3	5
Number of T/C in Salt	112	32	32
Number of Stressmeters	28	28	22
Multi-Point Extensometers (6 Point)	7	3	3
Combustible Gas Sensor	0	2	0
Heat Flux Meters	3	0	0
Maximum Extensometer Depth	11.0 m	11.0 m	11.0 m
Maximum T/C Depth	8.4 m	6.8 m	6.8 m



THERMOCOUPLE BOREHOLE NUMBER	RADIAL DISTANCE FROM HEATER CENTERLINE (METERS)	THERMOCOUPLE CHANNEL NO.
1	0.61	233-237
2	0.34	238-243
3	0.27	244-249
4	0.46	250-254
5	0.68	255-259
6	0.92	260-264

Figure 3-1. Plan View of Heater and Thermocouple Borehole Locations and Thermocouple Channel Designation at Site C.

Table 2-2. Measured Temperatures (C) in the Salt After 1,000 Days of Heating

SITE A[1]

Radial Distance From Heater Centerline[2], m	Elevation[3], m -0.05	-1.28	-2.80	-4.02	-5.24	-6.77	-8.29
0.31	35	55	119	153	120	49	38
0.39	35	54	108	140	113	49	38
0.47	35	52	100	126	100	48	38
0.59	33	50	89	110	89	47	38
0.71	32	49	83	101	82	47	38
0.98	33	46	71	82	70	46	37
1.47	31	43	58	64	58	44	37
3.32	28	34	39	40	40	37	34

SITE B

	Elevation[3], m -0.05	-1.37	-2.90	-4.11	-5.33	-6.86
0.30	35	43	67	81	65	37
0.33	34	42	63	75	61	37
0.52	33	41	57	65	55	
0.59	32	40	56	64	54	
0.71	32	39	52	57	49	
0.97	31	37	47	51	46	

SITE C

	Elevation[3], m -0.05	-1.52	-3.05	-4.27	-5.49	-7.01
0.20	38	70	147	124	149	
0.27	38	66	133	157	121	62
0.34	36	64	127	147	116	62
0.46	37	64	119	138	110	
0.61	36	62	112	128	107	
0.68	37	62	107	122	102	
0.92	36	60	100	111	95	

[1] Temperatures and radial location are averaged for pairs of thermocouples at similar locations.

[2] Potential error in the radial location is ±0.5 percent of the depth.

[3] Actual elevations vary ±0.1, 0.05, 0.03 m from given elevation for Sites A, B, and C, respectively.

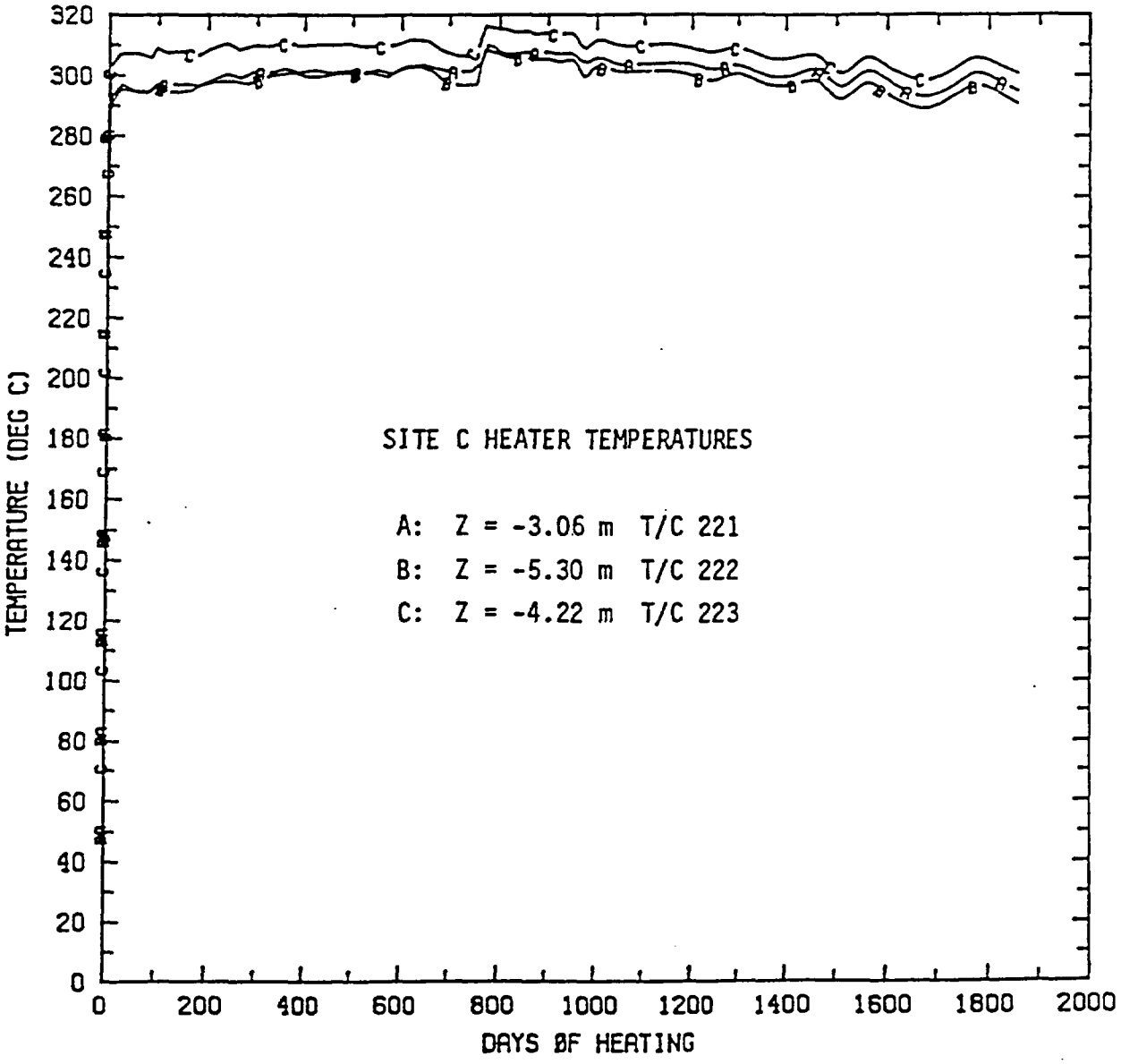


Figure 3-3. Temperatures of the Site C Heater.

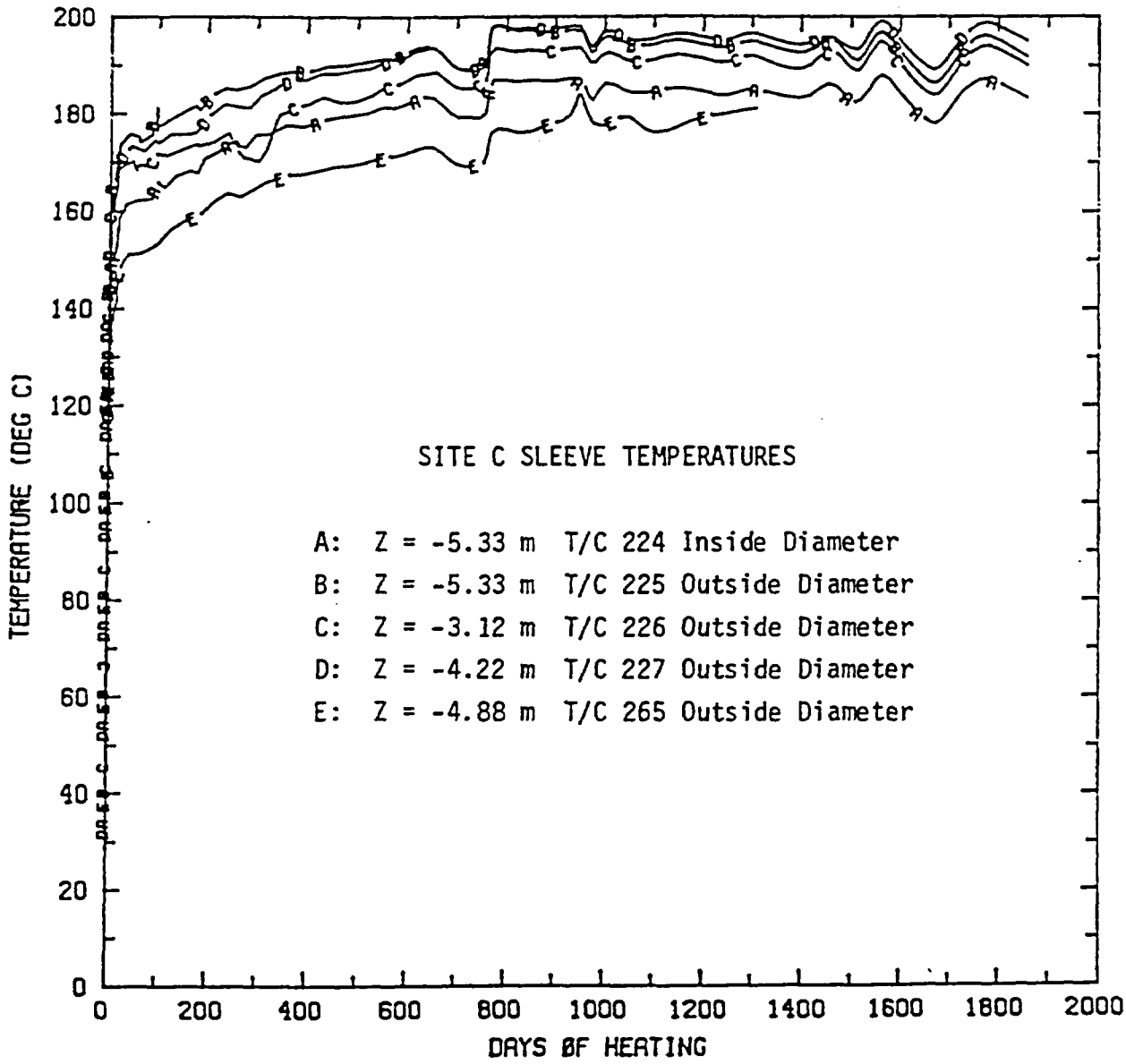


Figure 3-4. Temperatures of the Site C Sleeve.

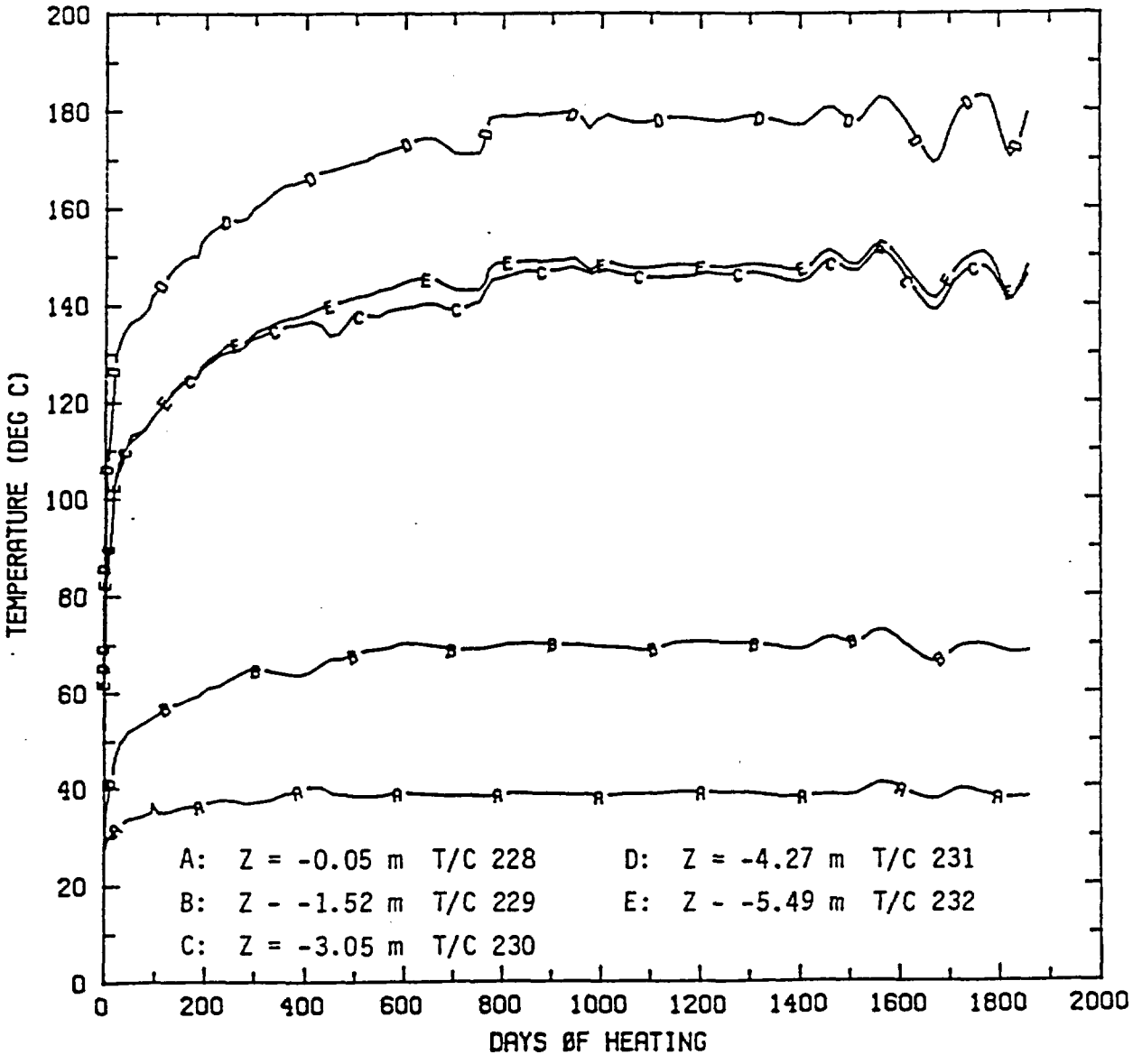


Figure 3-5. Temperatures Within the Site C Backfill.

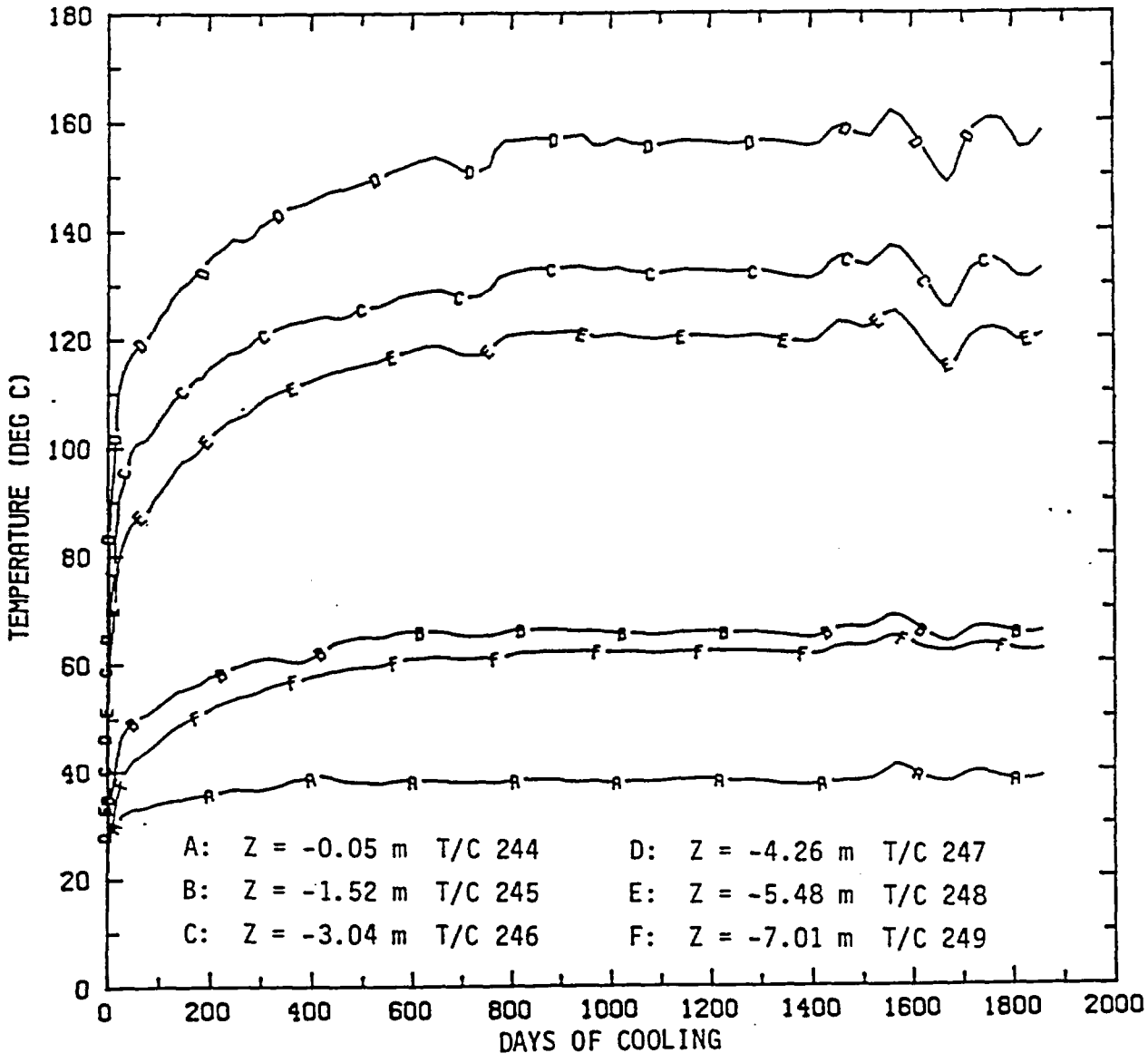


Figure 3-6. Temperatures in the Salt Around the Site C Heater at a Radial Distance of 0.27 m.

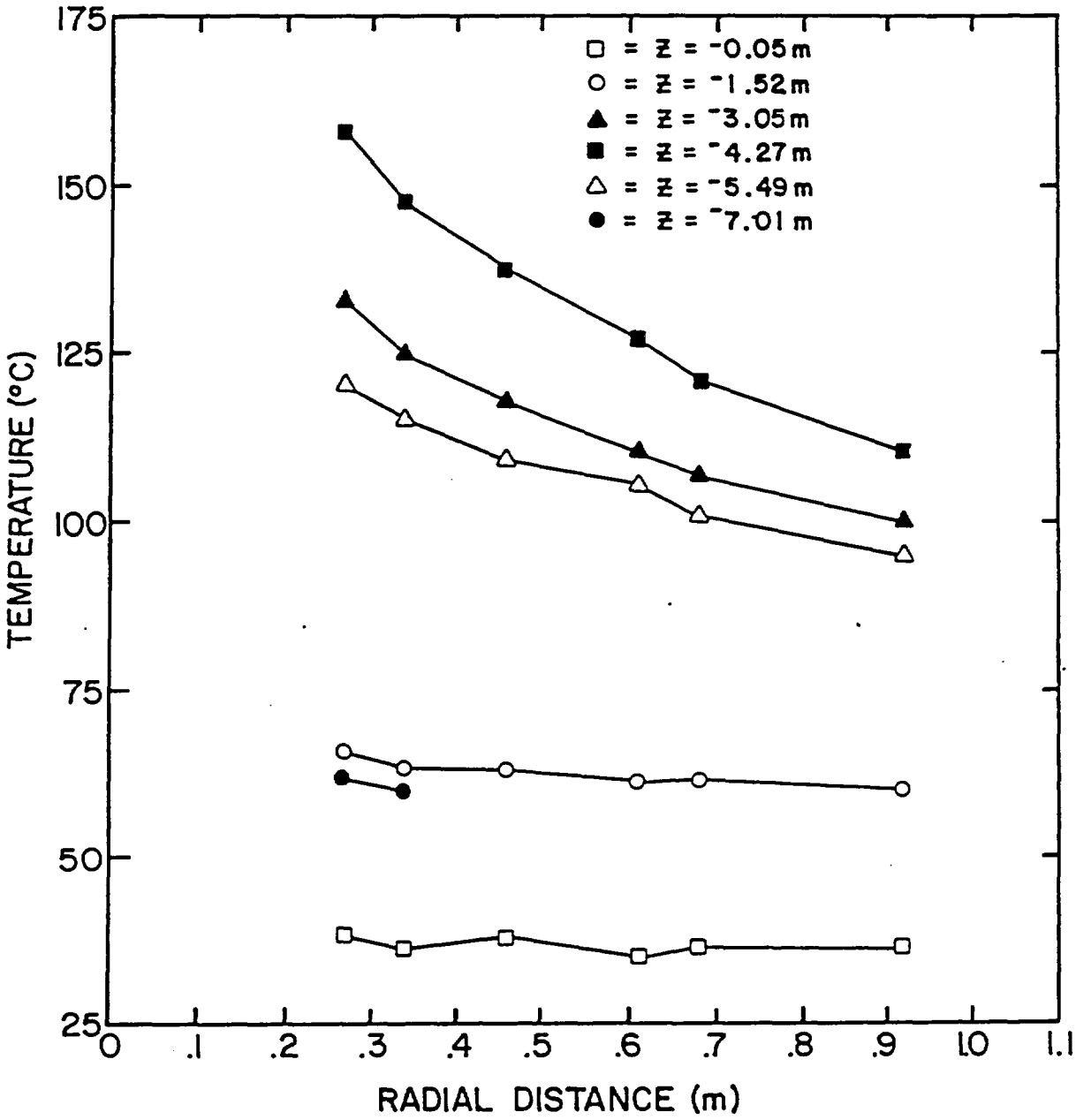


Figure 3-7. Site C Temperature Profiles as a Function of Radial Distance From the Heater Centerline After 1,858 Days of Heating.

RSI DWG 025-83-47

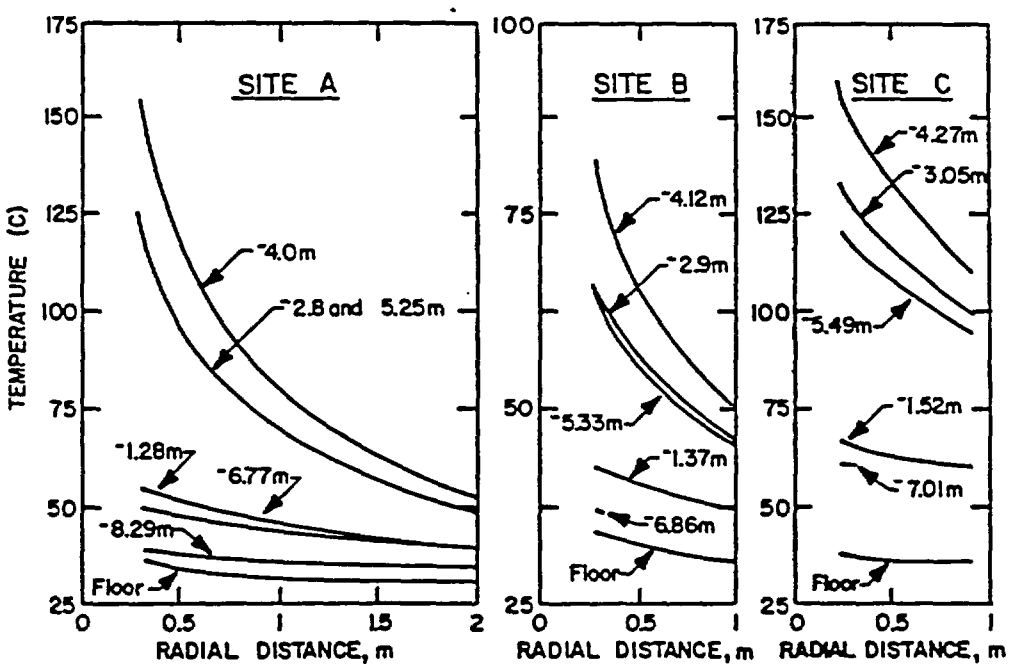


Figure 2-1. Temperature Profiles After 1,000 Days of Heating at Various Depths [After Van Sambeek, 1981].

