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Civilian Radioactive Waste Management System
Management &Operating Contractor

Data Qualification Report:
Borehole Stratigraphic Contacts
Revision 01

TDR-NBS-GS-000007

March 2000

Prepared for:

U.S. Department of Energy
Yucca Mountain Site Characterization Office
P.O. Box 30307
North Las Vegas, Nevada 89036-0307

Prepared by:

TRW Environmental Safety Systems Inc.
1211 Town Center Drive
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Under Contract Number
DE-AC08-91RW00134

QA:QA

Data Qualification Report: Borehole Stratigraphic Contacts

Revision 01

Qualification Team:

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SNL

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NOTE: The row and column headings on the spreadsheet Attachments (I, VI, VII, and VIII) are for cell referencing only, and do not correlate between Attachments. To correlate between Attachments, use borehole identifiers.

NOTE TO THIS REVISION: This document was revised to include qualification of the "special case data" listed in Attachment VIII.

Data Qualification Report: Borehole Stratigraphic Contacts

Executive Summary

The data set considered here is the borehole stratigraphic contacts data (DTN: MO9811MWDGFM03.000) used as input to the Geologic Framework Model. A Technical Assessment method used to evaluate these data with a two-fold approach: 1) comparison to the geophysical logs on which the contacts were, in part, based; and 2) evaluation of the data by mapping individual units using the entire data set. Qualification of the geophysical logs is being performed in a separate activity. A representative subset of the contacts data was chosen based on importance of the contact and representativeness of that contact in the total data set. An acceptance window was established for each contact based on the needs of the data users. Data determined to be within the acceptance window were determined to be adequate for their intended use in three-dimensional spatial modeling and were recommended to be Qualified. These methods were chosen to provide a two-pronged evaluation that examines both the origin and results of the data.

The result of this evaluation is a recommendation to qualify all contacts. No data were found to lie outside the pre-determined acceptance window. Where no geophysical logs are available, data were evaluated in relation to surrounding data and by impact assessment. These data are also recommended to be qualified. The stratigraphic contact data contained in this report (Attachment VII; DTN: MO0004QGFMPICK.000) are intended to replace the source data, which will remain unqualified.

Introduction

This qualification activity was performed in accordance with *Data Qualification Plan: Borehole Stratigraphic Contacts* (DI: TDP-NBS-GS-000001), which describes the scope, objectives, methods, QA procedures, and criteria for this activity.

This activity was performed in conjunction with other activities to qualify borehole data. The other activities are documented in the following reports:

- Borehole core samples: *Data Qualification Report: Drill Core, Core Samples, Core Photos, Downhole Video, and Geophysical Logs from Boreholes, UE-25 a #1, EU-25 a #5, UE-25 a #6, UE-25 a #7, UE-25 b #1, USG G-1, USGG-2, USG G-3, USG G-4, and USW GU-3* (DI: TDR-NBS-GS-000006)
- Geophysical Logs: *Data Qualification Report: Composite Geophysical Logs* (DI: TDR-NBS-GS-000005)
- Topographic grid: Data Qualification Report: Topographic Grid (DI: TDR-NBS-GS-000004)

Each step of this activity is documented in this report. This report is approved and signed by the qualification team. Qualifications of the team members are as follows:

Robert W. Clayton
Ph.D. in Geological Sciences, 8 years professional experience using geophysical logs and stratigraphic contacts data in subsurface exploration, including 6 years on the Yucca Mountain Project. Was not associated with acquisition of the contacts data.

Clinton Lum
Ph.D. in Geology, 7 years professional experience in Geology including 4 years on the Yucca Mountain Project. Was not associated with acquisition of the contacts data.

Data Retrieval

The borehole stratigraphic contacts data were requested and retrieved from the Technical Data Management System (TDMS). The data tracking number (DTN) is MO9811MWDGFM03.000. The data were provided on 3.5 inch floppy disk with transcription verification files and a copy of the Technical Data Information Form. The transmittal letter, floppy disk, and a printout of the data are included in Attachment I to this report. The data are in Excel spreadsheet format, and were verified against original copies of the spreadsheet obtained from TDMS at the time of original data submittal. The data appear to be original and accurate.

Data Plotting

The borehole stratigraphic contacts data were plotted on a suite of geophysical logs for conduct of this activity. The TDMS retrieval Excel spreadsheet was first edited for plotting by removing redundant contacts data. The redundant data were included in the spreadsheet to accommodate the requirements of 3D modeling software, which requires all cells filled to allow calculation of rock layer thicknesses (repeated contact depths are used to denote zero thickness). Cells coded as "not formed," "not present; faulted", or otherwise with repeated numbers were deleted. This editing step was verified during the qualification process as the plots were checked against the input data.

The contacts data were plotted on paper copies of the geophysical logs. While this could have been done by hand, to save time it was done using the plotting routine of QLA2/GES software, which was obtained from Configuration Management (CSCI 30005 V1.0). QLA2/GES software qualification is in progress, and the software was designated non-Q at the time of this report. However, plotting the stratigraphic contacts on the geophysical logs provided a rigorous validation of the plotting software because any errors would become obvious during examination of the data due to the inter-related nature of the contacts data and the level of detail at which the data were examined. No problems were found. The data qualification team concludes that the current qualification status of the plotting software does not affect the results of this data qualification because 1) the software plotting routine does not manipulate the data in any way, 2) the software was not used to develop or modify the data in any way, and 3) data qualification effectively validated the plotting software for this use.

Oversize color copies of the plots are being submitted with this report to the Records Information System, where the originals will be stored for future examination. The plots were also made available to the reviewers of this activity.

Selection of Data to be Examined

Users of the Geologic Framework Model were queried to determine which contacts are most important to their analyses and the acceptance window (or tolerance) required for their analyses. The users queried are UZ Flow/Transport Model (Jennifer Hinds) and Repository Subsurface Design (Robert Elayer). The query letter and their responses are listed in Attachment II.

Based on the responses, a list of contacts was chosen to be examined as a) the most important contacts that appeared on both users' lists, and b) a representative sample of the contacts data. The required acceptance window (plus or minus) is also listed (the smallest of the acceptance windows provided by the users were used).

Tpcpv2/top of PTn	10 ft.
Tptrv1/top of TSw	10 ft.
Tptpv3/top of TSw3	5 ft.
Tptpv2/top of CHn	15 ft.

These are the most important contacts used in the GFM/ISM and downstream models. They are also the contacts where the acceptance window is most stringent, and so should provide a rigorous test of the contacts data and an indication of the applicability of these data to the GFM/ISM. The 5 meter acceptance window listed in Attachment II was rounded to 15 feet from the actual 16.4 feet for convenience in using the 10 foot grid interval on the geophysical logs plots (that is, a 15 foot window can be more easily determined visually than a 16.4 foot window).

Because all contacts were acquired using the same methods and based on the same types of data, the Data Qualification Team determined that a sub-sampling of the borehole contacts data is a reasonable and valid examination of the data set.

Attachment III is an oversize color cross section from the Geologic Framework Model version GFM3.1 through several boreholes. Geophysical logs are plotted at the borehole locations, except SD-6 for which no logs were available in the specialized format required for this type of plot. There is no vertical exaggeration in the cross section. The cross section demonstrates the large scale typical of the models which use the contacts data, and the relatively small impact of the acceptance windows. Because changing stratigraphic data by 15 feet (or more, in some cases) has negligible impact on the three-dimensional models, the Data Qualification Team concluded that the acceptance windows provided by the data users are reasonable and applicable to 3-D modeling.

Because no geophysical logs exist for the UZN series boreholes, these boreholes were not considered in this activity.

Method of Examination

The contacts data were evaluated by examining the plots of the contacts data for all boreholes side-by-side. Each contact was compared through the entire data set for consistency, geologic reasonability, and fit to geophysical curve signatures. The Q data from boreholes SD-6 and WT-24 were included in each comparison. In addition, maps were made of the thickness of the rock layer below each contact to provide an indication of the geospatial reasonability of each contact location. Because the thickness of each rock layer is inexorably linked to the stratigraphic package above and below it, thickness can be used as an indicator of the accuracy of a layer's top and bottom contact data. Thickness distribution of a layer should be reasonable in the context of the geologic setting. Thickness maps were also used because they were originally made as part of the Geologic Framework Model version GFM3.1 (DTN: MO9901MWDGFM31.000), and therefore provide a direct indication of the applicability of the contacts data to geospatial modeling. It should be noted, however, that the geologic setting at Yucca Mountain makes it difficult to evaluate the thickness maps because most units are highly variable in thickness and lithology from place to place. The thickness maps do provide, however, the only practical means to evaluate the contacts in their geospatial context, and are therefore a valuable tool. The thickness maps are included in Attachment IV.

Attachment V shows typical geophysical log signatures for each of the examined contacts (which are the boundaries between the rock layers above and below) and the expected placement of each contact. Borehole SD-12 was used as the standard because of its good quality logs. The plotted data were compared against this standard to determine whether the contact lies within the required acceptance window. Downhole conditions, log quality, lateral variations in lithology, and known local conditions were accounted for in making this determination.

Data that were determined to lie within the acceptance window were marked with a check (√) on Attachment VI, the Contacts Data Examination Checklist. The checklist is the record of data evaluation by the data qualification team, and the plots of contacts on the geophysical logs (which are being submitted to the Records Information System concurrently with this report) are the record of what was examined. With these records and this report, the data qualification activity should be repeatable.

Data for which questions arose were marked with a question mark (?) in Attachment VI, and were compared to the thickness maps and data from surrounding boreholes for geologic reasonability, fit to thickness trends, and impact of borehole conditions. Anomalies in the thickness maps were examined to determine their origins as geologic or data-related. Data-related anomalies were further examined to determine whether the data should be accepted as qualified. If these examinations provided reasonable assurance that the contact is within the specified acceptance window, the contact was annotated with "okay" next to the question mark (?) on the Attachment VI checklist.

Contacts data found not to be within the required acceptance window were labelled with an X on the Attachment VI checklist. (NOTE: The results of this activity found no such data).

Observed Log Signatures for Contacts

The contacts shown in Attachment V are typical for the central Yucca Mountain site, but variations do occur due to geologic variability and local hole conditions.

The contact at the top of unit Tpcpv2 (top of PTn thermal-mechanical unit) is at the upper inflection point of a downward-decreasing, smooth ramp on the density log. In many locations, a low density break occurs near or above this contact (WT-24 is a good example). The key to defining rock layer Tpcpv2 is that it includes the slope on the density curve. The top contact also coincides with prominent breaks (abrupt changes from high to low plateaus) in the gamma and resistivity curves (a good example is SD-6).

The Tptrv1 rock layer (at the top of TSw) includes the first high density peak below the low-density PTn rocks. In most holes, this layer is only a few feet thick. Gamma and resistivity curves typically have prominent breaks at the top contact (good examples are WT-24 and SD-6).

The contact at the top of unit Tptpv3 (top of TSw3 vitrophyre) frequently has a low density zone at its top, typically related to borehole enlargement. In a few holes there are two or more additional low density (enlarged borehole) zones within the vitrophyre. The vitrophyre is characterized by relatively featureless log curves below the low density zones and to the lower density unit below (Tptpv2). Density values are typically at or above those of the overlying nonlithophysal zones. The top contact is usually (but not always) associated with prominent breaks in the gamma and resistivity curves (good examples are WT-24 and SD-6).

The contact at the top of unit Tptpv2 (base of vitrophyre, top of CHn) is similar to the contact at the top of unit Tpcpv2, because the Tptpv2 rock layer includes the density curve slope. The top contact of Tpcpv2 is the break in slope from the relatively featureless high density unit above (Tptpv3) to the low density unit below (Tptpv1).

Results

All examined data were found to be within the required acceptance window. Table 1 shows that no data were found to be outside the acceptance window. This result is not surprising in view of the rigorous technical review the data have previously received. The contacts for which questions arose, but which were justified for Q recommendation are listed in Table 2, with justification.

The contacts recommended to be qualified are listed in Attachment VII. Special case contacts are listed in Attachment VIII. The special case contacts are those for which no geophysical logs are available, or where the geophysical logs are of so poor quality that they can not be used reliably to determine contacts. These data are discussed in the following section. The UZN series boreholes are not listed in the attachments because they were not considered in this activity.

Borehole	Contact	Depth	Justification for non-Q recommendation
-none-	-none-		-none were found-

Table 1. Data recommended as non-Q.

Borehole	Contact	Depth	Justification for Q recommendation
b#1	Tptpv3	1283	Gamma and Resistivity curves used instead of noisy Density curve
H-3	Tptpv3	1194	Resistivity curve used instead of noisy Density curve
H-4	Tptpv3	1185	Gamma and Resistivity curves used instead of noisy Density curve
H-4	Tptpv2	1209	This unit is the density transition on noisy Density curve, in accordance with the definition of the unit

Table 2. Data requiring justification.

The Data Qualification Team determined that all of the examined contacts lie within the acceptance window. Because the remaining contacts data were acquired on a hole-by-hole basis using the same methods as the data examined here, and because the acceptance windows for the other contacts are larger, it is anticipated that a similarly high percentage of the other contacts would be found to lie within the acceptance window.

Based on examination of the Attachment IV thickness maps, all examined contacts appear to be reasonable in their geologic and spatial context. The extreme thickness of layer Tpcpv2 in borehole WT-24 (Q data) was re-examined and determined to be reasonable. No other data anomalies were apparent. The anomalously thin Tptpv3 in borehole WT-1 is due to faulting, and so is acceptable. The Data Qualification Team concludes that thickness mapping of the units is a useful test of the contact data's adequacy for use in geoscientific modeling.

The recommendation to qualify these data is limited by the acceptance windows stated. Applications which require contacts to be less than the acceptance windows used here should evaluate the data in that context.

Special Case Contacts Data

For the contacts listed in Attachment VIII, no geophysical logs were available or the logs were of insufficient quality to be reliable in determining contact locations. These data were evaluated by two methods: 1) comparison to data in surrounding boreholes, and 2) impact assessment.

Comparison to surrounding data. All special case contacts were used in construction of the GFM, during which the data were rigorously compared to data in surrounding boreholes and in the context of the geologic system. No data were found to be anomalous or unacceptable. Examples of thickness maps using these data are found in Attachment IV and the GFM Analysis Model Report (MOL.20000121.0115, Figures 15 through 27). The methods used to map the data are discussed in the GFM Analysis Model Report section 6.3.

Impact assessment. The impacts of all special case contacts were evaluated, and the data were found to be acceptable based on the following rationale:

- Potential impacts of the special case contacts are small because users of the GFM either a) abstract (subsample) the GFM so that precise details are not preserved, or b) do not use data outside the immediate potential repository footprint and repository host horizons (all special case contacts are either outside the footprint or outside the potential repository host horizons [Tptpul through Tptpln]).
- Boreholes b#1, G-2, H-6, J-13, NRG#1, 2, 2b, 2c, 2d, and WT#6 are not located in the potential repository area and therefore changes in stratigraphic contacts are unlikely to adversely impact analyses and models related to safety and waste isolation.
- All special case contacts were obtained by the same principal investigators as the data recommended to be qualified and using the same processes, procedures, and criteria; therefore, the data are unlikely to be unacceptable.
- The lack of anomalies and continuity of the special case data in comparison to surrounding data suggests that the contact elevations are constrained by the 15 foot (5 meter) acceptance window. This, and the fact that the special case data comprise less than 5% of the contacts suggest that the impacts of the special case data on the results of the GFM are small.

Impacts of Data Qualification

The contacts recommended to be qualified (Attachment VII; DTN: MO0004QGFMPICK.000) comprise 100% of the input contacts to the Geologic Framework Model version GFM3.1 (DTN: MO9901MWDGFM31.000), which is the primary customer for these data. The UZN series boreholes are not used as input to the GFM3.1, and were not considered in this activity. The source data (DTN: MO9811MWDGFM03.000) remain unqualified.

This qualification activity revealed no reason to suspect the technical quality of the borehole geophysical logs, the contacts, core, or other borehole data.

Signatures & Dates

Robert W. Clayton 3/29/00 Data Qualification Team Member	Clinton Lum 4/6/00 Data Qualification Team Chair
Robert L. Howard 04/10/00 Responsible Manager	Richard E. Spence 4/10/00 (Deputy) AMOPE

Attachment I:
Data and Transmittal Letter from TDMS

p. I-1 of 5
Plus attached floppy disk
28 page spreadsheet is numbered separately

p I-2 of 5

TRW

TRW Environmental Safety Systems Inc.
1261 Town Center Drive
Las Vegas, NV 89134
702.295.5400

QA: N/A

Contract # DE-AC08-91RW00134
LV.TDM.REK.07/99-029

July 14, 1999

Robert W. Clayton
M&O/URSGWCFS
Yucca Mountain Project Office
1261 Town Center Drive
Las Vegas, NV 89134

Dear Mr. Clayton:

Subject: Transmittal of GFM3.0 input data in support of data qualification activities.
DTN: MO9811MWDGFM03.000; TDIF: 307530

The enclosed 3¼" diskette contains a copy of the above referenced data. Also included on the diskette are the UNIX checksum and Message Digest Algorithm (MD5) results that may be used to verify the integrity of this file transfer.

Sincerely,

Raymond E. Keeler
MWD/SPA DBA

REK

Enclosure:
(1) Technical Data Information Form; 2 Pages
(2) File list; 1 Page
(3) 3¼" diskette

cc w/o encl.:
S. J. Bodnar, M&O, Las Vegas, Nevada, M/S 423

YMP-023-R6
04/99

YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT
TECHNICAL DATA INFORMATION FORM

☐ ACQUIRED DATA

☒ DEVELOPED DATA

DTN: M09811MWDGFM03.000

Preliminary Data: ______

PART I Identification of Data

Title of Data: ______

Description of Data: INPUT DATA TO GEOLOGIC FRAMEWORK MODEL GFM3.0. VA SUPPORTING DATA.

Data Originator/Preparer: BUESCH, D C
Last Name / First and Middle Initials

Data Originator/Preparer Organization: U.S. GEOLOGICAL SURVEY

Qualification Status: ☐ Q ☒ Un-Q ☐ Accepted Governing Plan: SCP

SCP Activity Number(s): 8.3.1.4.2.1.1

WBS Number(s): 1.2.3.2.2.1.1

PART II Data Acquisition/Development Information

Method: EQUATING AND CORRELATING LITHOLOGIC FEATURES TO BOREHOLE GEOPHYSICAL LOGS.

