

299-W18-154 (A7637) Log Data Report

Borehole Information:

Borehole: 299-W18-154 (A7637)			Site: 216-Z-12 Crib		
Coordinates (WA St Plane)		GWL¹ (ft): None	GWL Date: 01/03/06		
North (m)	East (m)	Drill Date	TOC Elevation	Total Depth (ft)	Type
135480.398	566369.52	08/76	684.48 ft	20	Cable tool

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Welded Steel	0.9	10 3/4	10	3/8	0.9	17
Steel	-0.5	7 1/4	6 1/2	3/8	-0.5	20

Borehole Notes:

The logging engineer measured the steel casing diameter and stickup using a steel tape.

The driller's report indicates contamination was encountered at 17 ft; this depth coincides with an approximate 18 ft log depth. Drilling was stopped and apparently, the borehole was backfilled, at least partially. The borehole was deepened in 1980 to 20 ft

Log data acquisition is referenced to the top of casing.

Logging Equipment Information:

Logging System: Gamma 4N	Type: HPGe (60%) SN: 45-TP22010A
Effective Calibration Date: 08/16/05	Calibration Reference: DOE-EM-GJ953-2005
	Logging Procedure: MAC-HGLP 1.6.5, Rev. 0

Logging System: Gamma 4 I	Type: PNLs SN: U1754
Effective Calibration Date: N/A	Calibration Reference: Not required
	Logging Procedure: MAC-HGLP 1.6.5, Rev. 0

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2	3 Repeat		
Date	01/03/06	01/04/06	01/04/06		
Logging Engineer	Spatz	Spatz	Spatz		
Start Depth (ft)	20.0	11.0	18.0		
Finish Depth (ft)	10.0	1.0	18.0		
Count Time (sec)	200	200	1000		
Live/Real	R	R	R		
Shield (Y/N)	N	N	N		
MSA Interval (ft)	1.0	1.0	NA		
ft/min	NA	NA	NA		
Pre-Verification	DN041CAB	DN061CAB	DN061CAB		
Start File	DN051000	DN061000	DN061011		

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Log Run	1	2	3 Repeat		
Finish File	DN051010	DN061010	DN061011		
Post-Verification	DN051CAA	DN061CAA	DN061CAA		
Depth Return Error (in.)	0	0	0		
Comments	No fine gain adjustment.	No fine gain adjustment.	No fine gain adjustment.		

Passive Neutron Logging System (PNLS) Log Run Information:

Log Run	4	5 Repeat			
Date	01/04/06	01/04/06			
Logging Engineer	Spatz	Spatz			
Start Depth (ft)	20.0	20.0			
Finish Depth (ft)	1.0	14.0			
Count Time (sec)	N/A	N/A			
Live/Real	R	R			
Shield (Y/N)	N	N			
Sample Interval (ft)	1.0	1.0			
ft/min	NA	NA			
Pre-Verification	DI262CAB	DI262CAB			
Start File	DI262000	DI262020			
Finish File	DI262019	DI262026			
Post-Verification	DI262CAA	DI262CAA			
Depth Return Error (in.)	0	0			
Comments	None	None			

Logging Operation Notes:

Logging was conducted with a centralizer on each sonde and measurements are referenced to top of casing. Repeat data acquired with the SGLS were acquired at a 1000-second counting time at 18 ft to provide additional detail. For purposes of this report, the data acquired at 1000 seconds are reported as main log data rather than as repeat data.

Analysis Notes:

Analyst:	P.D. Henwood	Date:	06/19/07	Reference:	GJO-HGLP 1.6.3, Rev. 0
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Pre-run and post-run verifications for the logging systems were performed before and after the day's data acquisition. The acceptance criteria were met.

A combined casing correction for a 0.75 in. (0.375 + 0.375, for the 10- and 7-in. casings, respectively) thick casing was applied to the SGLS data from TOC to 17 ft. Below 17 ft, a correction for 0.375 -in. casing was applied.

SGLS spectra were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated with an EXCEL worksheet template identified as G4NAug05.xls using an efficiency function and corrections for casing, dead time, and water as determined from annual calibrations. The passive neutron data are used for qualitative purposes and do not require a calibration. Data are reported in counts per second.