RSI DWG 025-83-72

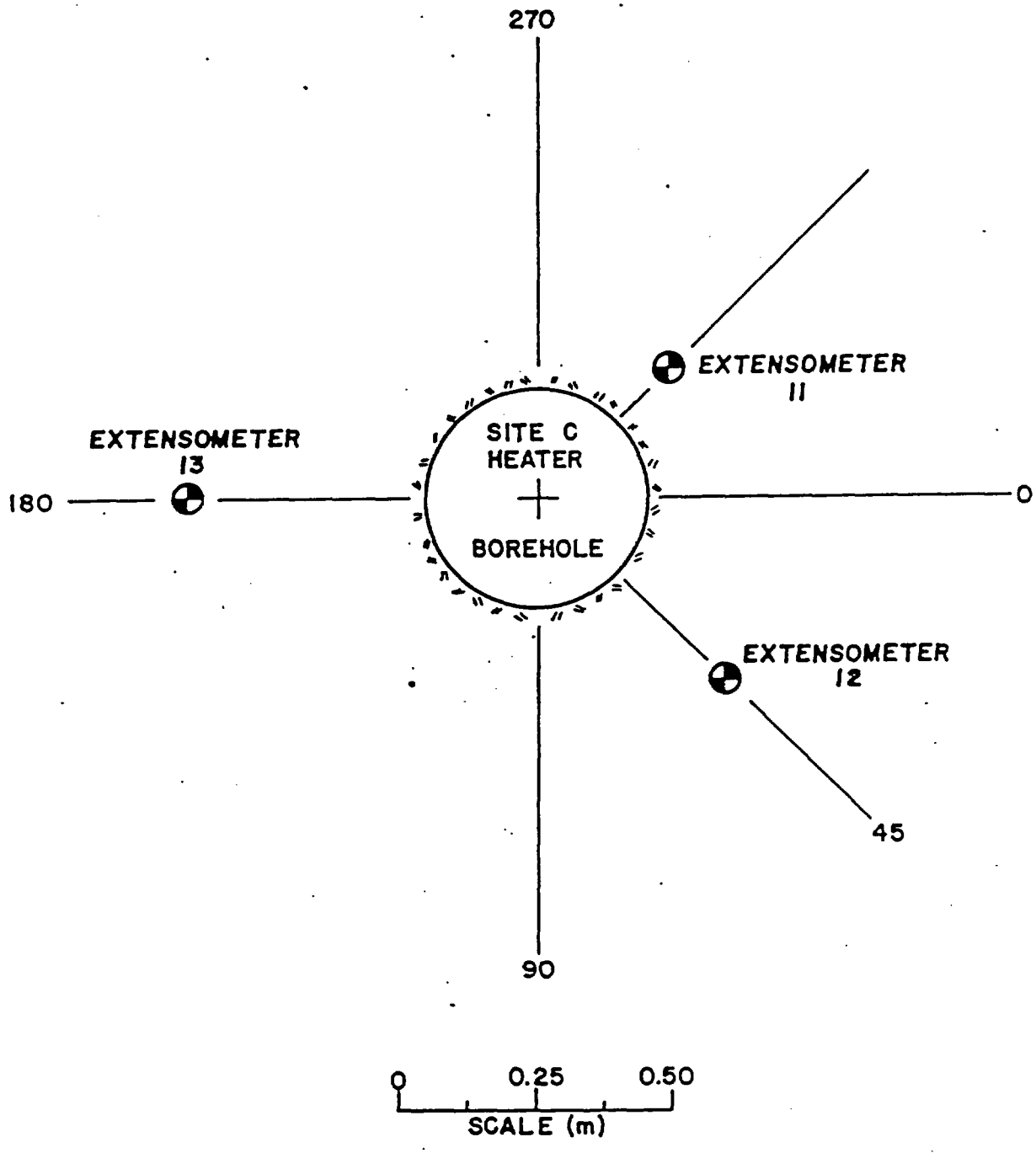


Figure 4-1. Plan View of Extensometer Placement at Site C.

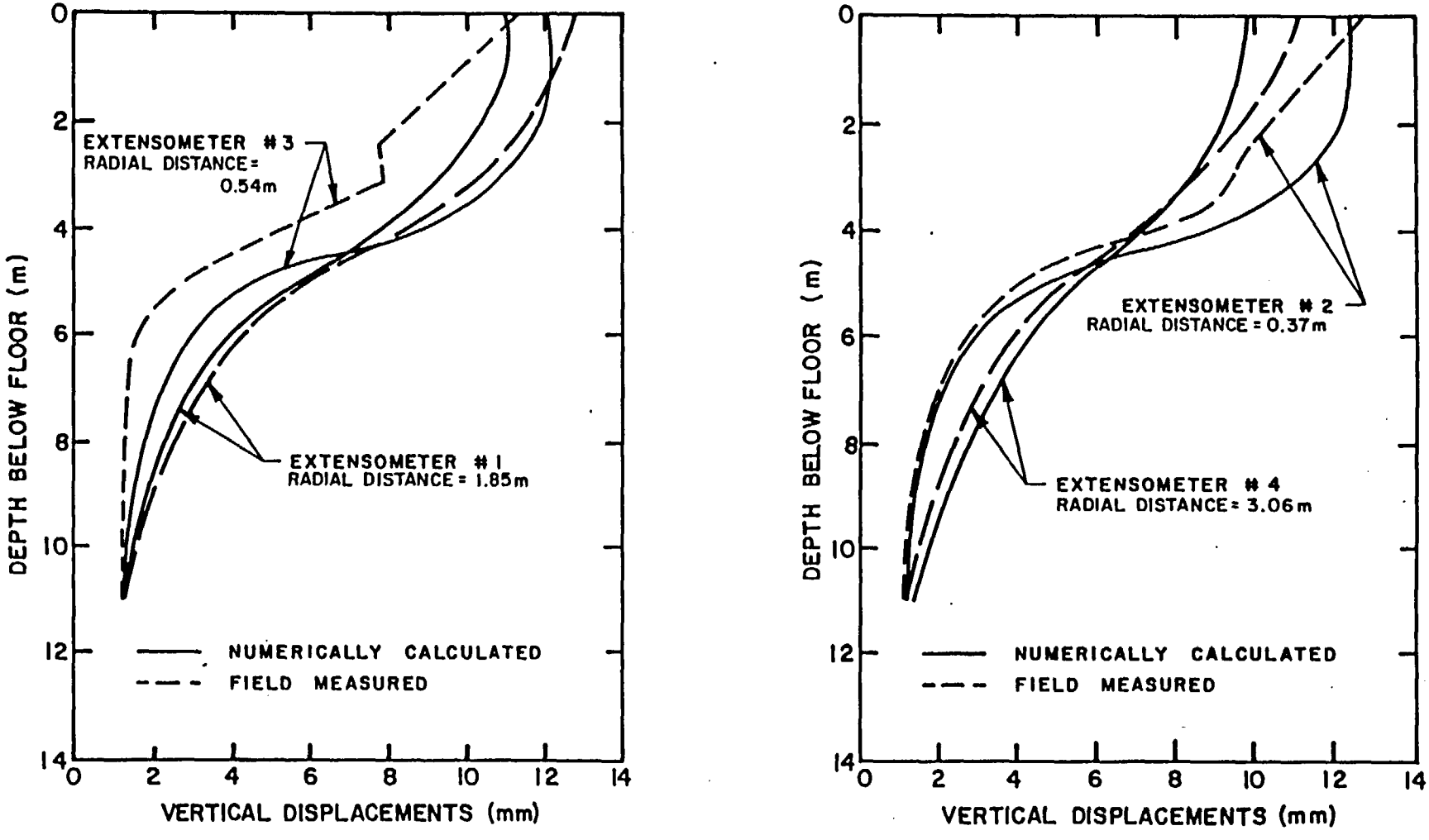


Figure 2-3. Displacements Measured by Vertical Extensometers and Level Surveys at Site A After 1,000 Days of Heating [After Stickney and Wagner, 1982].

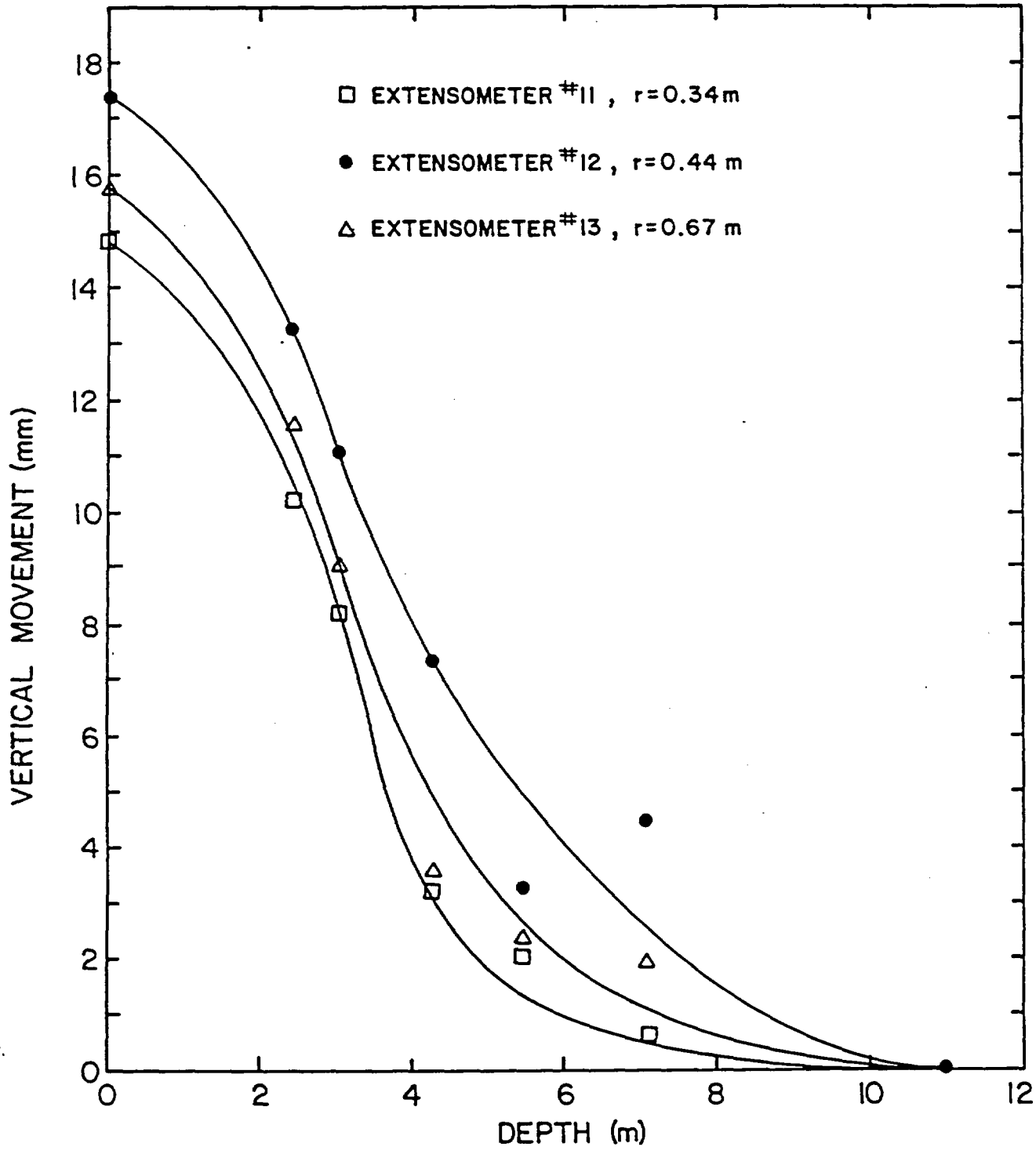


Figure 4-2. Movement After 1,858 Days of Heating Referenced to the Deepest Anchor for the Site C Extensometers.

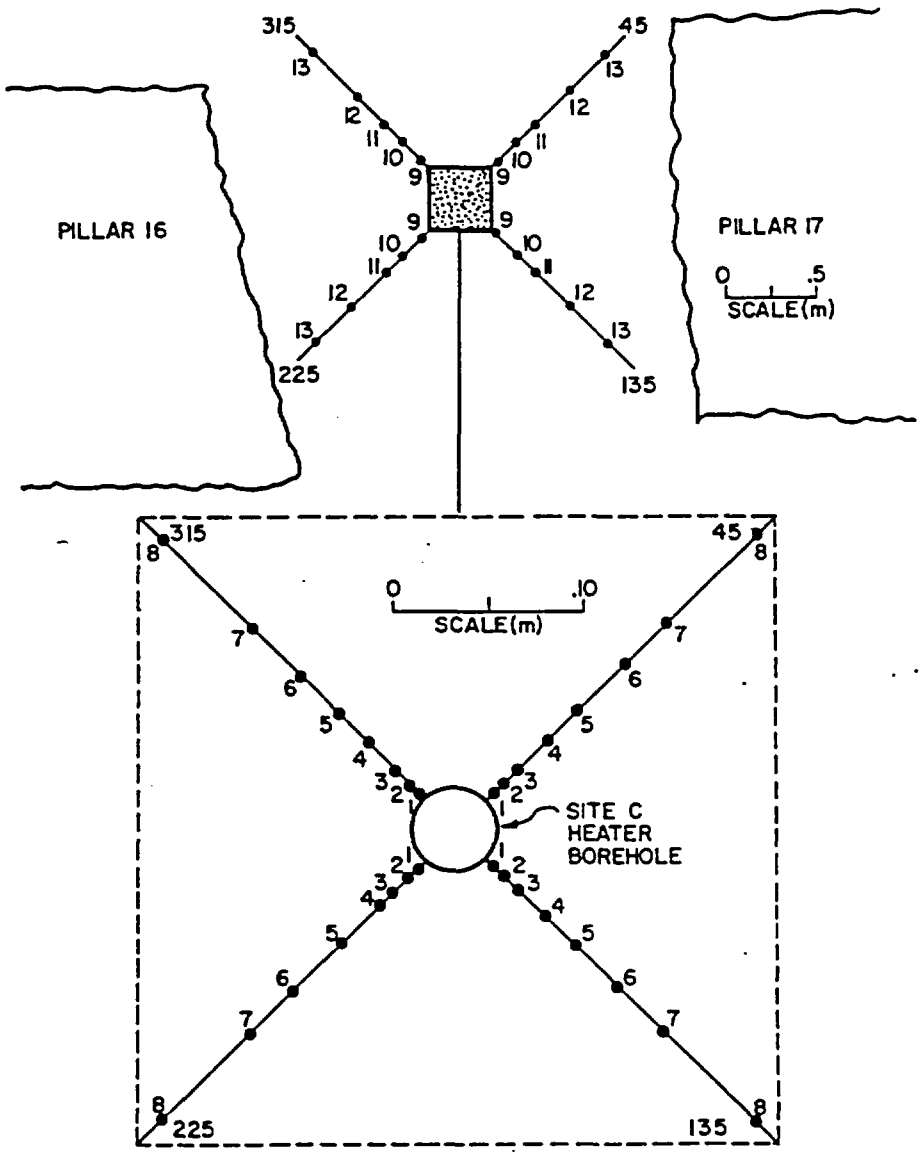


Figure 4-3. Site C Leveling Pin Measurement Locations.

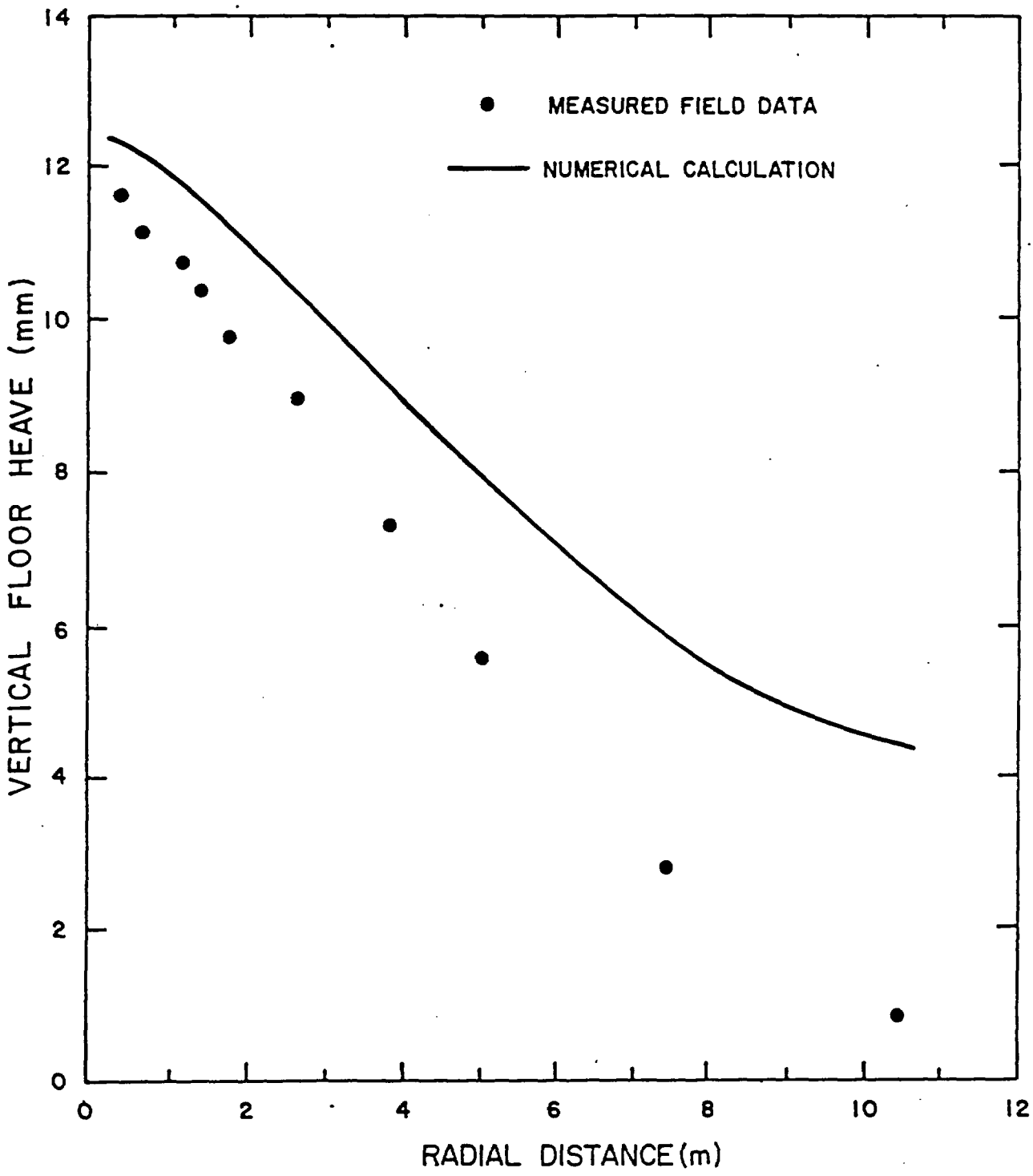


Figure 2-6. Measured and Calculated Floor Heaves at Site A After 500 Days of Heating [After Stickney and Wagner, 1982].

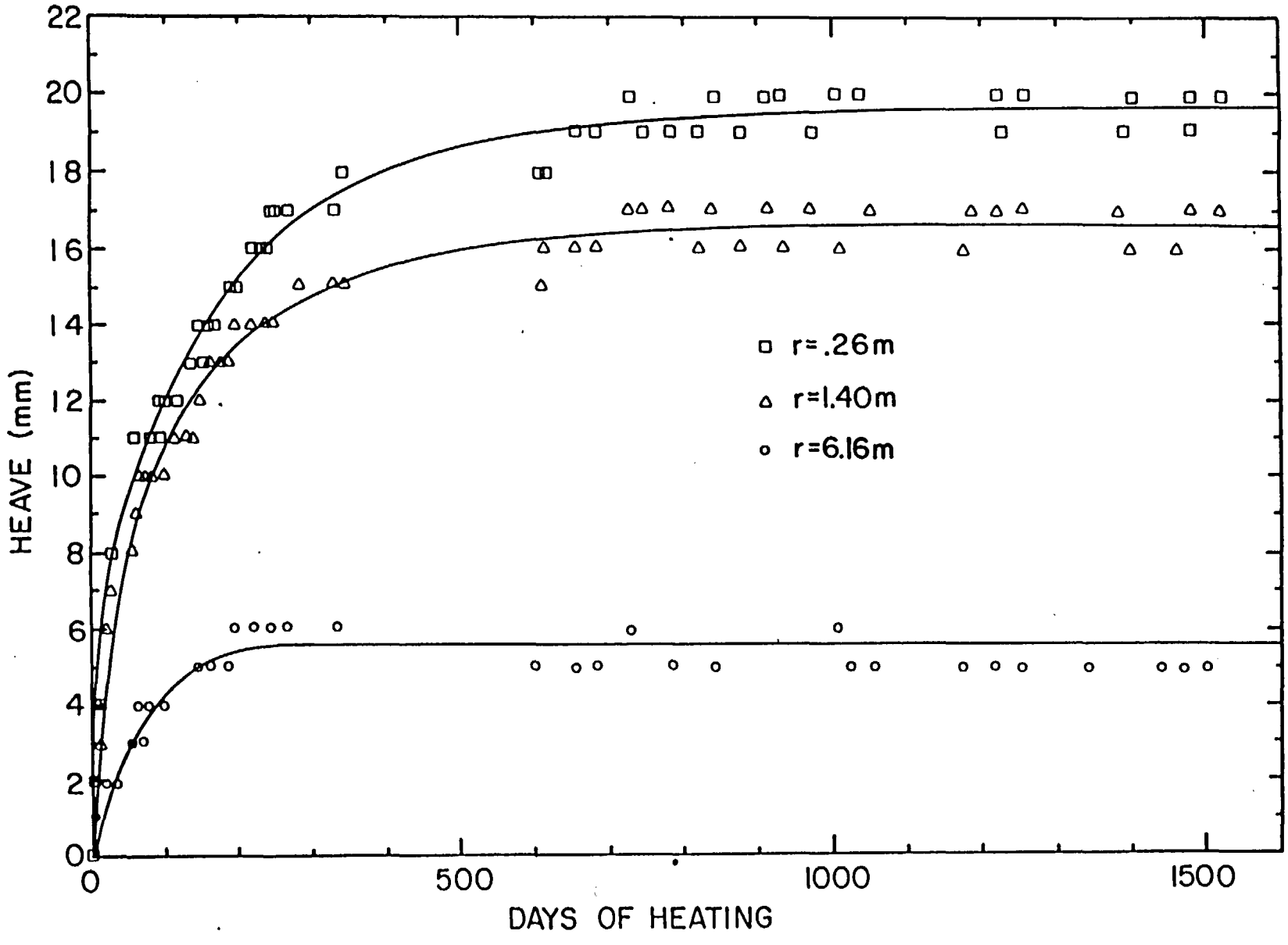


Figure 4-4. Floor Heave at Three Radial Distances From the Site C Heater for 1,500 Days of Heating.