Location(s): USGS, LAS VEGAS

Period(s): 5/5/1997 to 9/30/1997
From: MM/DD/YY To: MM/DD/YY

Sample ID Number(s): ______

PART III Source Data DTN(s)

GS950708314211.033	TMUSWSD1200095.001	
GS960908312231.004	TMUSWSD1200096.001	
GS980108314211.001		

Comments

INPUT DATA TO GEOLOGIC FRAMEWORK MODEL GFM3.0. SOME DATA WERE MODIFIED FROM DTN GS980108314211.001 FOR BOREHOLES NRG#5 AND WT#16 TO CORRECT TYPOGRAPHICAL ERRORS AND OMISSIONS. THESE DATA WERE REVIEWED IN

Checked by: [signature] Signature

14 July 1999 Date

YMP-023-R6
04/99

YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT
TECHNICAL DATA INFORMATION
CONTINUATION SHEET

Comments (continued)

ACCORDANCE WITH QUALITY ASSURANCE PROCEDURE QAP-SIII-2, REVIEW OF SCIENTIFIC DOCUMENTS AND DATA (THE MODIFIED DATA WERE CORRECTED TO THE REVIEWED VALUES). THE DATA WERE ACQUIRED USING Q INFORMATION EXCEPT SELECT INTERVALS IN BOREHOLES G-4, H-3, AND A#4.