Results and Interpretations:

Am-241 is detected at 18 ft at a concentration of approximately 137,000 pCi/g. Gamma rays at approximately 662 and 722 keV were detected that represent Am-241. Cs-137 emits a 661.66 gamma ray that cannot be distinguished from the 662.40 gamma ray emitted from Am-241. The energy peak at 722.01 keV is used to establish the presence of Am-241 rather than Cs-137. In this borehole, the 722.01 keV energy peak was detected at only one depth location (18 ft) where the 662 keV energy peak was also detected and is assigned to Am-241. At all other depth

locations where the 662 keV energy peak is detected, it is assumed the contribution is from Cs-137. The Cs-137 at 18 ft is not corrected for the Am-241 contribution, which results in a slight overestimation (a few pCi/g) of the Cs-137 concentration.

Using this approach, Cs-137 is detected from 17 to 20 ft. The maximum concentration of 92 pCi/g is measured at 18 ft. Cs-137 is also detected at the ground surface and 13 ft near its MDL.

Pu-239 was detected at 18 ft; the maximum concentration is approximately 21,000 pCi/g. Primary energy peaks associated with Pu-239 were detected only at approximately 414 keV. Interferences from the 415.76 and 415.88 keV gamma energy lines originating from the decay of Pa-233 and Am-241, respectively, are probable and would result in a slight over estimation of the Pu-239 concentration. At 18 ft, the assay for Pa-233 using the 415.76 energy peak is high relative to that derived from the 312 keV peak. Therefore, it is concluded Pu-239 exists near an MDL of approximately 10,000 pCi/g at 18 ft. The energy peak at 414 keV is also influenced by Pa-233.

Np-237 is detected with the SGLS by measuring a daughter product (protactinium-233) that emits a prominent gamma ray at an energy of 312.17 keV. Pa-233 was detected from 18 to 20 ft. The maximum concentration is approximately 15 pCi/g at an 18 ft depth.

Passive neutron logging was performed in the borehole. This logging method has been shown to be effective in qualitatively detecting zones of alpha-emitting contaminants from secondary neutron flux generated by the (α ,n) reaction and may indicate the presence of α -emitting nuclides, including transuranic radionuclides, even where no gamma emissions are available for detection above the MDL. The passive neutron signal depends on the concentration of α sources, and also the concentrations of lighter elements such as N, O, F, Mg, Al, and Si, which emit neutrons after alpha capture. The passive neutron log indicated a maximum count rate of 10 counts per second (cps) at 18 ft.

A reaction F-19 (α ,n) Na-22 yields a gamma ray at 1274.53 keV and a positron at 511 keV. A 1274.44 keV gamma ray also occurs from the decay of Eu-154. However, there are no corroborating peaks for the Eu-154 and the gamma ray is attributed to the fluorine reaction. The half-life of Na-22 is short (i.e., 2.6 years), but will continue to be produced as long as sufficient fluorine and alpha activity exist. The Na-22 was detected at 18 ft at similar depth intervals as the relatively high Pu-239, Am-241, and Np-237. The maximum concentration of Na-22 is approximately 0.4 pCi/g at 18 ft. The 1274 keV energy peak may also be influenced by a prompt gamma ray induced by alpha particles interacting with F-19.

Spectral gamma data were acquired in this borehole in 1993 by Westinghouse Hanford Company using the Radionuclide Logging System (RLS). A comparison plot of the RLS (1993) and SGLS (2006) manmade radionuclides show similar concentrations for Pa-233 and Cs-137. Am-241 and Pu-239 were observed in the RLS analysis but could not be quantified.

A comparison of the Cs-137 profiles from 1993 to 2006 suggests a slight decrease in concentration that could be attributable to decay.

This borehole, originally drilled in 1976, was deepened as part of the Kasper study in 1980. Kasper (1982) reported that most of the sediment in the borehole in 1980 was from backfill placed in the borehole after drilling in 1976. Only one meter of undisturbed sediment was recovered from the borehole and samples were sent for analysis. However, Kasper believed there was a potential for cross contamination of the samples. As a result, Kasper did not prepare a log for this borehole. The soil samples that were acquired were analyzed for Pu-239/240 and Am-241. Kasper (1982) reports the detection limits for Pu-239/240 and Am-241 using gamma energy analysis (GEA) were 2,000 and 200 pCi/g, respectively. The detection limits using the SGLS are approximately 10,000 and 50,000 pCi/g. For soil samples below the GEA detection limits, alpha energy analysis was performed. The detection limit for Pu-239/240 and Am-241 alpha energy analysis was approximately 0.1 pCi/g. These sample results plotted with the SGLS/RLS results indicate contamination at approximately the same depths. However, the concentrations differ by an order of magnitude or more. The difference may be caused by the cross contamination possibility or because the interval of contamination is so thin that sample volumes of the two methods are vastly different.