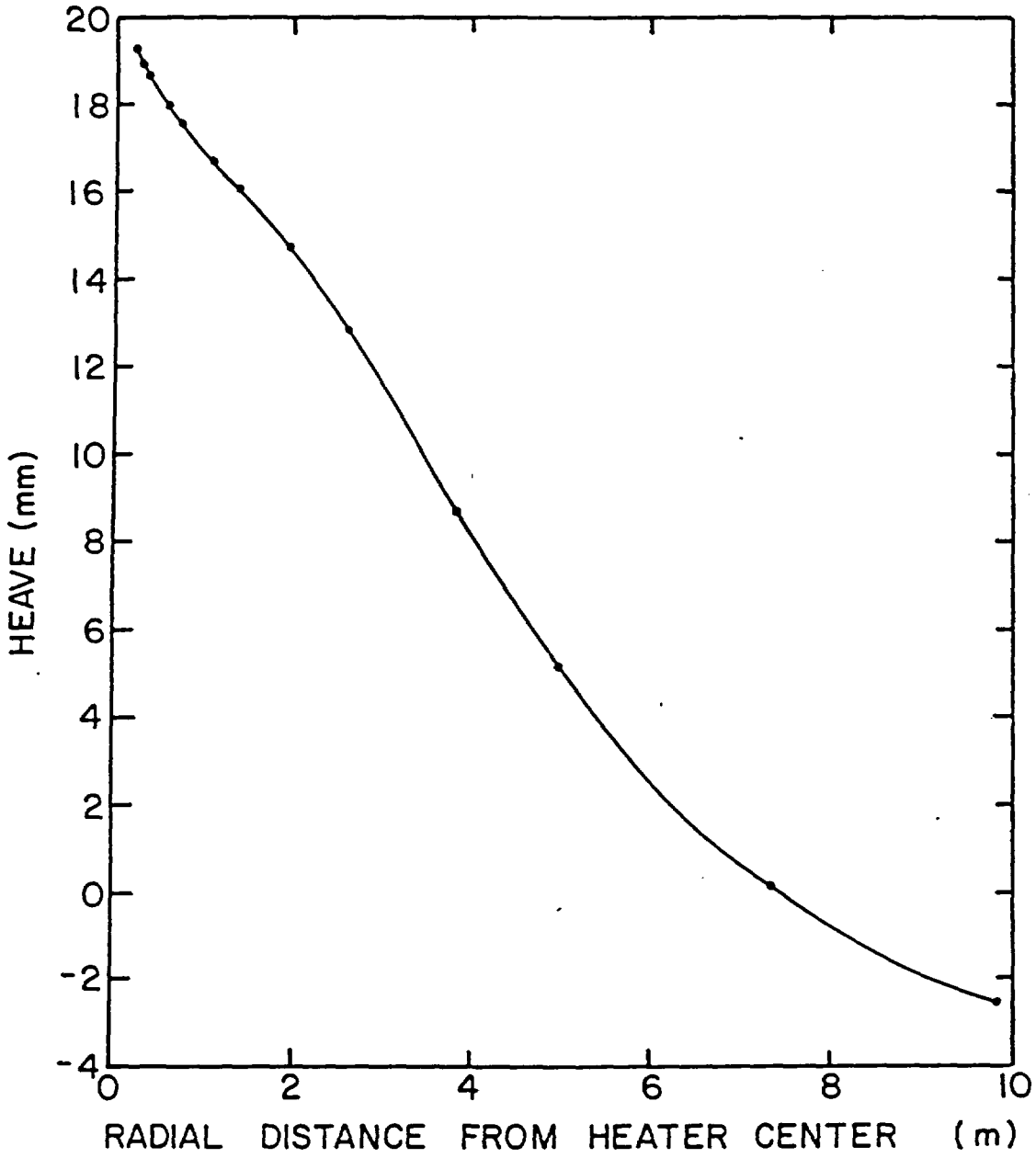
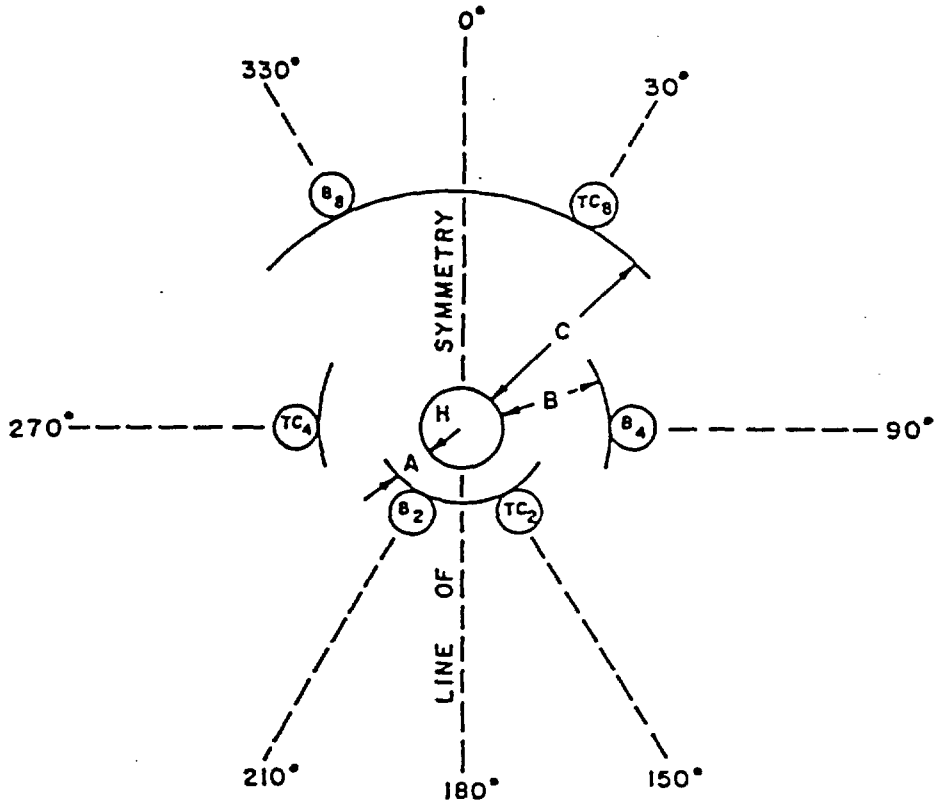


Figure 4-5. Floor Heave Profile at Site C After 1,500 Days of Heating.



H REPRESENTS THE HEATER BOREHOLE

B_2, B_4, B_8 REPRESENT BRINE BOREHOLES

TC_2, TC_4, TC_8 REPRESENT THERMOCOUPLE BOREHOLES

A = 50mm
B = 100mm
C = 200mm

Figure 3-1. Orientation and Layout of Boreholes for Brine Migration Sites [After Krause and Gnirk, 1981].

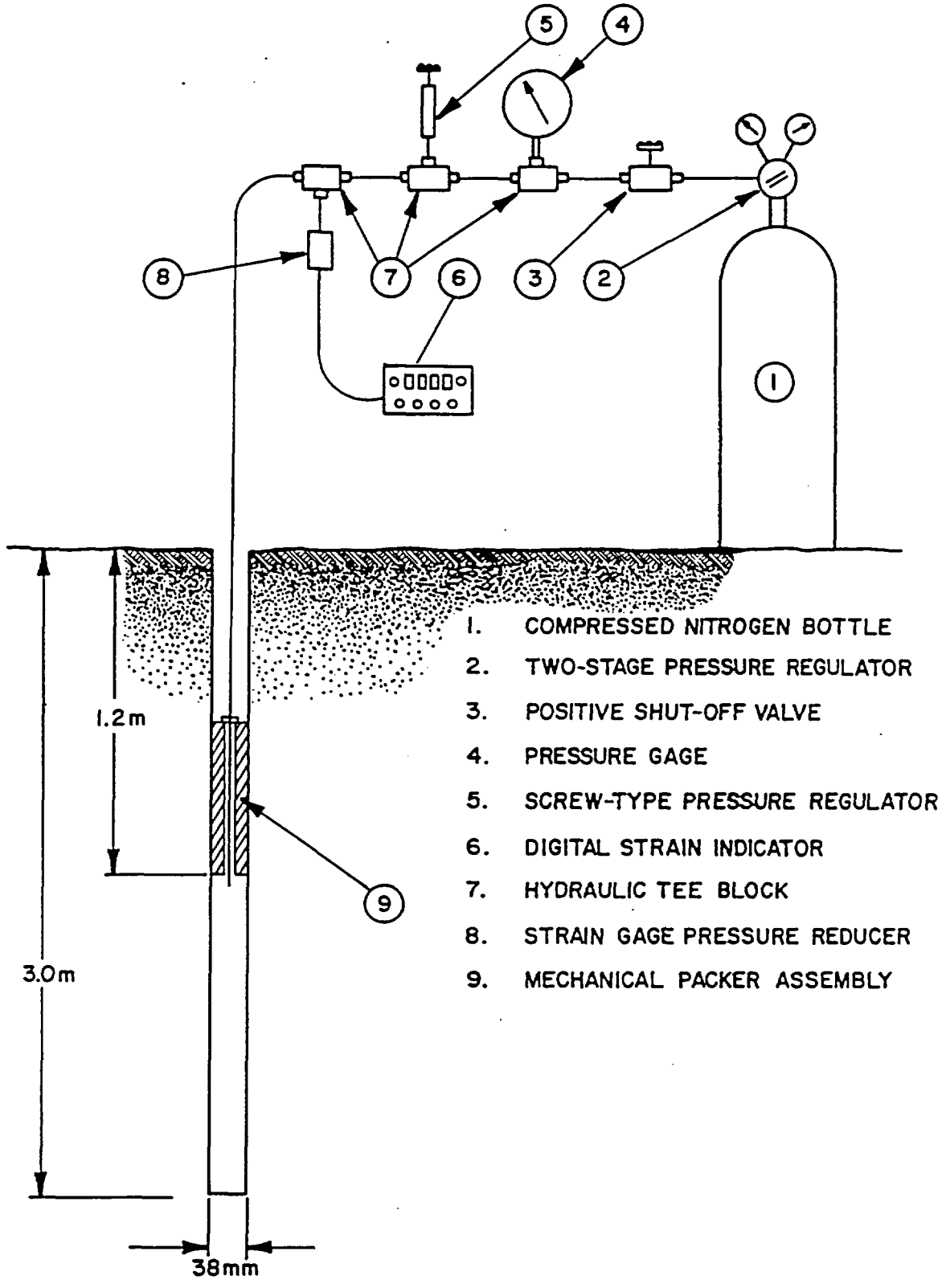


Figure 4-1. Permeability Testing Apparatus [After Blankenship and Stickney, 1983].

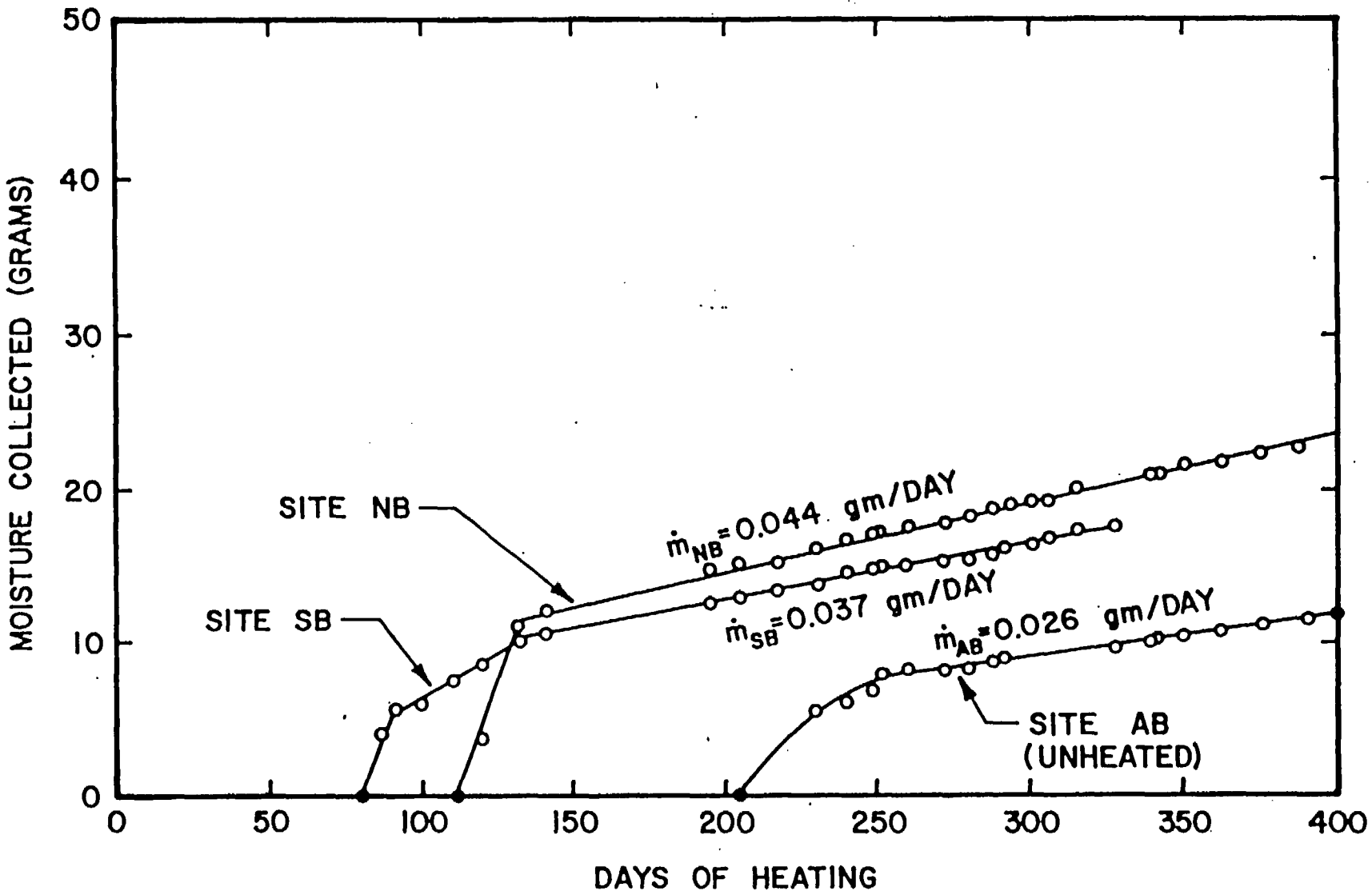


Figure 3-2. Comparison of Cumulative Moisture Collection [After Krause, 1982].

RSI DWG 025-83-57

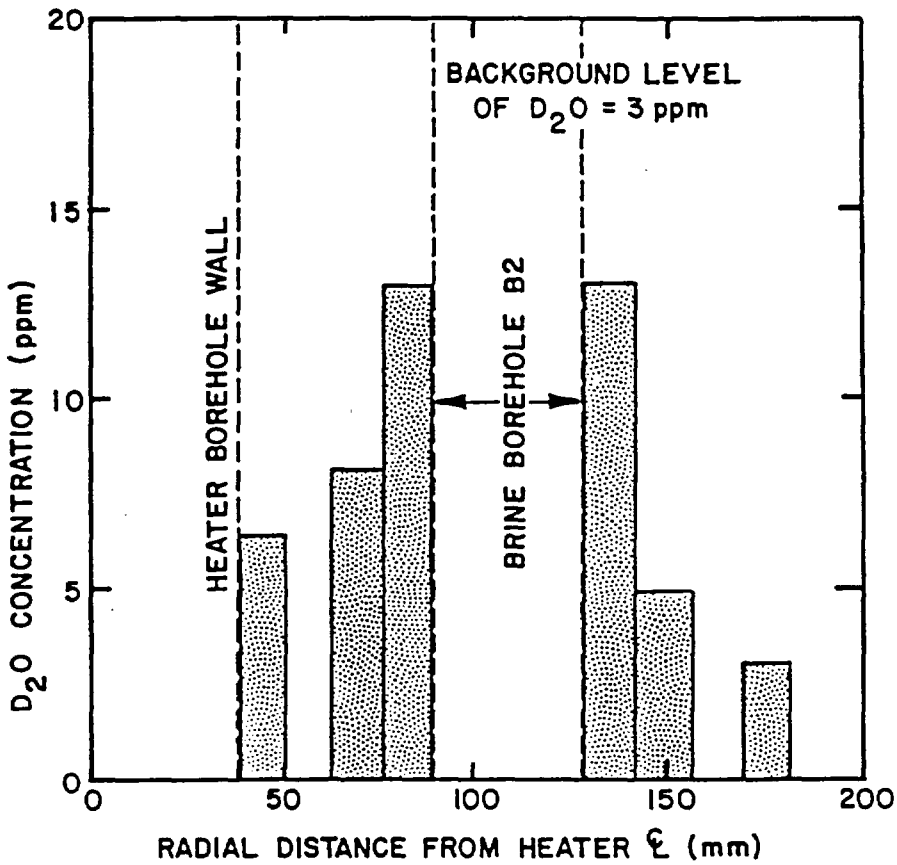


Figure 3-3. Concentration of D_2O Around Brine Borehole [After Krause, 1982].

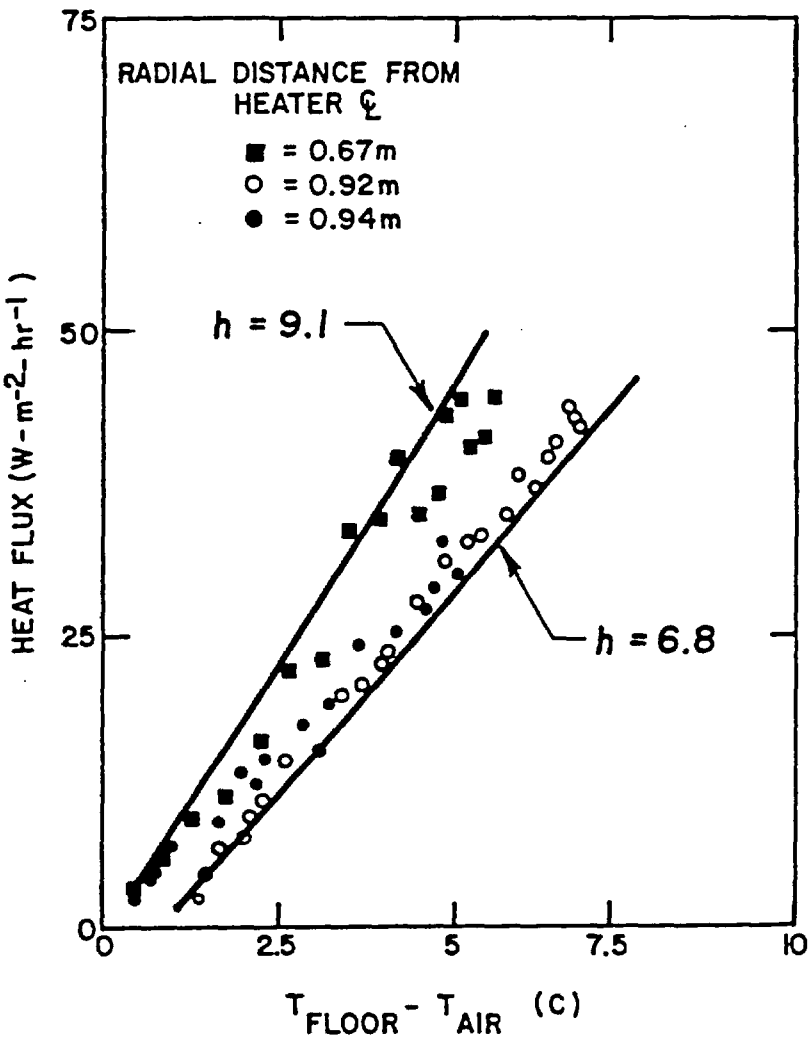


Figure 2-2. Heat Flux From the Floor at Site A [After Van Sambeek et al, 1983].

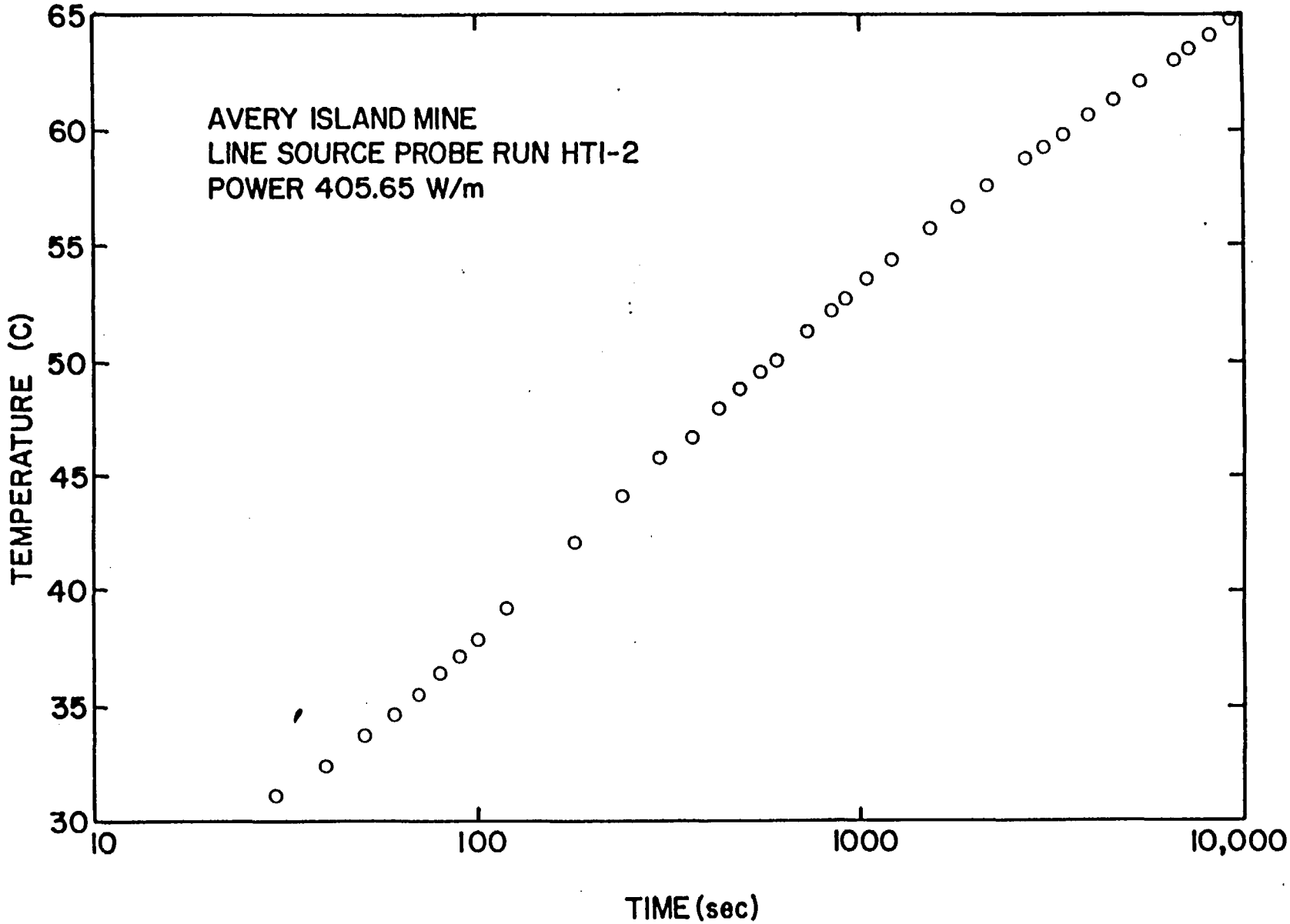


Figure 6-5. Typical Data From the Line Source Thermal Probe [After McVey, 1981].

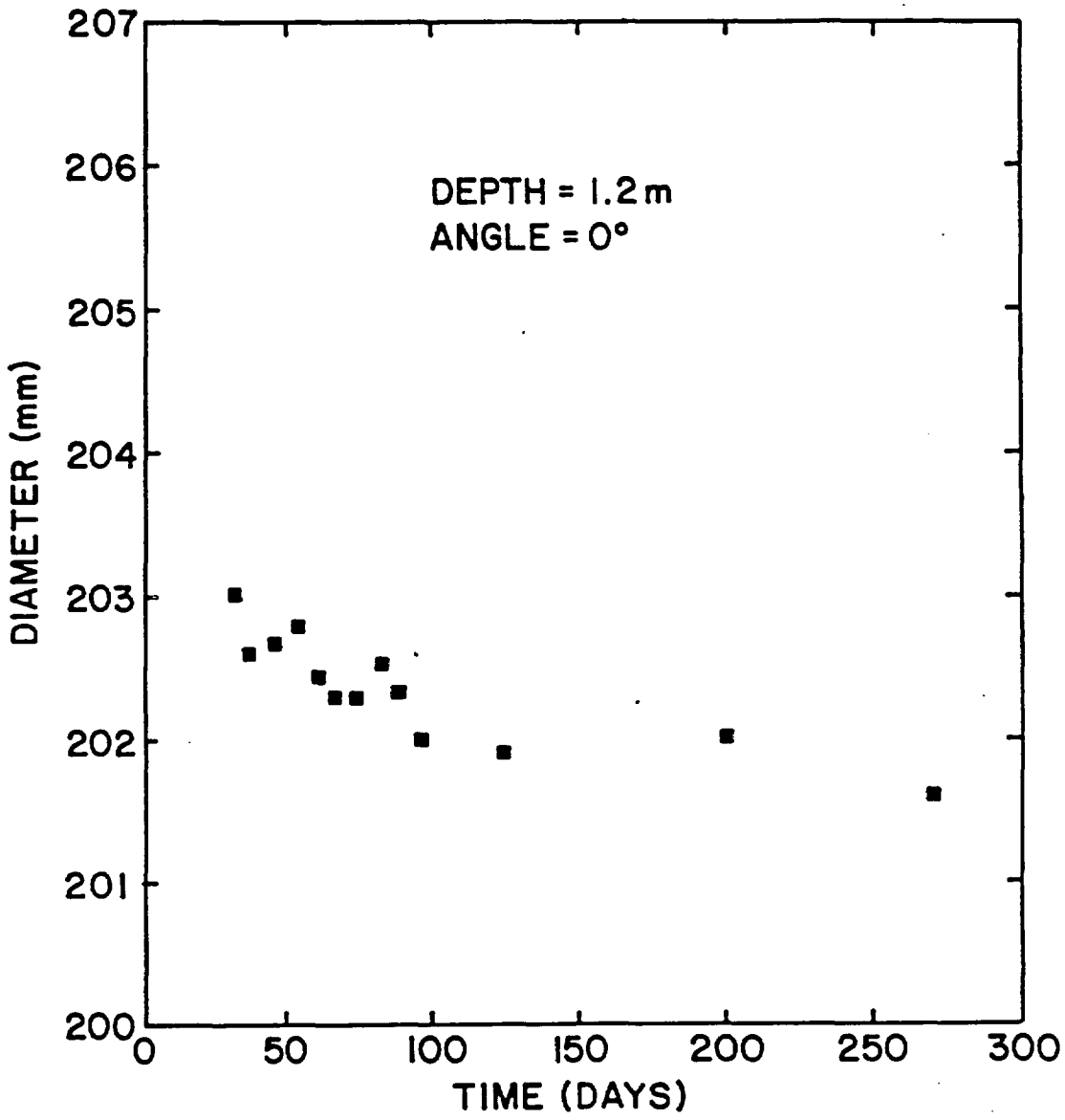


Figure 6-4. Typical Data From the Pillar Borehole Closure Measurement.