p. I-5 of 5

```
 Volume in drive A is STRAT_PICKS
 Directory of A:\

CHECKS~1 TXT            70  07-14-99  7:53a checksum results.txt
MD5_SI~1 SIG           340  07-14-99  7:53a md5_signature.sig
PIX98U~1 XLS       226,816  07-14-99  7:53a pix98usgs.xls
MO9811~1 HTM           148  07-14-99  7:59a MO9811MWDGFM03_000.html
         4 file(s)        227,374 bytes
         0 dir(s)       1,229,312 bytes free
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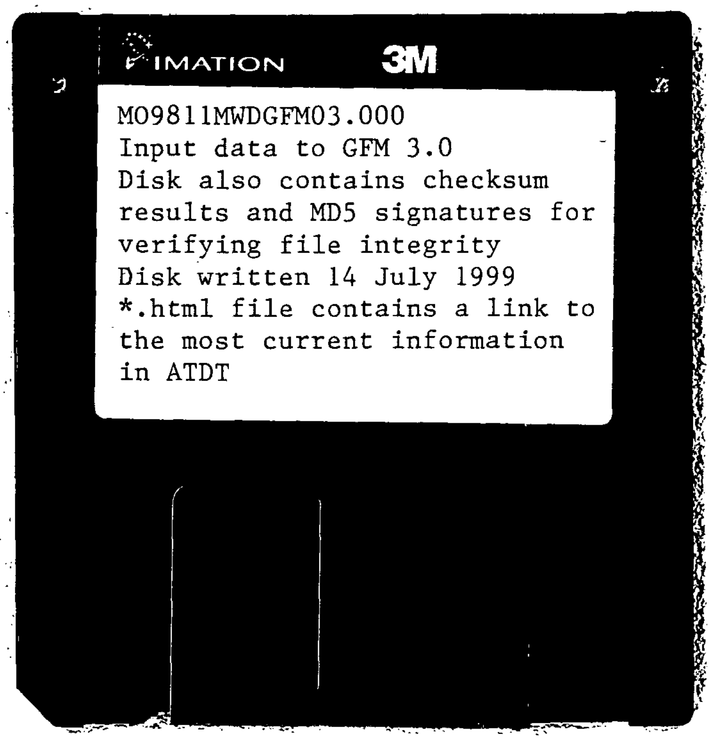
IMATION
3M
M09811MWDGFM03.000
Input data to GFM 3.0
Disk also contains checksum
results and MD5 signatures for
verifying file integrity
Disk written 14 July 1999
*.html file contains a link to
the most current information
in ATDT

	A	B	C	D	E	F	G	H	I	J
1	**Re-evaluation of key subsurface lithostratigraphic contacts: FY97 milestone SPG39IM4. Typos and omissions corrected for input to GFM3.0 by R.W. Clayton.**									
2	In addition to the lithostratigraphic contacts, the table contains values for the:									
3	1. vitric-zeolitic boundary (V-Z)		Green cells	Resolution of contacts initially challenged by overview committee during the January 21-22, 1998, workshop.						
4	2. total depth of each borehole		Blue cells	Modified contacts based on suggestions by Clayton after review workshop in addition to re-examination in the contex						
5	3. type of contact at the top of each unit									
6	Repository Host Horizon (RHH) identified by R. Elayer (MK M&O) based on character of geophysical logs									
7	Colors of headers indicate: Black - Q-status geophysical logs (mostly) and core or cuttings									
8	Blue - Q-status core or cuttings, no geophysical logs									
9				Contact		Contact		Contact		Contact
10	Lithostrat unit	Symbol	UE-25 A#1	type	UE-25 A#4	type	UE-25 A#5	type	UE-25 A#6	type
11	Not described	NC	0.0	nd	0.0	nd	0.0	nd	0.0	nd
12	alluvium	Qa	0.0	d	0.0	d	0.0	d	0.0	d
13	Rainier Mesa Tuff, includes pre-Rainier Mesa Tuff bedded tuff	Tmr	30.0	ne	30.0	ne	90.0	ne	20.0	ne
14	rhyolite of Comb Peak	Tpk	30.0	ne	30.0	ne	90.0	ne	20.0	ne
15	Tiva Canyon Tuff (Tpc) nondivided	Tpc_un	30.0	pe	30.0	pe	90.0	pe	20.0	pe
16	Tpc, crystal-poor vitric densely welded subzone	Tpcpv3	196.0	nf	119.0	nf	128.0	nf	124.5	nf
17	Tpc, crystal-poor vitric moderately welded subzone	Tpcpv2	196.0	c-v	119.0	c-v	128.0	c-v	124.5	c-v
18	Tpc, crystal-poor vitric nonwelded to partially welded subzones	Tpcpv1	205.0	w	135.0	w	136.0	w	135.0	w
19	pre-Tiva Canyon Tuff bedded tuff	Tpbt4	210.0	d	150.7	d	149.0	d	144.2	d
20	Yucca Mountain Tuff nondivided	Tpy	217.3	nf	154.3	d	155.0	d	149.3	d
21	pre-Yucca Mountain Tuff bedded tuff	Tpbt3	217.3	d	179.2	d	164.5	d	167.0	d
22	Pah Canyon Tuff nondivided	Tpp	218.2	d	197.0	d	180.0	d	186.0	d
23	pre-Pah Canyon Tuff bedded tuff	Tpbt2	245.9	d	273.6	d	233.0	d	201.5	d
24	Topopah Spring Tuff (Tpt) crystal-rich vitric nonwelded to partially welded zones	Tptrv3	266.8	d	301.9	d	262.0	d	229.8	d
25	Tpt, crystal-rich vitric moderately welded zone	Tptrv2	273.0	w	309.0	w	269.0	w	236.0	w
26	Tpt, crystal-rich vitric densely welded zone	Tptrv1	275.6	w	316.8	w	277.0	nf	241.7	w
27	Tpt, crystal-rich nonlithophysal zone	Tptrn	279.5	v-c	317.0	v-c	277.0	v-c, w	242.0	v-c
28	Tpt, crystal-rich lithophysal zone	Tptrl	409.8	c		np-td	442.4	c	402.0	c
29	Tpt, lithic-rich zone	Tptf	438.0	nf			475.0	nf	422.0	nf
30	Tpt, crystal-poor upper lithophysal zone	Tptpul	438.0	c			475.0	c	422.0	c
31	Tpt, crystal-poor middle nonlithophysal zone	Tptpmn	673.0	c				np-td		np-td
32	Tpt, crystal-poor lower lithophysal zone	Tptpll	745.0	c						
33	Tpt, crystal-poor lower nonlithophysal zone	Tptpln	1084.0	c						
34	Tpt, crystal-poor vitric densely welded subzone	Tptpv3	1271.6	c-v fi						
35	Tpt, crystal-poor vitric moderately welded subzone	Tptpv2	1310.1	w						
36	Tpt, crystal-poor vitric nonwelded to partially welded subzones	Tptpv1	1324.6	w						
37	pre-Topopah Spring Tuff bedded tuff	Tpbt1	1360.0	d az						
38	Calico Hills Formation undifferentiated	Tac	1368.6	d az						
39	pre-Calico Hills Formation bedded tuff	Tacbt	1789.3	d az						
40	Prow Pass Tuff (Tcp) upper vitric(zeolitic) nonwelded to partially welded zones	Tcpuv	1832.2	d az						
41	Tcp, upper crystallized nonwelded to partially welded zones	Tcpuc	1845.1	v-c (az-c)						
42	Tcp, crystallized moderately to densely welded zones	Tcpm	1944.0	c, w						
43	Tcp, lower crystallized nonwelded to partially welded zones	Tcplc	2006.0	c, w						
44	Tcp, lower vitric(zeolitic) nonwelded to partially welded zones	Tcplv	2030.0	c-v az (c-az)						
45	pre-Prow Pass Tuff bedded tuff	Tcpbt	2331.4	d az						
46	Bullfrog Tuff (Tcb) upper vitric(zeolitic) nonwelded to partially welded zones	Tcbuv	2333.2	np-e						
47	Tcb, upper crystallized nonwelded to partially welded zones	Tcbuc	2333.2	pe (az-c)						
48	Tcb, crystallized moderately to densely welded zones	Tcbm	2415.0	c, w						
49	Tcb, lower crystallized nonwelded to partially welded zones	Tcblc		np-td						
50	Tcb, lower vitric(zeolitic) nonwelded to partially welded zones	Tcblv								
51	pre-Bullfrog Tuff bedded tuff	Tcbbt								
52	Tram Tuff (Tct) upper vitric(zeolitic) nonwelded to partially welded zones	Tctuv								

	A	B	C	D	E	F	G	H	I	J
53	Tct, upper crystallized nonwelded to partially welded zones	Tctuc								
54	Tct, crystallized moderately to densely welded zones	Tctm								
55	Tct, lower crystallized nonwelded to partially welded zones	Tctlc								
56	Tct, lower vitric(zeolitic) nonwelded to partially welded zones	Tctlv								
57	pre-Tram Tuff bedded tuff	Tctbt								
58	lower Tertiary units undifferentiated	Tund								
59	Palezoic and older units	Pz								
60										
61	Vitric-Zeolitc boundary (noncrystallized rocks pervasively vitric versus zeolitic)	V-Z	1360.0	a		np a		np a		np a
62	Repository Host Horizon (top)	RHH	639.0	g		nd p		nd p		nd p
63										
64										
65	Total depth (from ISM2.0 unless in blue)	TD	2501.0		500.0		487.0		500.0	
66										
67										
68	**Symbols:**									
69	Contact type: d, w, v, c, a (ac, az), np, np-e (pe), np-f (t,i,b), np-td, nf, ne, ni, g, nd	d - deposition; w - welding; v - vitric; c - crystallization; a - alteration (ac - clay; az - zeolite); np - not penetrated; np-e - eroded (pe - partially eroded)								
70	Hyphenated symbols	Contacts between vitric, crystallized, and zeolitic material are hyphenated to emphasize fundamental boundaries.								
71	Rock that is altered to zeolites (and/or clay): az, faz	az - rocks that are pervasively altered to zeolite (and/or clay) are indicated by "az"; faz - rocks from the crystal-poor, vitric, densely welded subzone o								
72										
73										
74										
75	**Footnotes:**									
76	1	In C#1 -- The lower part of Tpbt3 might be Tpp, but this is poorly constrained.								
77	2	In C#1, 2, and 3 -- The lowest unit (Tct2c) locally contains brecciated intervals: C#1 (2775 to 2975 ft), C#2 (2775 to 2935), and C#3 (2800 to 300								
78	3	In C#3 -- The lower part of Tpbt3 might be Tpp, but this is poorly constrained.								
79	4	In G-1 -- Tcpm is not well developed. The density log indicates the rocks are in the upper part of the partially welded subzone to lower part of the mo								
80	5	In G-1 -- The total thickness of Tct approximately the same as H-1. Tct2v is thicker in G-1 than H-1, but Tctm is correspondingly thinner. The char								
81	6	In G-1 -- Tct1v includes the lithic-rich member below 3053.								
82	7	In G-2 -- The Tram Tuff in this borehole is much more lithic rich (varying from 5 percent to 40 percent) and the entire formation is nonwelded to pa								
83	8	In G-4 -- Tcpm is not well developed. The density log indicates the rocks are in the upper part of the partially welded subzone to lower part of the mo								
84	9	In H-1 -- Tcpm is not well developed. The density log indicates the rocks are in the upper part of the partially welded subzone to lower part of the mo								
85	10	In H-6 -- Tcpm is not well developed. The density log indicates the rocks are in the upper part of the partially welded subzone to lower part of the mo								
86	11	In UZ-14 -- Tcpm is not well developed. The density log indicates the rocks are in the upper part of the partially welded subzone to lower part of the								
87	12	In WT#3 -- A fault is inferred between the surface and bottom of casing at 40 ft: therefore, there are no constraints on this depth other than it is behi								

	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
1														
2														
3														
4	of committee challenges.													
5														
6														
7														
8														
9		Contact		Contact		Contact		Contact		Contact		Contact		Contact
10	UE-25 A#7	type	UE-25 B#1	type	UE-25 C#1	type	UE-25 C#2	type	UE-25 C#3	type	USW G-1	type	USW G-2	type
11	0.0	nd	0.0	nd	0.0	nd	0.0	nd	0.0	nd	0.0	nd	0.0	nd
12	0.0	d	0.0	d	0.0	ne	0.0	d	0.0	d	0.0	d	0.0	np
13	165.0	ne	156.0	ne	0.0	ne	69.9	ne	80.1	ne	60.0	ne	0.0	ne
14	165.0	ne	156.0	ne	0.0	ne	69.9	ne	80.1	ne	60.0	ne	0.0	ne
15	165.0	pe	156.0	pe	60.0	pe	69.9	pe	80.1	pe	60.0	pe	0.0	pe
16	170.0	nf	180.0	nf	251.0	nf	243.0	nf	221.0	nf	60.0	np-e	225.0	nf
17	170.0	c-v	180.0	c-v	251.0	c-v	243.0	c-v	221.0	c-v	60.0	np-e	225.0	c-v
18	175.8	w	182.0	w	266.0	w	257.0	w	238.0	w	60.0	np-e	228.0	w
19	190.0	d	189.0	d	271.0	d	264.0	d	247.0	d	60.0	np-e	235.0	d
20	194.2	d	192.5	nf	274.0	nf	267.0	nf	250.0	nf	60.0	pe	245.0	d
21	212.0	d	192.5	d	274.0	d (1)	267.0	d	250.0	d (3)	102.0	d	341.5	d
22	226.5	d	204.5	d	300.0	nf	286.0	nf	271.0	nf	135.0	d	494.2	d
23	266.7	d	243.0	d	300.0	d	286.0	d	271.0	d	235.0	d	730.8	d
24	291.9	d	259.0	d	319.0	d	306.0	d	286.0	d	265.0	nf	755.2	d
25	303.6	w	267.0	w	327.0	w	313.0	w	295.0	w	265.0	d	761.7	w
26	304.5	w	275.0	w	329.0	w	315.0	w	298.0	w	270.0	w	766.8	w
27	311.0	v-c	279.9	v-c	332.0	v-c (fb-435)	318.0	v-c	303.0	v-c	280.0	v-c	771.2	v-c
28	483.0	c	413.0	c	424.0	ft	423.0	c	400.0	c	438.0	c	909.1	nf
29	508.0	nf	440.0	nf	438.0	nf	457.0	nf	438.0	nf	456.5	nf	909.1	d
30	508.0	c	440.0	c	438.0	c	457.0	c	438.0	c	456.5	c	977.2	d
31	770.0	c	680.5	c	595.0	c	591.0	c	563.0	ft	713.4	c	1246.0	c
32	878.8	c	765.0	c	726.0	c	725.0	c	703.0	c	814.8	c	1280.0	c
33		np-td	1130.0	c	1040.0	c	1038.0	c	1030.0	c	1199.2	c	1604.0	c
34			1283.0	c-v faz	1216.0	c-v faz	1205.0	c-v faz	1183.0	c-v faz	1287.0	c-v	1633.8	c-v faz
35			1336.0	w az	1293.0	w az	1290.0	w az	1270.0	w az	1342.4	w	1670.0	w az
36			1352.0	w az	1320.0	w az	1320.0	w az	1298.0	w az	1360.5	w >1394.3 az	1684.5	w az
37			1374.0	d az	1334.0	nf	1335.0	nf	1320.0	nf	1403.9	d az	1702.1	d az
38			1385.0	d az	1334.0	d az	1335.0	d az	1320.0	d az	1425.5	d az	1757.0	d az
39			1845.0	d az	1581.0	d az	1580.0	d az	1580.0	d az	1736.4	d az	2576.7	d az
40			1882.0	pe	1692.0	np-e	1658.0	np-e	1635.0	np-e	1799.0	d az	2704.7	np-e
41			1896.0	v-c	1692.0	v-c pe az (az-c)	1658.0	v-c pe az (az-c)	1635.0	v-c pe az (az-c)	1862.5	v-c az (az-c)	2704.7	np-e
42			1992.0	c, w	1787.0	c, w	1773.0	c, w	1762.0	c, w	1920.0	c, w (4)	2704.7	pe
43			2039.0	c, w	1863.0	c, w	1849.0	c, w	1838.0	c, w	1960.0	c, w	2963.7	c, w
44			2071.0	c-v az (c-az)	1884.0	c-v az (c-az)	1872.0	c-v az (c-az)	1863.0	c-v az (c-az)	1985.7	c-v az (c-az)	2980.0	c-v az (c-az)
45			2355.6	d az	2119.0	d az	2109.5	d az	2110.0	d az	2154.9	d az	3246.5	d az
46			2361.3	np-e	2153.0	d az	2138.0	d az	2130.0	d az	2173.2	d az	3281.9	d az
47			2361.3	pe (az-c)	2240.0	v-c az (az-c)	2227.0	v-c az (az-c)	2218.0	v-c az (az-c)	2337.0	v-c az (az-c)	3302.5	v-c (az-c)
48			2468.0	c, w	2275.0	c, w	2262.0	c, w	2267.0	c, w	2461.0	c, w	3320.0	c, w
49			2782.8	c, w	2446.0	c, w	2445.0	c, w	2428.0	c, w	2547.0	nf	3447.0	c, w
50			2799.5	c-v az (c-az)	2575.0	c-v az (c-az)	2550.0	c-v az (c-az)	2547.0	c-v az (c-az)	2547.0	c-v, w	3485.0	c-v az (c-az)
51			2852.7	d az	2692.0	d az	2667.0	d az	2670.0	d az	2601.6	d az	3503.4	d az
52			2882.5	d az	2754.0	np-e	2725.0	np-e	2704.0	np-e	2639.4	d az	3574.0	nf (7)

	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
53			2933.0	v-c (az-c)	2754.0	pe (az-c) (2)	2725.0	pe (az-c) (2)	2704.0	pe (az-c) (2)	2800.0	v-c az (az-c)	3574.0	nf (7)
54			3158.0	c, w		np-td		np-td		np-td	2840.0	c, w (5)	3574.0	nf (7)
55			3322.0	c, w							2956.0	c, w	3574.0	nf (7)
56			3359.9	c-v az (c-az)							3005.0	c-v az (6)	3574.0	d az
57			3900.9	d az							3522.0	d az	3914.0	d az
58			3960.3	d az							3558.2	d az	3982.0	d az
59				np-td								np-td		np-td
60														
61		np a	1336.0	a	1293.0	a	1290.0	a	1270.0	a	1394.3	a	1670.0	a
62		nd p	632.0	g	515.0	g	520.0	g	500	g	600.0	g	1131.9	g
63														
64														
65	1002.0		4003.0		3000.0		3000.0		3000.0		6000.0		6602.0	
66														
67														
68														
69	np-f - faulted (ft - faulted top, fi - faulted interior, fb - faulted base); np-td - total depth in superjacent unit; nf - not formed; ne - not encountered; ni - not identified; g - geophysical log; nd - not described													
70														
71	the Topopah Spring Tuff that have significant alteration along (typically high-angle) fractures													
72														
73														
74														
75														
76														
77	[total depth]).													
78														
79	erately welded subzone and crystallized. The Tcpm unit could be modeled as absent in this location if unit density and calculated porosity are the dominant modeling parameters.													
80	cter of the upper part of Tctm and possibly lower part of Tct2c appear to differ from the typical profile.													
81														
82	tially welded. Occurrence of large amounts of lithic clasts probably inhibited development of welding profile.													
83	erately welded subzone and crystallized. The Tcpm unit could be modeled as absent in this location if unit density and calculated porosity are the dominant modeling parameters.													
84	erately welded subzone and crystallized. The Tcpm unit could be modeled as absent in this location if unit density and calculated porosity are the dominant modeling parameters.													
85	erately welded subzone and crystallized. The Tcpm unit could be modeled as absent in this location if unit density and calculated porosity are the dominant modeling parameters.													
86	oderately welded subzone and crystallized. The Tcpm unit could be modeled as absent in this location if unit density and calculated porosity are the dominant modeling parameters.													
87	casing.													

	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL
1														
2														
3														
4														
5														
6														
7														
8														
9		Contact		Contact		Contact		Contact		Contact		Contact		Contact
10	USW GU-3/G-3	type	USW G-4	type	USW H-1	type	USW H-3	type	USW H-4	type	USW H-5	type	USW H-6	type
11	0.0	nd	0.0	nd	0.0	nd	0.0	nd	0.0	nd	0.0	nd	0.0	nd
12	0.0	ne	0.0	d	0.0	ne	0.0	ne	0.0	ne	0.0	ne	0.0	d
13	0.0	ne	30.0	ne	0.0	ne	0.0	ne	0.0	ne	0.0	ne	29.9	ne
14	0.0	ne	30.0	ne	0.0	ne	0.0	ne	0.0	ne	0.0	ne	29.9	ne
15	0.0	pe	30.0	pe	0.0	pe	0.0	pe	0.0	pe	0.0	pe	29.9	pe
16	348.1	c-v	118.0	nf	61.0	nf	369.8	c-v	173.9	nf	0.0	nf	190.0	nf
17	357.0	w	118.0	c-v	61.0	c-v	376.0	w	173.9	c-v	390.0	c-v	190.0	c-v
18	368.4	w	130.0	w	70.0	w	388.0	w	185.0	w	415.0	w	200.1	w
19	372.5	d	141.0	d	90.0	d	400.0	d	193.0	d	437.5	d	260.2	d
20	375.5	nf	146.0	d	95.1	d	403.9	nf	202.0	nf	438.0	d	270.0	d
21	375.5	d	148.8	d	160.8	d	403.9	d	202.0	d	457.0	d	275.0	d
22	391.7	nf	168.2	d	190.3	d	417.0	nf	221.0	nf	471.0	d	278.0	d
23	391.7	d	198.9	d	278.9	d	417.0	d	221.0	d	510.0	d	290.0	d
24	417.7	d	224.0	nf	295.0	d	435.0	d	243.5	d	542.0	d	300.2	d
25	424.9	w	236.5	w	320.0	w	441.9	w	248.5	w	560.0	w	330.0	w
26	427.8	nf	239.0	w	330.0	w	445.0	w	251.0	w	562.0	w	330.0	w