The SGLS and PNLs repeat data show good repeatability.

References:

1982. Kasper, R.B. *216-Z-12 Transuranic Crib Characterization: Operational History and Distribution of Plutonium and Americium*. RHO-ST-44. Rockwell Hanford Operations. Richland, Washington.

List of Log Plots:

Depth Reference is top of casing

Manmade Radionuclides

Natural Gamma Logs

Combination Plot

Total Gamma, Dead Time, & Passive Neutron

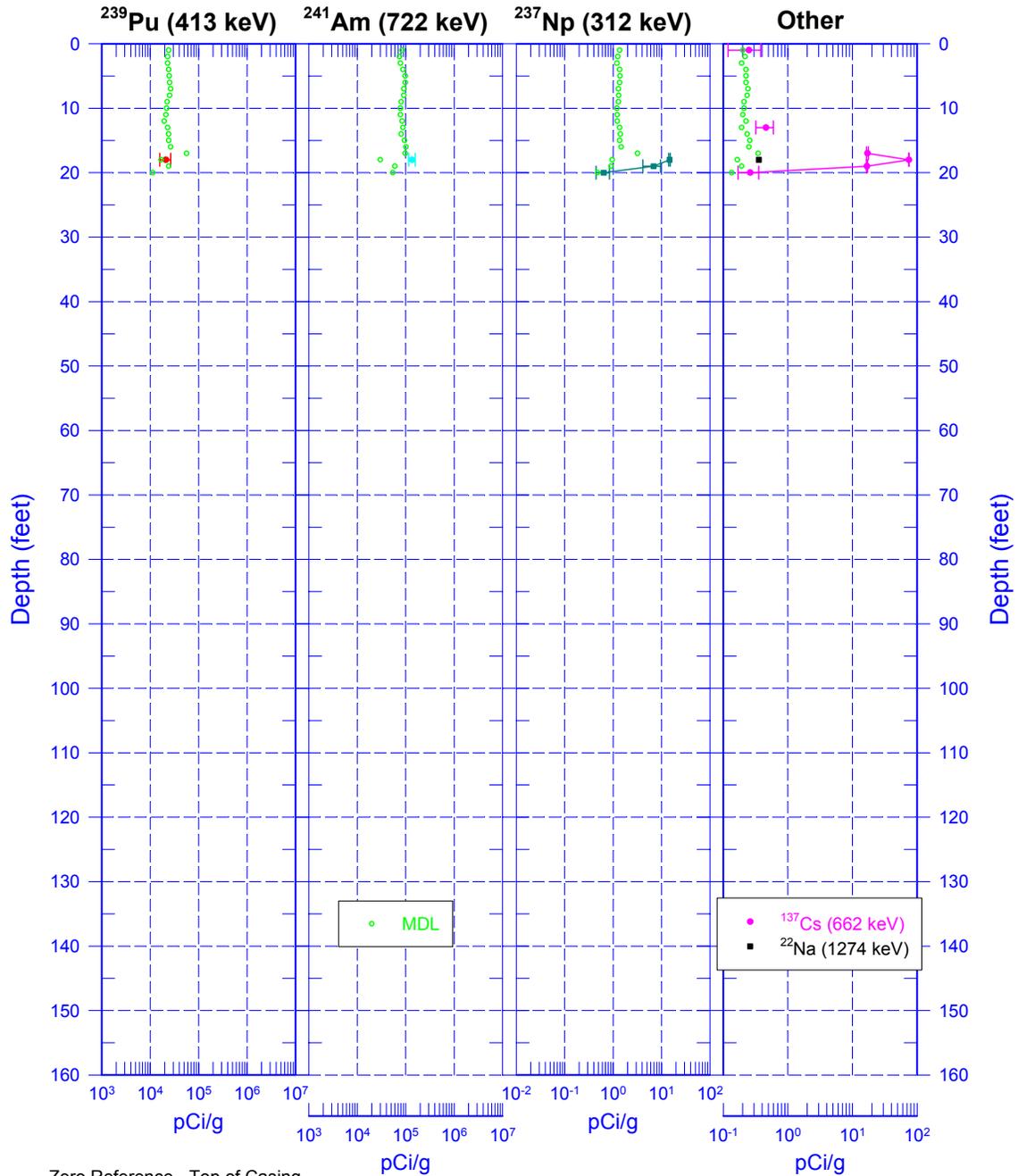
Comparison of RLS/SGLS & Soil Samples (0-40 ft)

Comparison of RLS/SGLS & Soil Samples (0-160 ft)