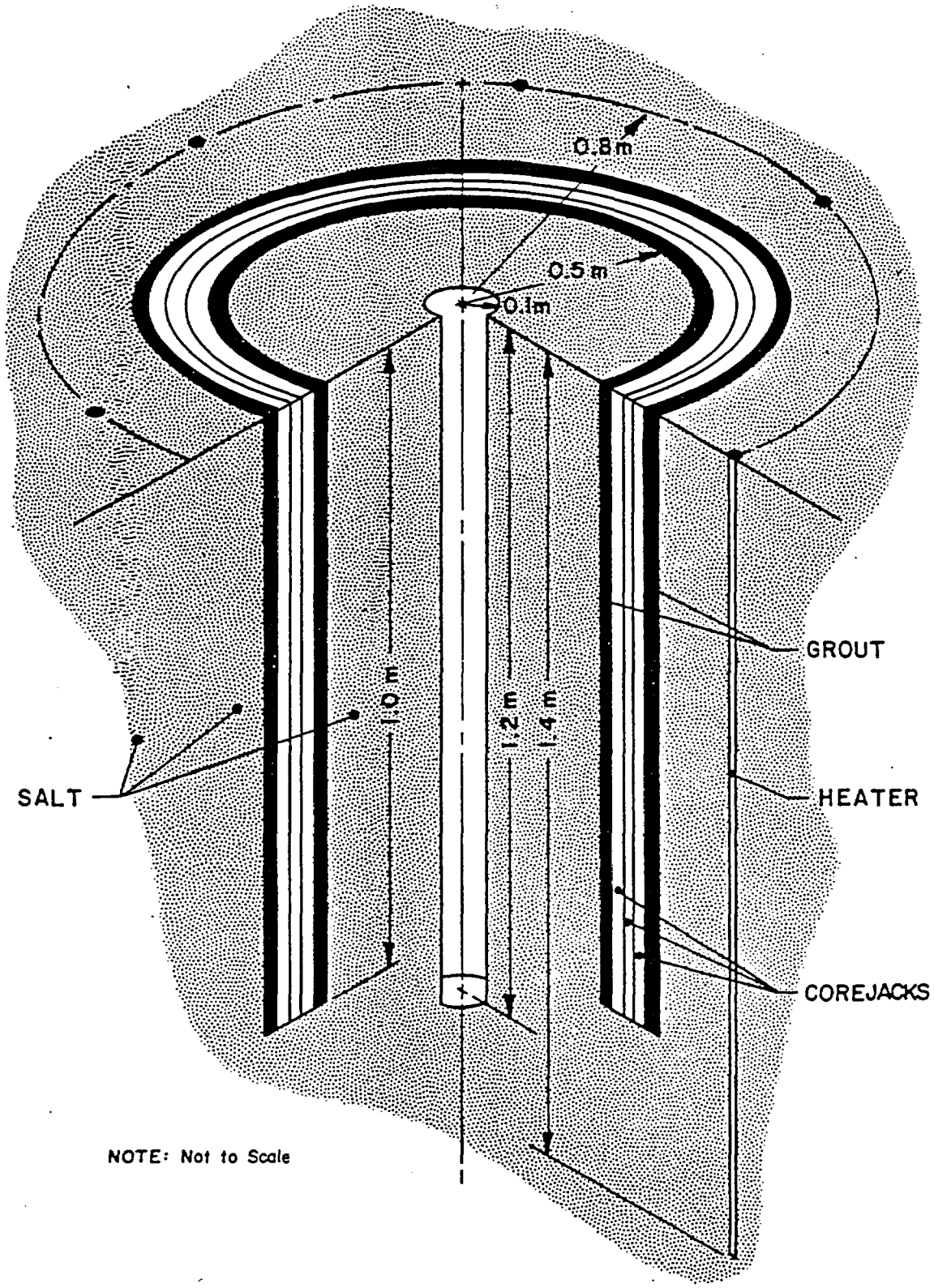
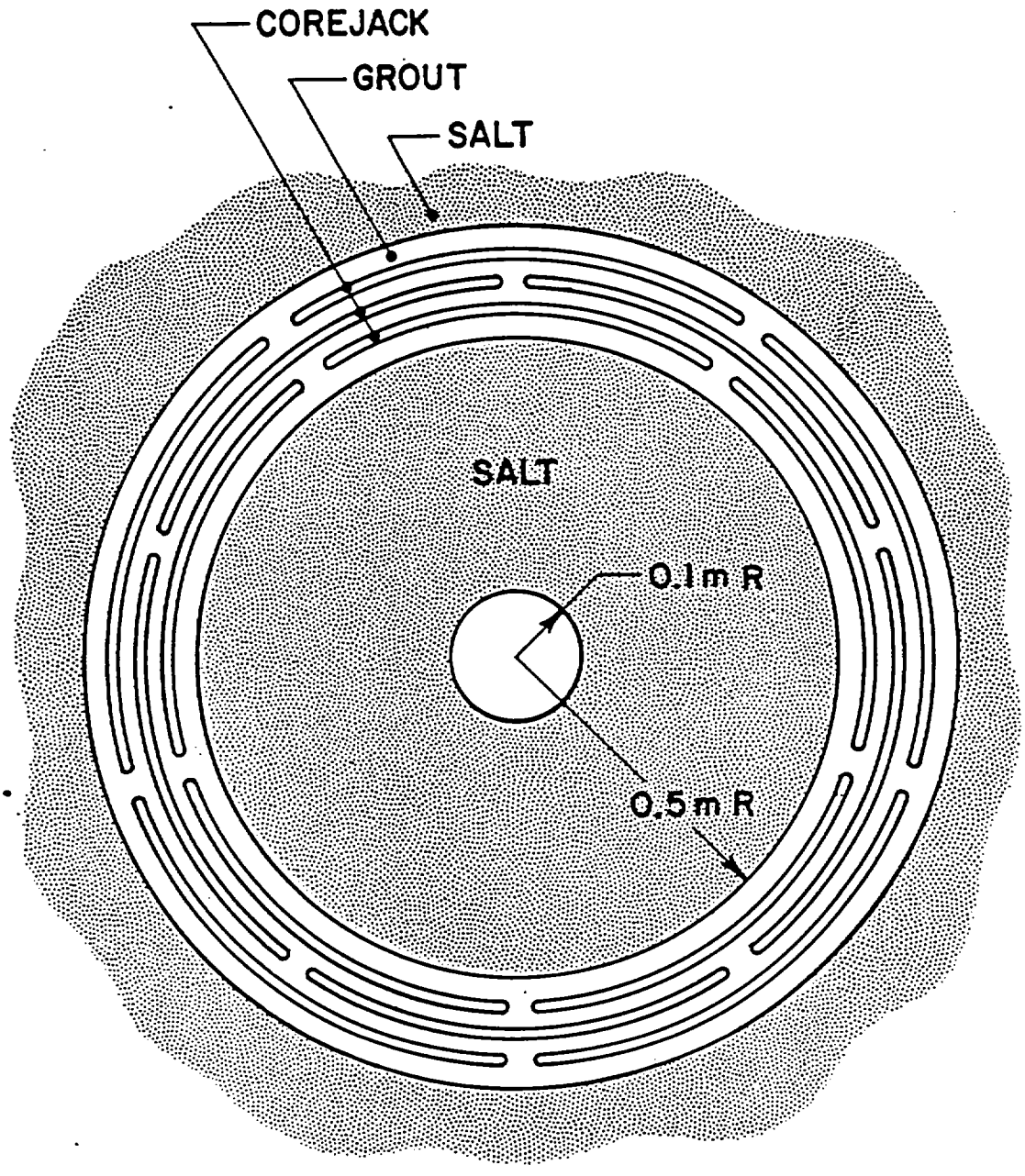


Figure 5-1. Schematic Drawing of the Corejacking Test Configuration [After Brekken et al, 1983].



NOTE: Not to Scale

Figure 5-2. Cross Section of a Corejacking Test Showing the Staggered Placement of the Corejacks [After Brekken et al, 1983].

Table 1. Measured Diameters at Two Elevations in the Central Borehole at Test HCJ-410 (P_o = 10 MPa, T = 40°C)

DATE	DAYS OF OBSERVATION	COREJACK PRESSURE (MPa)	MEASURED DIAMETER (mm)	
			-0.25 m	-0.5 m
11/7/83	-0.016	0.00	198.167	197.422
11/7/83	-0.015	1.03	197.990	197.410
11/7/83	-0.014	2.00	197.990	197.380
11/7/83	-0.010	3.07	197.990	197.350
11/7/83	-0.009	3.93	197.960	197.285
11/7/83	-0.008	4.96	197.900	197.185
11/7/83	-0.004	5.65	197.715	196.990
11/7/83	-0.003	6.96	197.550	196.770
11/7/83	-0.002	8.07	197.310	196.540
11/7/83	-0.001	8.96	197.130	196.270
11/7/83	0.000	10.00	197.040	196.155
11/7/83	0.004	10.20	196.670	195.770
11/7/83	0.005	10.20	196.590	195.705
11/7/83	0.006	10.20	196.485	195.640
11/7/83	0.007	10.27	196.460	195.565
11/7/83	0.008	9.93	196.460	195.550
11/7/83	0.008	9.79	196.460	195.560
11/7/83	0.009	9.79	196.640	195.535
11/7/83	0.010	10.00	196.445	195.525
11/7/83	0.011	9.96	196.370	195.515
11/7/83	0.012	9.96	196.375	195.510
11/7/83	0.013	9.96	196.370	195.522
11/7/83	0.014	9.96	196.400	195.500

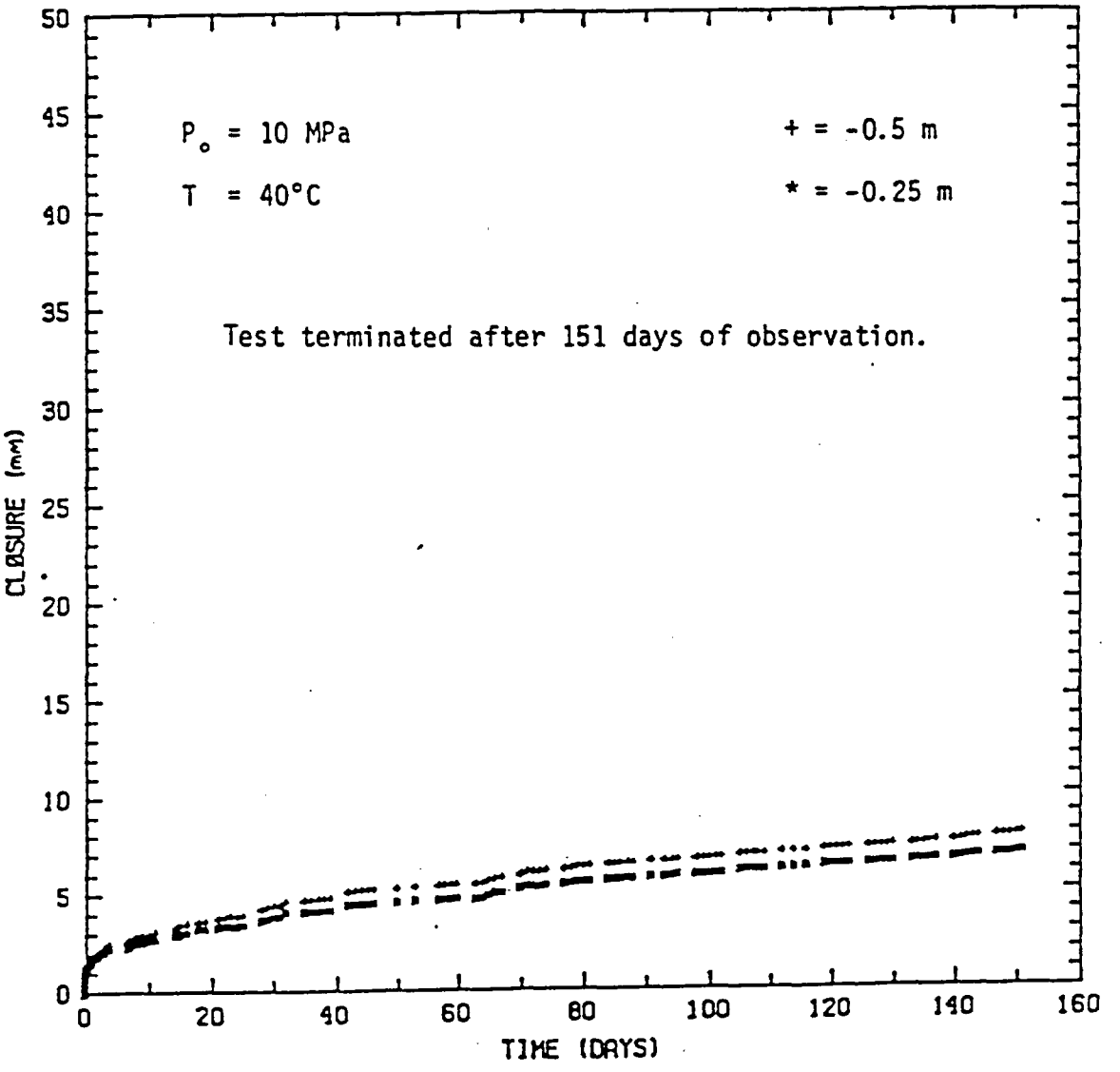


Figure 1. Diametrical Creep Closure Measured at Two Depths in the Central Borehole of Test HCJ-410 for 151 Days of Observation.

RSI DWG 025-84-75

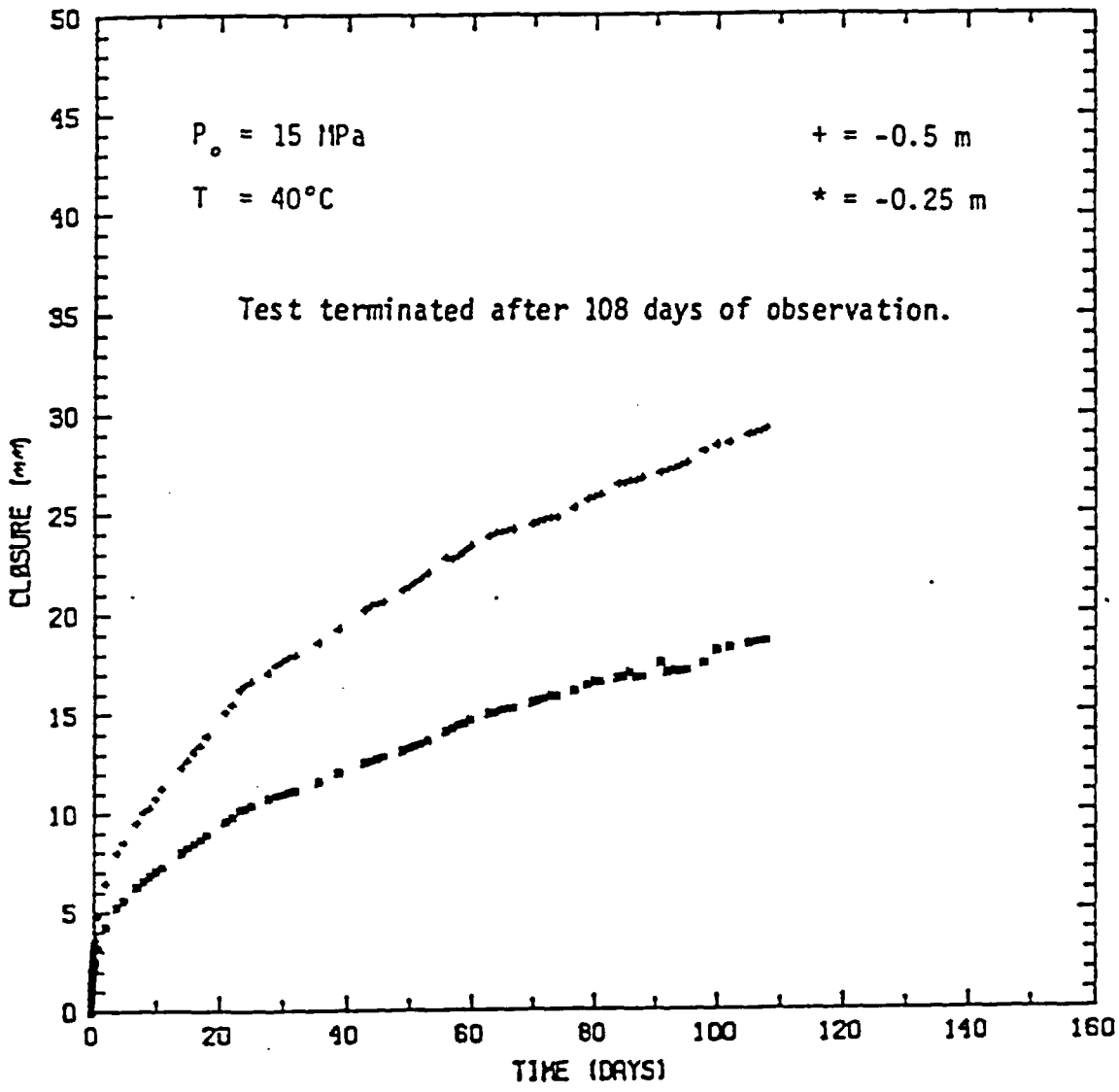


Figure 2. Diametrical Creep Closure Measured at Two Depths in the Central Borehole of Test HCJ-415 for 108 Days of Observation.

RSI DWG 025-84-87

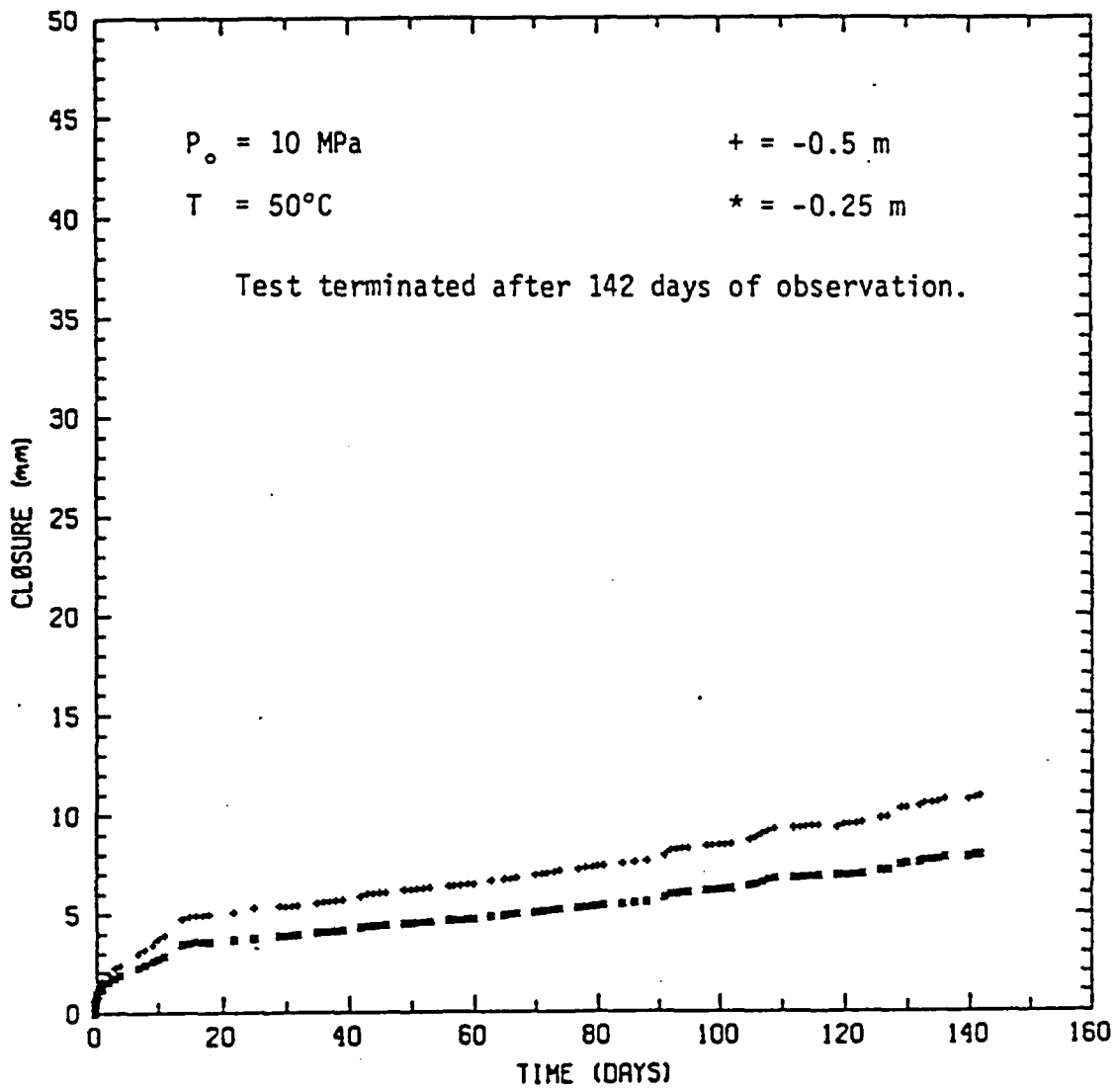


Figure 3. Diametrical Creep Closure Measured at Two Depths in the Central Borehole of Test HCJ-510 for 142 Days of Observation.