27	427.8	v-c, w	242.8	v-c	335.0	v-c (fb)	449.0	v-c	254.0	v-c	564.0	v-c	332.0	v-c
28	542.0	c	400.4	c	505.0	ft	526.9	c	376.0	nf(?)	700.0	c	409.0	c
29	548.0	nf	420.0	nf	538.0	nf	540.0	nf	376.0	nf	741.0	nf	435.0	nf
30	548.0	c	420.0	c	538.0	c	540.0	c	376.0	c	741.0	c	435.0	c
31	688.0	c	674.0	c	788.0	c	680.1	c	576.0	c	988.0	c	653.0	c
32	830.0	c	774.0	c	897.0	c	848.1	c	703.0	c	1088.0	c	795.0	c
33	1044.0	c	1127.9	c	1324.0	c	1049.9	c	987.0	c	1450.0	c	1097.0	c
34	1186.7	c-v	1316.5	c-v	1410.0	c-v	1194.0	c-v	1185.0	c-v	1582.0	c-v	1213.0	c-v
35	1280.0	w	1345.4	w	1469.5	w	1308.0	w	1209.0	w	1659.0	w	1310.0	w
36	1317.0	w	1353.6	w >1376.0 az	1486.2	w >1490.0 az	1341.0	w	1247.0	w	1672.0	w	1322.0	w
37	1406.3	d	1406.8	d az	1498.0	d	1392.0	d	1312.0	d	1699.1	d	1356.0	np-e?
38	1412.5	d	1409.4	d az	1505.0	d az	1400.0	d	1317.0	d >1330.0 az	1705.0	d	1356.0	d >1429.0 az
39	1506.3	d	1705.4	d az	1802.0	d az	1437.0	d	1572.0	d az	1879.9	d az	1458.0	d az
40	1553.9	d	1762.7	d az	1861.0	d az	1495.0	d	1626.9	d az	1944.9	d az	1508.0	d az
41	1597.0	v-c	1793.6	v-c (az-c)	1911.0	v-c (az-c)	1518.0	v-c	1662.0	v-c (az-c)	1967.0	v-c (az-c)	1555.0	v-c (az-c)
42	1663.0	c, w	1880.0	c, w (8)	1969.0	c, w (9)	1640.0	c, w	1746.0	c, w	2085.0	c, w	1602.0	c, w (10)
43	1744.0	c, w	1946.0	c, w	2021.0	c, w	1690.0	c, w	1820.0	c, w	2113.0	c, w	1670.0	c, w
44	1755.0	c-v >1816.0 az	1954.6	c-v az (c-az)	2053.0	c-v az (c-az)	1702.0	c-v >1762 az	1840.0	c-v az (c-az)	2130.0	c-v az (c-az)	1685.0	c-v az (c-az)
45	1992.3	d az	2238.0	d az	2300.0	d az	1899.9	d az	2263.1	d az	2240.1	d az	1765.1	d az
46	1998.7	d az	2245.7	d az	2319.5	d az	1907.1	d az	2274.9	d az	2263.1	d az	1794.9	d az
47	2021.3	v-c (az-c)	2255.0	v-c (az-c)	2337.0	v-c (az-c)	1922.0	v-c (az-c)	2369.0	v-c (az-c)	2310.0	v-c (az-c)	1881.0	v-c (az-c)
48	2102.0	c, w	2560.0	c, w	2533.0	c, w	2092.0	c, w	2494.0	c, w	2388.0	c, w	1894.0	c, w
49	2549.5	c, w	2677.0	nf	2629.0	c, w	2350.0	c, w	2559.0	c, w	2468.0	c, w	1990.0	c, w
50	2550.8	c-v az (c-az)	2677.0	c-v w az (c-az)	2676.0	c-v az (c-az)	2397.0	c-v az (c-az)	2635.0	c-v az (c-az)	2510.0	c-v az (c-az)	2138.1	c-v az (c-az)
51	2617.0	d az	2733.3	d az	2690.3	d az	2449.1	d az	2644.0	d az	2712.9	d az	2225.0	d az
52	2637.0	d az	2755.6	d az	2729.6	d az	2477.0	d az	2664.0	d az	2742.1	d az	2258.0	d az

	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL
53	2719.0	v-c (az-c)	2839.0	v-c (az-c)	2823.0	v-c (az-c)	2567.0	v-c (az-c)	2745.0	v-c (az-c)	2845.0	v-c (az-c)	2348.0	v-c (az-c)
54	2890.0	c, w	2950.0	c, w	2862.0	c, w	2692.0	c, w	2835.0	c, w	2897.0	c, w	2439.0	c, w
55	3265.0	c, w		np-td	3073.0	c, w	3086.0	c, w	3200.0	c, w	3130.0	c, w	2655.0	c, w
56	3290.0	c-v az (c-az)			3111.0	c-v az (c-az)	3120.0	c-v az (c-az)	3228.0	c-v az (c-az)	3150.0	c-v az (c-az)	2667.0	c-v az (c-az)
57	3850.1	d az			3618.7	d az	3595.1	d az	3788.0	d az	3412.0	d az	2869.1	d az
58	3876.3	d az			3661.4	d az	3637.1	d az	3818.9	d az	3421.9	d az	2877.9	d az
59		np-td				np-td		np-td		np-td		np-td		np-td
60														
61	1816.0	a	1376.0	a	1490.0	a	1762.0	a	1330.0	a	1888.0	a	1429.0	a
62	675.0	g	618.0	g	650.0	g	605.0	g	553.0	g	931.0	g	585.0	g
63														
64														
65	5031.0		3001.0		6000.0		4000.0		4004.0		4000.0		4002.0	
66														
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	AM	AN	AO	AP	AQ	AR	AS	AT	AU	AV	AW
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2											
3											
4											
5											
6											
7											
8											
9		Contact		Contact		Contact		Contact		Contact	
10	UE-25 J#13	type	UE-25 NRG#1	type	UE-25 NRG#2	type	UE-25 NRG#2A	type	UE-25 NRG#2B	type	UE-25 NRG#2C
11	0.0	nd	0.0	nc	0.0	nd	0.0	nc	0.0	nd	0.0
12	0.0	d	9.5	nf	0.0	np	80.6	ni	0.0	ne	50.0
13	435.0	ne	9.5	ne	0.0	ne	80.6	ni	2.2	np-e	50.0
14	435.0	ne	9.5	ne	164.6	ne	80.6	d	157.3	d	150.1
15	435.0	pe	9.5	pe	164.6	f	165.9	pe	232.3	f	
16	587.0	c-v		np-td	276.3	nf		np-td	232.3	f	
17	591.0	w			276.3	c-v			232.3	f	
18	610.0	w			282.8	w			232.3	f	
19	629.0	d				np-td			265.2	d	
20	632.0	nf							267.1	d	
21	632.0	d							268.9	d	
22	650.0	nf							285.3	d	
23	650.0	d							324.0	d	
24	682.0	d								np-td	
25	686.0	w									
26	691.0	nf									
27	691.0	v-c									
28	755.0	c									
29	801.0	nf									
30	801.0	c									
31	905.0	c									
32	1003.0	c									
33	1193.0	c									
34	1300.0	c-v faz									
35	1415.0	w az									
36	1450.0	w az									
37	1475.0	d az									
38	1482.0	d az									
39	1682.0	d az									
40	1711.0	d az									
41	1742.0	v-c (az-c)									
42	1848.0	c, w									
43	1942.0	c, w									
44	1961.0	c-v az (c-az)									
45	1993.0	d az									
46	2017.0	np-e									
47	2017.0	v-c (az-c)									
48	2082.0	c, w fb									
49	2322.0	np-f									
50	2322.0	np-f									
51	2322.0	ft									
52	2358.0	d az									

	AM	AN	AO	AP	AQ	AR	AS	AT	AU	AV	AW
53	2465.0	v-c									
54	2658.0	c, w									
55	2862.0	c, w									
56	2991.0	c-v az (c-az)									
57	3200.0	d az									
58	3220.0	d az									
59		np-td									
60											
61	1415.0	a		np a		np a		np a		np a	
62		nd g		np g		np g		np g		np g	
63											
64											
65	3498.0		150.0		294.0		266.0		330.0		151.0
66											
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9	Contact		Contact
10	type	UE-25 NRG#2D	type
11	nc	0.0	nc
12	nc	38.1	nc
13	nc	38.1	nc
14	d	125.9	d
15	np-td		np-td
16			
17			
18			
19			
20			
21			
22			
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61	np a		np a
62	np g		np g
63			
64			
65		170.0	
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	BA	BB	BC	BD	BE	BF	BG	BH	BI	BJ	BK	BL
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8												
9			Contact		Contact		Contact		Contact		Contact	
10	Symbol	UE-25 NRG#3	type	UE-25 NRG#4	type	UE-25 NRG#5	type	USW NRG-6	type	USW NRG-7/7A	type	ONC#1
11	NC	0.0	nd	0.0	nd	0.0	nd	0.0	nd	0.0	nc	0.0
12	Qa	0.0	np	0.0	nf	0.0	ne	0.0	ne	17.0	ne	0.0
13	Tmr	0.0	np	0.0	nf	0.0	ne	0.0	ne	17.0	ne	98.0
14	Tpk	0.0	np	0.0	nf	0.0	ne	0.0	ne	17.0	ne	193.0
15	Tpc_un	0.0	pe	0.0	pe	0.0	pe	0.0	pe	17.0	pe	206.0
16	Tpcpv3		np-td	318.0	nf	140.0	nf	135.3	nf	69.7	nf	578.0
17	Tpcpv2			318.0	c-v	140.0	c-w	135.3	c-v	69.7	c-v	578.0
18	Tpcpv1			323.0	w	154.0	w	151.8	w	79.2	w	589.0
19	Tpbt4			338.0	d	163.0	d	158.6	d	102.0	d	597.0
20	Tpy			344.0	d	170.0	d	162.8	nf	106.4	d	600.0
21	Tpbt3			354.0	d	187.0	d	162.8	d	156.0	d	600.0
22	Tpp			375.0	d	215.0	d	174.9	d	172.0	d	621.0
23	Tpbt2			458.0	d	288.0	d	220.8	d	258.8	d	621.0
24	Tptrv3			477.0	d	321.0	d	244.7	d	284.3	d	643.0
25	Tptrv2			481.5	w	327.0	w	257.4	w	292.7	w	653.0
26	Tptrv1			485.0	w	330.0	w	259.8	w	296.2	w	654.0
27	Tptrn			488.9	v-c	332.0	v-c	263.2	v-c	299.0	v-c	658.0
28	Tptrl			660.5	c	517.0	c	429.0	c	478.2	c	774.0
29	Tptf			700.0	nf	565.0	nf	465.5	nf	518.4	nf	810.0
30	Tptpul			700.0	c	565.0	c	465.5	c	518.4	c	810.0
31	Tptpmn				np-td	770.0	c	713.0	c	740.0	c	977.0
32	Tptpll					901.5	c	810.0	c	877.6	c	1100.0
33	Tptpln					1230.0	c		np-td	1243.0	c	1178.0
34	Tptpv3						np-td			1414.8	c-v	1178.0
35	Tptpv2									1457.0	w >1466.0 az	1178.0
36	Tptpv1									1474.6	w az	1213.0
37	Tpbt1									1493.0	d az	1253.0
38	Tac									1498.0	d az	1274.0
39	Tacbt										np-td	
40	Tcp4v											
41	Tcp3n2c											
42	Tcp3m-d											
43	Tcp1-3n1c											
44	Tcp1-3n1v											
45	Tcpbt											
46	Tcbn2v											
47	Tcbn2c											
48	Tcbm-d											
49	Tcbn1c											
50	Tcbn1v											
51	Tcbbt											
52	Tctn2v											

	BA	BB	BC	BD	BE	BF	BG	BH	BI	BJ	BK	BL
53	Tctn2c											
54	Tctm-d											
55	Tctn1c											
56	Tctn1v											
57	Tctbt											
58	Tund											
59	Pz											
60												
61	V-Z		np a		np a		np a		np a	1466.0	a	1153.0
62	RHH		np g		np g	681.0	g	620.0	g	659.0	g	927.0
63												
64												
65	TD	330.0		726.0		1350.0		1100.0		1513.0		1540.0
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	BM	BN	BO	BP	BQ	BR	BS	BT	BU	BV	BW	BX	BY	BZ
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8														
9	Contact		Contact		Contact		Contact		Contact		Contact		Contact	
10	type	UE-25 P#1	type	USW SD-7	type	USW SD-9	type	USW SD-12	type	USW UZ-1	type	UE-25 UZ#4	type	UE-25 UZ#5
11	nd	0.0	nd	0.0	nc	0.0	nc, dp	0.0	nc	0.0	nd	0.0	nd	0.0
12	d	0.0	d	50.1	ne	53.6	d	5.3	ne	0.0	ne	0.0	d	3.0
13	np-e	127.0	np-e	50.1	ne	53.6	nf	5.3	ne	40.0	ne	39.0	ne	3.0
14	d	127.0	np-e	50.1	ne	53.6	nf	5.3	ne	40.0	ne	39.0	ne	3.0
15	pe	127.0	pe	50.1	pe	53.6	pe	5.3	pe	40.0	pe	39.0	pe	3.0
16	nf	127.0	np-e	305.0	nf	57.2	nf	239.5	nf	40.0	ne	71.4	nf	89.0
17	c-w	127.0	np-e	305.0	c-v	57.2	c-v	239.5	c-v	40.0	ne	71.4	c-v	89.0
18	w	127.0	np-e	316.0	w	76.5	w	256.0	w	40.0	ne	78.0	w	100.0
19	d	127.0	np-e	325.8	d	91.5	d	263.7	d	40.0	ne	99.0	d	118.0
20	nf	127.0	np-e	330.6	nf	95.9	d	266.0	nf	40.0	np-e	106.0	d	122.0
21	d	127.0	np-e	330.6	d	140.8	d	266.0	d	78.0	d	151.5	d	162.0
22	nf	127.0	np-e	343.0	d	155.5	d	278.3	d	105.0	d	173.9	d	186.0
23	d	127.0	np-e	356.0	d	226.6	d	291.2	d	242.0	d	305.0	d	316.0
24	d	140.0	d	384.3	d	255.6	d	314.1	d	272.0	d	333.0	d	345.0
25	w	145.0	w	384.3	w	266.7	w	320.8	w	282.5	w	343.0	w	352.5
26	w	148.0	w	386.3	nf	268.5	w	324.5	w	284.0	w	345.0	w	354.5
27	v-c	150.0	c	386.3	v-c	272.2	v-c	330.7	v-c	288.0	v-c	346.0	v-c	356.1
28	c	228.0	c	490.0	c	450.0	c	436.4	c	436.0	c		np-td	
29	nf	248.0	nf	490.0	nf	473.0	nf	470.2	nf	470.0	nf			
30	c	248.0	c	490.0	c	473.0	c	470.2	c	470.0	c			
31	c	493.0	c	682.5	c	730.0	c	663.7	c	717.0	c			
32	c	640.0	c	803.3	c	845.8	c	786.9	c	830.0	c			
33	f	958.0	c	1020.0	c	1182.0	c	1065.5	c	1145.0	c			
34	f	1090.0	c-v faz	1182.0	c-v	1358.0	c-v	1278.1	c-v		np-td			
35	f >1153.0 az	1200.0	w az	1285.0	w	1418.4	w	1308.0	w					
36	w az	1243.0	w az	1308.0	w	1425.7	w >1457.0 az	1337.5	w					
37	d az	1270.0	nf	1395.4	d	1464.1	d az	1408.1	d					
38	d az	1270.0	d az	1405.6	d	1479.9	d az	1411.5	d					
39	np-td	1390.0	d az	1567.2	d >1562.0 az	1764.4	d az	1599.5	d >1600 az					
40		1441.0	d az	1621.5	d	1820.7	d az	1648.4	d az					
41		1468.0	v-c (az-c)	1646.5	v-c (az-c)	1868.7	v-c	1677.0	v-c					
42		1535.0	w,c	1765.0	c, w	1938.5	c, w	1787.0	c, w					
43		1630.0	w,c	1832.0	c, w	1991.4	c, w	1842.0	c, w					
44		1680.0	c-v az (c-az)	1872.0	c-v (c-az)	2015.8	c-v az (c-az)	1865.0	c-v az (c-az)					
45		1790.0	d az	2167.8	d az		np-td	2133.0	d az					
46		1826.0	np-e	2183.9	np-e			2137.8	d az					
47		1826.0	np-e	2183.9	np-e				np-td					
48		1953.0	w,c	2183.9	np-e									
49		2130.0	w,c	2450.0	pe									
50		2162.0	c-v (c-az)	2478.0	c-v (c-az)									
51		2240.0	d az	2579.4	d az									
52		2262.0	d az	2598.0	d az									

	BM	BN	BO	BP	BQ	BR	BS	BT	BU	BV	BW	BX	BY	BZ
53		2340.0	v-c (az-c)	2611.8	v-c (az-c)									
54		2395.0	w,c		np-td									
55		2595.0	w,c											
56		2616.0	nf(?)											
57		2863.0	f, nf(?)											
58		2863.0	f, nf(?)											
59		4080.0	d or f											
60														
61	a	1200.0	a	1562.0	a	1457.0	a	1600.0	a		np a		np a	
62	g	453.0	ni	640.0	g	628.0	g	630.0	g	585.0	g		np g	
63														
64														
65		5923.0		2675.1		2223.0		2166.3		1270.0		411.0		405.0
66														
67														
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8													
9	Contact		Contact		Contact		Contact		Contact		Contact		Contact
10	type	USW UZ-6	type	USW UZ-7A	type	USW UZ-14	type	UE-25 UZ#16	type	USW UZ-N11	type	USW UZ-N15	type
11	nd	0.0	nd	0.0	nc	0.0	nc	0.0	nd	0.0	nd	0.0	nd
12	ne	0.0	ne	38.5	ne	39.7	nd	0.0	d	0.0	d	0.0	d
13	ne	0.0	ne	38.5	ne	39.7	ne	39.7	ne	1.7	ne	2.3	ne
14	ne	0.0	ne	38.5	ne	39.7	ne	39.7	ne	1.7	ne	2.3	ne
15	pe	0.0	pe	38.5	pe	39.7	pe	39.7	pe	1.7	pe	2.3	pe
16	nf	383.0	c-v	163.9	nf	39.7	np-e	140.8	nf	25.2	nf		np-td
17	c-v	407.0	w	163.9	c-v	39.7	np-e	140.8	c-v	25.2	c-v		
18	w	422.0	w	184.0	w	39.7	np-e	153.0	w	29.7	w		
19	d	432.5	d	197.7	d	39.7	np-e	160.7	d	46.4	d		
20	d	437.2	nf	203.6	nf	39.7	np-e	165.9	d	60.6	d		
21	d	437.2	d	203.6	d	78.2	d	173.4	d		np-td		
22	d	450.1	d	214.9	d	102.1	d	188.8	nf				
23	d	455.5	d	218.6	d	240.4	d	188.8	d				
24	d	478.2	d	243.0	d	268.2	d	217.0	d				
25	w	483.0	w	247.3	w	280.9	w	228.1	w				
26	w	489.0	w	248.6	nf	282.5	w	229.4	w				
27	v-c	490.0	v-c	248.6	v-c	286.0	v-c	238.9	v-c				
28	np-td	575.0	c	377.8	nf	430.0	c	357.8	c				
29		610.0	nf	377.8	nf	468.0	nf	371.0	nf				
30		610.0	c	377.8	c (fi)	468.0	c	371.0	c				
31		778.0	c	480.0	c	715.0	c	545.0	c				
32		917.0	c	607.0	c	828.0	c	669.0	c				
33		1190.0	c		np-td	1138.0	c	935.0	c				
34		1333.0	c-v			1279.1	c-v	1107.5	c-v faz				
35		1379.0	w			1358.0	w	1165.2	w az				
36		1422.0	w			1383.0	w >1395.5 az	1178.0	w az				
37		1450.0	d			1404.2	d az	1190.0	d az				
38		1460.0	d			1420.2	d az	1197.0	d az				
39		1547.2	d			1694.0	d az	1455.4	d az				
40		1592.0	d			1750.2	d az	1485.0	d az				
41		1614.0	v-c			1815.1	v-c	1497.7	v-c				
42		1750.0	c, w			1850.0	c, w (11)	1571.0	c, w				
43		1802.0	c, w			1893.0	c, w	1638.0	c, w				
44		1829.0	c-v az (c-az)			1899.0	c-v az (c-az)	1669.2	c-v az (c-az)				
45			np-td			2046.6	d az		np-td				
46						2072.1	d az						
47							np-td						
48													
49													
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60													
61	np a		np a		np a	1392.5	a	1165.2	a		np a		np a
62	np g	690.0	g		np g		np g	485.0	g		nd g		nd g
63													
64													
65		1887.0		770.0		2207.0		1686.0		84.4		59.9	
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9		Contact		Contact		Contact		Contact		Contact		Contact	
10	USW UZ-N16	type	USW UZ-N17	type	USW UZ-N27	type	USW UZ-N31	type	USW UZ-N32	type	USW UZ-N33	type	USW UZ-N34
11	0.0	nd	0.0	nd	0.0	nd	0.0	nc	0.0	nd	0.0	nc	0.0
12	0.0	d	0.0	d	0.0	ne	15.0	d	0.0	ne	13.1	d	0.0
13	4.2	ne	2.5	ne	0.0	ne	15.0	ne	0.0	ne	13.1	ne	50.1
14	4.2	ne	2.5	ne	0.0	ne	15.0	ne	0.0	ne	13.1	ne	50.1
15	4.2	pe	2.5	pe		pe	15.0	pe	0.0	pe	13.1	pe	50.1
16		np-td		np-td		np-td	87.5	nf	96.0	nf	13.1	nf	50.1
17							87.5	c-v	96.0	c-v	13.1	c-v	50.1
18							102.7	w	107.5	w	22.6	w	50.1
19							106.7	d	113.1	d	44.2	d	50.1
20							111.5	nf	118.0	nf	47.3	d	50.1
21							111.5	d	118.0	d		np-td	
22							119.6	d	130.0	d			
23							144.5	d	158.5	d			
24							168.2	d	186.0	d			
25							179.9	w	198.1	w			
26							181.2	w	199.4	w			
27							185.5	v-c	202.4	v-c			
28								np-td		np-td			
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61		np a		np a		np a		np a		np a		np a	
62		nd g		nd g		nd g		nd g		nd g		nd g	
63													
64													
65	60.0		59.9		202.4		192.6		207.4		75.0		84.1
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9	Contact		Contact		Contact				Contact		Contact		Contact
10	type	USW UZ-N35	type	USW UZ-N36	type		Symbol	USW UZ-N37	type	USW UZ-N38	type	USW UZ-N53	type
11	nd	0.0	nd	0.0	nd		NC	0.0	nd	0.0	nd	0.0	nd
12	d	0.0	d	0.0	d		Qa	0.0	d	0.0	d	0.0	d
13	ne	11.9	ne	0.9	ne		Tmr	36.3	ne	17.9	ne	2.1	ne
14	ne	11.9	ne	0.9	ne		Tpk	36.3	ne	17.9	ne	2.1	ne
15	pe	11.9	pe	0.9	pe		Tpc_un	36.3	pe	17.9	pe	2.1	pe
16	np-e		np-td		np-td		Tpcpv3	109.4	nf	80.9	nf	150.6	nf
17	np-e						Tpcpv2	109.4	c-v	80.9	c-v	150.6	c-v
18	np-e						Tpcpv1	121.1	w		np-td	159.2	w
19	np-e						Tpbt4	127.7	d			173.4	d
20	np-e						Tpy	133.4	nf			175.2	d
21	np-td						Tpbt3	133.4	d			180.3	d
22							Tpp	148.2	d			195.6	nf
23							Tpbt2	219.6	d			195.6	d
24							Tptrv3	244.6	d			220.8	d
25							Tptrv2	250.8	w			227.7	w
26							Tptrv1	256.7	w			230.1	nf
27							Tptrn	258.0	v-c			230.1	v-c
28							Tptrl		np-td				np-td
29							Tptf						
30							Tptpul						
31							Tptpmn						
32							Tptpll						
33							Tptpln						
34							Tptpv3						
35							Tptpv2						
36							Tptpv1						
37							Tpbt1						
38							Tac						
39							Tacbt						
40							Tcp4v						
41							Tcp3n2c						
42							Tcp3m-d						
43							Tcp1-3n1c						
44							Tcp1-3n1v						
45							Tcpbt						
46							Tcbn2v						
47							Tcbn2c						
48							Tcbm-d						