Repeat of Passive Neutron

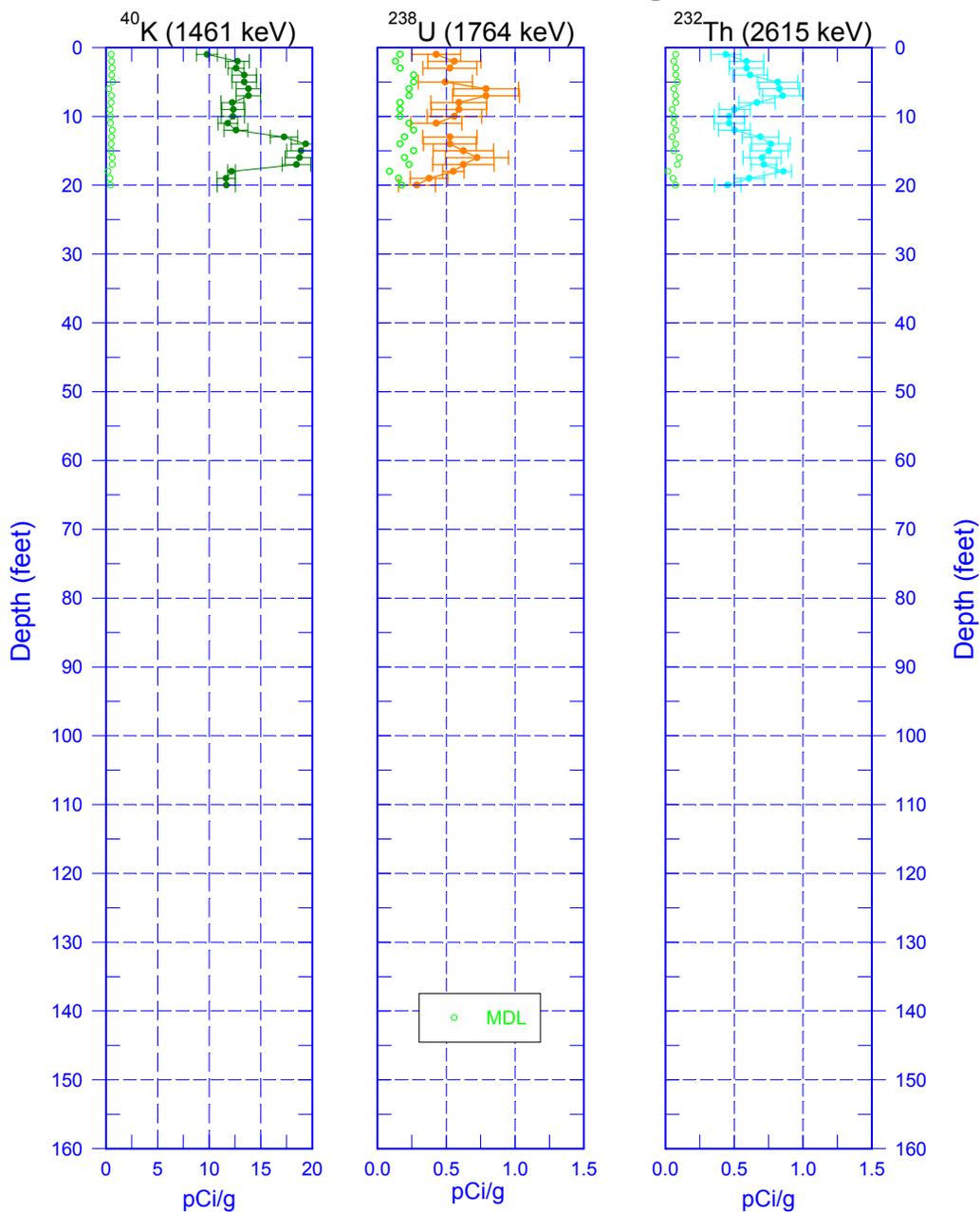
¹ GWL – groundwater level

299-W18-154 (A7637) Manmade