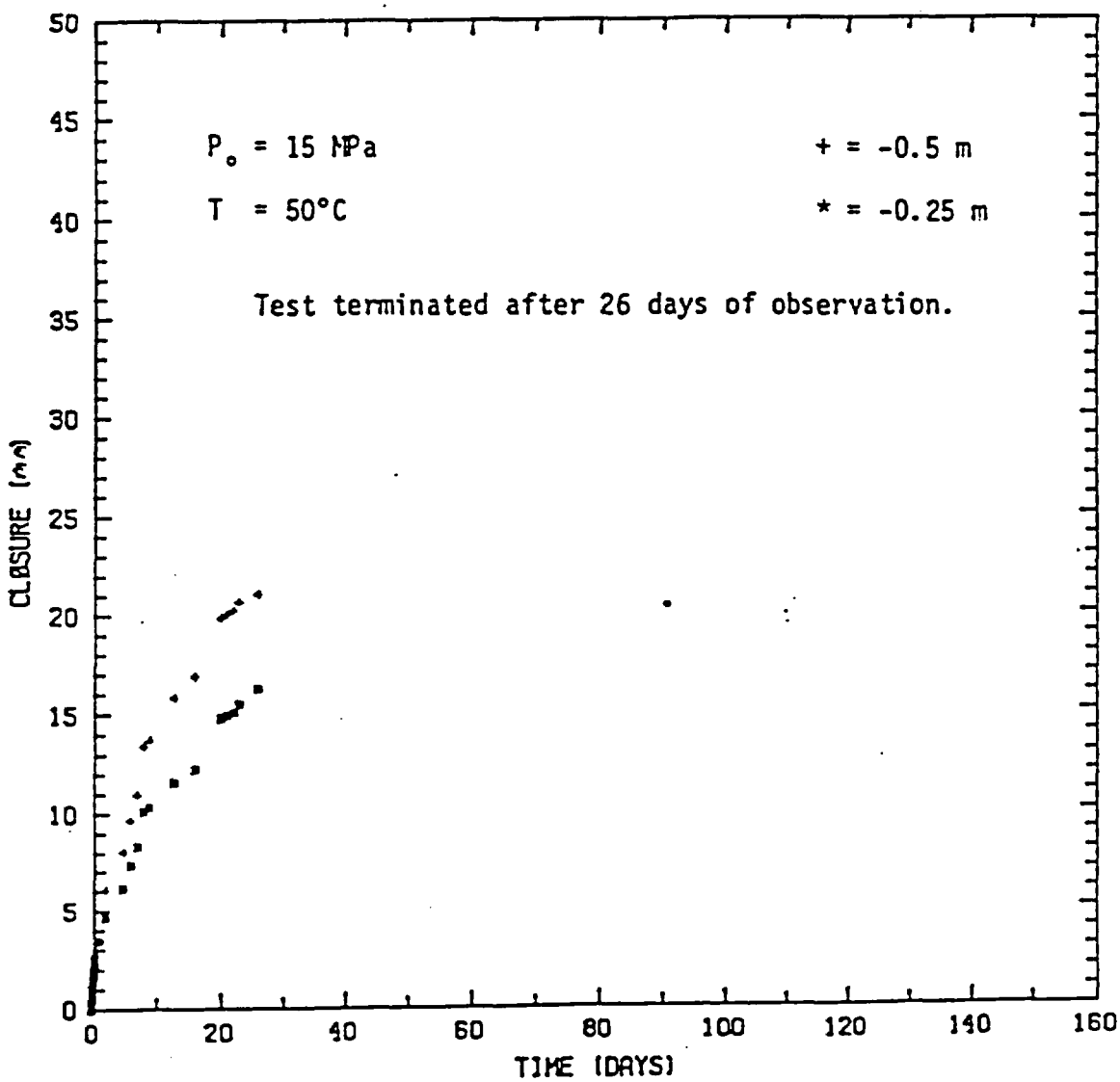


Figure 4. Diametrical Creep Closure Measured at Two Depths in the Central Borehole of Test HCJ-515 for 26 Days of Observation.

RSI DWG 025-84-88

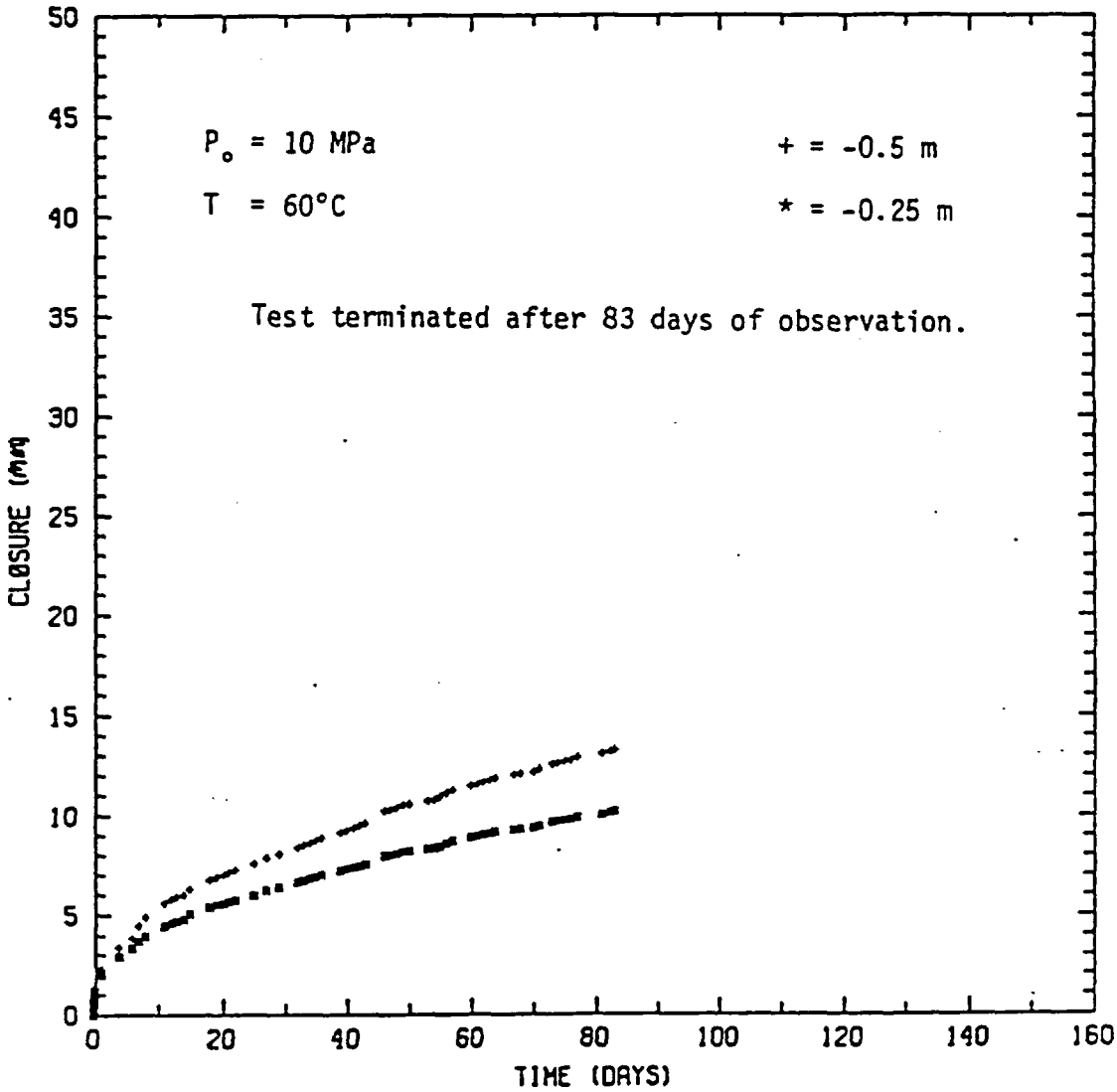


Figure 5. Diametrical Creep Closure Measured at Two Depths in the Central Borehole of Test HCJ-610 for 83 Days of Observation.

RSI DWG 025-84-79

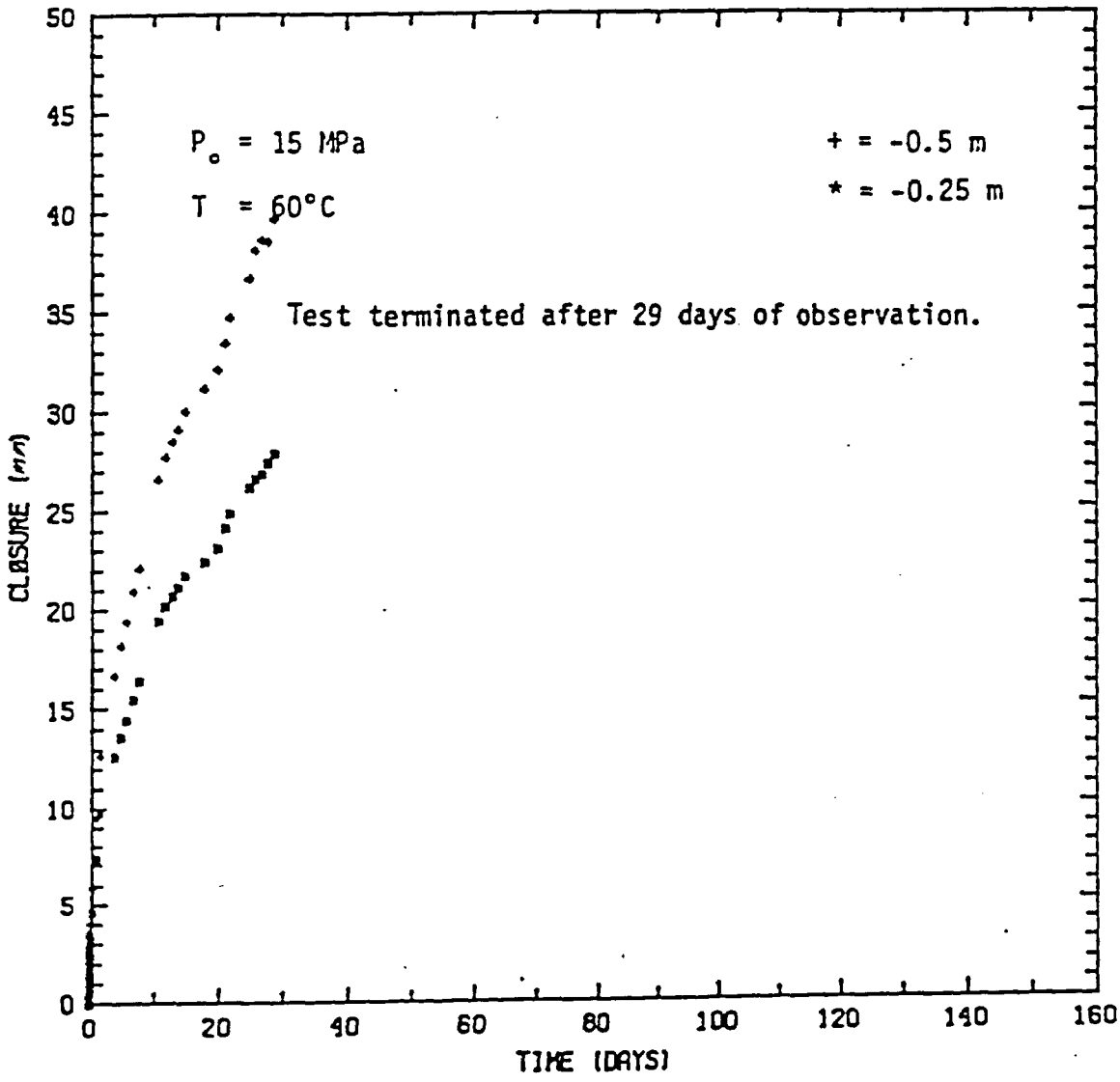


Figure 6. Diametrical Creep Closure Measured at Two Depths in the Central Borehole of Test HCJ-615 for 29 Days of Observation.

Information Management Systems Meeting
Columbus, Ohio - August 8, 1984

NRC staff and contractors met with SRP staff to discuss issue tracking and Information Management Systems (final agenda including list of other attendees is attached). The objective of the meeting was to inform SRP of NRC activities and to identify systems presently in use or planned.

Summary

The SRP Technical Data Management System (TDMS), consisting of the Records Information System (RIS), Records Turnover Package (RTP), Catalog, SRP Technical Data Base (SRP/TDB), and tracking systems, were described. NRC presented an overview of their activities which at this time are primarily directed towards requirements analysis and systems evaluation.

A basic guideline for NRC Information Management Systems development is to not unnecessarily duplicate existing information sources and to have compatibility wherever practical. Accordingly, the information exchange was extremely useful.

SRP and NRC are both moving towards development of issue tracking systems and these will be linked to Information Management Systems. Although these will be independent, it was agreed that we will keep each other informed of our developments.

NRC and DOE staff discussed planned activities in issue tracking. NRC presented a system concept and noted some possible systems for investigation (such as DOE's LICOM). It was agreed that as both NRC and DOE develop their tracking systems future meetings will be held to share results and discuss areas of coordination and cooperation.

List of Attachments to the Meeting

1) Agenda including list of other attendees.

2) Handout of Matt Golis' presentation.

3) Handout of vugraphs of NRC presentation.

4) April 27, 1984 Requirement Specification for Management of SRP Technical Data and Information.

AGENDA
for a
Briefing to the NRC and NRC Contractors on
the SRP Information Management Systems
August 8, 1984 in the Program Control Center Room 13-6-080 in Columbus, Ohio

9:00	Welcome and Introductions Purpose and Objectives	SRPO/NRC
9:15	Overview of the Technical Data Management System (TDMS) o System Philosophy (Purpose, Users) o System Features (Basis, structures) o Logical Designs RIS/RTP SRP/TDB Tracking Systems (SIMS/Catalog/Ref Tracking System) o Utilization Issues Special User Groups Security Backup Systems	Matt Golis, ONWI
10:30	Break	
10:45	General Discussion of the Existing Information Management Systems Question/Answer session with Technical Support staff	ONWI/BPMD/BCL staff
11:00	Planned Enhancements to Existing Systems RIS (Link Between Documents in RIS and EA/SCP) SRP/TDB (Raw Data Tape Access, Computer-Code Status) SCP/Licensing Issue Tracking System	 Ruth Linebaugh, BPMD Matt Golis, ONWI Jack Parry, ONWI
11:15	Overview of NRC Activities/Plans for Information Management Systems	NRC
12:00	Lunch	
1:00	Demonstration of SRP Information Management Systems o Bibliographic and Records (RIS/RTP) o Technical Data (SRP/TDB) o Tracking Systems (Catalog/Ref Track/SIMS)	 Ruth Linebaugh, BPMD Gary LaRue, BPMD Ann Kirk, BPMD
3:00	Summary and Response o Preparation of meeting notes	DOE/NRC
4:00	Adjourn	

Other Attendees:

Avi Bender, NRC
Phil Altomare, NRC
Reg Brown, NRC
Don Keller, ONWI
Sunil Gupta, ONWI
Jack McDowell, ONWI
Joe Peters, ONWI

Sarah Starr, SRPO
Leslie Casey, SRPO
Susan Buchanan, SRPO
Roger Wu, SRPO
Al Shoemaker, P-R

Bill Swartwood, Aerospace Corporation
Hank Bauer, Aerospace Corporation
Bob Niehoff, BCL
Janet Tisher, BPMD

ISSUE TRACKING SYSTEM STATUS REVIEW

NUCLEAR REGULATORY COMMISSION

DIVISION OF WASTE MANAGEMENT (DWM)

PURPOSE OF THIS MEETING

- INFORM DOE OF WHAT WE ARE DOING
- FAMILIARIZE DWM STAFF WITH CURRENT/PLANNED DOE HIGH LEVEL WASTE ISSUE TRACKING/INFORMATION MANAGEMENT SYSTEMS

WHY THE NEED FOR ISSUE TRACKING

- NRC NEEDS TO IDENTIFY ISSUES RELEVANT TO LICENSING HIGH LEVEL WASTE REPOSITORIES
- NRC NEEDS TO SYSTEMATICALLY AND LOGICALLY TRACK AND DOCUMENT STEPS TO IDENTIFY AND RESOLVE ISSUES IN ORDER TO FACILITATE LICENSING AND SATISFY FOIA AND DISCOVERY PHASE
- MANAGEMENT TOOL FOR USE BY TECHNICAL/MANAGERIAL STAFF
- IMMEDIATE ACCESS TO KEY ISSUES IMPACTING NRC/DOE

WHAT IS AN ISSUE TRACKING SYSTEM?

° A SYSTEM IS A SET OF COMPONENTS THAT INTERACT WITH ONE ANOTHER TO ACHIEVE A COMMON PURPOSE

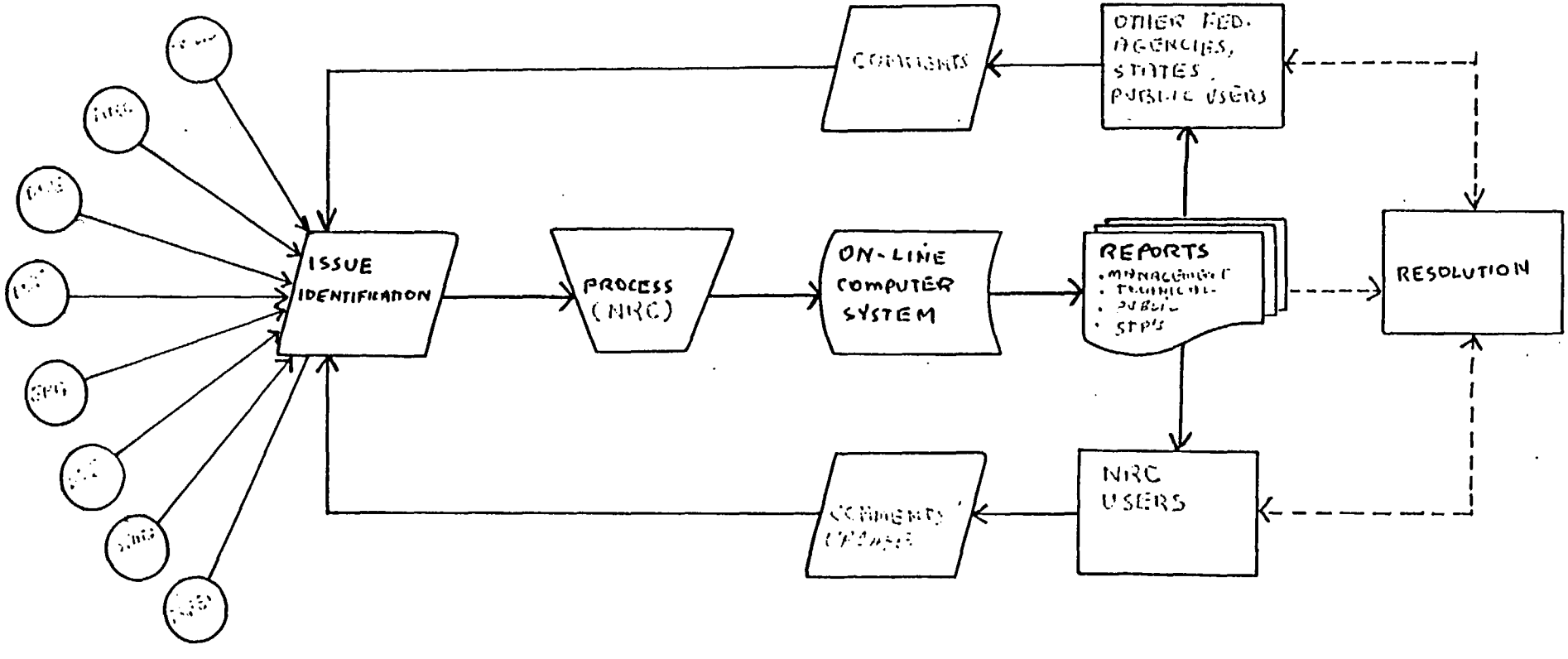
° THE COMPONENTS OF AN ISSUE TRACKING SYSTEM ARE:

-- INTERNAL PROCESSES AND PROCEDURES

-- HARDWARE/SOFTWARE PACKAGE

-- USERS

° PURPOSE - TIMELY IDENTIFICATION TRACKING AND RESOLUTION OF ISSUES IMPACTING NRC'S LICENSING MISSION



ISSUE TRACKING SYSTEM

CONCEPT

WHAT WILL THE SYSTEM DO?

SYSTEM FUNCTIONS

IDENTIFY

DOCUMENT

REVIEW

PROCESS

CODE

ASSIGN

TRACK

PLANNED ACTIVITIES

- REQUIREMENTS ANALYSIS
- SYSTEM DESIGN
- EVALUATION OF HARDWARE/SOFTWARE
- PROCEDURES FOR ISSUE PROCESSING
- SYSTEM DEMONSTRATION

INFORMATION MANAGEMENT SYSTEM (IMS) STATUS REVIEW

NUCLEAR REGULATORY COMMISSION (NRC)

DIVISION OF WASTE MANAGEMENT (DWM)

BASIC OBJECTIVE OF NRC DWM IMS

- THE DWM IMS BASIC OBJECTIVE IS TO HAVE TIMELY AVAILABILITY OF INFORMATION THAT IS NEEDED FOR LICENSING REVIEWS AND HEARINGS.

- THE INFORMATION/DATA IN THE DWM IMS WILL REFLECT THE UNIQUE ROLE, ACTIVITIES AND PRODUCTS OF NRC.

- THE INFORMATION IN THE DWM IMS TOGETHER WITH THE INFORMATION IN THE IMSs OF DOE WILL BE THE TWO MAJOR SOURCES OF INFORMATION NEEDED TO SUPPORT PRELICENSING AND LICENSING.

LEGAL INFORMATION RETRIEVAL REQUIREMENTS OF NRC

- NRC REGULATIONS (10 CFR 9 SUBPART A - FREEDOM OF INFORMATION ACT REGULATIONS) REQUIRE ANY IDENTIFIABLE RECORD, WHETHER IN THE POSSESSION OF THE NRC, ITS CONTRACTORS, ITS SUBCONTRACTORS, OR OTHERS, SHALL BE MADE AVAILABLE FOR INSPECTION AND COPYING PURSUANT TO THE PROVISIONS OF THIS PART, UPON REQUEST OF ANY MEMBER OF THE PUBLIC.

- NRC REGULATIONS (10 CFR 2.741(2) (d)) REQUIRE WRITTEN RESPONSE WITHIN 30 DAYS TO WRITTEN REQUESTS FOR THE PRODUCTION OF RECORDS AND DOCUMENTS SUBMITTED DURING THE DISCOVERY PART OF A HEARING.

- THE SYSTEM SHOULD HAVE THE CAPABILITY TO IDENTIFY THE EXISTENCE, DESCRIPTION, NATURE, CUSTODY, AND LOCATION OF ANY BOOKS, DOCUMENTS, OR OTHER TANGIBLE THINGS THAT ARE DISCOVERABLE MATTER.

USE OF OTHER AGENCIES' IMSs

- PROPOSALS INVOLVING NRC RELIANCE ON DOE, NATIONAL LABS, OR DOE CONTRACTOR INFORMATION MANAGEMENT SYSTEMS WILL BE REVIEWED BY LEGAL STAFF FOR CONFLICT OF INTEREST IMPLICATIONS.

- IF DOE MAKES ITS IMSs AVAILABLE TO STATES, TRIBES, OR THE GENERAL PUBLIC THEN THERE SHOULD BE NO CONFLICT OF INTEREST IMPLICATIONS. NRC SHOULD HAVE NO SPECIAL PRIVILEGES.

- NRC IS NOT RESPONSIBLE FOR MAKING AVAILABLE DOCUMENTS PRODUCED BY OR FOR OTHER AGENCIES.

PLANNED ACTIVITIES

- REQUIREMENTS ANALYSIS
- EVALUATION OF HARDWARE/SOFTWARE SYSTEMS
- GENERAL SYSTEM DESIGN

TYPES OF PROBLEMS TO BE ADDRESSED

- INTERFACING BETWEEN SYSTEMS
- INFORMATION/DATA RELIABILITY AND QUALITY CONTROL
- TYPE OF INFORMATION STORAGE, SEARCH AND RETRIEVAL
- SYSTEMS RELIABILITY AND BACKUP

April 27, 1984

REQUIREMENT SPECIFICATION FOR MANAGEMENT OF SRP TECHNICAL DATA AND INFORMATION

INTRODUCTION

The purpose of this document is to clearly state the Salt Repository Project (SRP) needs for the introduction, maintenance and continued availability of technical data and information[1], as well as project control, i.e., costs and schedules.

Thus this document addresses the general needs of the project and its handling of working technical data, support information and any other technical information that may be of concern to the project. The document is organized into sections to address (1) the general characteristics of the overall system needs, (2) the control characteristics of the system, (3) the retrieval characteristics of the system, (4) the display characteristics of the system and (5) the schedule by which the system is needed to evolve.

Another purpose of this document is to assure that all data/information work done on behalf of ONWI is done in accordance with DOE orders [e.g., 1324.4, 1324.4], NQA-1 (Supplement 17S-1), NRC directives [10CFR60, Reg. Guides, Standard Review Plan for Site Characterization of HLW Repositories], public information and cooperation, and technical staff integration.

---

[1]Definitions:

- Technical data: The quantitative and qualitative statements of fact that become the basis for decisions and conduct of the SRP.
- Technical information comprises the broad collection of documents and records that put the technical data into context and indirectly justify its use within the project.
- Unanalyzed data: Data that have been accepted by technical staff members but may not yet have been used in project supportive documents. Unanalyzed data shall be in published form, i.e., formally issued by the data generators such as subcontractor reports or ONWI data reports.
- Raw data: Data that have been received, often as data tapes, and available for analysis by SRP and ONWI technical staff.
- Approved data: Data that have completed the patent review cycle.

2. A simple method for tracking data entry revisions and for finding primary source documents.

   Each item of technical data must be referenced to the source document from which the item came. As changes are introduced into the content of the data base, a record must exist that clearly shows which items have been changed, why they were changed, who authorized the change and when did it occur.