49							Tcbn1c						
50							Tcbn1v						
51							Tcbbt						
52							Tctn2v						

	DA	DB	DC	DD	DE	DF	DG	DH	DI	DJ	DK	DL	DM
53							Tctn2c						
54							Tctm-d						
55							Tctn1c						
56							Tctn1v						
57							Tctbt						
58							Tund						
59							Pz						
60													
61	np a		np a		np a		V-Z		np a		np a		np a
62	nd g		nd g		nd g		RHH		nd g		nd g		nd g
63													
64													
65		175.8		59.8			TD	271.3		89.4		234.5	
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9		Contact		Contact		Contact		Contact		Contact		Contact	
10	USW UZ-N54	type	USW UZ-N55	type	USW UZ-N57	type	USW UZ-N58	type	USW UZ-N59	type	USW UZ-N61	type	USW UZ-N62
11	0.0	nd	0.0	nd	0.0	nc	0.0	nc	0.0	nc	0.0	nc	0.0
12	0.0	d	0.0	ne	1.2	d	8.9	d	13.1	ne	9.8	ne	1.0
13	19.0	ne	0.0	ne	1.2	ne	22.1	ne	13.1	ne	9.8	ne	1.0
14	19.0	ne	0.0	ne	1.2	ne	22.1	ne	13.1	ne	9.8	ne	1.0
15	19.0	pe	0.0	pe	1.2	pe	22.1	pe	13.1	pe	9.8	pe	1.0
16	145.5	nf	177.0	nf		np-td		np-td		np-td		np-td	
17	145.5	c-v	177.0	c-v									
18	158.8	w	190.0	w									
19	167.7	d	203.9	d									
20	168.7	d	207.9	d									
21	175.5	d	213.9	d fb									
22	191.4	nf	221.6	nf									
23	191.4	d	221.6	ft									
24	217.5	d	233.4	d									
25	227.7	w	241.0	w									
26	232.6	nf	244.0	w									
27	232.6	v-c	246.6	v-c									
28		np-td		np-td									
29													
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61		np a		np a		np a		np a		np a		np a	
62		nd g		nd g		nd g		nd g		nd g		nd g	
63													
64													
65	244.7		255.3		118.9		118.9		118.8		118.9		60.0
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9	Contact		Contact		Contact		Contact		Contact		Contact		Contact
10	type	USW UZ-N63	type	USW UZ-N64	type	USW WT-1	type	USW WT-2	type	UE-25 WT#3	type	UE-25 WT#4	type
11	nd	0.0	nd	0.0	nd	0.0	nd	0.0	nd	0.0	nd	0.0	nd
12	ne	0.0	d	0.0	d	0.0	d	0.0	d	0.0	d	0.0	d
13	ne	4.4	ne	1.8	ne	30.0	ne, nf	60.0	ne	11.0	np-e	51.0	ne
14	ne	4.4	ne	1.8	ne	30.0	ne, nf	60.0	ne	11.0	np-e	51.0	ne
15	pe	4.4	pe	1.8	pe	30.0	pe	60.0	pe	11.0	np-e	51.0	pe
16	np-td		np-td		np-td	395.0	c-v	193.0	c-v	11.0	np-e	261.0	nf
17						410.0	w	200.0	w	11.0	np-e	261.0	c-v
18						417.0	w	215.0	w	11.0	np-e	270.0	w paz(?)
19						431.0	d	227.0	d	11.0	np-e	281.0	d paz(?)
20						435.0	nf	230.0	nf	11.0	np-e	293.0	nf
21						435.0	d	230.0	d	11.0	np-e	293.0	d paz(?)
22						446.0	nf	247.0	nf	11.0	np-e	324.0	d
23						446.0	d	247.0	d	11.0	np-e	419.0	d az(?
24						477.0	d	271.0	d	11.0	np-e	444.0	d
25						481.0	w	275.0	w	11.0	np-e	448.0	w
26						484.0	w	280.0	w	11.0	np-e	456.0	w
27						492.0	v-c	285.0	v-c	11.0	np-e	458.0	v-c
28						575.0	c	380.0	c	11.0	np-e	630.0	c
29						593.0	nf	421.0	nf	11.0	np-e	630.0	nf
30						593.0	c	421.0	c	11.0	np-e	660.0	c
31						733.0	c	590.0	c	11.0	np-e	727.0	c
32						888.0	c	727.0	c	11.0	pe fb	785.0	c
33						1187.0	c	1014.0	c	35.0	ft (12)	1091.0	nf
34						1299.0	c-v	1179.0	c-v	189.0	c-v faz	1091.0	c-v faz
35						1337.0	w az	1223.0	w	293.0	w az	1122.0	w az
36						1368.0	w az	1264.0	w	327.0	w az	1141.0	w az
37						1380.0	d az	1315.0	d	351.0	d az	1150.0	d az
38						1384.0	d fb az	1319.0	d 1435- 1st az	358.0	d az	1156.0	d az
39						1564.0	f	1521.0	d	461.0	d az		np-td
40						1564.0	f	1594.0	np-e	512.0	d az		
41						1564.0	f	1594.0	v-c	554.0	v-c (az-c)		
42						1564.0	f	1706.0	c, w	660.0	c, w		
43						1564.0	f	1776.0	c, w	704.0	c, w		
44						1564.0	f	1794.0	c-v az (c-az)	710.0	c-v az (c-az)		
45						1564.0	f		np-td	835.0	d az		
46						1564.0	f			846.0	d pe(?) az		
47						1564.0	f			850.0	v-c (az-c)		
48						1564.0	ft			909.0	c, w		
49							np-td				np-td		
50													
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61	np a		np a		np a	1337.0	a	1452.0	a	293.0	a	1122.0	a
62	nd g		nd g		nd g	713.0	g	540.0	g		nd g	679.0	g
63													
64													
65		60.0		60.0		1689.0		2060.0		1142.0		1580.0	
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9		Contact		Contact		Contact		Contact		Contact		Contact	
10	UE-25 WT#6	type	USW WT-7	type	USW WT-10	type	UE-25 WT#11	type	UE-25 WT#12	type	UE-25 WT#13	type	UE-25 WT#14
11	0.0	nd	0.0	nd	0.0	nd	0.0	nd	0.0	nd	0.0	nd	0.0
12	0.0	d	0.0	d	0.0	d	0.0	d	0.0	d	0.0	d	0.0
13	170.0	ne	40.0	ne	60.0	np-e	40.0	ne, nf(?)	60.0	ne	220.0	ne	107.0
14	170.0	ne	40.0	ne	627.0	nd	40.0	ne, nf	60.0	ne	220.0	ne	107.0
15	170.0	np-e	40.0	pe	627.0	d	40.0	pe	60.0	pe	220.0	pe	107.0
16	170.0	np-e	344.0	nf	863.0	c-v	239.0	c-v	297.0	c-v	416.0	nf	107.0
17	170.0	np-e	344.0	c-v	872.0	w	243.5	w	300.0	w	416.0	c-v	107.0
18	170.0	np-e	355.0	w	880.0	w	263.0	w	306.0	w	427.0	w	107.0
19	170.0	np-e	369.5	d	887.0	d	271.0	d	319.0	d	440.0	d	107.0
20	170.0	np-e	372.0	d	894.0	nf	272.0	nf	323.0	nf	450.0	nf	107.0
21	170.0	np-e	374.5	d	894.0	d	272.0	d	323.0	d	450.0	d	107.0
22	170.0	np-e	391.0	nf	924.0	nf	287.0	nf	339.0	nf	460.0	d	107.0
23	170.0	np-e	391.0	d	924.0	d	287.0	d	339.0	d	469.0	d	107.0
24	170.0	np-e	415.0	d	954.0	d	307.0	d	362.0	d	490.0	d	107.0
25	170.0	np-e	426.0	w	960.5	w	313.0	w	365.0	w	497.0	w	122.0
26	170.0	np-e	432.0	w	967.0	w	317.0	w	369.0	w	498.0	w	124.0
27	170.0	np-e	435.0	v-c	971.0	v-c	324.0	v-c	374.0	v-c	500.0	v-c	128.0
28	170.0	np-e	515.0	c	1035.0	c	430.0	c	478.0	nf	612.0	c	247.0
29	170.0	pe	546.0	nf	1049.0	nf	430.0	nf	478.0	nf	630.0	nf	275.0
30	250.0	nf	546.0	c	1049.0	c	430.0	c	478.0	c	630.0	c	275.0
31	250.0	nf	706.0	c	1250.0	c	661.0	c	680.0	c	755.0	c	446.0
32	250.0	d, c	959.0	c		np-td	782.0	c	760.0	c	868.0	c	534.0
33	303.0	nf	1091.0	c			875.0	c	890.0	c	1103.0	c	830.0
34	303.0	c-v faz	1287.0	c-v faz			1058.0	c-v	1151.0	c-v		np-td	1024.0
35	337.0	w az	1351.0	w az			1146.0	w paz	1215.0	w			1117.0
36	352.0	w az	1360.0	w az			1186.0	w	1250.0	w			1137.0
37	369.0	d az	1433.0	d az			1198.0	d	1259.0	d			1157.0
38	383.0	d az	1438.0	d az			1208.0	d >1271.0 az	1276.0	d			1210.0
39		np-td	1510.0	d az				np-td		np-td			
40			1571.0	d az									
41			1598.0	v-c (az-c)									
42				np-td									
43													
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61	305.0	a	1351.0	a		np a	1271.0	a	1180.0	a		np a	1117.0
62		nd g	665.0	g	1233.0	g	641.0	g	660.0	g	740.0	g	392.0
63													
64													
65	1258.0		1610.0		1412.0		1446.0		1308.0		1154.0		1310.0
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9	Contact		Contact		Contact		Contact		Contact
10	type	UE-25 WT#15	type	UE-25 WT#16	type	UE-25 WT#17	type	UE-25 WT#18	type
11	nd	0.0	nd	0.0	nd	0.0	nd	0.0	nd
12	d	0.0	d	0.0	d	0.0	d	0.0	ne
13	ne	210.0	np-e	137.0	np-e	30.0	np-e	0.0	ne
14	ne	210.0	np-e	137.0	np-e	30.0	np-e	0.0	ne
15	np-e	210.0	pe	137.0	pe	30.0	pe	0.0	pe
16	np-e	332.0	nf	368.0	nf	188.0	nf	314.0	nf
17	np-e	332.0	c-v	368.0	c-v	188.0	c-v	314.0	c-v
18	np-e	334.0	w	375.0	w	194.0	w	332.0	w
19	np-e	349.0	d	386.0	d	197.0	d	340.0	d
20	np-e	356.0	nf	395.0	nf	203.0	nf	353.0	d
21	np-e	356.0	d	395.0	d	203.0	d	423.0	d
22	np-e	372.0	f	462.0	d	217.0	nf	497.0	d
23	np-e	413.0	d	558.0	d	217.0	d	651.0	d
24	np-e	436.0	d	580.0	d	242.0	d	692.0	d
25	w	440.0	w	588.0	w	245.0	w	698.0	w
26	w	442.0	w	594.0	w	248.0	w	701.0	w
27	v-c	444.0	v-c	596.0	v-c	251.0	v-c	702.0	v-c
28	c	608.0	c	818.0	c	312.0	c	879.0	c
29	nf	641.0	nf	830.0	nf	336.0	nf	900.0	nf
30	c	641.0	c	830.0	nf	336.0	c	900.0	c
31	c	852.0	c	830.0	nf	472.0	c	1078.0	c
32	c	919.0	c	830.0	nf	535.0	c	1170.0	c
33	c	1260.0	c	1013.0	c	668.0	c	1501.0	nf
34	c-v faz		np-td	1013.0	c-v faz	874.0	c-v faz	1501.0	c-v faz
35	w az			1050.0	w az	959.0	w az	1564.0	w az
36	w az			1057.0	w az	989.0	w az	1592.0	w az
37	d az			1068.0	nf	998.0	d az	1620.0	nf
38	d az			1068.0	d az	998.0	d az	1620.0	d az
39	np-td				np-td	1184.0	d az		np-td
40						1271.0	d az		
41						1313.0	v-c (az-c)		
42						1318.0	c, w		
43							np-td		
44									
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61	a		np a	1050.0	a	961.0	a	1564.0	a
62	g	840.0	g		nd g	412.0	g	990.0	g
63									
64									
65		1360.0		1709.0		1450.0		2043.0	
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Attachment II
Query Letter and Response from Data Users

Robert Clayton
07/07/99 12:50 PM

To: Robert Elayer/YM/RWDOE@CRWMS, Jennifer Hinds/YM/RWDOE@CRWMS
cc:

Subject: Tolerance (not social)

Bob and Jennifer,

For some record-keeping we're doing as we qualify the borehole data, I need from you the following information. We have discussed this topic many times in the past, but I need an updated record.

* For your modeling activities, how close do you need the stratigraphic contacts (the input "picks" to the Geologic Framework Model) to be **when compared to** geophysical logs, core, samples, tests, and/or other downhole data? NOTE: This is a comparison of the picks to other borehole data, not to anything else.

** Please list the GFM strata that are of high importance and those that do not apply to your modeling.

Please be specific to strata and borehole (if necessary) in describing tolerance--for example, Subsurface Design may need closer precision on the lower vitrophyre than on Tptrn, and may not be concerned with boreholes far removed from the repository area.

Also consider this: If your modeling depends only on GFM surfaces (grids) and not on other specific borehole data, the "picks" tolerance probably does not matter in your modeling. I know the UZ model uses some other borehole data as we discussed in relation to UZ-14/UZ-1, but if those data can be placed in your model by strata and not by elevation without adverse effects on your model, tolerance is probably not stringent. That kind of information is central to this data qualification.

Please carefully formulate your reply, as it will influence the format and outcome of our effort to qualify the "picks". For example, if your requirements are plus-or-minus 5 feet and we find a contact outside that range when plotted on the geophysical logs, we will call it non-Q.

Please reply with history by Friday July 9th. Contact me with any questions.

Thanks very much,
-=- Robb -=-
Stratigraphic Contacts Qualification Team Leader
and Geologic Janitor

Robert Elayer 07/07/99 02:58 PM

To: Robert Clayton/YM/RWDOE@CRWMS
cc:

Subject: Re: Tolerance (not social)

Gee, I wish I could remember exactly what number I gave during our previous discussions. What I am about to say is based entirely on engineering judgement. I am sure that for your determination of Q-ness based on needs of design and the UZ folks you will need some basis or justification for the numbers. I will try and give this, but it is still all based on engineering judgement.

1. The only boreholes we have a direct interest are the ones within the repository siting area of the central block and those that penetrate through all or part of the repository host horizon.

2. The stratigraphic section we have a direct interest include the units down from the surface to the upper part of the CHn thermal/mechanical unit. Specifically, these include the TCw, PTn, TSw1, TSw2, TSw3, and top of CHn thermal/mechanical units.

3. Our top contact position tolerance for each lithostratigraphic unit within the above stratigraphic section is listed as follows

TCw

- undiff. units +-15ft Importance to shaft and ramp siting and sealing only.

PTn

- top +-10ft The nonwelded nature of these units make the location of the top and bottom contacts critical to shaft and ramp design and sealing.
- units within - +-15ft These units are variable in their thickness and distribution. They are not individually important to design except collectively as a total PTn unit.

TSw1

- Tptrv1 +-10ft Importance of this unit is that it defines the bottom of the nonwelded PTn units which is critical to shaft and slope design and sealing.
- Tptrn +-15ft This is above the repository and is not critical to design except in shaft and slope design.
- Tptrl +-15ft This is above the repository and is not critical to design except in shaft and slope design.
- Tptpul +-15ft This contact between the crystal-rich (above) and crystal-poor (below) is not critical to design.
- top of RHH +-15ft This gradational contact currently defines the upper limit of the repository siting volume, but this may be eliminated as a constraint in future work.

TSw2

- Tptpmn +-15ft Gradational contact is not critical to design.
- Tptpll +-15ft Contact is not critical to design.
- Tptpln +-15ft Gradational and often times poorly defined contact is not critical to design.

TSw3

- Tptpv3 +-5ft This is probably our most critical contact to know because the repository should avoid this vitrophyre unit.

CHn

- Tptpv2 +-15ft This defines the top of the nonwelded units in the CHn, but the repository will not penetrate to these depths, so it is not critical to design.

Hope this is what you needed. I will be around tomorrow (Thursday) then will be out of town for 3-4 weeks (Phase II of our Idaho home). See Bob Saunders if you need to contact me. Cheers!
Robert Clayton

Robert Clayton
07/07/99 12:50 PM

To: Robert Elayer/YM/RWDOE@CRWMS, Jennifer Hinds/YM/RWDOE@CRWMS
cc:

Subject: Tolerance (not social)

Bob and Jennifer,

For some record-keeping we're doing as we qualify the borehole data, I need from you the following information. We have discussed this topic many times in the past, but I need an updated record.

* For your modeling activities, how close do you need the stratigraphic contacts (the input "picks" to the Geologic Framework Model) to be **when compared to** geophysical logs, core, samples, tests, and/or other downhole data? NOTE: This is a comparison of the picks to other borehole data, not to anything else.

** Please list the GFM strata that are of high importance and those that do not apply to your modeling.

Please be specific to strata and borehole (if necessary) in describing tolerance--for example, Subsurface Design may need closer precision on the lower vitrophyre than on Tptrn, and may not be concerned with boreholes far removed from the repository area.

Also consider this: If your modeling depends only on GFM surfaces (grids) and not on other specific borehole data, the "picks" tolerance probably does not matter in your modeling. I know the UZ model uses some other borehole data as we discussed in relation to UZ-14/UZ-1, but if those data can be placed in your model by strata and not by elevation without adverse effects on your model, tolerance is probably not stringent. That kind of information is central to this data qualification.

Please carefully formulate your reply, as it will influence the format and outcome of our effort to qualify the "picks". For example, if your requirements are plus-or-minus 5 feet and we find a contact outside that range when plotted on the geophysical logs, we will call it non-Q.

Please reply with history by Friday July 9th. Contact me with any questions.

Thanks very much,
-=- Robb -=-
Stratigraphic Contacts Qualification Team Leader
and Geologic Janitor

July 7, 1999

Robb,

Here are LBNL's responses to your GFM3.1 - data qualification - tolerance queries. Please give me a call when you've had a chance to look this over.

-Jennifer

**For your modeling activities, how close do you need the stratigraphic contacts (the input "picks" to the Geologic Framework Model) to be when compared to geophysical logs, core, samples, tests, and/or other downhole data? NOTE: This is a comparison of the picks to other borehole data, not to anything else.*

The core based contacts are probably the most important from a data perspective.

Please be specific to strata and borehole (if necessary) in describing tolerance.... If your modeling depends only on GFM surfaces (grids) and not on other specific borehole data, the "picks" tolerance probably does not matter in your modeling.... Please carefully formulate your reply, as it will influence the format and outcome of our effort to qualify the "picks". For example, if your requirements are plus-or-minus 5 feet and we find a contact outside that range when plotted on the geophysical logs, we will call it non-Q.