Radionuclides

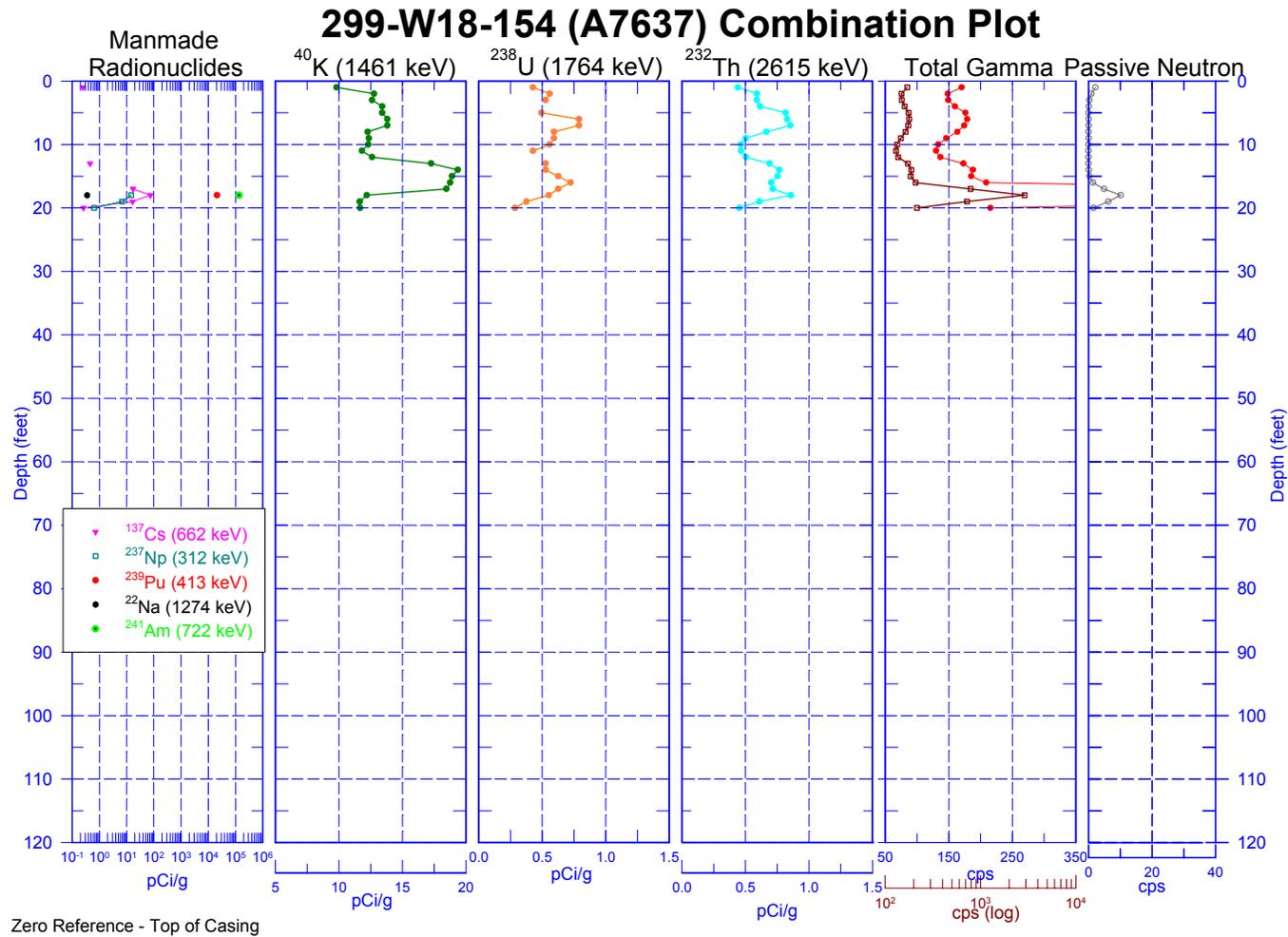


Zero Reference - Top of Casing

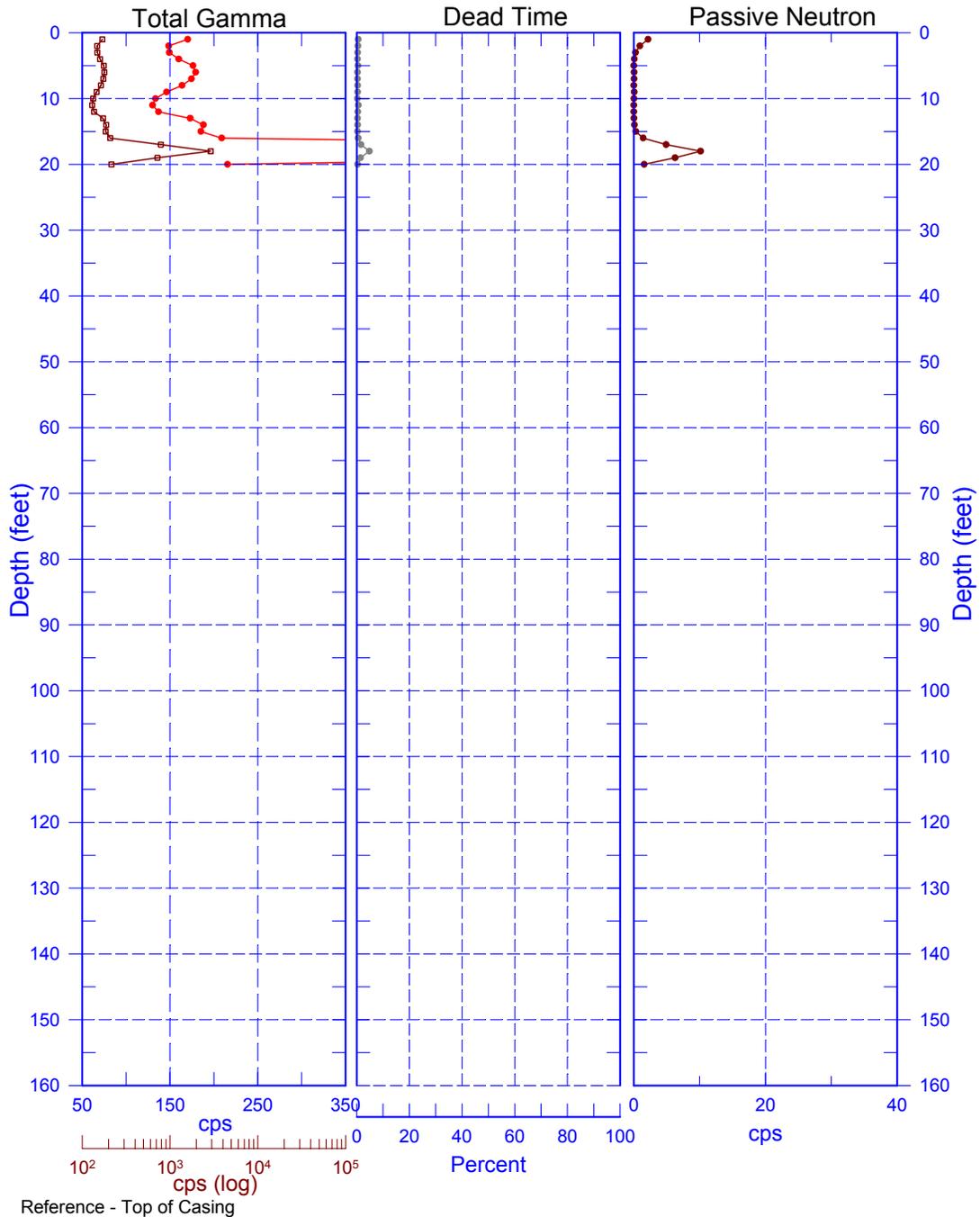