3. A simple method for locating supporting documents and affiliated information.

   Each source document for a cited technical data item must be retrievable in either an original or microform condition. Where supplemental information or cores and samples are involved, these too shall be readily accessible for interested parties.

4. The ability to display the integrity and/or uncertainty of each data item.

   Each item reflecting technical intelligence (typically numerical or quasi-analytical results) shall have the capability of displaying the manner by which the result was derived including reference to the standards and/or procedures followed while deriving the specific item.

5. The ability to show the distinction between raw (measured) values, project-accepted values and projected values.

   The system must be able to indicate to the viewer that a data item was the result of a specific measurement, i.e., hard data, or is a projection based on a given set of assumptions, criteria, estimations, judgements, opinions, i.e., soft data. Projections must always be accompanied by the manner by which they were derived. Raw data must always be clearly identifiable as obviously different from project-accepted data.

10. The ability to steer the casual user to all available technical data/ information resources.

The lead-in to the data base must reflect all search resources available to the user and instructions as to how to avail oneself of these resources. This calls for an initial software program that highlights the available data resources, indicates the nature and content of each, and instructs the user as to how to access the resources of their choice. The experienced user must have direct access to the working levels of the data base without having to wait for a directed entry through the use of menus or similar procedures.

11. A comprehensive set of documentation to explain the use and structure of the system.

An overall system description and operations manual intended to display a detailed understanding of the structure, operation and maintenance of the system. This description is to have an accompanying user manual and prompt card (fold out) to assist operations in the use of the system and shall be jointly developed by both CMO/IMS.

12. The ability to accept technical data and information from non-BCL host computers.

Technical data and information currently stored on SRP prime and subcontractor computers needs to be transferred to the TDMS. In order to reduce the introduction of translational errors, all efforts must be expended to achieve the utmost of direct data transfer between various components of the SRP including DOE prime contractors and designated subcontractors who possess large amounts of critical project data. Received data tapes shall be managed with inventories and status available on-line.

13. The ability to transfer technical data to other BCL host computers.

The system must have the ability to output a data file in a user-specified format to any of the BCL computers for subsequent use and analysis.

5. Able to highlight baseline, revision and raw data items for easy recognition.

   The system must be established so that items that have been baselined or revised since the last issue of the handbook or are unanalyzed raw data, can be easily recognized through the use of bold face display, reversed video, underlining, or some similar flagging technique. This technique may also apply to items that have been used in special documents such as the SCP, EA's, etc.

6. Able to safeguard key support documents.

   The system must be able to safeguard original and microform versions of key support documents such as references to EAs, the SCP, Record Turnover Packages and related letters, papers, and directives. These shall be maintained in accordance with DOE Orders and QA Specifications as cited in the ONWI contract. Access to these documents shall be through use of a controlled reading room for authorized personnel.

7. Able to safeguard key support materials.

   The system must be able to safeguard original and microform versions of maps and drawings. It must also be capable of storing and managing the use of computer tapes and samples or core intended for subsequent tests and evaluations. Each of these areas shall have an inventory control system whereby the amount of these items under project control and related historical information is readily available for use by project and interested personnel.

DISPLAY CHARACTERISTICS OF SYSTEM

1. Technical Data (TDMS content) shall be displayed by:

   - Computer terminal using menus, profiles, reports, special printouts such as boldface, under line, reverse video, blinking, etc., and suppressed computer jargon, to the maximum extent possible while maintaining a high level of good taste. All output formats shall be reviewed and approved by the CMO.

   - Batch-printer outputs in support of handbook and special report preparation. Specific formats shall be reviewed and approved by CMO prior to and during implementation.

   - Graphics printouts are to be dictated by specific needs on a case-by-case basis.

Reviewed and Concurred by: _____ Date 4/25/84
T. Steinborn*

_____ Date 4/25/84
H. Hume*

_____ Date 4/27/84
H. Kalia *

_____ Date 4/25/84
W. Harper *

*Members of the TDMS Steering Committee

AGENDA

for

Briefing to the NRC AND NRC Contractors on
the SRP Information Management Systems
August 8, 1984
in the Program Control Center
Room 13-6-080
in Columbus, Ohio

9:00	Welcome and Introduction Purpose and Objectives	SRPO/NRC
9:15	Overview of the Technical Data Management System (TDMS)	M. Golis
	• System Philosophy (Purpose, Users) • System Features (BASIS, structures) • Logical Designs RIS/RTP SRP/TDB Tracking Systems (SIMS/Catalog/Ref Tracking System) • Utilization Issues Special User Groups Security Backup Systems	
10:30	Break	
10:45	Questions about the Existing Information Management Systems Question/Answer session with technical support staff	ONWI/BPMD/BCL
11:00	Planned Enhancements to Existing Systems	
	• RIS (Link Between Documents in RIS and EA/SCP) • SRP/TDB (Raw Data Tape Access, Computer-Code Status) • SCP/License Issue Tracking System	R. Linebaugh M. Golis R. Klingensmith
11:15	Overview of NRC Activities/Plans for Information Management Systems	NRC
12:00	Lunch	
1:00	Demonstration of SRP Information Management Systems	
	• Bibliographic and Records (RIS/RTP) • Technical Data (SRP/TDB) • Tracking Systems (Catalog/Ref Track/SIMS)	R. Linebaugh G. LaRue A. Kirk
3:00	Summary and Response • Preparation of meeting notes	DOE/NRC
4:00	Adjourn	

TOPICS OF INTEREST RELATED TO SRPO INFORMATION MANAGEMENT SYSTEMS

-- Type of information/data elements (data, documents, samples, issues, etc.)

-- Type of information storage used (full text, abstracts)

-- Type of searches and retrievals (full text, keyword, title, etc.)

-- Type of interfaces with other DOE systems

-- Type of users

-- Volume of information/data handled

-- Type of security in place (user I.D., password)

-- Information/data reliability for system input

-- Type of system reliability (backup tapes, backup hard copy system, system recovery/reconstruction)

-- Type of issue tracking systems

-- Requirements analyses used

TDMS

BIBLIOGRAPHIC SOURCES	-	RIS
PROJECT RECORDS	-	RTP
PROJECT DATA	-	TBD
STATUS TRACKING	-	SIMS, EDRS CATALOG, REFERENCE TRACKING

SUMMARY OF HOW THE SYSTEM WILL ANSWER STAFF CONCERNS

Concerns of Staff	Characteristics of System										
	Ownership (PM)	Level Control	Team (Indexer-PM)	Weekly Update (input)	User Record	Stepped Access	Unlimited Access	Ready Access to Summary	Historic Track	Update Reports	Audits
Validity	X	X	X						X		X
Consistency	X	X	X							X	X
Timeliness	X		X	X							
Traceability	X		X					X	X		X
Technical Staff Inv.	X	X	X		X						
Subcontractor Data	X	X				X					
Dissemination	X	X		X	X		X	X	X	X	
Usefulness	X			X	X		X	X	X	X	
Visibility of Central Source	X	X	X		X		X	X		X	
Universality of System	X						X	X		X	
Monitored (Internal Checks)		X	X					X		X	X
Non-Contractor Data		X	X			X			X		

X = a characteristic that is designed to help remove a staff concern.

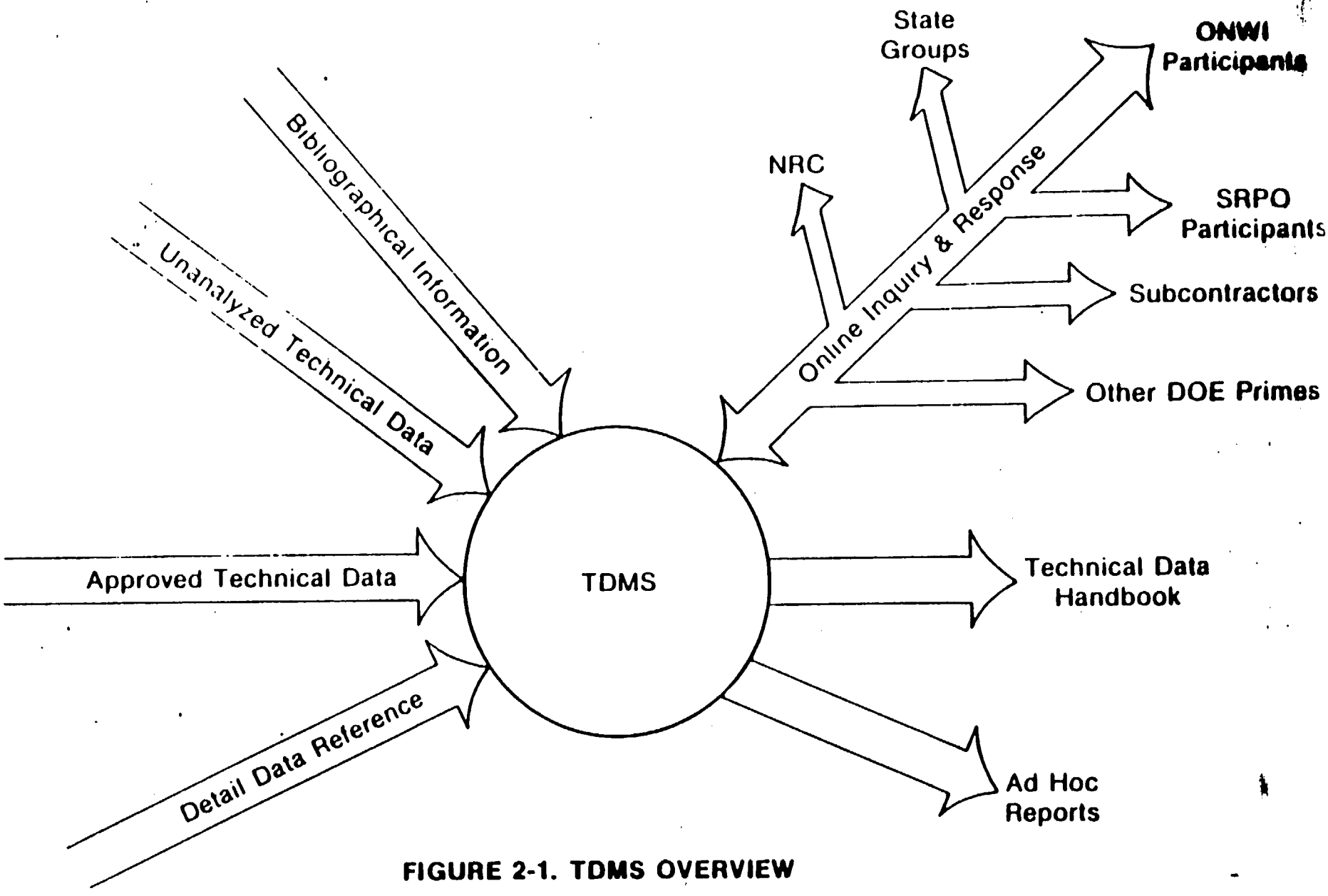


FIGURE 2-1. TDMS OVERVIEW

1/ 2fields

FIELD NAME	NUMBER	TYPE	LABEL
ACC	1	I KEY	ACC NO
DTENT	2	I	DATE ENTERED
TI	6	S NN	TITLE
DTDOC	10	I	DOC DATE
COAU	12	S	CORP AUTH
PREP	13	S	PREPARED FOR
ADDR	14	S	RECEIVER
TYPE	15	S	DOC TYPE
DE	20	S	DESCRIPTOR
CODE	24	S	CODE
LIBNO	30	I	REF.LIBRARY NO
DOCREF	31	S	DOC. REF. BY
STATUS	32	S	DOC. STATUS
MFN	51	I	MFLM FR NO.
OCN	52	S	ONWI CTL NOS.
ECN	53	S	EXT CTL NOS.
ATTM	56	S	ATTACHMTS
SEN	57	S	SENDER
CRN	58	I	X REF NOS.
MN	59	S	MEETING
DTCHG	60	I	DATE LAST CHG
ABS	61	S	ABSTRACT
COREC	62	S	RECEIVING CO
MFCN	65	S	MICROFICHE NO
DIVCODE	66	S	DIVISION CODE
DISTR	67	S	RPT DIST
CALLNO	75	S	CALL NUMBER
RPTCAT	76	S	RPT CATEGORY
RPTNO	77	S	REPORT NO
WBS	78	S	WBS NO
DESCRIP	79	S	DESCRIPTION
AUORG	80	S	AUTHOR ORG
MAILNO	81	S	MAIL LOG NO.
COMAC	82	S	COMMIT/ACTION
SEC	98	I NP	SECURITY
FLD	99	MAP	
RPT	100	MAP	
MAILNO	101	MAP	

1/

5/ find 1 and 2
* 0 5/ 1 AND 2
6/ find 2 and 3
* 1 6/ 2 AND 3
7/ display all for all

ITEM 1

ACC NO 95266
DATE ENTERED 840210
TITLE PERMIAN BASIN LOCATION RECOMMENDATION REPORT
DOC DATE 830901
CORP AUTH ONWI
PREPARED FOR DOE
DOC TYPE R
DESCRIPTOR SITE GEOMETRY;GEOHYDROLOGY;GEOCHEMISTRY;STRATIGRAPHY; ATMOSPHERE
CODE RTE
REF.LIBRARY NO 464
DOC. REF. BY EA-PM
DOC. STATUS C
EXT CTL NOS. DOE-CH-10140-2;DE-AC02-83CH10140
SENDER NONE
DATE LAST CHG 840327
ABSTRACT
CANDIDATE STUDY AREAS ARE SCREENED FROM THE PALO DURO AND DALHART BASIN AREAS USING DATA OBTAINED FROM STUDIES TO DATE AND CRITERIA AND SPECIFICATIONS THAT CONSIDER
ROCK GEOMETRY; ROCH CHARACTERISTICS; HUMAN INTRUSION POTENTIAL; SURFACE CHARACTERISTICS; AND ENVIRONMENTAL AND SOCIOECONOMIC CONDITIONS. TWO PREFERRED LOCATIONS ARE RECOMMENDED FROM AMONG THESE AREAS FOR ADDITIONAL CHARACTERIZATION TO IDENTIFY POTENTIAL NATIONAL WASTE TERMINAL STORAGE (NWTS) SALT REPOSITORY SITES. ONE LOCATION, IN NORTHEASTERN DEAF SMITH COUNTY AND SOUTHEASTERN OLDHAM COUNTY, IS UNDERLAIN BY TWO SALT UNITS THAT MEET THE ADOPTED SCREENING SPECIFICATIONS. THE OTHER LOCATION, IN NORTHCENTRAL SWISHER COUNTY, IS UNDERLAIN BY ONE SALT UNIT THAT MEETS THE ADOPTED SCREENING SPECIFICATIONS. BOTH LOCATIONS HAVE SEVERAL FAVORABLE FEATURES, RELATIVE TO SURROUNDING AREAS, AND NO OBVIOUSLY UNDESIRABLE CHARACTERISTICS. BOTH LIE WHOLLY ON THE SOUTHERN HIGH PLAINS SURFACE, ARE IN RELATIVELY SPARSELY POPULATED AREAS, CONTAIN NO UNIQUE LAND USE CONFILCTS, AND COMPRISE LARGE ENOUGH GEOGRAPHIC AREAS TO PROVIDE FLEXIBILITY IN SITE SELECTION. DATA GATHERED TO DATE INDICATE THAT THESE LOCATIONS CONTAIN SALT UNITS SUFFICIENT IN THICKNESS AND IN DEPTH FOR THE SAFE CONSTRUCTION AND OPERATION OF THE UNDERGROUND FACILITIES UNDER CONSIDERATION.
MICROFICHE NO 84-01-0187
DIVISION CODE ONWI
RPT CATEGORY LIT
SECURITY 1
7/

```
10/ report display dtdoc.ti,sen end

  DOC DATE          TITLE                        SENDER
     610926  INVESTIGATIONS ON THE MOVEMENT  BAETSLE L;DEJON
     781231  AN INVESTIGATION OF THE UTILIT  MARTINEZ JD;THO
     830901  PERMIAN BASIN LOCATION RECOMME  NONE
     830101  REGIONAL GEOHYDROLOGY OF THE N  RYALS GN
     781231  AN INVESTIGATION OF THE UTILIT  MARTINEZ JD;THO
     781231  AN INVESTIGATION OF THE UTILIT  MARTINEZ JD;THO
     610926  INVESTIGATIONS ON THE MOVEMENT  BAETSLE L;DEJON
     781231  AN INVESTIGATION OF THE UTILIT  MARTINEZ JD;THO
     830901  PERMIAN BASIN LOCATION RECOMME  NONE

ENTER REPORT DIRECTIVE
    / end
  10/


  10/ display doc
USER ERROR.
DISPLAY DOC
      *
USER ERROR.  NO SUCH FIELD/MAP NAME
  10/


  10/ display dtdoc,ti,sen for 1-2

ITEM 1

DOC DATE        610926
TITLE           INVESTIGATIONS ON THE MOVEMENT OF RADIOACTIVE SUBSTANCE
                IN THE GROUND: PART III PRACTICAL ASPECTS OF THE
                PROGRAM AND PHYSIOCHEMICAL CONSIDERATIONS, PG 198
SENDER          BAETSLE L;DEJONGHE P

ITEM 2

DOC DATE        610926
TITLE           INVESTIGATIONS ON THE MOVEMENT OF RADIOACTIVE SUBSTANCE
                IN THE GROUND: PART III PRACTICAL ASPECTS OF THE
                PROGRAM AND PHYSIOCHEMICAL CONSIDERATIONS, PG 198
SENDER          BAETSLE L;DEJONGHE P
  10/
```

2/ find de=geochem*
* 12 2/ DE=GEOCHEM*
3/ display rpt for 1-2

ITEM 1

ACC NO 60467
DOC DATE 790901
TITLE TECHNICAL REQUIREMENTS FOR QUALIFICATION OF A POTENTIAL NUCLEAR WASTE REPOSITORY SITE IN BASALT
SENDER JOHNSON RE;DEJU RA
CORP AUTH RHO;RHO
ABSTRACT
THIS DOCUMENT IS THE IDENTIFICATION AND DEFINITION OF THE REQUIREMENTS FOR LONG-TERM RADIOACTIVE WASTE STORAGE IN A REPOSITORY IN BASALT, WHICH ARE BASED ON RADIOLOGICAL STANDARDS, TECHNICAL, AND SOCIOECONOMIC SITE-SUITABILITY CONSIDERATIONS. THE PRINCIPAL REQUIREMENTS ARE CATEGORIZED BY DISCIPLINE AND INCLUDE RADIOLOGICAL ENGINEERING, HYDROLOGIC, GEOCHEMICAL, GEOLOGIC, AND SOCIOECONOMIC. EACH REQUIREMENT IS DEFINED AND BRIEFLY DISCUSSED IN THIS DOCUMENT. THE BASALT WASTE ISOLATION PROJECT ACTIVITIES NEEDED TO ASSURE THAT THE REQUIREMENTS CAN BE MET ARE ALSO NOTED.

ITEM 2

ACC NO 72926
DOC DATE 830101
TITLE SELECTED HYDROLOGIC AND GEOCHEMICAL ISSUES IN SITE CHARACTERIZATION FOR NUCLEAR WASTE DISPOSAL. FLOOD BASALTS AT THE HANFORD RESERVATION
SENDER CARNAHAN CL;DELANY JM;LONG JC;SILVA RJ;WATKINS DJ;WHITE AF;WILSON CR
CORP AUTH LBL;LBL;LBL;LBL;LBL
ABSTRACT
FOUR ISSUES ARE CONSIDERED THAT MUST BE ADDRESSED BY A SITE CHARACTERIZATION PROGRAM DESIGNED TO EVALUATE THE SUITABILITY OF THE FLOOD BASALTS OF THE PASCO BASIN IN CENTRAL WASHINGTON AS A SITE FOR THE CONSTRUCTION OF A REPOSITORY FOR THE DISPOSAL OF HIGH-LEVEL NUCLEAR WASTE. THE FOUR ISSUES ARE (1) IDENTIFICATION OF HYDROSTRATIGRAPHIC UNITS WITHIN A SEQUENCE OF FLOOD BASALTS, (2) MECHANISMS AND POINTS OF GROUNDWATER RECHARGE AND DISCHARGE, (3) SOLUBILITY OF RADIONUCLIDES, AND (4) PHASE TRANSFORMATION OF FRACTURE FILLING MATERIALS. EACH ISSUE IS DISCUSSED IN TERMS OF ITS SIGNIFICANCE TO WASTE ISOLATION. AVAILABLE APPROACHES FOR RESOLVING THE ISSUES ARE PRESENTED AND THEIR LIMITATIONS IDENTIFIED. WHERE APPROPRIATE, RESEARCH PROGRAMS FOR OVERCOMING THESE LIMITATIONS ARE INDICATED.
3/

16/ ?fields

FIELD NAME	NUMBER	TYPE	LABEL
ACC	1	I KEY	ACC NO
DTENT	2	I NP	DATE ENTERED
ID	5	I NN	ID
TI	6	S	TITLE
DTDOC	10	I	DOC DATE
CTR	12	S	CONTRACTOR
ADDR	14	S	ADDR
TYPE	15	S NN	DOC TYPE
DE	20	S	DESCRIP
CODE	24	S	CODE
DTCST	30	I	CTR ST DTE
DTCED	31	I	CTR END DTE
PM	32	S	PGM MGR
OPM	33	S	ONWI PGM MGR
SCTR	34	S	SUBCTR
STI	35	S	SHORT TITLE
MFN	51	I	MFLM FR NO.
OCN	52	S	ONWI CTL NOS.
ECN	53	S	EXT CTL NOS.
SEN	57	S	SENDER
DTCHG	60	I	DATE LAST CHG
SEC	98	I NP	SECURITY
RTP	99	MAP	
RTPP	100	MAP	

5/ display all for 6-8,10,13,18

ITEM 6

ACC NO	38002
DATE ENTERED	831220
ID	00015
DOC DATE	800114
DOC TYPE	P
CODE	VOU
SHORT TITLE	GEOMORPHOLOGY AND FLUVIAL PROCESSES CAPROCK CANYON ST PARK WTWI
YFLM FR NO.	50267-3553
DATE LAST CHG	840419
SECURITY	2

ITEM 7

ACC NO	43287
DATE ENTERED	840110
ID	00013
DOC DATE	800207
DOC TYPE	P
CODE	ASS
SHORT TITLE	RATES OF GEOMORPHIC PROCESSES IN SELECTED AREAS OF THE ROLLING PLAINS AND SOUTHERN HIGH PLAINS, TEXAS PANHANDLE
YFLM FR NO.	50269-1757
AUTHOR	GUSTAVSON, STANLEY R
DATE LAST CHG	840113
SECURITY	2

ITEM 8

ACC NO	[illegible]
DATE ENTERED	[illegible]
ID	00013
DOC DATE	800207
DOC TYPE	[illegible]
CODE	[illegible]
SHORT TITLE	[illegible] ARE IN GEOMORPHIC ANALYSIS
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	840113

SRP TECHNICAL DATA BASE

DATA CATEGORIES, RECORD AND TOPIC TYPES

- MATERIAL PROPERTIES
- SITE DESCRIPTIONS
- DESIGNS
- IMPACTS/ASSESSMENTS
- AUXILLARY SUPPORT

SRP TECHNICAL DATA BASE
DATA CATEGORIES, RECORD AND TOPIC TYPES

SITE DESCRIPTIONS

- AREAL GEOLOGY
  - GEOLOGIC DESCRIPTION
  - FORMATION DESCRIPTION
  - GEOLOGIC PROCESSES
  - GEOCHEMISTRY

- AREAL HYDROLOGY
  - HYDROSTRATOGRAPHIC UNIT
  - SURFACE WATER HYDROLOGY
  - HYDROGECHEMISTRY

- BACKGROUND ENVIRONMENTAL
  - AIR QUALITY
  - SOUND LEVEL
  - SURFACE WATER QUALITY
  - WATER SUPPLY AND USE
  - METEROLOGY
  - CLIMATILOGICAL INFORMATION
  - LAND USE
  - AGRICULTURE PRODUCTION
  - CULTURAL RESOURCES
  - AESTHETICS
  - TRANSPORTATION UNIT FACTORS
  - TRANSPORTATION CHARACTERISTICS
  - ECOSYSTEMS
  - SOILS
  - EXTERNAL RADIATION
  - RADIOLOGICAL MEASUREMENTS