Well, I hate to be the bearer of unpleasant news, but we do, in fact, use many of the borehole stratigraphic picks for our work with the UZ model; thus, they will need to be evaluated for qualification. These contact elevations may be very important since they define intervals within which rock properties data (given to us as well ID, elevation or depth, and property value) and perched water data are grouped/assigned.

Bo suggests that a tolerance of plus-or-minus 5 *meters* (everywhere) is sufficient when comparing the picks to other borehole data, especially for the thicker, repository layers, which are most important in our modeling studies. Does this number sound reasonable to you, or do you feel another value would be more appropriate? Regardless of the tolerance we agree upon, justification of our selection must be documented. This would likely be done with UZ model sensitivity studies, and it is something that we would want to begin fairly soon. Let me know what you think about this. I believe a joint effort is our only way to see this through successfully.

In the meanwhile, we hope to narrow the scope of your efforts a bit with the information provided below. We *may* be able to reduce this list somewhat (though probably not drastically) by looking through all of the rock property data used as input to the UZ model and their precise elevation/depth, thus omitting layer picks for certain boreholes if no data were collected for that particular layer. Given the short notice and other schedules to work around, we have not yet had the chance to thoroughly go through each borehole data set. If, indeed, this is what you require, we may be able to complete that process next week.

*** Please list the GFM strata that are of high importance and those that do not apply to your modeling.*

The table below lists the GFM3.1 stratigraphic intervals used in the UZ model and the boreholes for which the GFM3.1 file "pix99el.dat" was used in UZ model development. In addition to the file "pix99el.dat," GFM3.1 isochores for each of these units (except for Tpcr and Tpcp) were used in UZ model development, as were the elevation files for the bedrock surface, the upper Tpcp, and upper Tpbt4 contacts.

SD-6, SD-7, SD-9, SD-12, UZ-7a, UZ-14, UZ#16, and WT#24 are the most important boreholes because these are where the core saturation data come from. All except SD-6, UZ-7a, and WT#24 have data from the bedrock surface to the bottom of the borehole. For SD-6, we have data from depths 110 m to 171 m and 383 m to 653 m. For UZ-7a, we have data from depths 39 m to 235 m. For WT#24, we have data from depths 514 m to 770 m. Other boreholes where we have in-situ data are NRG#4, NRG#5, NRG-6, NRG-7a, ONC#1, UZ-1, UZ#4, and UZ#5. Sorry we didn't have time to find the exact max depth for the data from these boreholes, but none of them go beyond the bottom of the Topopah.

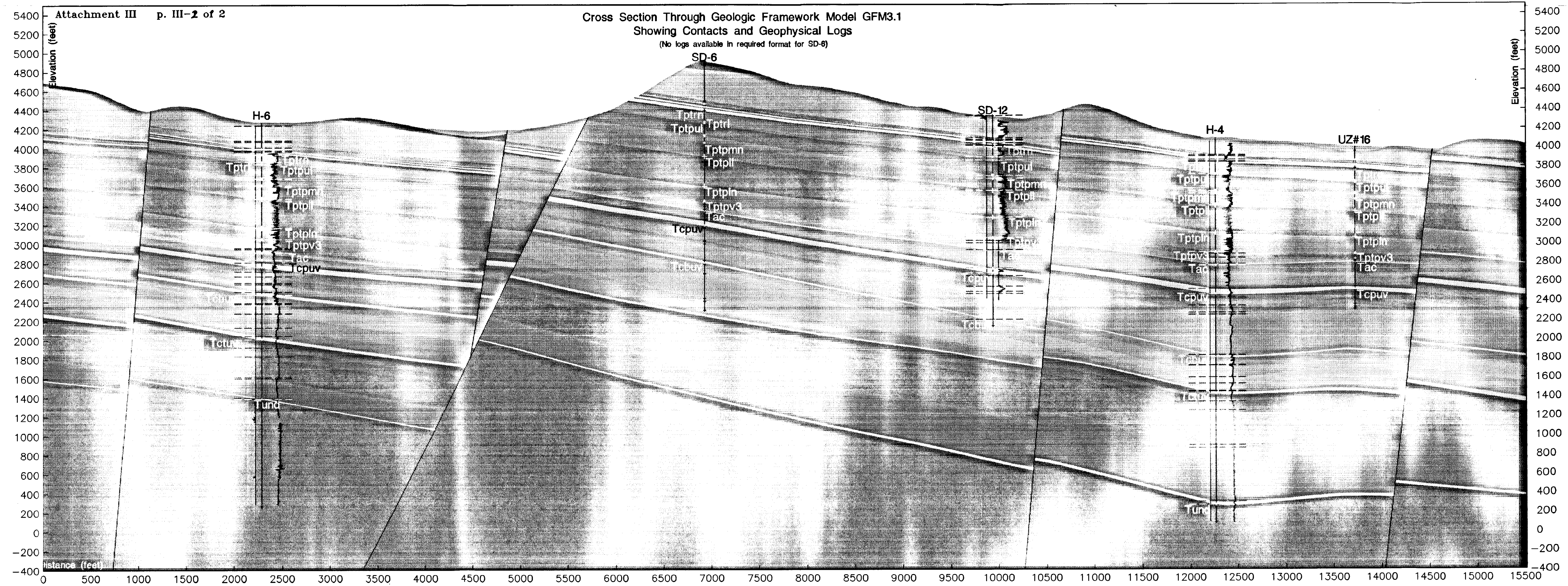
GFM3.1 Strata	Boreholes for which "pix99el.dat" was used
Tpcr	SD-6
Tpcp	NRG-7a, SD-7, SD-9, SD-12, UZ#4, UZ-7a, UZ#16
TpcLD	unit combined with Tpcp in UZ model; thus, layer pick is not crucial
Tpcpv3	NRG#5, NRG-6, NRG-7a, SD-6, SD-7, SD-9, SD-12, UZ#4, UZ-7a, UZ#16
Tpcpv2	unit combined with Tpcpv3 in UZ model; thus, layer pick is not crucial
Tpcpv1	NRG#5, NRG-6, NRG-7a, SD-6, SD-7, SD-9, SD-12, UZ#4, UZ-7a, UZ#16
Tpbt4	NRG#5, NRG-6, NRG-7a, SD-6, SD-7, SD-9, SD-12, UZ#4, UZ-7a, UZ#16
Tpy	NRG#5, NRG-6, NRG-7a, SD-6, SD-7, SD-9, SD-12, UZ#4, UZ-7a, UZ#16
Tpbt3	NRG#5, NRG-6, NRG-7a, SD-6, SD-7, SD-9, SD-12, UZ#4, UZ-7a, UZ#16
Tpp	NRG#5, NRG-6, NRG-7a, SD-6, SD-7, SD-9, SD-12, UZ#4, UZ-7a, UZ#16
Tpbt2	NRG#5, NRG-6, NRG-7a, SD-6, SD-7, SD-9, SD-12, UZ#4, UZ-7a, UZ#16
Tptrv3	Unit is combined with Tpbt2 in UZ model; thus, layer pick is not crucial
Tptrv2	Unit is combined with Tpbt2 in UZ model; thus, layer pick is not crucial
Tptrv1	NRG#5, NRG-6, NRG-7a, SD-6, SD-7, SD-9, SD-12, UZ#4, UZ-7a, UZ#16
Tptrn	NRG#5, NRG-6, NRG-7a, SD-6, SD-7, SD-9, SD-12, UZ#4, UZ-7a, UZ#16
Tptrl	NRG#5, NRG-6, NRG-7a, SD-6(?), SD-7, SD-9, SD-12, UZ-7a, UZ#16
Tptf	Unit is combined with Tptrl in UZ model; thus, layer pick is not crucial
Tptpul	Unit is combined with Tptrl in UZ model; thus, layer pick is not crucial
Tptpmn	NRG#5, NRG-6, NRG-7a, SD-6(?), SD-7, SD-9, SD-12, UZ-7a, UZ#16
Tptpll	NRG#5, NRG-6, NRG-7a, SD-6, SD-7, SD-9, SD-12, UZ-7a, UZ#16
Tptpln	NRG#5, NRG-7a, SD-6, SD-7, SD-9, SD-12, UZ#16
Tptpv3	NRG-7a, SD-6, SD-7, SD-9, SD-12, UZ#16, WT#24
Tptpv2	NRG-7a, SD-6, SD-7, SD-9, SD-12, UZ-14, UZ#16, WT#24
Tptpv1	NRG-7a, SD-6, SD-7, SD-9, SD-12, UZ-14, UZ#16, WT#24
Tpbt1	Unit is combined with Tptpv1 in UZ model; thus, layer pick is not crucial
Tac	NRG-7a, SD-6, SD-7, SD-9, SD-12, UZ-14, UZ#16, WT#24, G-2
Tacbt	SD-6, SD-7, SD-9, SD-12, UZ-14, UZ#16
Prowuv	SD-6, SD-7, SD-9, SD-12, UZ-14, UZ#16
Prowuc	SD-6, SD-7, SD-9, SD-12, UZ-14, UZ#16

GFM3.1 Strata	Boreholes for which "pix99el.dat" was used
Prowmd	SD-6, SD-7, SD-12, UZ-14, UZ#16
Prowlc	unit is combined with Prowmd in UZ model; thus, layer pick is not crucial
Prowlv	SD-6, SD-7, SD-12, UZ-14
Prowbt	unit is combined with Prowlv in UZ model; thus, layer pick is not crucial
Bulluv	unit is combined with Prowlv in UZ model; thus, layer pick is not crucial
Bulluc	SD-6
Bullmd	unit is combined with Bulluc in UZ model; thus, layer pick is not crucial
Bulllc	unit is combined with Bulluc in UZ model; thus, layer pick is not crucial
Bulllv	N/A, no rock property data
Bullbt	unit is combined with Bulllv in UZ model; thus, layer pick is not crucial
Tramuv	unit is combined with Bulllv in UZ model; thus, layer pick is not crucial
Tramuc	N/A, no rock property data
Trammd	unit is combined with Tramuc in UZ model; thus, layer pick is not crucial
Tramlc	unit is combined with Tramuc in UZ model; thus, layer pick is not crucial

Layers Bullbt through Tramlc are included in the UZ model where they lie above the water table, but their exact contact elevations are not essential since little or no data exist to characterize them hydrogeologically.

GFM3.1 strata that DO NOT apply to UZ modeling:
RHH
Tund (older Tertiary)
Paleozoic

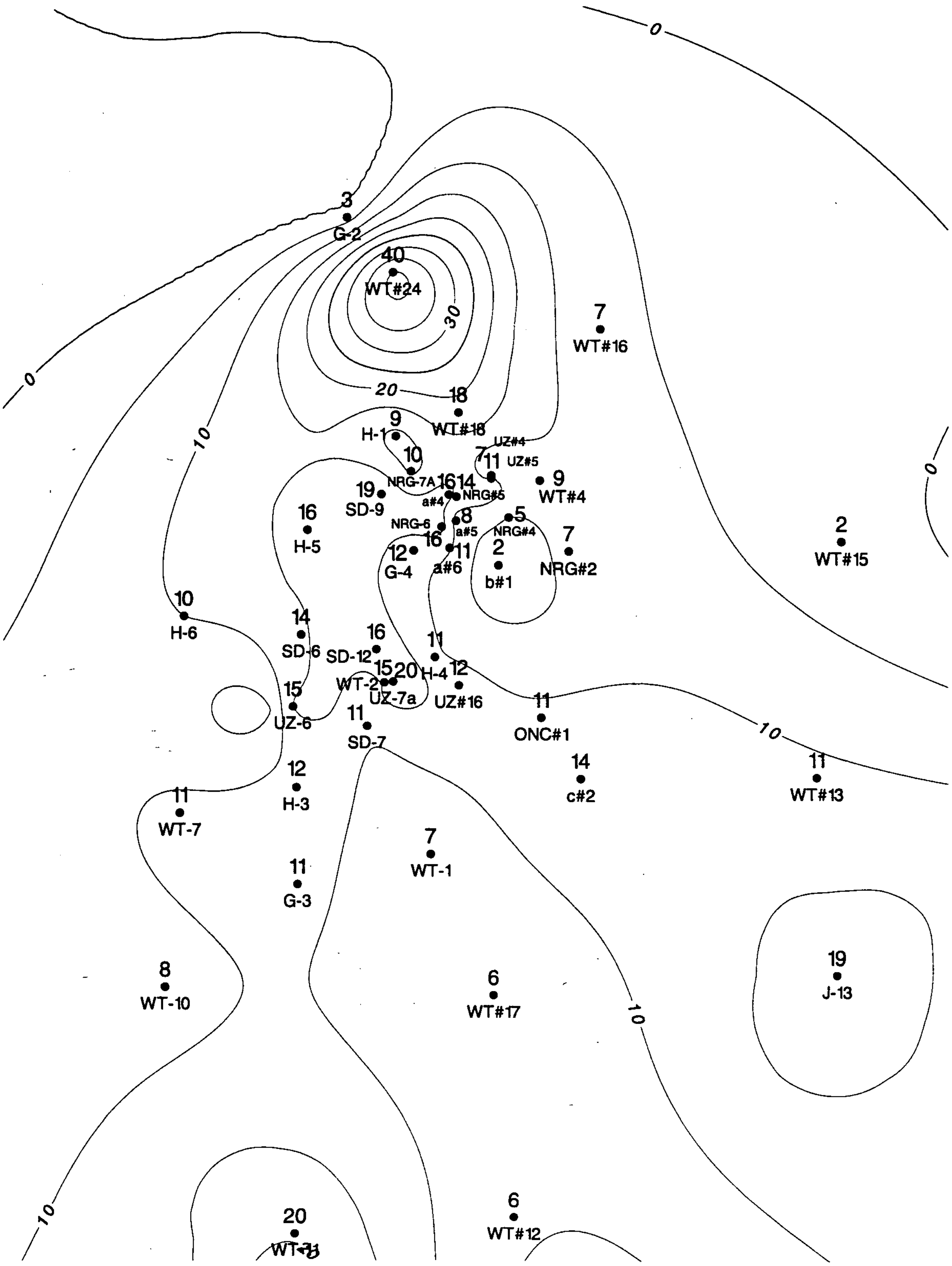
Attachment III:
Cross Section from GFM3.1 Showing Logs


Cross Section Through Geologic Framework Model GFM3.1
Showing Contacts and Geophysical Logs
(No logs available in required format for SD-6)
Elevation (feet)
Distance (feet)
H-6
SD-6
SD-12
H-4
UZ#16
Tptrn
Tptrl
Tptpul
Tptpmn
Tptpll
Tptpln
Tptpv3
Tac
Tcpuv
Tund
5400
5200
5000
4800
4600
4400
4200
4000
3800
3600
3400
3200
3000
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
−200
−400
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
6500
7000
7500
8000
8500
9000
9500
10000
10500
11000
11500
12000
12500
13000
13500
14000
14500
15000
15500

Attachment IV:
Thickness Maps

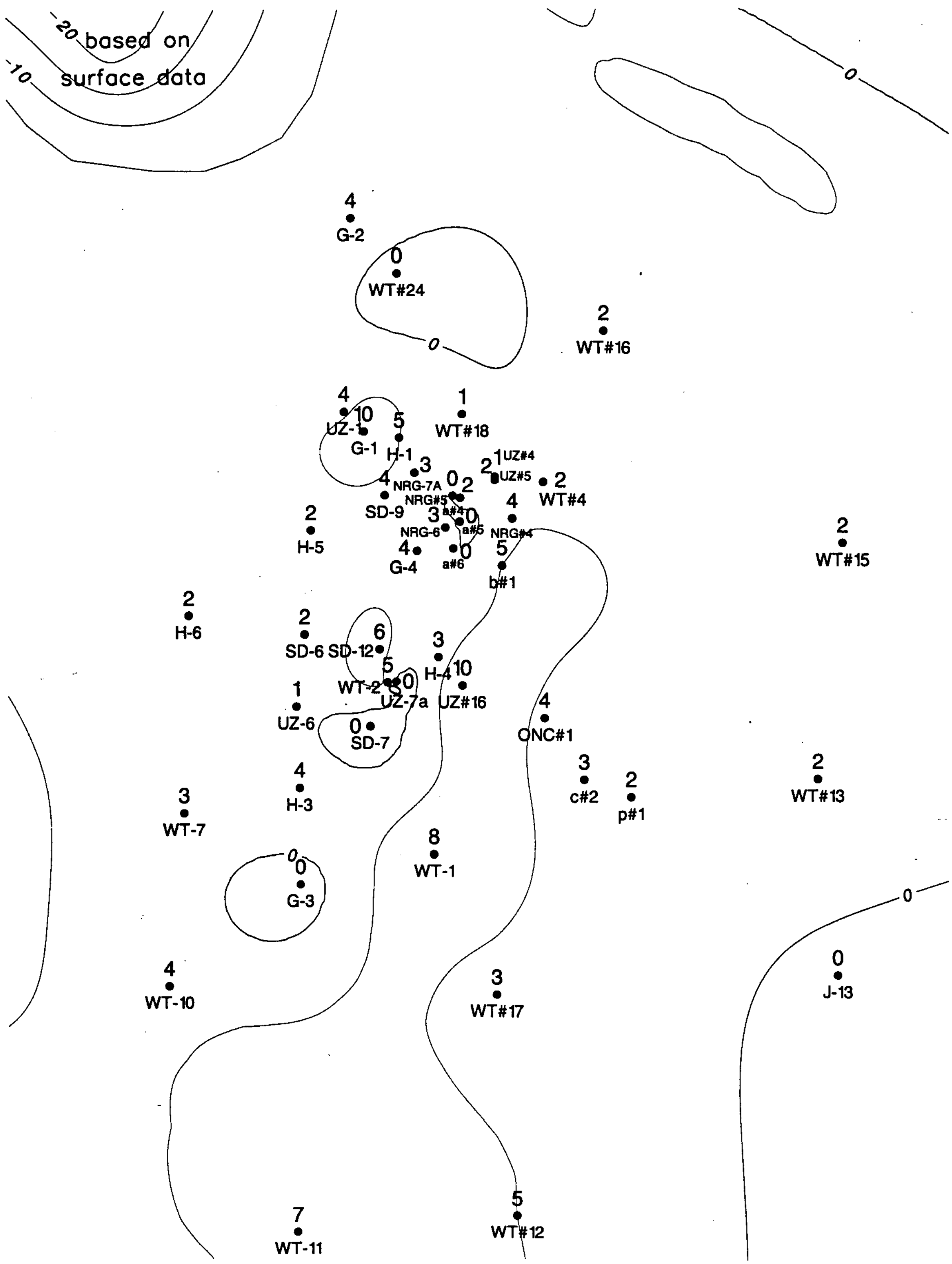
Attachment IV: Thickness maps

Thickness of Tpcpv2
contour interval 5 feet



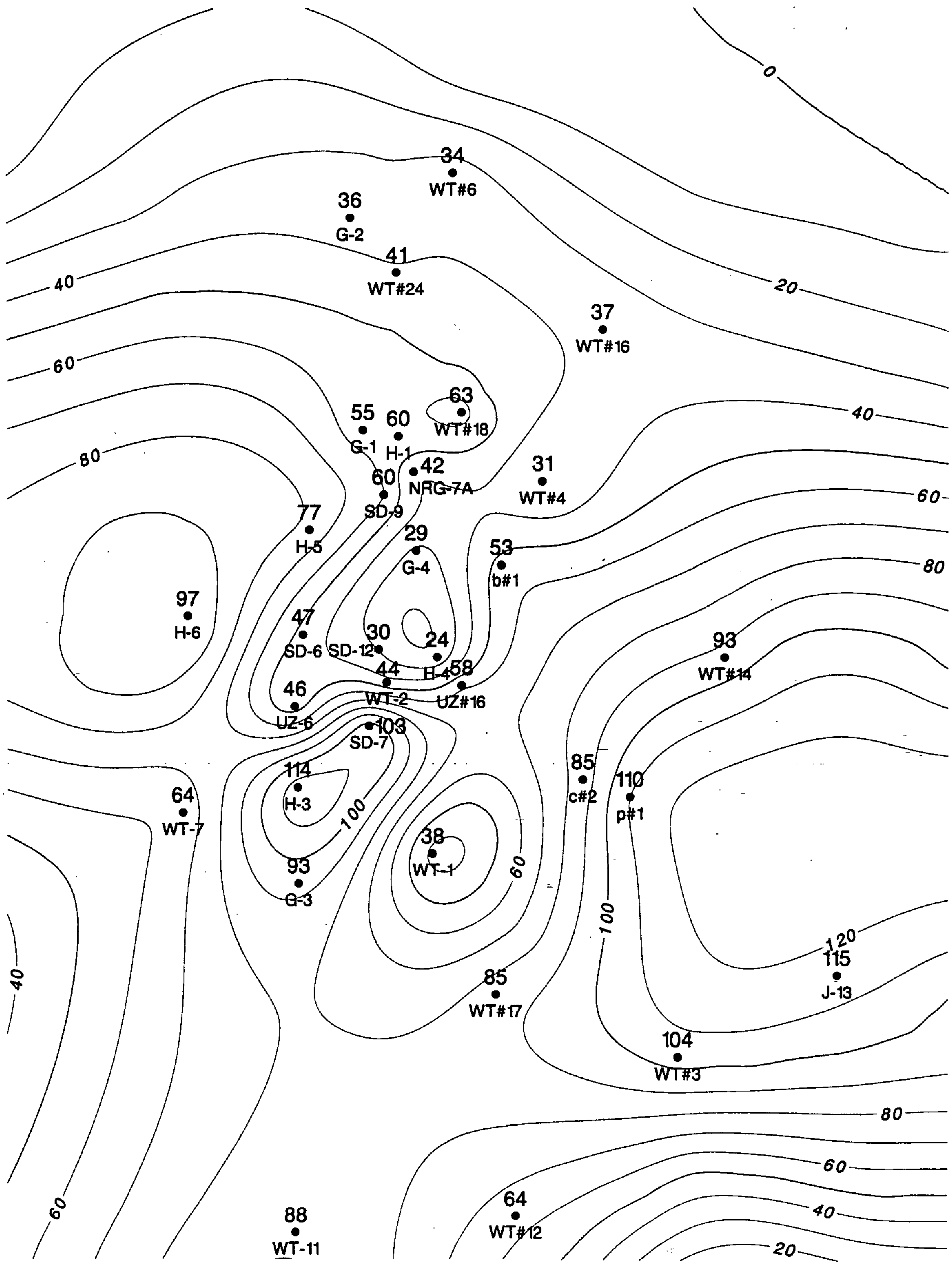
Attachment IV: Thickness maps

Thickness of Tptrv1
contour interval 5 feet



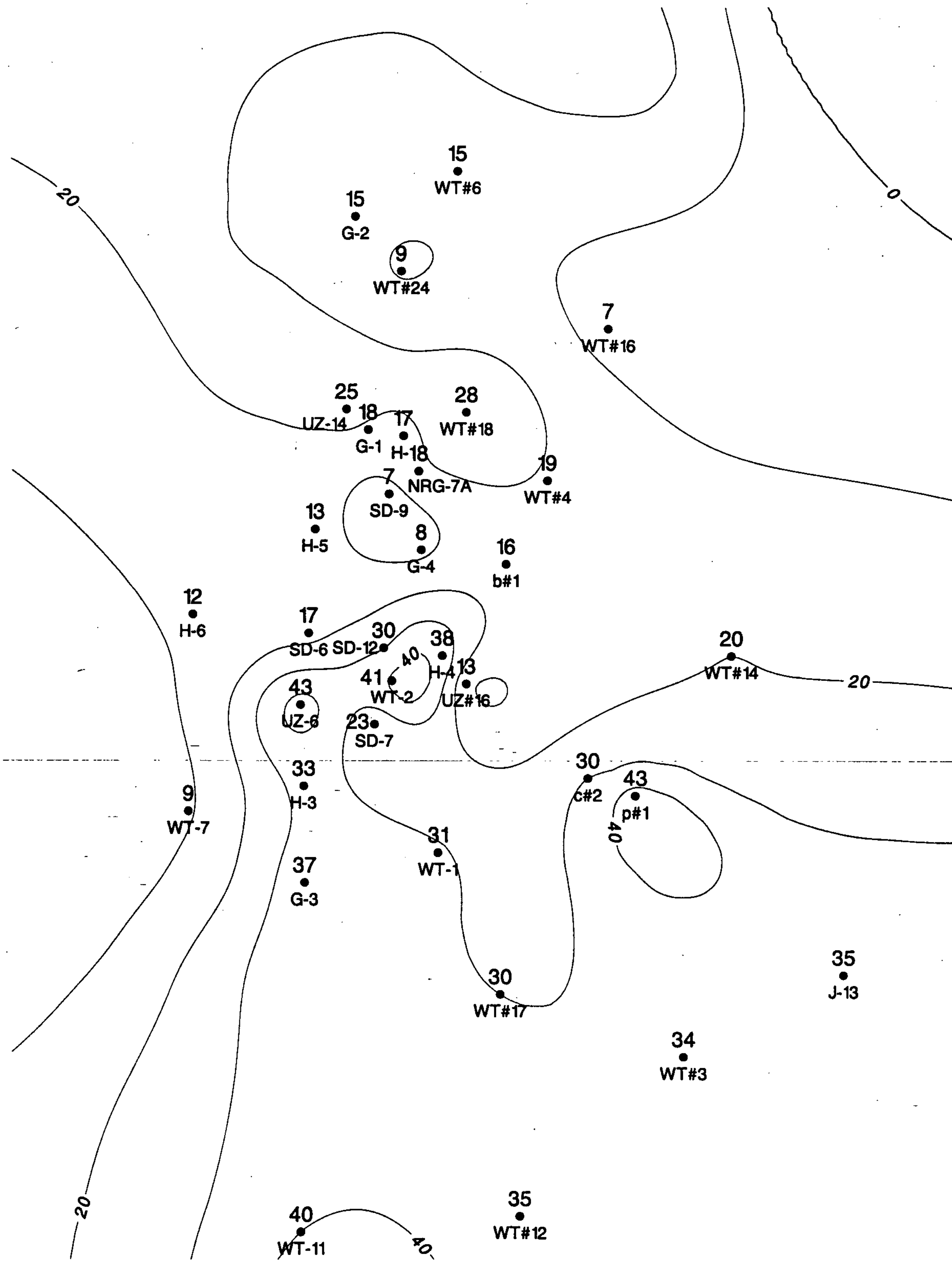
Attachment IV: Thickness maps

Thickness of Tptpv3
contour interval 10 feet



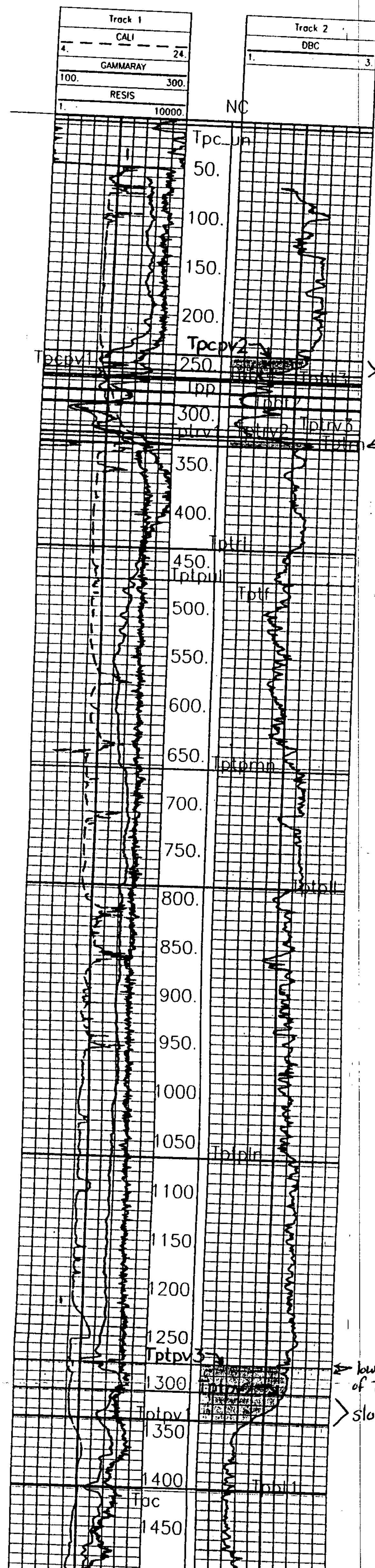
Attachment IV: Thickness maps

Thickness of Tptpv2
contour interval 10 feet



Attachment V:
Typical Geophysical Log Signatures for the Sample Contacts

Borehole SD-12



Attachment VI:
Contacts Examination Checklist

	A	B	C	D
1	**Appendix VI: Contacts Examination Checklist**			
2	Data Qualification Report: Borehole Stratigraphic Contacts Data			
3	**Borehole**	**Contact**	**Status**	**Justification**
4	a#1	Tpcpv2	NL ✓	} No density log;
5	a#1	Tptrv1	NL ✓	} Could be made based on Gamma Ray log; acceptable contact
6	a#1	Tptpv3	✓	} Poor log signature, but contacts are recognizable
7	a#1	Tptpv2	✓	
8	a#4	Tpcpv2	✓	
9	a#4	Tptrv1	✓	
10	a#4	Tptpv3	N/A	
11	a#4	Tptpv2	N/A	
12	a#5	Tpcpv2	✓	
13	a#5	Tptrv1	✓	
14	a#5	Tptpv3	N/A	
15	a#5	Tptpv2	N/A	
16	a#6	Tpcpv2	✓	
17	a#6	Tptrv1	✓	
18	a#6	Tptpv3	N/A	
19	a#6	Tptpv2	N/A	
20	a#7	Tpcpv2	✓	Noisy log, but passable
21	a#7	Tptrv1	✓	
22	a#7	Tptpv3	N/A	
23	a#7	Tptpv2	N/A	
24	b#1	Tpcpv2	NL	No logs; existent logs are very poor; other data may be available
25	b#1	Tptrv1	NL	No logs; existent logs are very poor; other data may be available
26	b#1	Tptpv3	? okay	Comparison to a#1 and UZ#16 shows reasonable signature + thickness. Break in gamma and
27	b#1	Tptpv2	✓	RWC 07/28/99] Resistivity support this contact.
28	c#1	Tpcpv2	NL ✓	No ~~diagnostic~~ density logs; made on Resistivity log.
29	c#1	Tptrv1	✓	Consistent with GammaRay
30	c#1	Tptpv3	✓	
31	c#1	Tptpv2	✓	RWC 07/28/99
32	c#2	Tpcpv2	NL ✓	No ~~diagnostic~~ density logs } Contacts determined by Resistivity log
33	c#2	Tptrv1	NL ✓	No ~~diagnostic~~ density logs
34	c#2	Tptpv3	✓	
35	c#2	Tptpv2	✓	

NL = no logs
N/A = contact not in borehole

	A	B	C	D
36	c#3	Tpcpv2	NL ✓	} No ~~diagnostic~~ density logs; made based on resistivity breaks
37	c#3	Tptrv1	NL ✓	}
38	c#3	Tptpv3	✓	
39	c#3	Tptpv2	✓	
40	G-1	Tpcpv2	N/A	
41	G-1	Tptrv1	NL	
42	G-1	Tptpv3	✓	The low density "cap" is subtly expressed. Density is same as nonlithophysal intervals.
43	G-1	Tptpv2	✓	
44	G-2	Tpcpv2	NL	
45	G-2	Tptrv1	✓	
46	G-2	Tptpv3	✓	Low density / Washout is within 5 ft of contact
47	G-2	Tptpv2	✓	
48	G-3	Tpcpv2	✓	
49	G-3	Tptrv1	✓	
50	G-3	Tptpv3	✓	
51	G-3	Tptpv2	✓	
52	G-4	Tpcpv2	✓	Hole washed out, but contact is at slope change
53	G-4	Tptrv1	✓	This contact pushes the ±10 ft window, but is within it
54	G-4	Tptpv3	✓	Confirmed by break in Gamma Ray log
55	G-4	Tptpv2	✓	
56	H-1	Tpcpv2	NL	No logs
57	H-1	Tptrv1	NL	No logs
58	H-1	Tptpv3	✓	Low-density zone in top of vitrophyre
59	H-1	Tptpv2	✓	
60	H-3	Tpcpv2	✓	
61	H-3	Tptrv1	✓	
62	H-3	Tptpv3	? okay	Poor log + Washout. Low resistivity is diagnostic of this unit's top. Vitrophyre is expected
63	H-3	Tptpv2	✓	to have thick and thin pods – this contact is reasonable. Depth based on
64	H-4	Tpcpv2	✓	resistivity.
65	H-4	Tptrv1	✓	
66	H-4	Tptpv3	? okay	Poor logs + Washout. Thickness consistent with G-4 and SD-12. Consistent with Resistivity.
67	H-4	Tptpv2	? okay	Poor logs + Washout. Thickness consistent with WT-2 and SD-12. Consistent with Resistivity.
68	H-5	Tpcpv2	✓	
69	H-5	Tptrv1	✓	
70	H-5	Tptpv3	✓	
71	H-5	Tptpv2	✓	

p. VI-3 of 8

	A	B	C	D
72	H-6	Tpcpv2	NL	No diagnostic logs
73	H-6	Tptrv1	✓	
74	H-6	Tptpv3	✓	Very thick, but consistent with ~~Gamma Ray +~~ Resistivity break. DWC 7/27/99
75	H-6	Tptpv2	✓	
76	J-13	Tpcpv2	✓	Gamma + Resistivity break
77	J-13	Tptrv1	✓	Gamma + Resistivity break
78	J-13	Tptpv3	✓	Gamma + Resistivity; smooth curve is diagnostic
79	J-13	Tptpv2	✓	Gamma + Resistivity break
80	NRG#1	Tpcpv2	N/A	} No logs available
81	NRG#1	Tptrv1	N/A	
82	NRG#1	Tptpv3	N/A	
83	NRG#1	Tptpv2	N/A	
84	NRG#2	Tpcpv2	NL	
85	NRG#2	Tptrv1	N/A	
86	NRG#2	Tptpv3	N/A	
87	NRG#2	Tptpv2	N/A	
88	NRG#2b	Tpcpv2	N/A	
89	NRG#2b	Tptrv1	N/A	
90	NRG#2b	Tptpv3	N/A	
91	NRG#2b	Tptpv2	N/A	
92	NRG#4	Tpcpv2	✓	
93	NRG#4	Tptrv1	✓	
94	NRG#4	Tptpv3	N/A	
95	NRG#4	Tptpv2	N/A	
96	NRG#5	Tpcpv2	✓	Log through casing, but pattern appears to be correct.
97	NRG#5	Tptrv1	✓	
98	NRG#5	Tptpv3	N/A	
99	NRG#5	Tptpv2	N/A	
100	NRG#6	Tpcpv2	✓	
101	NRG#6	Tptrv1	✓	
102	NRG#6	Tptpv3	N/A	
103	NRG#6	Tptpv2	N/A	

	A	B	C	D
104	NRG#7	Tpcpv2	✓	
105	NRG#7	Tptrv1	✓	
106	NRG#7	Tptpv3	NL	No logs
107	NRG#7	Tptpv2	NL	No logs
108	ONC#1	Tpcpv2	✓	
109	ONC#1	Tptrv1	✓	
110	ONC#1	Tptpv3	N/A	} These units are faulted out
111	ONC#1	Tptpv2	N/A	
112	p#1	Tpcpv2	N/A	
113	p#1	Tptrv1	✓	
114	p#1	Tptpv3	✓	} noisy log signatures
115	p#1	Tptpv2	✓	
116	SD-7	Tpcpv2	✓	
117	SD-7	Tptrv1	✓	
118	SD-7	Tptpv3	✓	As in many holes, cpv3 here has a distinct low-density layer in its top
119	SD-7	Tptpv2	✓	
120	SD-9	Tpcpv2	✓	Log signature not good quality, but is acceptable
121	SD-9	Tptrv1	✓	
122	SD-9	Tptpv3	✓	Low density zone in top of vitrophyre
123	SD-9	Tptpv2	✓	
124	SD-12	Tpcpv2	✓	} These are the type section for this activity
125	SD-12	Tptrv1	✓	
126	SD-12	Tptpv3	✓	
127	SD-12	Tptpv2	✓	
128	UZ-1	Tpcpv2	N/A	
129	UZ-1	Tptrv1	✓	
130	UZ-1	Tptpv3	NL	Not logged
131	UZ-1	Tptpv2	NL	Not logged
132	UZ#4	Tpcpv2	✓	
133	UZ#4	Tptrv1	✓	
134	UZ#4	Tptpv3	N/A	
135	UZ#4	Tptpv2	N/A	

	A	B	C	D
136	UZ#5	Tpcpv2	✓	
137	UZ#5	Tptrv1	✓	
138	UZ#5	Tptpv3	N/A	
139	UZ#5	Tptpv2	N/A	
140	UZ-6	Tpcpv2	✓	
141	UZ-6	Tptrv1	✓	
142	UZ-6	Tptpv3	✓	Top consistent with Gamma + Resistivity breaks
143	UZ-6	Tptpv2	✓	
144	UZ-7a	Tpcpv2	✓	
145	UZ-7a	Tptrv1	✓	Density log is choppy, but contact is consistent with Gamma + Resistivity breaks.
146	UZ-7a	Tptpv3	N/A	
147	UZ-7a	Tptpv2	N/A	
148	UZ-14	Tpcpv2	N/A	
149	UZ-14	Tptrv1	NL	No logs
150	UZ-14	Tptpv3	NL	No logs
151	UZ-14	Tptpv2	✓	
152	UZ#16	Tpcpv2	✓	
153	UZ#16	Tptrv1	✓	
154	UZ#16	Tptpv3	✓	vitrophyre is broken up, but recognizable
155	UZ#16	Tptpv2	✓	
156	WT-1	Tpcpv2	✓	
157	WT-1	Tptrv1	✓	
158	WT-1	Tptpv3	✓	Low density zone is well developed.
159	WT-1	Tptpv2	✓	Low slope gradient is consistent with (but subdued from) other holes.
160	WT-2	Tpcpv2	✓	
161	WT-2	Tptrv1	✓	
162	WT-2	Tptpv3	✓	
163	WT-2	Tptpv2	✓	
164	WT#3	Tpcpv2	N/A	
165	WT#3	Tptrv1	N/A	
166	WT#3	Tptpv3	✓	Lack of deep density lows distinguishes from normal welded Tpt.
167	WT#3	Tptpv2	✓	

	A	B	C	D
168	WT#4	Tpcpv2	✓	Big cavity just above masks the contact, but it's consistent with the reference (type) section.
169	WT#4	Tptrv1	✓	
170	WT#4	Tptpv3	✓	Unusual density signature; consistent with Gamma + Resistivity breaks.
171	WT#4	Tptpv2	✓	
172	WT#6	Tpcpv2	N/A	
173	WT#6	Tptrv1	N/A	
174	WT#6	Tptpv3	✓	Well-developed low-density zone
175	WT#6	Tptpv2	✓	
176	WT-7	Tpcpv2	✓	~~Big cavity just above~~ RWMC 07/27/99
177	WT-7	Tptrv1	✓	
178	WT-7	Tptpv3	✓	Unusual density log, but consistent with gamma + Resistivity breaks.
179	WT-7	Tptpv2	✓	Consistent with Gamma Ray break.
180	WT-10	Tpcpv2	✓	
181	WT-10	Tptrv1	✓	
182	WT-10	Tptpv3	N/A	
183	WT-10	Tptpv2	N/A	
184	WT-11	Tpcpv2	✓	Consistent with Gamma + Resistivity breaks.
185	WT-11	Tptrv1	✓	
186	WT-11	Tptpv3	✓	
187	WT-11	Tptpv2	✓	
188	WT#12	Tpcpv2	✓	
189	WT#12	Tptrv1	✓	
190	WT#12	Tptpv3	✓	Low density zones are within tpv3 — lowest high density peak must still be vitrophyre.
191	WT#12	Tptpv2	✓	
192	WT#13	Tpcpv2	✓	
193	WT#13	Tptrv1	✓	
194	WT#13	Tptpv3	N/A	
195	WT#13	Tptpv2	N/A	
196	WT#14	Tpcpv2	N/A	
197	WT#14	Tptrv1	NL	
198	WT#14	Tptpv3	✓	
199	WT#14	Tptpv2	✓	

	A	B	C	D
200	WT#15	Tpcpv2	✓	
201	WT#15	Tptrv1	✓	Barely within the 10 ft window; all logs are odd here.
202	WT#15	Tptpv3	N/A	
203	WT#15	Tptpv2	N/A	
204	WT#16	Tpcpv2	✓	Within the 10 ft window.
205	WT#16	Tptrv1	✓	
206	WT#16	Tptpv3	✓	
207	WT#16	Tptpv2	✓	
208	WT#17	Tpcpv2	✓	Large low-density (corroded) zone above contact.
209	WT#17	Tptrv1	✓	
210	WT#17	Tptpv3	✓	
211	WT#17	Tptpv2	✓	
212	WT#18	Tpcpv2	✓	
213	WT#18	Tptrv1	✓	
214	WT#18	Tptpv3	✓	low-density zone in top of vitrophyre
215	WT#18	Tptpv2	✓	

Attachment VII:
Data Recommended to be Qualified

22-page spreadsheet numbered separately

	A	B	C	D	E
1	**Re-evaluation of key subsurface lithostratigraphic contacts: FY97 milestone SPG39IM4. Typos and omissions corrected for input to GFM3.0 by R.**				
2	In addition to the lithostratigraphic contacts, the table contains values for the:				
3	1. vitric-zeolitic boundary (V-Z)		Green cells	Resolution of contacts initially ch	
4			Blue cells	Modified contacts based on sugg	
5	2. type of contact at the top of each unit				
6	Repository Host Horizon (RHH) identified by R. Elayer (MK M&O) based on character of geophysical logs				
7	Colors of headers indicate: Black - Q-status geophysical logs (mostly) and core or cuttings				