299-W18-154 (A7637) Natural Gamma Logs



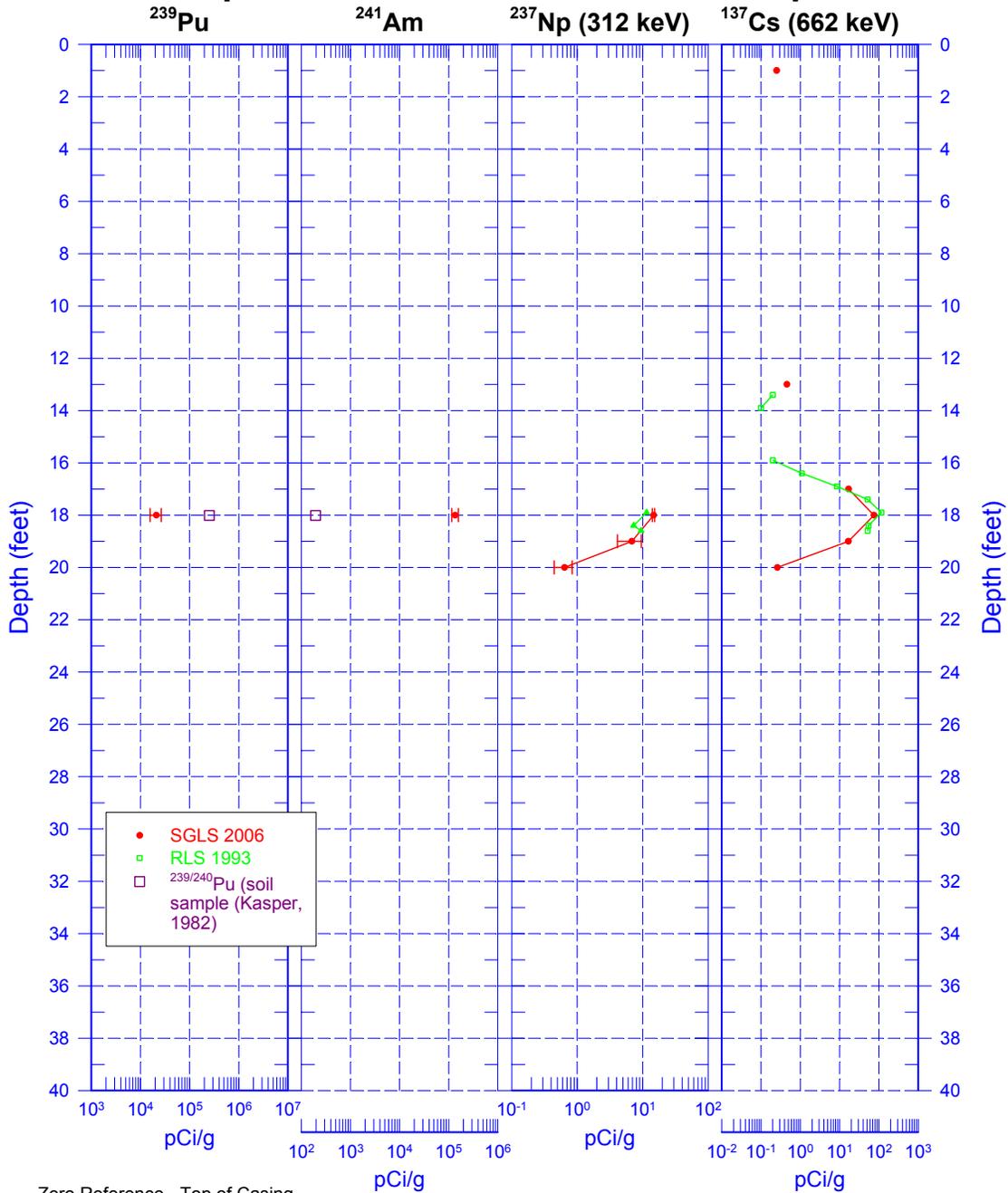
Zero Reference = Top of Casing