- BACKGROUND SOCIOECONOMICS
  - DEMOGRAPHICS
  - ECONOMICS
  - GOVERNMENT AND FISCAL

- BOREHOLE SUMMARIES

SRP TECHNICAL DATA BASE
DATA CATEGORIES, RECORD AND TOPIC TYPES

MATERIAL PROPERTIES

- MATERIAL PROPERTIES
  - THERMAL
  - MECHANICAL
  - HYDROLOGY
  - CHEMICAL
  - RADIATION EFFECTS
  - INTERACTION

SRP TECHNICAL DATA BASE

DATA CATEGORIES, RECORD AND TOPIC TYPES

DESIGNS

- WASTE PACKAGE DESIGN
- EXPLORATORY SHAFT DESIGN
- EXPLORATORY SHAFT SOURCE TERMS
  - AIR EMISSIONS
  - SOUND EMISSIONS
  - SALT
- REPOSITORY DESIGN
  - EXPECTED WASTE
  - DESIGN
- REPOSITORY SOURCE TERMS
  - AIR EMISSIONS
  - SOUND EMISSIONS
  - SALT
  - RADIOLOGICAL EMISSIONS

SRP TECHNICAL DATA BASE
DATA CATEGORIES, RECORD AND TOPIC TYPES

IMPACTS/ASSESSMENTS

- EXPLORATORY SHAFT ENVIRONMENTAL IMPACT
  - AIR QUALITY
  - SOUND LEVEL
  - SALT
- REPOSITORY ENVIRONMENTAL IMPACT
  - AIR QUALITY
  - SOUND LEVEL
  - SALT
  - RADIOLOGICAL DOSE
  - TRANSPORTATION
- PERFORMANCE ASSESSMENT
  (TEST CASES)

SRP TECHNICAL DATA BASE
DATA CATEGORIES, RECORD AND TOPIC TYPES

AUXILLARY SUPPORT

- REVISION
- DATA ELEMENT DICTIONARY
- UNITS CONVERSION
- METHODOLOGY

Data Base Conventions/Standards

- Measurement Units – always metric units; English optional
- Reference – one with each data element for primary
- Comments – may be used to handle secondary references
- Revisions – all are logged; indicated by *
- Baseline data – indicated by B
- NR, NA

Battelle
Project Management Division

Data Base Conventions/Standards

- Measurement Units – always metric units; English optional
- Reference – one with each data element for primary
- Comments – may be used to handle secondary references
- Revisions – all are logged; indicated by *
- Baseline data – indicated by B
- NR, NA

Battelle
Project Management Division

ITEM 2

ACCESSION NUMBER :260
RECORD TYPE :background environmental
TOPIC TYPE :water supply and use
BASIN,SUBBASIN :(14-1), Permian, Palo Duro
COUNTY,STATE :(14-6), Castro, TX
SITE :(14-1), Deaf Smith
WATER RESOURCE REGION [region, subregion]:
, NR
RIVER BASIN :
, NR
TOTAL WATER USE RATE :
, NR
[use, year, rate in bil.l/day(mgd)]
SURFACE WATER USE RATE :
, NR
[use, year, rate in bil.l/day(mgd)]
GROUND WATER USE RATE :
, NR
[use, year, rate in bil.l/day(mgd)]
WATER USE RATE METHODS/UNCERTAINTIES :, NA
TOTAL WATER USE VOLUME :
(14-6), irrigation, 800000, 515.810, (418174)
(14-6), municipal, 800000, 2.397, (1943)
(14-6), livestock, 800000, 4.222, (3423)
(14-6), manufacturing, 800000, 1.673, (1356)
[use, year, vol. in cu-m X 10E6(acre-ft)]
SURFACE WATER USE VOLUME :
(14-6), irrigation, 800000, 0.000, (0)
(14-6), municipal, 800000, 0.000, (0)
(14-6), livestock, 800000, 0.000, (0)
[use, year, vol. in cu-m X 10E6(acre-ft)]
GROUND WATER USE VOLUME :
(14-6), irrigation, 800000, 515.810, (418174)
(14-6), municipal, 800000, 2.397, (1943)
[use, year, vol. in cu-m X 10E6(acre-ft)]
WATER USE VOLUME METHODS/UNCERTAINTIES :(14-6), Texas Natural
Resources Information System
TOTAL MUNICIPAL WATER USE VOLUME :
(14-8), Dimmitt, 800000, 1.511, (1225)
(14-8), Hart, 800000, 0.229, (186)
[city/town,year,vol. in cu-m X 10E6(acre-ft)]
MUNICIPAL SURFACE WATER USE VOLUME :
(14-8), Dimmitt, 800000, 0.000, (0)
(14-8), Hart, 800000, 0.000, (0)
[city/town,year,vol. in cu-m X 10E6(acre-ft)]
MUNICIPAL GROUND WATER USE VOLUME :
(14-8), Dimmitt, 800000, 1.511, (1225)
(14-8), Hart, 800000, 0.229, (186)
[city/town,year,vol. in cu-m X 10E6(acre-ft)]
MUNICIPAL WATER USE METHODS/UNCERTAINTIES:(14-8), Texas Natural
Resources Information System

BE-9
cont.

```
TOTAL WATER SUPPLY                          :
, NR
        [use, year, vol. in cu-m X 10E6(acre-ft)]
SURFACE WATER SUPPLY                        :
, NA
        [use, year, vol. in cu-m X 10E6(acre-ft)]
GROUND WATER SUPPLY                         :
, NR
        [use, year, vol. in cu-m X 10E6(acre-ft)]
WATER SUPPLY METHODS/UNCERTAINTIES          :, NOTE:  go to
                              Hydrology-Surface water record type for
                              impoundment data
EFFECTIVE ANNUAL GROUND WATER RECHARGE      :
(14-24), 800000, 4/083, (3310), Ogallala Formation
        [year,vol. in cu-m X10E6(acre-ft),source]
GROUND WATER WITHDRAWAL                     :
(14-24), 800000, 523.778, (424634), Ogallala Formation
        [year,vol. in cu-m X10E6(acre-ft),source]
GROUND WATER RECHARGE/WITHDRAWAL METHODS/UNCERTAINTIES:(14-24), TDWR
                              data
SURFACE WATER SOURCES                       :
(14-29), lake, Lake Meredith, principal source of surface water
  operated by Canadian River Municipal Water Authority
       [type, name, comments]
GROUND WATER SOURCES                        :
(14-34), aquifer, Ogallala, principal source of all water,  Santa Rosa
 formation and Wolfcamp series under Ogallala yields water
       [type, name, comments]
RECOVERABLE STORAGE                         :
(14-25), Ogallala, 800000, 15200.800, (12323488)
       [source,year,volume in cu-m(acre-ft)]
RECOVERABLE STORAGE METHODS/UNCERTAINTIES:(14-25), TDWR data for high
                              growth rate projections
INITIALIZATION              :
000000, , , BJM
       [date,tech authority,SRP authority,data entry]
SOURCES                     :
(14), NUS Corporation for ONWI, October 1983
```

4/ display all for all

ITEM 1

ACCESSION NUMBER :2
RECORD TYPE :borehole results
WELL ID :, Gibson Dome #1
UNIT,SUBUNIT :, Cycle 6
BASIN,SUBBASIN :, Paradox, Gibson Dome
COUNTY,STATE :, San Juan, UT
TEST LAB :, RE/SPEC Inc
CORE SUPPLIER :, Woodward Clyde Consultants
MATERIALS ID :, salt
FORMATION :, PARADOX
HORIZON :, 1000.1, (3281) meters(feet)
CREEP LAW PARAMETER: A :, 6.33 x 10E-4 MPaE-n per sec
CREEP LAW PARAMETER: n :, 1.86
CREEP LAW PARAMETER: Ea :, 11.9 x 10E-2
CREEP LAW PARAMETER: B :, 192
CREEP LAW PARAMETER: Ess* :. 5 x 10E-8 per sec
CREEP LAW PARAMETER: Q/R :, 6835 deg K
CREEP LAW PARAMETER: TEST CONDITIONS :, (5 MPA, 100C), (10 MPa, 100C) and (5 MPa, 200C)
CREEP LAW PARAMETER: METHODS/UNCERTAINTIES:
, three triaxial creep tests
FAILURE CRITERION: k :, 2.2 MPa
FAILURE CRITERION: ALPHA :, 48.2 MPa
FAILURE CRITERION: BETA :, 0.0129 1/MPa
FAILURE CRITERION: EQUATION :, Mises-Schleicher
FAILURE CRITERION: METHODS/UNCERTAINTIES:
, triaxial compression tests, indirect tension tests
YOUNGS MODULUS [STATIC]: MIN :, 21.9 GPa
YOUNGS MODULUS [STATIC]: MAX :, 32.6 GPa
YOUNGS MODULUS [STATIC]: MEAN :, 26.9 GPa
YOUNGS MODULUS [STATIC]: STD DEV :, 3.2 GPa
POISSONS RATIO [STATIC]: MIN :, 0.17
POISSONS RATIO [STATIC]: MAX :, 0.39
POISSONS RATIO [STATIC]: MEAN :, 0.31
POISSONS RATIO [STATIC]: STD DEV :, 0.06
SORT WELL NAME :, Gibson Dome #1
INITIALIZATION [date,authorities,field numbers,source] :
830825, S Versluis, MJ Golis, BJM, 1-100,102-202, (1)
831114, S Versluis, KA St. John, CAB, 101, (2)
SOURCES:
, (1) Pfeifle, T.W. et al, 1983. Preliminary Constitutive Properties for Salt and Nonsalt Rocks from Four Potential Repository Sites, ONWI-450, RE/SPEC Inc.
, (2) Woodward Clyde Consultants, 1982. Well Completion Report for Gibson Dome #1 Borehole. ONWI-388

ITEM 1

ACCESSION NUMBER :2
RECORD TYPE :borehole results
WELL ID :, Gibson Dome #1
UNIT,SUBUNIT :, Cycle 6
BASIN,SUBBASIN :, Paradox, Gibson Dome
COUNTY,STATE :, San Juan, UT
TEST LAB :, RE/SPEC Inc
CORE SUPPLIER :, Woodward Clyde Consultants
MATERIALS ID :, salt
FORMATION :, PARADOX
HORIZON :, 1000,1, (3281) meters(feet)
CREEP LAW PARAMETER: A :, 6.33 x 10E-4 MPaE-n per sec
CREEP LAW PARAMETER: n :, 1.86
CREEP LAW PARAMETER: Ea :, 11.9 x 10E-2
CREEP LAW PARAMETER: B :, 192
CREEP LAW PARAMETER: Ess* :, 5 x 10E-8 per sec
CREEP LAW PARAMETER: Q/R :, 6835 deg K
CREEP LAW PARAMETER: TEST CONDITIONS :, (5 MPA, 100C), (10 MPa, 100C) and (5 MPa, 200C)
CREEP LAW PARAMETER: METHODS/UNCERTAINTIES:
, three triaxial creep tests
FAILURE CRITERION: k :, 2.2 MPa
FAILURE CRITERION: ALPHA :, 48.2 MPa
FAILURE CRITERION: BETA :, 0.0129 1/MPa
FAILURE CRITERION: EQUATION :, Mises-Schleicher
FAILURE CRITERION: METHODS/UNCERTAINTIES:
, triaxial compression tests, indirect tension tests
YOUNGS MODULUS [STATIC]: MIN :, 21.9 GPa
YOUNGS MODULUS [STATIC]: MAX :, 32.6 GPa
YOUNGS MODULUS [STATIC]: MEAN :, 26.9 GPa
YOUNGS MODULUS [STATIC]: STD DEV :, 3.2 GPa
POISSONS RATIO [STATIC]: MIN :, 0.17
POISSONS RATIO [STATIC]: MAX :, 0.39
POISSONS RATIO [STATIC]: MEAN :, 0.31
POISSONS RATIO [STATIC]: STD DEV :, 0.06
NEAR WELL NAME :, Gibson Dome #1
INITIALIZATION [date,authorities,field numbers,source] :
830825, S Versluis, MJ Golis, BJM, 1-100,102-202, (1)
831114, S Versluis, KA St. John, CAB, 101, (2)
SOURCES:
, [1] Pfeifle, T.W. et al, 1983. Preliminary Constitutive Properties for Salt and Nonsalt Rocks from Four Potential Repository Sites, Omaha, NE, RE/SPEC Inc.
, [2] Woodward Clyde Consultants, 1982. Well Completion Report for Gibson Dome #1 Borehole.

TABLE 4.3

SUMMARY OF EXPONENTIAL-TIME CREEP LAW PARAMETERS FOR FOUR SALTS

SITE	A ($MPa^{-n}s^{-1}$)	n	Q/R (K)	$\dot{\epsilon}_{ss}$ [a] (s^{-1})	ϵ_a	B
Richton [2]	2.60×10^{-2}	5.01	9,895	5×10^{-8}	4.22×10^{-2}	126
Vacherie [2]	8.71×10^{-3}	2.22	7,569	5×10^{-8}	5.93×10^{-2}	188
Permian [2] (Cycle 4)	4.66×10^{-3}	4.60	8,660	5×10^{-8}	3.97×10^{-2}	82
Permian (Cycle 5)	1.93×10^{-4}	4.15	7,154	5×10^{-8}	5.50×10^{-2}	180
Paradox [2] (Cycle 7)	1.52×10^{-7}	1.39	3,468	5×10^{-8}	14.1×10^{-2}	158
Paradox (Cycle 6)	6.33×10^{-4}	1.86	6,835	5×10^{-8}	11.9×10^{-2}	192

[a] Assumed value based on large Avery Island and S.E. New Mexico data sets.

TABLE 4.2

FAILURE CRITERIA SUMMARY[a]

SITE	k (MPa)	α (MPa)	β (MPa^{-1})
Richton	0.2	40.0	0.0180
Vacherie	0.7	46.4	0.0133
Permian			
Cycle 4	1.0	38.8	0.0174
Cycle 5	1.1	43.5	0.0151
Paradox			
Carnallite	1.5	47.1	0.0149
Cycle 6	2.2	48.2	0.0129
Cycle 7	1.6	51.4	0.0134

```
ENTER YOUR REQUEST
   1/ /show

DATA BASE FILE
B1     BOREFORM
B2     BOREHOLE SUMMARY
B3     DIRECTORY
B4     FORMATIONS
B5     MECHANICAL FAILURE SALT
B6     MECHANICAL PROPERTIES NONSALT
B7     MECHANICAL PROPERTIES SALT
B8     MISS DEEP PRINT
B9     MISS SHALLOW PRINT
B10    MISSISSIPPI DEEP
B11    MISSISSIPPI SHALLOW
B12    REPORT BOREFORM
B13    REVISION
B14    STATE
B15    STATE PRINT
B16    THERMAL PROPERTIES SALT
B17    THERMAL PROPS PRINT

DO YOU WANT TO EXECUTE ANY OF THE PROFILES?
    / b5
```

MECHANICAL FAILURE CRITERIA (SALT)

WELL	BASIN,SUBBASIN, UNIT	HORIZON (M)	k MPa	ALPHA MPa	BETA 1/MPa
Gibson Dome #1	Paradox Gibson Dome Cycle 6	1000.1	2.2	48.2	0.0129
Gibson Dome #1	Paradox Gibson Dome Cycle 7	1040.0	1.6	51.4	0.0134
MRIG-9	Gulf Interior Richton Dome	374.9	0.2	40.0	0.0180
US DOE-Smith #1	Gulf Interior Vacherie Dome	599.9	0.7	46.4	0.0133
Grabbe #1	Permian Palo Duro Cycle 4	799.8	1.0	38.8	0.0174
Mansfield #1	Permian Palo Duro Cycle 5	449.9	1.1	43.5	0.0151

```
  3/ find horiz=1000.1
*       1    3/  horiz=1000.1
  4/ display 3,11,4,102,151,152,153
```

ITEM 1

```
BASIN,SUBBASIN              :, Paradox, Gibson Dome
UNIT,SUBUNIT                :, Cycle 6
HORIZON                     :, 1000.1, (3281) meters(feet)
FAILURE CRITERION: k        :, 2.2 MPa
FAILURE CRITERION: ALPHA    :, 48.2 MPa
FAILURE CRITERION: BETA     :, 0.0129 1/MPa
```

ACCESSION NUMBER :[illegible]
RECORD TYPE :borehole summary
WELL ID :, MRIG-9
BASIN,SUBBASIN :, Gulf Interior, Richton Dome
COUNTY,STATE :, Perry, MS
LATITUDE :, 31-32 deg-min
LONGITUDE :, 88-58 deg-min
SECTION,BLOCK :, Sec 26, T5N R10W
DRILLING COMPLETION DATE :, 791130 (yymmdd)
BOREHOLE STATUS :, plugged
GROUND LEVEL ELEVATION :, 78.2, (256.7) meters(feet)
KELLY BUSHING ELEVATION :, 81.5, (267.48) meters(feet) above msl
TOTAL DEPTH OF BOREHOLE :, 388.6, (1275) meters(feet)
DRILLING TECHNIQUE :, mud rotary;
DRILLING FLUID PROGRAM :, fresh water bentonite mud to 174 meters and brine based mud from 174 to 389 meters.

DRILLING PROGRAM [bit,dia.-cm(in),interval-m(ft),comments] :
, NR, 66.0, (26), 0.0, 18.0, (0-59)
, NR, 38.1, (15), 18.0, 138.1, (59-453)
, NR, 27.9, (11), 137.2, 203.9, (450-669)
, NR, 19.8, (7-13/16), 170.4, 388.3, (559-1274)

CASING SUMMARY [diameter in cm(in),depth in m(ft),comments]:
, 40.6, (16), 18.0, (59)
, 32.4, (12-3/4), 137.2, (450)
, 21.9, (8-5/8), 170.4, (559)

LITHOLOGIC LOGS :, YES, lithologic descriptions, photographs
GEOPHYSICAL LOGS :, YES, acoustilog, gamma ray, caliper, temperature, compensated density, compensated neutron, SP, dual induction focused logs, laterolog, differential temperature, resistivity
CORE LOGS :, YES, conventional core
MUD LOGS :, YES, gas detector, mud condition

FORMATIONS PENETRATED [interval in meters(ft)] :
, HATTIESBURG-CATAHOULA, 0.0, 178.0, (0-584)
, CAPROCK, 178.0, 233.8, (584-767)
, SALT, 233.8, 388.6, (767-1275)

CORES [diameter in cm(in), interval in meters(ft),comments]:
, 10.2, (4), 138.4, 388.6, (454-1255)

SAMPLING PROGRAM [type, interval in meters(ft),comments] :
, sidewall, 138.4, 388.6, (454-1275)
, fluid samples, 170.4, 234.7, (559-770)

FORMATION TESTS [type,num.,interval in meters(ft),comments]:
, slug, NR, 228.6, 234.7, (750-770)
, production, NR, 170.4, 234.7, (559-770)
, drawdown and recovery, NR, 170.4,234.7, (559-770)

HYDROGEOLOGIC MONITORING :, YES, water levels on monthly basis initially then quarterly

GEOMECHANICAL FIELD TESTS [type,comments] :
, NA
GEOMECHANICAL LAB TESTS [type,comments] :
, strength
, index
, creep
, density
, thermal
ROCK SAMPLE TESTS [type,comments] :
, grain size analysis
, petrographic analysis
, permeability
, elemental composition
HYDROCHEMICAL TESTS [type,comments]
, dissolved organic and inorganic materials
, gas analysis
LITHOLOGY [formation,description]:
, NR
SORT WELL NAME :, MRIG- 9
INITIALIZATION [date,authorities,field [illegible]] :
830825, CZ Kuntz, KA St. John, BJM, [illegible],63,70,72-80, [illegible]
830825, CS Kuntz, KA St. John, BJM, [illegible]
830825, CZ Kuntz, KA St. John, BJM, [illegible]
831031, CZ Kuntz, KA St. John, CAS, 47,[illegible], (4)
831031, CS Kuntz, KA St. John, CAS, 46,[illegible], (DE Swanson)
SOURCES:
, (1) Law Engineering Testing Company, 1982. Gulf Coast Salt Domes Well Completion Report: Site MRIG-9, ONWI-178
, (2) Drumheller, J.C. et al, 1982. Petrographic and Geochemical Characteristics of the Richton Salt Core, ONWI-277, Law Engineering Testing Company
, (3) Pfeifle, T. W. et al, 1983. Constitutive Properties of Salt from Four Sites, ONWI-314, RE/SPEC Inc.
, (4) Law Engineering Testing Company, July 1982. Gulf Coast Salt Domes Geologic Area Characterization Report Mississippi Study Area, Volume VII, ONWI-120
47/ find type=rev*
* 4 47/ type=rev*
48/ display all for 1

ITEM 1

ACCESSION NUMBER :8
RECORD TYPE :revision
RECORD REFERENCE :5
REVISION [#,field num,old value,reason,authority,source]:
[illegible] prsmax, 0.39, typo, Mishoff (1)
[illegible] find acc=5
[illegible] 48/ acc=5

ITEM

ACCESSION NUMBER :1269
RECORD TYPE :repository design
BASIN,SUBBASIN :BE, Paradox
SITE :BE, Lavender Canyon
WASTE TYPE :BE, spent fuel
WASTE MATERIAL :BE, BWR fuel assemblies (24 each)
ROOM DIMENSIONS[length,height,width] :BE, 152.4, 6.1, 4.2 m
ROWS OF PACKAGES/ROOM :BE, 1
BOREHOLE DIMENSIONS [diameter, depth] :BE, 93.0, 590.0 cm
SPACINGS [waste packages, rooms] :BE, 18.3, 20.1 m
LOCAL EXTRACTION RATIO :BE, 21.1 %
HEAT DENSITY :BE, 15. W/sq-m
ROOMS/REPOSITORY :BE, NR
WASTE PACKAGES/ROOM :BE, NR
WASTE PACKAGES/REPOSITORY :BE, NR
TOTAL ROOM AREA :BE, NR sq-m X 10E6
SITE TEMPERATURE PROFILE [depth in m(ft), deg C, comments] :
NR
MEAN ANNUAL SURFACE TEMPERATURE :BE, 15.5 deg C
TEMPERATURE GRADIENT :BE, 20. deg C/km depth
REPOSITORY HORIZON :BE, 914.4, (3000) meters(feet)
THERMAL CONDUCTIVITY CONSTANT, SALT [constant, comment]: A :
BE, 4.19, Gibson Dome Unit 6
BE, 4.24, Gibson Dome Various Halite Units
BE, 3.82, Salt Valley Halite
THERMAL CONDUCTIVITY CONSTANT, SALT [constant, comment]: B :
BE, 0.899, Gibson Dome Unit 6
BE, 1.05, Gibson Dome Various Halite Units
BE, 0.778, Salt Valley Halite
THERMAL CONDUCTIVITY CONSTANT, SALT [constant, comment]: C :
BE, 1152.62, Gibson Dome Unit 6
BE, 1322.72, Gibson Dome Various Halite Units
BE, 931.57, Salt Valley Halite
THERMAL CONDUCTIVITY CONSTANT, SALT [constant, comment]: D :
BE, 0.347, Gibson Dome Unit 6
BE, 0.168, Gibson Dome Various Halite Units
BE, 0.713, Salt Valley Halite
THERMAL CONDUCTIVITY CONSTANT, SALT: TEST CONDITIONS :
NR
THERMAL CONDUCTIVITY CONSTANT, SALT: METHODS/UNCERTAINTIES :
BE, least squares analysis, NR
PEAK SALT TEMPERATURE :BE, NR deg C
INITIALIZATION [date,authorities,field numbers,source] :
000000, SC Matthews, JL Easterday, RMM,
951,952,954,956,958,960,962,964,966, (1), 000000, SC Matthews, JL Easterday, RMM, 953, (2), 000000, SC Matthews, JL Easterday, RMM, 968,969, (3), 000000, SC Matthews,JL Easterday, RMM, 973,974,975,976,977,979, (4), 000000, SC Matthews, JL Easterday, RMM, 970 (5),

[illegible] Interior Geologic Survey, [illegible] Thermal Data From Hole GD-1, Gibson Dome, Paradox Valley, [illegible] Open File Report 83-476

BE, (4) Lagedrost, J.T., and Capp S.W., December 1983, Thermal Property and Density Measurements of Samples Taken From Drilling Cores for Potential Geologic Media, Fiber Materials, Inc., ONWI-522

BE, (5) Stearns-Rogers Services, Inc., February 7, 1984. Repository Depths at Four Sites: Lavender Canyon, Cypress, Vacherie and Richton Domes.Communications to N.C. Henderson (ONWI)

```
  41/ find type
*       0   41/  type
  42/ find type=waste*
*       8   42/  type=waste*
  43/ display all for1
```