8	Blue - Q-status core or cuttings, no geophysical logs				
9				Contact	
10	Lithostrat unit	Symbol	UE-25 A#1	type	UE-25 A#4
11	Not described	NC	0.0		0.0
12	alluvium	Qa	0.0		0.0
13	Rainier Mesa Tuff, includes pre-Rainier Mesa Tuff bedded tuff	Tmr	30.0		30.0
14	rhyolite of Comb Peak	Tpk	30.0		30.0
15	Tiva Canyon Tuff (Tpc) nondivided	Tpc_un	30.0		30.0
16	Tpc, crystal-poor vitric densely welded subzone	Tpcpv3	196.0		119.0
17	Tpc, crystal-poor vitric moderately welded subzone	Tpcpv2	196.0		119.0
18	Tpc, crystal-poor vitric nonwelded to partially welded subzones	Tpcpv1	205.0		135.0
19	pre-Tiva Canyon Tuff bedded tuff	Tpbt4	210.0		150.7
20	Yucca Mountain Tuff nondivided	Tpy	217.3		154.3
21	pre-Yucca Mountain Tuff bedded tuff	Tpbt3	217.3		179.2
22	Pah Canyon Tuff nondivided	Tpp	218.2		197.0
23	pre-Pah Canyon Tuff bedded tuff	Tpbt2	245.9		273.6
24	Topopah Spring Tuff (Tpt) crystal-rich vitric nonwelded to partially welded zones	Tptrv3	266.8		301.9
25	Tpt, crystal-rich vitric moderately welded zone	Tptrv2	273.0		309.0
26	Tpt, crystal-rich vitric densely welded zone	Tptrv1	275.6		316.8
27	Tpt, crystal-rich nonlithophysal zone	Tptrn	279.5		317.0
28	Tpt, crystal-rich lithophysal zone	Tptrl	409.8		
29	Tpt, lithic-rich zone	Tptf	438.0		
30	Tpt, crystal-poor upper lithophysal zone	Tptpul	438.0		
31	Tpt, crystal-poor middle nonlithophysal zone	Tptpmn	673.0		
32	Tpt, crystal-poor lower lithophysal zone	Tptpll	745.0		
33	Tpt, crystal-poor lower nonlithophysal zone	Tptpln	1084.0		
34	Tpt, crystal-poor vitric densely welded subzone	Tptpv3	1271.6		
35	Tpt, crystal-poor vitric moderately welded subzone	Tptpv2	1310.1		
36	Tpt, crystal-poor vitric nonwelded to partially welded subzones	Tptpv1	1324.6		
37	pre-Topopah Spring Tuff bedded tuff	Tpbt1	1360.0		
38	Calico Hills Formation undifferentiated	Tac	1368.6		
39	pre-Calico Hills Formation bedded tuff	Tacbt	1789.3		
40	Prow Pass Tuff (Tcp) upper vitric(zeolitic) nonwelded to partially welded zones	Tcpuv	1832.2		
41	Tcp, upper crystallized nonwelded to partially welded zones	Tcpuc	1845.1		
42	Tcp, crystallized moderately to densely welded zones	Tcpm	1944.0		
43	Tcp, lower crystallized nonwelded to partially welded zones	Tcplc	2006.0		
44	Tcp, lower vitric(zeolitic) nonwelded to partially welded zones	Tcplv	2030.0		
45	pre-Prow Pass Tuff bedded tuff	Tcpbt	2331.4		
46	Bullfrog Tuff (Tcb) upper vitric(zeolitic) nonwelded to partially welded zones	Tcbuv	2333.2		
47	Tcb, upper crystallized nonwelded to partially welded zones	Tcbuc	2333.2		
48	Tcb, crystallized moderately to densely welded zones	Tcbm	2415.0		
49	Tcb, lower crystallized nonwelded to partially welded zones	Tcblc			
50	Tcb, lower vitric(zeolitic) nonwelded to partially welded zones	Tcblv			
51	pre-Bullfrog Tuff bedded tuff	Tcbbt			
52	Tram Tuff (Tct) upper vitric(zeolitic) nonwelded to partially welded zones	Tctuv			
53	Tct, upper crystallized nonwelded to partially welded zones	Tctuc			
54	Tct, crystallized moderately to densely welded zones	Tctm			
55	Tct, lower crystallized nonwelded to partially welded zones	Tctlc			
56	Tct, lower vitric(zeolitic) nonwelded to partially welded zones	Tctlv			
57	pre-Tram Tuff bedded tuff	Tctbt			
58	lower Tertiary units undifferentiated	Tund			
59	Palezoic and older units	Pz			
60	Vitric-Zeolitc boundary (noncrystallized rocks pervasively vitric versus zeolitic)	V-Z	1360.0		
61	Repository Host Horizon (top)	RHH	639.0		

	F	G	H	I	J	K	L	M	N
1	. Clayton.								
2									
3	llenged by overview committee during the January 21-22, 1998, workshop.								
4	stions by Clayton after review workshop in addition to re-examination in the context of committee challenges.								
5									
6									
7									
8									
9	Contact		Contact		Contact		Contact		Contact
10	type	UE-25 A#5	type	UE-25 A#6	type	UE-25 A#7	type	UE-25 B#1	type
11		0.0		0.0		0.0		0.0	
12		0.0		0.0		0.0		0.0	
13		90.0		20.0		165.0		156.0	
14		90.0		20.0		165.0		156.0	
15		90.0		20.0		165.0		156.0	
16		128.0		124.5		170.0		180.0	
17		128.0		124.5		170.0		180.0	
18		136.0		135.0		175.8		182.0	
19		149.0		144.2		190.0		189.0	
20		155.0		149.3		194.2		192.5	
21		164.5		167.0		212.0		192.5	
22		180.0		186.0		226.5		204.5	
23		233.0		201.5		266.7		243.0	
24		262.0		229.8		291.9		259.0	
25		269.0		236.0		303.6		267.0	
26		277.0		241.7		304.5		275.0	
27		277.0		242.0		311.0		279.9	
28		442.4		402.0		483.0		413.0	
29		475.0		422.0		508.0		440.0	
30		475.0		422.0		508.0		440.0	
31						770.0		680.5	
32						878.8		765.0	
33								1130.0	
34								1283.0	
35								1336.0	
36								1352.0	
37								1374.0	
38								1385.0	
39								1845.0	
40								1882.0	
41								1896.0	
42								1992.0	
43								2039.0	
44								2071.0	
45								2355.6	
46								2361.3	
47								2361.3	
48								2468.0	
49								2782.8	
50								2799.5	
51								2852.7	
52								2882.5	
53								2933.0	
54								3158.0	
55								3322.0	
56								3359.9	
57								3900.9	
58								3960.3	
59									
60								1336.0	
61								632.0	

	O	P	Q	R	S	T	U	V	W
1									
2									
3									
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5									
6									
7									
8									
9		Contact		Contact		Contact		Contact	
10	UE-25 C#1	type	UE-25 C#2	type	UE-25 C#3	type	USW G-1	type	USW G-2
11	0.0		0.0		0.0		0.0		0.0
12	0.0		0.0		0.0		0.0		0.0
13	0.0		69.9		80.1		60.0		0.0
14	0.0		69.9		80.1		60.0		0.0
15	60.0		69.9		80.1		60.0		0.0
16	251.0		243.0		221.0		60.0		225.0
17	251.0		243.0		221.0		60.0		225.0
18	266.0		257.0		238.0		60.0		228.0
19	271.0		264.0		247.0		60.0		235.0
20	274.0		267.0		250.0		60.0		245.0
21	274.0		267.0		250.0		102.0		341.5
22	300.0		286.0		271.0		135.0		494.2
23	300.0		286.0		271.0		235.0		730.8
24	319.0		306.0		286.0		265.0		755.2
25	327.0		313.0		295.0		265.0		761.7
26	329.0		315.0		298.0		270.0		766.8
27	332.0		318.0		303.0		280.0		771.2
28	424.0		423.0		400.0		438.0		909.1
29	438.0		457.0		438.0		456.5		909.1
30	438.0		457.0		438.0		456.5		977.2
31	595.0		591.0		563.0		713.4		1246.0
32	726.0		725.0		703.0		814.8		1280.0
33	1040.0		1038.0		1030.0		1199.2		1604.0
34	1216.0		1205.0		1183.0		1287.0		1633.8
35	1293.0		1290.0		1270.0		1342.4		1670.0
36	1320.0		1320.0		1298.0		1360.5		1684.5
37	1334.0		1335.0		1320.0		1403.9		1702.1
38	1334.0		1335.0		1320.0		1425.5		1757.0
39	1581.0		1580.0		1580.0		1736.4		2576.7
40	1692.0		1658.0		1635.0		1799.0		2704.7
41	1692.0		1658.0		1635.0		1862.5		2704.7
42	1787.0		1773.0		1762.0		1920.0		2704.7
43	1863.0		1849.0		1838.0		1960.0		2963.7
44	1884.0		1872.0		1863.0		1985.7		2980.0
45	2119.0		2109.5		2110.0		2154.9		3246.5
46	2153.0		2138.0		2130.0		2173.2		3281.9
47	2240.0		2227.0		2218.0		2337.0		3302.5
48	2275.0		2262.0		2267.0		2461.0		3320.0
49	2446.0		2445.0		2428.0		2547.0		3447.0
50	2575.0		2550.0		2547.0		2547.0		3485.0
51	2692.0		2667.0		2670.0		2601.6		3503.4
52	2754.0		2725.0		2704.0		2639.4		3574.0
53	2754.0		2725.0		2704.0		2800.0		3574.0
54							2840.0		3574.0
55							2956.0		3574.0
56							3005.0		3574.0
57							3522.0		3914.0
58							3558.2		3982.0
59									
60	1293.0		1290.0		1270.0		1394.3		1670.0
61	515.0		520.0		500		600.0		1131.9

	X	Y	Z	AA	AB	AC	AD	AE	AF
1									
2									
3									
4									
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6									
7									
8									
9	Contact		Contact		Contact		Contact		Contact
10	type	USW GU-3/G-3	type	USW G-4	type	USW H-1	type	USW H-3	type
11		0.0		0.0		0.0		0.0	
12		0.0		0.0		0.0		0.0	
13		0.0		30.0		0.0		0.0	
14		0.0		30.0		0.0		0.0	
15		0.0		30.0		0.0		0.0	
16		348.1		118.0		61.0		369.8	
17		357.0		118.0		61.0		376.0	
18		368.4		130.0		70.0		388.0	
19		372.5		141.0		90.0		400.0	
20		375.5		146.0		95.1		403.9	
21		375.5		148.8		160.8		403.9	
22		391.7		168.2		190.3		417.0	
23		391.7		198.9		278.9		417.0	
24		417.7		224.0		295.0		435.0	
25		424.9		236.5		320.0		441.9	
26		427.8		239.0		330.0		445.0	
27		427.8		242.8		335.0		449.0	
28		542.0		400.4		505.0		526.9	
29		548.0		420.0		538.0		540.0	
30		548.0		420.0		538.0		540.0	
31		688.0		674.0		788.0		680.1	
32		830.0		774.0		897.0		848.1	
33		1044.0		1127.9		1324.0		1049.9	
34		1186.7		1316.5		1410.0		1194.0	
35		1280.0		1345.4		1469.5		1308.0	
36		1317.0		1353.6		1486.2		1341.0	
37		1406.3		1406.8		1498.0		1392.0	
38		1412.5		1409.4		1505.0		1400.0	
39		1506.3		1705.4		1802.0		1437.0	
40		1553.9		1762.7		1861.0		1495.0	
41		1597.0		1793.6		1911.0		1518.0	
42		1663.0		1880.0		1969.0		1640.0	
43		1744.0		1946.0		2021.0		1690.0	
44		1755.0		1954.6		2053.0		1702.0	
45		1992.3		2238.0		2300.0		1899.9	
46		1998.7		2245.7		2319.5		1907.1	
47		2021.3		2255.0		2337.0		1922.0	
48		2102.0		2560.0		2533.0		2092.0	
49		2549.5		2677.0		2629.0		2350.0	
50		2550.8		2677.0		2676.0		2397.0	
51		2617.0		2733.3		2690.3		2449.1	
52		2637.0		2755.6		2729.6		2477.0	
53		2719.0		2839.0		2823.0		2567.0	
54		2890.0		2950.0		2862.0		2692.0	
55		3265.0				3073.0		3086.0	
56		3290.0				3111.0		3120.0	
57		3850.1				3618.7		3595.1	
58		3876.3				3661.4		3637.1	
59									
60		1816.0		1376.0		1490.0		1762.0	
61		675.0		618.0		650.0		605.0	

	AG	AH	AI	AJ	AK	AL	AM	AN	AO
1									
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5									
6									
7									
8									
9		Contact		Contact		Contact		Contact	
10	USW H-4	type	USW H-5	type	USW H-6	type	UE-25 J#13	type	UE-25 NRG#1
11	0.0		0.0		0.0		0.0		0.0
12	0.0		0.0		0.0		0.0		9.5
13	0.0		0.0		29.9		435.0		9.5
14	0.0		0.0		29.9		435.0		9.5
15	0.0		0.0		29.9		435.0		9.5
16	173.9		404.0		190.0		587.0		
17	173.9		404.0		190.0		591.0		
18	185.0		420.0		200.1		610.0		
19	193.0		437.5		260.2		629.0		
20	195.0		438.0		270.0		632.0		
21	198.0		457.0		275.0		632.0		
22	216.0		471.0		278.0		650.0		
23	224.0		510.0		290.0		650.0		
24	242.0		542.0		300.2		682.0		
25	248.5		560.0		330.0		686.0		
26	251.0		562.0		330.0		691.0		
27	254.0		564.0		332.0		691.0		
28	376.0		700.0		409.0		755.0		
29	376.0		741.0		435.0		801.0		
30	376.0		741.0		435.0		801.0		
31	576.0		988.0		653.0		905.0		
32	703.0		1088.0		795.0		1003.0		
33	987.0		1450.0		1097.0		1193.0		
34	1185.0		1582.0		1213.0		1300.0		
35	1209.0		1659.0		1310.0		1415.0		
36	1247.0		1672.0		1322.0		1450.0		
37	1312.0		1699.1		1356.0		1475.0		
38	1317.0		1705.0		1356.0		1482.0		
39	1572.0		1879.9		1458.0		1682.0		
40	1626.9		1944.9		1508.0		1711.0		
41	1662.0		1967.0		1555.0		1742.0		
42	1746.0		2085.0		1602.0		1848.0		
43	1820.0		2113.0		1670.0		1942.0		
44	1840.0		2130.0		1685.0		1961.0		
45	2263.1		2240.1		1765.1		1993.0		
46	2274.9		2263.1		1794.9		2017.0		
47	2369.0		2310.0		1881.0		2017.0		
48	2494.0		2388.0		1894.0		2082.0		
49	2559.0		2468.0		1990.0		2322.0		
50	2635.0		2510.0		2138.1		2322.0		
51	2644.0		2712.9		2225.0		2322.0		
52	2664.0		2742.1		2258.0		2358.0		
53	2745.0		2845.0		2348.0		2465.0		
54	2835.0		2897.0		2439.0		2658.0		
55	3200.0		3130.0		2655.0		2862.0		
56	3228.0		3150.0		2667.0		2991.0		
57	3788.0		3412.0		2869.1		3200.0		
58	3818.9		3421.9		2877.9		3220.0		
59									
60	1330.0		1888.0		1429.0		1415.0		
61	553.0		931.0		585.0				

	AP	AQ	AR	AS	AT	AU	AV
1							
2							
3							
4							
5							
6							
7							
8							
9	Contact		Contact		Contact		Contact
10	type	UE-25 NRG#2	type	UE-25 NRG#2A	type	UE-25 NRG#2B	type
11		0.0		0.0		0.0	
12		0.0		80.6		0.0	
13		0.0		80.6		2.2	
14		164.6		80.6		157.3	
15		164.6		165.9		232.3	
16		276.3				232.3	
17		276.3				232.3	
18		282.8				232.3	
19						265.2	
20						267.1	
21						268.9	
22						285.3	
23						324.0	
24							
25							
26							
27							
28							
29							
30							
31							
32							
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	AW	AX	AY	AZ
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9		Contact		Contact
10	UE-25 NRG#2C	type	UE-25 NRG#2D	type
11	0.0		0.0	
12	50.0		38.1	
13	50.0		38.1	
14	150.1		125.9	
15				
16				
17				
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21				
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	BA	BB	BC	BD	BE	BF	BG	BH
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8								
9			Contact		Contact		Contact	
10	Symbol	UE-25 NRG#3	type	UE-25 NRG#4	type	UE-25 NRG#5	type	USW NRG-6
11	NC	0.0		0.0		0.0		0.0
12	Qa	0.0		0.0		0.0		0.0
13	Tmr	0.0		0.0		0.0		0.0
14	Tpk	0.0		0.0		0.0		0.0
15	Tpc_un	0.0		0.0		0.0		0.0
16	Tpcpv3			318.0		140.0		135.3
17	Tpcpv2			318.0		140.0		135.3
18	Tpcpv1			323.0		154.0		151.8
19	Tpbt4			338.0		163.0		158.6
20	Tpy			344.0		170.0		162.8
21	Tpbt3			354.0		187.0		162.8
22	Tpp			375.0		215.0		174.9
23	Tpbt2			458.0		288.0		220.8
24	Tptrv3			477.0		321.0		244.7
25	Tptrv2			481.5		327.0		257.4
26	Tptrv1			485.0		330.0		259.8
27	Tptrn			488.9		332.0		263.2
28	Tptrl			660.5		517.0		429.0
29	Tptf			700.0		565.0		465.5
30	Tptpul			700.0		565.0		465.5
31	Tptpmn					770.0		713.0
32	Tptpll					901.5		810.0
33	Tptpln					1230.0		
34	Tptpv3							
35	Tptpv2							
36	Tptpv1							
37	Tpbt1							
38	Tac							
39	Tacbt							
40	Tcp4v							
41	Tcp3n2c							
42	Tcp3m-d							
43	Tcp1-3n1c							
44	Tcp1-3n1v							
45	Tcpbt							
46	Tcbn2v							
47	Tcbn2c							
48	Tcbm-d							
49	Tcbn1c							
50	Tcbn1v							
51	Tcbbt							
52	Tctn2v							
53	Tctn2c							
54	Tctm-d							
55	Tctn1c							
56	Tctn1v							
57	Tctbt							
58	Tund							
59	Pz							
60	V-Z							
61	RHH					681.0		620.0

	BI	BJ	BK	BL	BM	BN	BO	BP	BQ
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8									
9	Contact		Contact		Contact		Contact		Contact
10	type	USW NRG-7/7A	type	ONC#1	type	UE-25 P#1	type	USW SD-7	type
11		0.0		0.0		0.0		0.0	
12		17.0		0.0		0.0		50.1	
13		17.0		98.0		127.0		50.1	
14		17.0		193.0		127.0		50.1	
15		17.0		206.0		127.0		50.1	
16		69.7		578.0		127.0		305.0	
17		69.7		578.0		127.0		305.0	
18		79.2		589.0		127.0		316.0	
19		102.0		597.0		127.0		325.8	
20		106.4		600.0		127.0		330.6	
21		156.0		600.0		127.0		330.6	
22		172.0		621.0		127.0		343.0	
23		258.8		621.0		127.0		356.0	
24		284.3		643.0		140.0		384.3	
25		292.7		653.0		145.0		384.3	
26		296.2		654.0		148.0		386.3	
27		299.0		658.0		150.0		386.3	
28		478.2		774.0		228.0		480.0	
29		518.4		810.0		248.0		490.0	
30		518.4		810.0		248.0		490.0	
31		740.0		977.0		493.0		682.5	
32		877.6		1100.0		640.0		803.3	
33		1243.0		1178.0		958.0		1020.0	
34		1414.8		1178.0		1090.0		1182.0	
35		1457.0		1178.0		1200.0		1285.0	
36		1474.6		1213.0		1243.0		1308.0	
37		1493.0		1253.0		1270.0		1395.4	
38		1498.0		1274.0		1270.0		1405.6	
39						1390.0		1567.2	
40						1441.0		1621.5	
41						1468.0		1646.5	
42						1535.0		1765.0	
43						1630.0		1832.0	
44						1680.0		1872.0	
45						1790.0		2167.8	
46						1826.0		2183.9	
47						1826.0		2183.9	
48						1953.0		2183.9	
49						2130.0		2450.0	
50						2162.0		2478.0	
51						2240.0		2579.4	
52						2262.0		2598.0	
53						2340.0		2611.8	
54						2395.0			
55						2595.0			
56						2616.0			
57						2863.0			
58						2863.0			
59						4080.0			
60		1466.0		1153.0		1200.0		1562.0	
61		659.0		927.0		453.0		640.0	

	BR	BS	BT	BU	BV	BW	BX	BY	BZ
1									
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8									
9		Contact		Contact		Contact		Contact	
10	USW SD-9	type	USW SD-12	type	USW UZ-1	type	UE-25 UZ#4	type	UE-25 UZ#5
11	0.0		0.0		0.0		0.0		0.0
12	53.6		5.3		0.0		0.0		3.0
13	53.6		5.3		40.0		39.0		3.0
14	53.6		5.3		40.0		39.0		3.0
15	53.6		5.3		40.0		39.0		3.0
16	57.2		239.5		40.0		71.4		89.0
17	57.2		239.5		40.0		71.4		89.0
18	76.5		256.0		40.0		78.0		100.0
19	91.5		263.7		40.0		99.0		118.0
20	95.9		266.0		40.0		106.0		122.0
21	140.8		266.0		78.0		151.5		162.0
22	155.5		278.3		105.0		173.9		186.0
23	226.6		291.2		242.0		305.0		316.0
24	255.6		314.1		272.0		333.0		345.0
25	266.7		320.8		282.5		343.0		352.5
26	268.5		324.5		284.0		345.0		354.5
27	272.2		330.7		288.0		346.0		356.1
28	450.0		436.4		436.0				