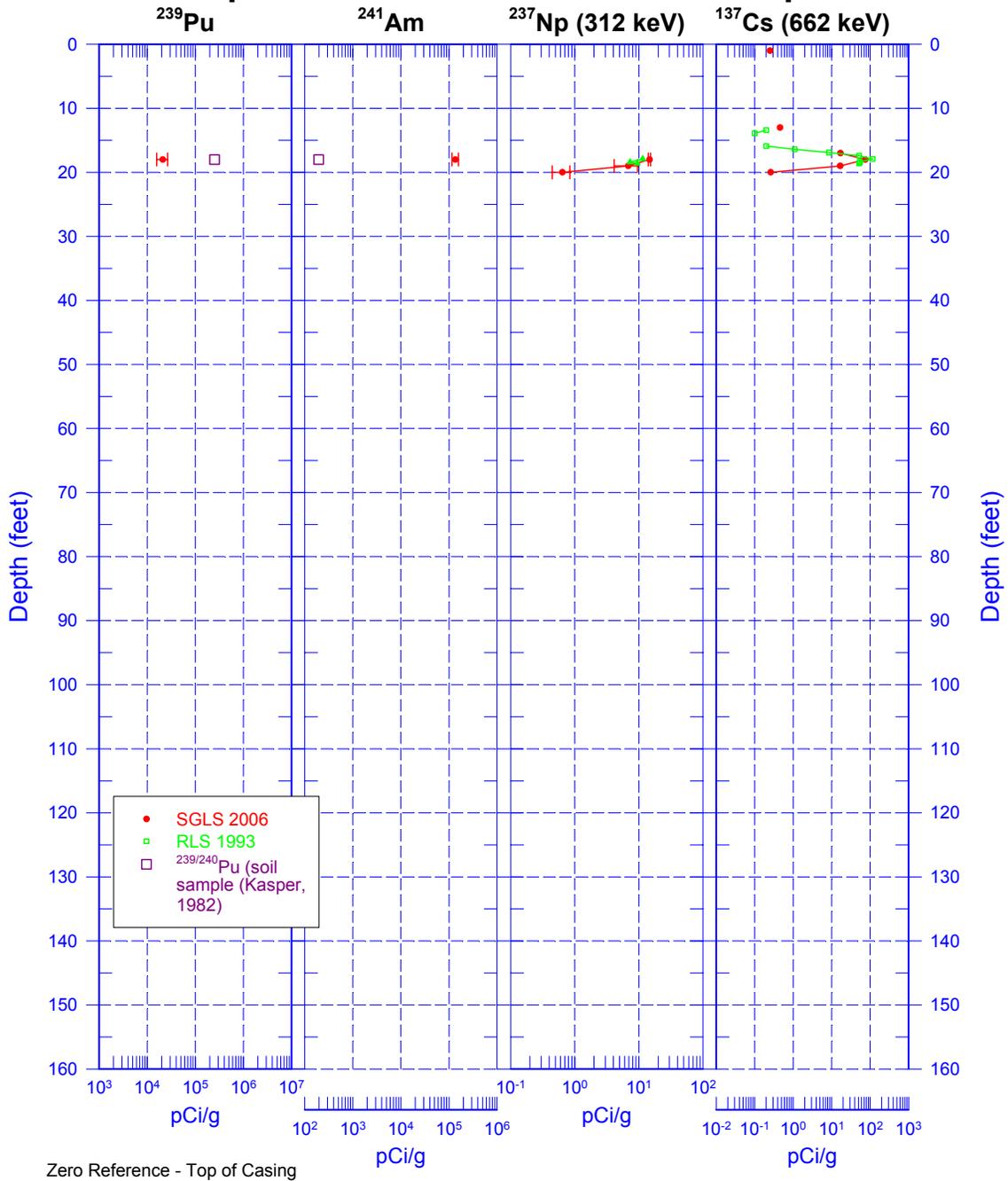
299-W18-154 (A7637)
Total Gamma, Dead Time, & Passive Neutron