ITEM 1

```
ACCESSION NUMBER              :253
RECORD TYPE                   :waste package design
SITE                          :BE, NR
WASTE TYPE                    :BE, commercial high level waste
WASTE MATERIAL                :BE, NR
CANISTER MATERIAL                          :BE, NR
CANISTER DIMENSIONS [ID, OD, length]       :BE, 53.5, 56.0, 409.0 cm
WASTE FORM WEIGHT [gross, net]             :BE, NR kg
CANISTER HEAT LOAD                         :BE, 9500 W
RADIOACTIVITY CONTENT, DESIGN              :BE, NR Ci
LEACH RATE                                 :BE, NR g/sq-cm/day
CANISTER HEAT LOAD HEIGHT                  :BE, 368.0 cm
CANISTER SURFACE RAD. LEVEL [total]        :BE, NR mrem/hr
CANISTER SURFACE RAD. LEVEL [neutron]      :BE, NR mrem/hr
CANISTER SURFACE RAD. LEVEL [gamma]        :BE, NR mrem/hr
OVERPACK MATERIAL                          :BE, NR
OVERPACK DIMENSIONS [ID, OD, length]       :BE, 59.0, 89.0, NR cm
OVERPACK THICKNESS[wall, head, bottom]     :BE, 15.0, 21.0, 21.0 cm
OVERPACK WEIGHT[tot.lifting,body,head]     :BE, NR kg
ANNULUS THICKNESS                          :BE, 2.5 cm
OVERPACK SURFACE RADIATION LEVEL           :BE, NR mrem/hr
PEAK TEMPERATURE [(in deg C)for waste form,canister,overpack]  :
BE, NR
OVERPACK CORROSION, ALLOWANCE [depth] :BE, NR cm
OVERPACK CORROSION, PREDICTED [medium,depth(cm) after 1000 yrs]:
BE, NR
WASTE PACKAGE COSTS [date, components]       :BE, NR dollars
WASTE PACKAGE COSTS [date, defense waste]    :BE, NR dollars/kg
WASTE PACKAGE COSTS [date, commercial waste]:BE, NR dollars/kg U
INITIALIZATION [date,authorities,field numbers,source]  :
840328, SC Matthews, KA St. John, RMM, all, (1),
SOURCES:
```

Westinghouse Electric Corporation, 1983. Engineered Waste Package Conceptual Design: Defense High-Level Waste (form 1), Commercial High-Level Waste (form 2),and Spent Fuel (form 3) Disposal in Salt, ONWI-422

[illegible] Salt, [illegible]
[illegible] Interior Geologic Survey,
[illegible] Data From Well [illegible], Gibson Dome, Paradox Valley,
Utah, Open-File Report 83-470
BE, (4) Lagedrost, J.T., and Capp S.W., December 1983, Thermal Property and Density Measurements of Samples Taken From Drilling Cores for Potential Geologic Media, Fiber Materials, Inc., ONWI-522
BE, (5) Stearns-Rogers Services, Inc., February 7, 1984. Repository Depths at Four Sites: Lavender Canyon, Cypress, Vacherie and Richton Domes,Communications to N.C. Henderson (ONWI)

```
  41/ find type
*       0   41/  type
  42/ find type=waste*
*       8   42/  type=waste*
  43/ display all for1
```

ITEM 1

```
ACCESSION NUMBER                :253
RECORD TYPE                     :waste package design
SITE                            :BE, NR
WASTE TYPE                      :BE, commercial high level waste
WASTE MATERIAL                  :BE, NR
CANISTER MATERIAL                          :BE, NR
CANISTER DIMENSIONS [ID, OD, length]       :BE, 53.5, 56.0, 409.0 cm
WASTE FORM WEIGHT [gross, net]             :BE, NR kg
CANISTER HEAT LOAD                         :BE, 9500 W
RADIOACTIVITY CONTENT, DESIGN              :BE, NR Ci
LEACH RATE                                 :BE, NR g/sq-cm/day
CANISTER HEAT LOAD HEIGHT                  :BE, 368.0 cm
CANISTER SURFACE RAD. LEVEL [total]        :BE, NR mrem/hr
CANISTER SURFACE RAD. LEVEL [neutron]      :BE, NR mrem/hr
CANISTER SURFACE RAD. LEVEL [gamma]        :BE, NR mrem/hr
OVERPACK MATERIAL                          :BE, NR
OVERPACK DIMENSIONS [ID, OD, length]       :BE, 59.0, 89.0, NR cm
OVERPACK THICKNESS[wall, head, bottom]     :BE, 15.0, 21.0, 21.0 cm
OVERPACK WEIGHT[tot.lifting,body,head]     :BE, NR kg
ANNULUS THICKNESS                          :BE, 2.5 cm
OVERPACK SURFACE RADIATION LEVEL           :BE, NR mrem/hr
PEAK TEMPERATURE [(in deg C)for waste form,canister,overpack]  :
BE, NR
OVERPACK CORROSION, ALLOWANCE [depth] :BE, NR cm
OVERPACK CORROSION, PREDICTED [medium,depth(cm) after 1000 yrs]:
BE, NR
WASTE PACKAGE COSTS [date, components]      :BE, NR dollars
WASTE PACKAGE COSTS [date, defense waste]   :BE, NR dollars/kg
WASTE PACKAGE COSTS [date, commercial waste]:BE, NR dollars/kg U
INITIALIZATION [date,authorities,field numbers,source]  :
840328, SC Matthews, KA St. John, RMM, all, (1),
SOURCES:
Westinghouse Electric Corporation, 1983. Engineered Waste Package
 Conceptual Design: Defense High-Level Waste (form 1), Commercial
 High-Level Waste (form 2),and Spent Fuel (form 3) Disposal in Salt,
```

```
    NT    ANHYDRITE
    NT    CAPROCK
    NT    CARBONATES
    NT    CARNALLITE
    NT    CHAOTIC MUDSTONE/SALT
    NT    CLASTICS
    NT    CLAYSTONE
    NT    DOLOMITE
    NT    EVAPORITE
    NT    HALITE
    NT    LIMESTONE
    NT    MUDSTONE
    NT    SALT
    NT    SANDSTONE
    NT    SHALE
    NT    SILTSTONE
    NT    SILTY SANDSTONE

ENTER TERM
    / clastics
clastics
  BT    SEDIMENTARY ROCK
  NT    CLAYSTONE
  NT    MUDSTONE
  NT    SANDSTONE
  NT    SHALE
  NT    SILTSTONE
  NT    SILTY SANDSTONE
  RT    CARBONATES
  RT    EVAPORITE

ENTER TERM
    / carbonates
carbonates
  BT    SEDIMENTARY ROCK
  NT    DOLOMITE
  NT    LIMESTONE
  RT    CLASTICS
  RT    EVAPORITE

ENTER TERM
    / evaporite
evaporite
  BT    SEDIMENTARY ROCK
  NT    ANHYDRITE
  NT    HALITE
  NT    SALT
  RT    CARBONATES
  RT    CLASTICS

ENTER TERM
    / texas
texas
  EQ    TX

ENTER TERM
    / tx
tx
  UF    TEXAS
  NT    DEAF SMITH
  NT    DETTEN #1
  NT    DETTEN #2
  NT    DONLEY
  NT    FREESTONE
  NT    FRIEMEL G #1
  NT    FRIEMEL J #1
  NT    GRABBE #1
  NT    HARMAN #1
  NT    HOLTZCLAW #1
  NT    KEECHI DOME
  NT    LEON
  NT    MANSFIELD #1
  NT    MANSFIELD #2
  NT    OAKWOOD DOME
  NT    OLDHAM
  NT    RANDALL
  NT    REX WHITE #1
  NT    SAWYER #1
  NT    SAWYER #2
  NT    SWISHER
  NT    TOG-1
  NT    TOH-2A
  NT    TOH-5D
  NT    ZEECK #1

ENTER TERM
    / oldham
oldham
  BT    PALO DURO
  BT    PERMIAN
  BT    TX
  UF    OLDHAM COUNTY
  NT    MANSFIELD #1
  NT    MANSFIELD #2

ENTER TERM
    / oldham county
oldham county
  EQ    OLDHAM
```

```
   1/ ?fields

FIELD NAME   NUMBER  TYPE    LABEL
----------     ----  -----   ---------------
ACC               1  I KEY   ACCESSION NO
RPTNO             2  S       REPORT NO
TI                3  S       TITLE
BASIN             4  S       BASIN
ABS               5  S       ABSTRACT
STAT              6  S NP    STATUS
PLNDT             7  I       PLANNED DATE
DTISS             8  I NP    DATE ISSUED
SAF               9  S NP    SAFTEY CLASS.
QA               10  S NP    QA CATEGORY
WBS              11  S       WBS CATEGORY
PMGR             12  S       PROJECT MANAGER
REVIEW           13  S       PLANNED REVIEW
ORIG             14  S       ORIGINATOR
FORM             15  S       FORM
RPTDT            16  I       REPORT ISSUE DT.
SUBMIT           17  S       SUBMITTED
DTENT            90  I NP    DATE ENTERED
DTCHG            91  I NP    DATE CHANGED
   1/ set talk=2
ENTER YOUR REQUEST
   1/ ?fields

FIELD NAME   NUMBER  TYPE    LABEL
----------     ----  -----   ---------------
ACC               1  I KEY   ACCESSION NO
RPTNO             2  S       REPORT NO
TI                3  S       TITLE
BASIN             4  S       BASIN
ABS               5  S       ABSTRACT
STAT              6  S NP    STATUS
PLNDT             7  I       PLANNED DATE
DTISS             8  I NP    DATE ISSUED
SAF               9  S NP    SAFTEY CLASS.
QA               10  S NP    QA CATEGORY
WBS              11  S       WBS CATEGORY
PMGR             12  S       PROJECT MANAGER
REVIEW           13  S       PLANNED REVIEW
ORIG             14  S       ORIGINATOR
FORM             15  S       FORM
RPTDT            16  I       REPORT ISSUE DT.
SUBMIT           17  S       SUBMITTED
DTENT            90  I NP    DATE ENTERED
DTCHG            91  I NP    DATE CHANGED

LEGEND FOR THE TYPE COLUMN
R=REAL, I=INTEGER, S=STRING, B=BOOLEAN
KEY=DOCUMENT UNIQUE KEY (ACCESSION NUMBER), MAP=MAPPED PSEUDO FIELD
NN=NO.NULL (REQUIRED FIELD), NP=NO.PROMPT (VERY OPTIONAL FIELD)
ENTER YOUR REQUEST
   1/
```

```
   2/ look orig=w*

  .ITEMS.    TERMS
A        2  ORIG=WESTERN RURAL DEVELOPMENT CENTER
B        2  ORIG=WESTINGHOUSE
C       12  ORIG=WOODWARD-CLYDE
END OF TERMS WITH YOUR STEM
PICK LETTERS TO COMBINE
   2/ b
      2 ITEMS SAVED AS SET 2
CONTINUE PICKS OR REQUESTS
   3/ display all for 1

ITEM 1

ACCESSION NO     7
REPORT NO        0-1255
TITLE
BRINE MIGRATION TEST EQUIPMENT FINAL REPORT - ASSE SALT MINE
BASIN            GENERIC
ABSTRACT
THIS REPORT WILL INCLUDE A DESCRIPTION OF THE TEST EQUIPMENT,
 PROCEDURES INCLUDING INSTALLATION, START-UP AND ANY DIFFICULTIES ON
 ANOMOLIES DISCOVERED DURING ALL PHASES OF THIS PROJECT. INCLUDED WILL
 BE A DESCRIPTION OF THE ASSE SALT MINE AND VARIOUS PROPERTIES OF THE
 SALT IN THE TEST AREA. ALSO INCLUDED WILL BE THE INITIAL DATA ON BRINE
 MIGRATION AND SALT BEHAVIOR VERSUS PREDICTED RESULTS.
STATUS           WORK IN PROGRESS
PLANNED DATE     840701
DATE ISSUED      830815
WBS CATEGORY     1.3.6.2
PROJECT MANAGER  COYLE
PLANNED REVIEW   ONWI-INTERNAL;DOE/SEPO;PATENT REVIEW
ORIGINATOR       WESTINGHOUSE
FORM             ANALYSIS REPORT
SUBMITTED        N
DATE ENTERED     830902
DATE CHANGED     840423
   3/


   3/ find plndt gt 840501
*     208    3/  PLNDT GT 840501
   4/ find plndt lt 840530
*      35    4/  PLNDT LT 840530
   5/ find 3 and 4
*       5    5/  3 AND 4
```

```
 19/ list 1-13

  .ITEMS. LINE-    REQUEST
*       0    1/  SHOW PREFIX
*       2    2/  ORIG=WESTINGHOUSE
*     208    3/  PLNDT GT 840501
*      35    4/  PLNDT LT 840530
*       5    5/  3 AND 4
*       9    6/  TI=BRINE
*       4    7/  TI=MIGRATION
*       3    8/  TI=BRINE AND TI=MIGRATION
*       0    9/  DS
*       0   10/  BASIN=BARADOX
*      19   11/  BASIN=PARADOX
*      19   12/  BASIN=PARADOX SORT=ORIG
*      19   13/  BASIN=PARADOX SORT=ORIG SORT=SORT ORIG,PLNDT
  19/ expand,line=11,orig,tally

    THE UNIQUE VALUES ARE

      4     BECHTEL GROUP INC
      1     DAPPOLONIA
      1     INTERA
      1     ONWI
      1     STEARNS-ROGER
     11     WOODWARD-CLYDE

  19/ expand,line=11,orig,count

     6  UNIQUE VALUES

  19/




  19/ set univ=11
  19/ find plndt gt 840501
*      13   19/  PLNDT GT 840501 ** UNIVERSE= 11 **
  20/ find plndt lt 840501
*       0   20/  PLNDT LT 840501 ** UNIVERSE= 11 **
  21/ find plndt lt 840531
*       7   21/  PLNDT LT 840531 ** UNIVERSE= 11 **
  22/ find 19 and 21
*       1   22/  19 AND 21
  23/ display plndt

ITEM 1

PLANNED DATE    840530
  23/ set universe off
  23/
```

2/ ?commands

```
DISPLAY   SHOW SOURCE FILE DATA ONLINE
COMP      CREATE AND PERFORM ARITHMETICAL AND STATISTICAL
          OPERATIONS ON DATASETS.
PRINT     SHOW SOURCE FILE DATA OFFLINE
FIND      FIND TERMS IN THE INDEX AND COMBINE THEM
LOOK      LOOK AT VARIOUS INDEX TERM LISTS (ADJACENT, STEM, BROWSE)
SCAN      SEARCH RECORDS FROM A DOCUMENT SET SEQUENTIALLY
LIST      LIST THE DOCUMENT SETS YOU HAVE FOUND, OR SHOW
          COMMANDS,PARAMETERS,STATUS,TOPICS,FIELDS,PROFILES,REPORTS
SET       CHANGE VARIOUS PARAMETERS
          FOR MORE INFORMATION ENTER  LIST PARAMETERS
QUIT,END  TERMINATE THE USAGE OF BASIS
LOGOUT    TERMINATE THE USAGE OF THE COMPUTER SYSTEM
RESTART   START THE SESSION FROM THE BEGINNING AGAIN
RUN       EXECUTE USER OWNCODE PROGRAMS
STOP      STOP THE PRESENT FUNCTION AND RETURN TO REQUEST MODE
ABORT     ABORT THE PRESENT FUNCTION AND RETURN TO REQUEST MODE
CLOCK     SHOW TIME USED SO FAR
?         EXPLAIN THE LAST MESSAGE OR A TOPIC
ROUTE     ROUTE A PRINT FILE TO A PRINTER IMMEDIATELY
EXPAND    EXPAND, TALLY, OR COUNT RECORDS IN A DOCUMENT SET
SORT      SORT A DOCUMENT SET BASED ON THE CONTENTS OF THE RECORDS
OLIVE     USE THE ON-LINE INPUT VERIFICATION AND EDITING SUB-SYSTEM
REPORT    INITIATE THE USE OF THE REPORT WRITER SUB-SYSTEM
XEQ       EXECUTE INTERCOM COMMANDS AND RETURN TO BASIS
SUSPEND   SUSPEND AND RETURN TO TIME-SHARING MODE
            (RETURN BY ENTERING=  ADVANCE.)
PROFILE   INITIATE THE USE OF THE PROFILE MODULE
DOCSET    SAVE A DOCUMENT SET FOR USE IN A LATER SESSION
ALSO:     ASK,TELL,OUTPUT
   2/
```

```
   2/ look de=geohy*

  .ITEMS.    TERMS
A        1  DE=GEOHYDROLOGIC
B        1  DE=GEOHYDROLOGICAL
C        2  DE=GEOHYDROLOGY
END OF TERMS WITH YOUR STEM
PICK LETTERS TO COMBINE
   2/ a,b,c
      4 ITEMS SAVED AS SET 2
CONTINUE PICKS OR REQUESTS
   3/ display de for all

ITEM 1

DESCRIPTOR      WILCOX-CARRIZO;SPARTA AQUIFERS;GEOHYDROLOGIC RELATIONS;
                POTENTIOMETRIC LEVELS

ITEM 2

DESCRIPTOR      GEOHYDROLOGICAL INVESTIGATIONS;SILICA SAND LAYERS;
                STRONTIUM

ITEM 3

DESCRIPTOR      SITE GEOMETRY;GEOHYDROLOGY;GEOCHEMISTRY;STRATIGRAPHY;
                ATMOSPHERE

ITEM 4

DESCRIPTOR      GEOMECHANICS;QUATERNARY STUDIES;VACHERIE DOME;RAYBURN'S
                DOME' GEOHYDROLOGY;REGIONAL GEOLOGY
   3/
```

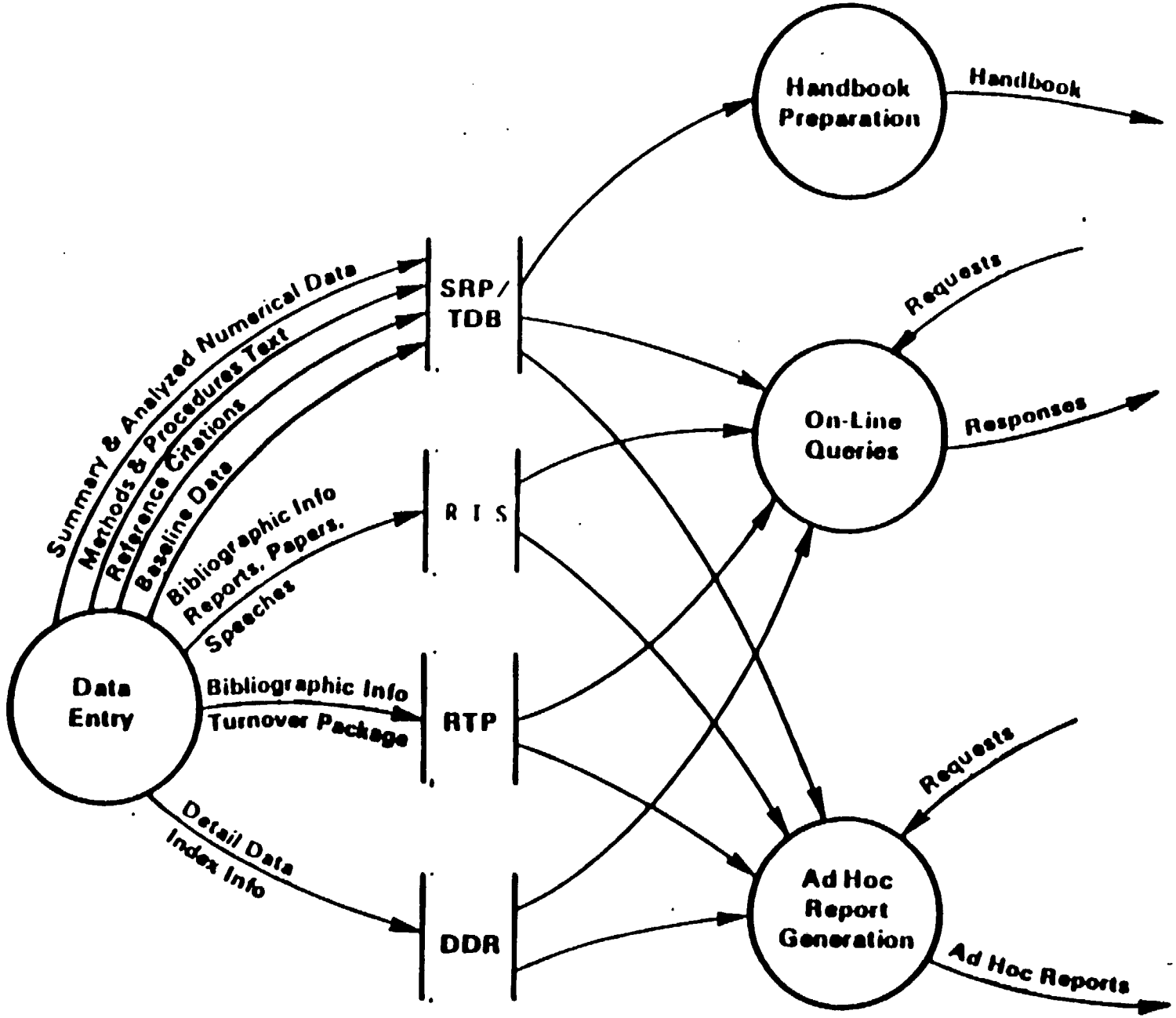


FIGURE 4-1. INFORMATION FLOW

4.6 How does the geologic repository design account for the effects of the disturbed zone, including borehole and shaft seals, in meeting the release rate requirements of 10 CFR 60.112?

After permanent closure, the geologic repository operations area will induce changes in the host rock. The radial extent to which these changes affect geologic repository performance is called the disturbed zone. To predict releases to the accessible environment, it is important to know the mechanism and rate at which radionuclides will be released from the disturbed zone.

4.6.1 How will borehole and shaft seals be designed to meet the release rate requirements to the accessible environment (60.112)?

Construction of shafts and boreholes in salt alters the geologic setting and can create potential pathways for groundwater flow and migration of radionuclides. Since these pathways could adversely affect the isolation capabilities of the repository, the NRC has required in 10 CFR Part 60.134(a) that boreholes and shafts be sealed at permanent closure of the facility. Seal system characteristics should be based on the performance DOE will require of the seal system.

4.6.1.1 How does borehole and shaft seal design account for changes in characteristics of sealing materials?

The compatibility of the physical and chemical characteristics of the seal material to the salt and other evaporite strata is an important consideration in seal design.

Aspects of the geologic setting should not have a detrimental affect on the integrity of the seal material. If the seal is not designed properly salt dissolutioning could occur or seal material set-up time could be retarded due to infiltration of brine. Incompatibility could result in seal deterioration by chemical attack causing seal system fracture. Differential creep could cause shearing of the seal system. Therefore, to meet the requirements of 10 CFR Part 60.134(b), the effect of the geologic setting on seal properties must be addressed.

4.6.1.2 What effect will construction of the shafts (e.g., rock damaged zone, liner effects), boreholes and in situ testing have on the ability to seal openings?

Construction of shafts, borehole drilling, and exploratory testing will change the rock characteristics surrounding the openings. Potential effects are rock damage by excavation and stress redistribution around the opening. The effect of these phenomena on the ability to seal the openings should be assessed.

4.6.1.3 How will placement of borehole and shaft seals be controlled to ensure that the performance objective stated as 10 CFR Part 60.112.?

The placement techniques used in sealing shafts and boreholes could be a controlling factor in seal performance. Reliability must be obtained in the methods and equipment used to install the seal materials. The reproducibility of results using these methods and equipment must be demonstrated, through field testing of emplacement methods and monitoring the performance of the emplaced seals.

4.6.1.4 How does the sealing system design account for rock movement, fracturing, creep, and groundwater chemical interaction?

Rock mass instabilities and creep could cause shearing of the seal system in shafts and boreholes. Effects of deformation on the seal materials and seal system should be assessed.

The compatibility of the chemical characteristics of the seal material, the groundwater, and the host rock is an important consideration in seal design. Incompatibility could result in seal deterioration by chemical attack which could result in failure of the seal system and dissolutioning of the salt formation.

4.6.2 How does the design incorporate the effects of thermal loading on the geomechanical properties of the rock in disturbed zone?

Thermal loading caused by the emplacement of waste in the repository will change the geomechanical properties of the surrounding rock. The amount and significance of these changes need to be assessed.