29	473.0		470.2		470.0				
30	473.0		470.2		470.0				
31	730.0		663.7		717.0				
32	845.8		786.9		830.0				
33	1182.0		1065.5		1145.0				
34	1358.0		1278.1						
35	1418.4		1308.0						
36	1425.7		1337.5						
37	1464.1		1408.1						
38	1479.9		1411.5						
39	1764.4		1599.5						
40	1820.7		1648.4						
41	1868.7		1677.0						
42	1938.5		1787.0						
43	1991.4		1842.0						
44	2015.8		1865.0						
45			2133.0						
46			2137.8						
47									
48									
49									
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56									
57									
58									
59									
60	1457.0		1600.0						
61	628.0		630.0		585.0				

	CA	CB	CC	CD	CE	CF	CG	CH	CI
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8									
9	Contact		Contact		Contact		Contact		Contact
10	type	USW UZ-6	type	USW UZ-7A	type	USW UZ-14	type	UE-25 UZ#16	type
11		0.0		0.0		0.0		0.0	
12		0.0		38.5		39.7		0.0	
13		0.0		38.5		39.7		39.7	
14		0.0		38.5		39.7		39.7	
15		0.0		38.5		39.7		39.7	
16		383.0		163.9		39.7		140.8	
17		407.0		163.9		39.7		140.8	
18		422.0		184.0		39.7		153.0	
19		432.5		197.7		39.7		160.7	
20		437.2		203.6		39.7		165.9	
21		437.2		203.6		78.2		173.4	
22		450.1		214.9		102.1		188.8	
23		455.5		218.6		240.4		188.8	
24		478.2		243.0		268.2		217.0	
25		483.0		247.3		280.9		228.1	
26		489.0		248.6		282.5		229.4	
27		490.0		248.6		286.0		238.9	
28		575.0		377.8		430.0		357.8	
29		610.0		377.8		468.0		371.0	
30		610.0		377.8		468.0		371.0	
31		778.0		480.0		715.0		545.0	
32		917.0		607.0		828.0		669.0	
33		1190.0				1138.0		935.0	
34		1333.0				1279.1		1107.5	
35		1379.0				1358.0		1165.2	
36		1422.0				1383.0		1178.0	
37		1450.0				1404.2		1190.0	
38		1460.0				1420.2		1197.0	
39		1547.2				1694.0		1455.4	
40		1592.0				1750.2		1485.0	
41		1614.0				1815.1		1497.7	
42		1750.0				1850.0		1571.0	
43		1802.0				1893.0		1638.0	
44		1829.0				1899.0		1669.2	
45						2046.6			
46						2072.1			
47									
48									
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57									
58									
59									
60						1392.5		1165.2	
61		690.0						485.0	

	CJ	CK	CL	CM	CN	CO	CP	CQ
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9		Contact		Contact		Contact		Contact
10	USW UZ-N11	type	USW UZ-N15	type	USW UZ-N16	type	USW UZ-N17	type
11								
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	CR	CS	CT	CU	CV	CW	CX	CY
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9		Contact		Contact		Contact		Contact
10	USW UZ-N27	type	USW UZ-N31	type	USW UZ-N32	type	USW UZ-N33	type
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	CZ	DA	DB	DC	DD	DE	DF	DG
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9		Contact		Contact		Contact		
10	USW UZ-N34	type	USW UZ-N35	type	USW UZ-N36	type		Symbol
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	DH	DI	DJ	DK	DL	DM	DN	DO
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9		Contact		Contact		Contact		Contact
10	USW UZ-N37	type	USW UZ-N38	type	USW UZ-N53	type	USW UZ-N54	type
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	DP	DQ	DR	DS	DT	DU	DV	DW
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9		Contact		Contact		Contact		Contact
10	USW UZ-N55	type	USW UZ-N57	type	USW UZ-N58	type	USW UZ-N59	type
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	DX	DY	DZ	EA	EB	EC	ED	EE
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9		Contact		Contact		Contact		Contact
10	USW UZ-N61	type	USW UZ-N62	type	USW UZ-N63	type	USW UZ-N64	type
11								
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	EF	EG	EH	EI	EJ	EK	EL	EM	EN
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8									
9		Contact		Contact		Contact		Contact	
10	USW WT-1	type	USW WT-2	type	UE-25 WT#3	type	UE-25 WT#4	type	UE-25 WT#6
11	0.0		0.0		0.0		0.0		0.0
12	0.0		0.0		0.0		0.0		0.0
13	30.0		60.0		11.0		51.0		170.0
14	30.0		60.0		11.0		51.0		170.0
15	30.0		60.0		11.0		51.0		170.0
16	395.0		193.0		11.0		261.0		170.0
17	410.0		200.0		11.0		261.0		170.0
18	417.0		215.0		11.0		270.0		170.0
19	431.0		227.0		11.0		281.0		170.0
20	435.0		230.0		11.0		293.0		170.0
21	435.0		230.0		11.0		293.0		170.0
22	446.0		247.0		11.0		324.0		170.0
23	446.0		247.0		11.0		419.0		170.0
24	477.0		271.0		11.0		444.0		170.0
25	481.0		275.0		11.0		448.0		170.0
26	484.0		280.0		11.0		456.0		170.0
27	492.0		285.0		11.0		458.0		170.0
28	575.0		380.0		11.0		630.0		170.0
29	593.0		421.0		11.0		660.0		170.0
30	593.0		421.0		11.0		660.0		250.0
31	733.0		590.0		11.0		727.0		250.0
32	888.0		727.0		11.0		785.0		250.0
33	1187.0		1014.0		35.0		1091.0		303.0
34	1299.0		1179.0		189.0		1091.0		303.0
35	1337.0		1223.0		293.0		1122.0		337.0
36	1368.0		1264.0		327.0		1141.0		352.0
37	1380.0		1315.0		351.0		1150.0		369.0
38	1384.0		1319.0		358.0		1156.0		383.0
39	1564.0		1521.0		461.0				
40	1564.0		1594.0		512.0				
41	1564.0		1594.0		554.0				
42	1564.0		1706.0		660.0				
43	1564.0		1776.0		704.0				
44	1564.0		1794.0		710.0				
45	1564.0				835.0				
46	1564.0				846.0				
47	1564.0				850.0				
48	1564.0				909.0				
49									
50									
51									
52									
53									
54									
55									
56									
57									
58									
59									
60	1337.0		1452.0		293.0		1122.0		305.0
61	713.0		540.0				679.0		

	EO	EP	EQ	ER	ES	ET	EU	EV	EW
1									
2									
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5									
6									
7									
8									
9	Contact		Contact		Contact		Contact		Contact
10	type	USW WT-7	type	USW WT-10	type	UE-25 WT#11	type	UE-25 WT#12	type
11		0.0		0.0		0.0		0.0	
12		0.0		0.0		0.0		0.0	
13		40.0		60.0		40.0		60.0	
14		40.0		627.0		40.0		60.0	
15		40.0		627.0		40.0		60.0	
16		344.0		863.0		239.0		297.0	
17		344.0		872.0		243.5		300.0	
18		355.0		880.0		263.0		306.0	
19		369.5		887.0		271.0		319.0	
20		372.0		894.0		272.0		323.0	
21		374.5		894.0		272.0		323.0	
22		391.0		924.0		287.0		339.0	
23		391.0		924.0		287.0		339.0	
24		415.0		954.0		307.0		362.0	
25		426.0		960.5		313.0		365.0	
26		432.0		967.0		317.0		369.0	
27		435.0		971.0		324.0		374.0	
28		515.0		1035.0		430.0		478.0	
29		546.0		1049.0		430.0		478.0	
30		546.0		1049.0		430.0		478.0	
31		706.0		1250.0		661.0		680.0	
32		959.0				782.0		760.0	
33		1091.0				875.0		890.0	
34		1287.0				1058.0		1151.0	
35		1351.0				1146.0		1215.0	
36		1360.0				1186.0		1250.0	
37		1433.0				1198.0		1259.0	
38		1438.0				1208.0		1276.0	
39		1510.0							
40		1571.0							
41		1598.0							
42									
43									
44									
45									
46									
47									
48									
49									
50									
51									
52									
53									
54									
55									
56									
57									
58									
59									
60		1351.0				1271.0		1180.0	
61		665.0		1233.0		641.0		660.0	

	EX	EY	EZ	FA	FB	FC	FD	FE
1								
2								
3								
4								
5								
6								
7								
8								
9		Contact		Contact		Contact		Contact
10	UE-25 WT#13	type	UE-25 WT#14	type	UE-25 WT#15	type	UE-25 WT#16	type
11	0.0		0.0		0.0		0.0	
12	0.0		0.0		0.0		0.0	
13	220.0		107.0		210.0		137.0	
14	220.0		107.0		210.0		137.0	
15	220.0		107.0		210.0		137.0	
16	416.0		107.0		332.0		368.0	
17	416.0		107.0		332.0		368.0	
18	427.0		107.0		334.0		375.0	
19	440.0		107.0		349.0		386.0	
20	450.0		107.0		356.0		395.0	
21	450.0		107.0		356.0		395.0	
22	460.0		107.0		372.0		462.0	
23	469.0		107.0		413.0		558.0	
24	490.0		107.0		436.0		580.0	
25	497.0		122.0		440.0		588.0	
26	498.0		124.0		442.0		594.0	
27	500.0		128.0		444.0		596.0	
28	612.0		247.0		608.0		818.0	
29	630.0		275.0		641.0		830.0	
30	630.0		275.0		641.0		830.0	
31	755.0		446.0		852.0		830.0	
32	868.0		534.0		919.0		830.0	
33	1103.0		830.0		1260.0		1013.0	
34			1024.0				1013.0	
35			1117.0				1050.0	
36			1137.0				1057.0	
37			1157.0				1068.0	
38			1210.0				1068.0	
39								
40								
41								
42								
43								
44								
45								
46								
47								
48								
49								
50								
51								
52								
53								
54								
55								
56								
57								
58								
59								
60			1117.0				1050.0	
61	740.0		392.0		840.0			

	FF	FG	FH	FI
1				
2				
3				
4				
5				
6				
7				
8				
9		Contact		Contact
10	UE-25 WT#17	type	UE-25 WT#18	type
11	0.0		0.0	
12	0.0		0.0	
13	30.0		0.0	
14	30.0		0.0	
15	30.0		0.0	
16	188.0		314.0	
17	188.0		314.0	
18	194.0		332.0	
19	197.0		340.0	
20	203.0		353.0	
21	203.0		423.0	
22	217.0		497.0	
23	217.0		651.0	
24	242.0		692.0	
25	245.0		698.0	
26	248.0		701.0	
27	251.0		702.0	
28	312.0		879.0	
29	336.0		900.0	
30	336.0		900.0	
31	472.0		1078.0	
32	535.0		1170.0	
33	668.0		1501.0	
34	874.0		1501.0	
35	959.0		1564.0	
36	989.0		1592.0	
37	998.0		1620.0	
38	998.0		1620.0	
39	1184.0			
40	1271.0			
41	1313.0			
42	1318.0			
43				
44				
45				
46				
47				
48				
49				
50				
51				
52				
53				
54				
55				
56				
57				
58				
59				
60	961.0		1564.0	
61	412.0		990.0	

	A
62	
63	**Symbols:**
64	Contact type: d, w, v, c, a (ac, az), np, np-e (pe), np-f (t,i,b), np-td, nf, ne, ni, g, nd
65	d - deposition; w - welding; v - vitric; c - crystallization; a - alteration (ac - clay; az - zeolit
66	np - not penetrated; np-e - eroded (pe - partially eroded); np-f - faulted
67	ft - faulted top, fi - faulted interior, fb - faulted base
68	np-td - total depth in superjacent unit; nf - not formed; ne - not encountered; ni - not iden
69	g - geophysical log; nd - not described
70	az - rocks that are pervasively altered to zeolite (and/or clay) are indicated by "az";
71	faz - rocks from the crystal-poor, vitric, densely welded subzone of the Topopah Spring Tuff that have significant alteration along (typically high-angle) fractures
72	Contacts between vitric, crystallized, and zeolitic material are hyphenated to emphasize fundamental boundaries.
73	
74	**Footnotes:**
75	1 In C#1 -- The lower part of Tpbt3 might be Tpp, but this is poorly constrained.
76	2 In C#1, 2, and 3 -- The lowest unit (Tct2c) locally contains brecciated intervals: C#1 (2775 to 2975 ft), C#2 (2775 to 2935), and C#3 (2800 to 3000[total depth]).
77	3 In C#3 -- The lower part of Tpbt3 might be Tpp, but this is poorly constrained.
78	4 In G-1 -- Tcpm is not well developed. The density log indicates the rocks are in the upper part of the partially welded subzone to lower part of the moderately welded subzone and crystallized. The Tcpm unit could be modeled as absent in this location if unit density and calculated porosity are the dominant modeling parameters.
79	5 In G-1 -- The total thickness of Tct approximately the same as H-1. Tct2v is thicker in G-1 than H-1, but Tctm is correspondingly thinner. The character of the upper part of Tctm and possibly lower part of Tct2c appear to differ from the typical profile.
80	6 In G-1 -- Tct1v includes the lithic-rich member below 3053.
81	7 In G-2 -- The Tram Tuff in this borehole is much more lithic rich (varying from 5 percent to 40 percent) and the entire formation is nonwelded to partially welded. Occurrence of large amounts of lithic clasts probably inhibited development of welding
82	8 In G-4 -- Tcpm is not well developed. The density log indicates the rocks are in the upper part of the partially welded subzone to lower part of the moderately welded subzone and crystallized. The Tcpm unit could be modeled as absent in this location if unit density and calculated porosity are the dominant modeling parameters.
83	9 In H-1 -- Tcpm is not well developed. The density log indicates the rocks are in the upper part of the partially welded subzone to lower part of the moderately welded subzone and crystallized. The Tcpm unit could be modeled as absent in this location if unit density and calculated porosity are the dominant modeling parameters.
84	10 In H-6 -- Tcpm is not well developed. The density log indicates the rocks are in the upper part of the partially welded subzone to lower part of the moderately welded subzone and crystallized. The Tcpm unit could be modeled as absent in this location if unit density and calculated porosity are the dominant modeling parameters.
85	11 In UZ-14 -- Tcpm is not well developed. The density log indicates the rocks are in the upper part of the partially welded subzone to lower part of the moderately welded subzone and crystallized. The Tcpm unit could be modeled as absent in this location if unit density and calculated porosity are the dominant modeling parameters.
86	12 In WT#3 -- A fault is inferred between the surface and bottom of casing at 40 ft: therefore, there are no constraints on this depth other than it is behind casing.

Attachment VIII:
Special Case Data Recommended to be Qualified

3-page spreadsheet numbered separately

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	**Contacts Data Not Recommended to be Qualified**																
2		*"" means no data; blank cells show where recommended-Q data are located*															
3		NOTE: These data were qualified based on corroboration with surrounding data or impact analysis.															
4	**borehole**	**Tmr**	**Tpk**	**Tpc_un**	**Tpcpv3**	**Tpcpv**	**Tpcpv**	**Tpbt4**	**Tpy**	**Tpbt3**	**Tpp**	**Tpbt2**	**Tptrv3**	**Tptrv2**	**Tptrv1**	**Tptrn**	**Tptrl**
5	b#1	""	""	""	180	180	182	189	192	192	204	243	259	267	275	280	
6	G-1	""	""	""	""	""	""	""	60	102	135	235	265	265	270	280	
7	G-2	""	""	""	225	225	228	235	245								
8	H-1	""	""	""	61	61	70	90	95	161	190	279	295	320	330	335	
9	H-6	""	""		190	190	200	260	270	275	278	290	300				
10	J-13																
11	NRG#1	""	""	9.5	""	""	""	""	""	""	""	""	""	""	""	""	""
12	NRG#2	""			276.3	276.3	282.8	""	""	""	""	""	""	""	""	""	""
13	NRG#2b											324	""	""	""	""	""
14	NRG#2c	50	150.1	""	""	""	""	""	""	""	""	""	""	""	""	""	""
15	NRG#2d	38.1	125.9	""	""	""	""	""	""	""	""	""	""	""	""	""	""
16	NRG-7A																
17	SD-9		""	""													
18	WT#6																

	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI
1																		
2																		
3																		
4	**Tptf**	**Tptpul**	**RHH**	**Tptpmn**	**Tptpll**	**Tptpln**	**Tptpv3**	**Tptpv2**	**Tptpv1**	**Tpbt1**	**Tac**	**Tacbt**	**Tcpuv**	**Tcpuc**	**Tcpm**	**Tcplc**	**Tcplv**	**Tcpbt**
5																		
6																		
7																		
8																		
9																		
10												1682	1711	1742	1848	1942	1961	1993
11	''''	''''	''''	''''	''''	''''	''''	''''	''''	''''	''''	''''	''''	''''	''''	''''	''''	''''
12	''''	''''	''''	''''	''''	''''	''''	''''	''''	''''	''''	''''	''''	''''	''''	''''	''''	''''
13	''''	''''	''''	''''	''''	''''	''''	''''	''''	''''	''''	''''	''''	''''	''''	''''	''''	''''
14	''''	''''	''''	''''	''''	''''	''''	''''	''''	''''	''''	''''	''''	''''	''''	''''	''''	''''
15	''''	''''	''''	''''	''''	''''	''''	''''	''''	''''	''''	''''	''''	''''	''''	''''	''''	''''
16							1414.8	1457	1474.6	1493	1498	''''	''''	''''	''''	''''	''''	''''
17											1464.1	1479.9	1764.4	1820.7	1868.7	1938.5	1991.4	2015.8
18				250	250							''''	''''	''''	''''	''''	''''	''''

	AJ	AK	AL	AM	AN	AO	AP	AQ	AR	AS	AT	AU	AV
1													
2													
3													
4	**Tcbuv**	**Tcbuc**	**Tcbm**	**Tcblc**	**Tcblv**	**Tcbbt**	**Tctuv**	**Tctuc**	**Tctm**	**Tctlc**	**Tctlv**	**Tctbt**	**Tund**
5													
6													
7													
8													
9													
10	2017	2017	2082	2322	2322	2322	2358	2465	2658	2862	2991	3200	3220
11	""""	""""	""""	""""	""""	""""	""""	""""	""""	""""	""""	""""	""""
12	""""	""""	""""	""""	""""	""""	""""	""""	""""	""""	""""	""""	""""
13	""""	""""	""""	""""	""""	""""	""""	""""	""""	""""	""""	""""	""""
14	""""	""""	""""	""""	""""	""""	""""	""""	""""	""""	""""	""""	""""
15	""""	""""	""""	""""	""""	""""	""""	""""	""""	""""	""""	""""	""""
16	""""	""""	""""	""""	""""	""""	""""	""""	""""	""""	""""	""""	""""
17	""""	""""	""""	""""	""""	""""	""""	""""	""""	""""	""""	""""	""""
18	""""	""""	""""	""""	""""	""""	""""	""""	""""	""""	""""	""""	""""