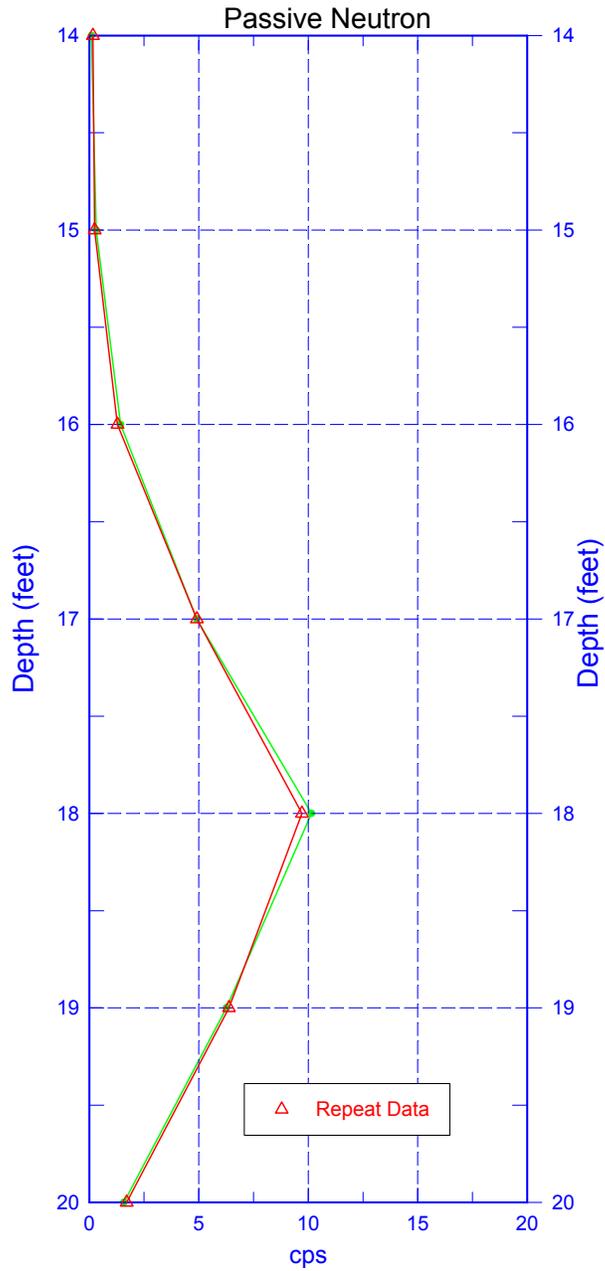
299-W18-154 (A7637) Comparison of RLS/SGLS & Soil Samples



299-W18-154 (A7637)
Comparison of RLS/SGLS & Soil Samples



299-W18-154 (A7637) Repeat of Passive Neutron



Reference - Top of Casing