Stoller
Hanford Office

299-W18-170 (A7652)
Log Data Report

Borehole Information:

Borehole:	299-W18-170 (A7652)		Site:	216-Z-1A Crib	
Coordinates (WA St Plane)		GWL[1] (ft): None		GWL Date: 07/17/06	
North (m)	East (m)	Drill Date	TOC Elevation	Total Depth (ft)	Type
135394.261	566547.122	09/77	675.99	30	Cable

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Steel	3.0	6 5/8	6	5/16	3.0	30

Borehole Notes:

The logging engineer measured the casing stick-up and diameter using a caliper and steel tape. Logging data acquisition is referenced to the TOC. According to the driller's log, contamination was encountered from 20 ft to the bottom of the borehole; the driller did not record information or sample the top 14 ft of the borehole. The driller reported hitting a hard object that "looks like metal" at approximately 30 ft. Further drilling was stopped and the borehole was "grouted around 6-in. casing and a grout plug in the bottom."

Logging Equipment Information:

Logging System:	Gamma 4N		Type:	SGLS (60%) SN: 45TP22010A
Effective Calibration Date:	04/06/06	Calibration Reference:	DOE-EM/GJ1177-2006	
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0	

Logging System:	Gamma 4H		Type:	NMLS SN: H310700352
Effective Calibration Date:	03/06/06	Calibration Reference:	DOE-EM/GJ1154-2006	
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0	

Logging System:	Gamma 4I		Type:	PNLS SN: U1754
Effective Calibration Date:	Not required	Calibration Reference:	None	
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0	

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2 Repeat	3 Repeat		
Date	07/17/06	07/17/06	07/18/06		
Logging Engineer	Spatz	Spatz	Spatz		
Start Depth (ft)	3.0	9.0	22.0		
Finish Depth (ft)	30.0	23.0	27.0		
Count Time (sec)	200	400	400		
Live/Real	R	R	R		
Shield (Y/N)	N	N	N		

Log Run	1	2 Repeat	3 Repeat		
MSA Interval (ft)	1.0	1.0	1.0		
ft/min	N/A[2]	N/A	N/A		
Pre-Verification	DN361CAB	DN361CAB	DN371CAB		
Start File	DN361000	DN361028	DN371000		
Finish File	DN361027	DN361042	DN371005		
Post-Verification	DN361CAA	DN361CAA	DN371CAA		
Depth Return Error (in.)	N/A	- 1	0		
Comments	No fine-gain adjustment.	No fine-gain adjustment.	No fine-gain adjustment.		

Neutron Moisture Logging System (NMLS) Log Run Information:

Log Run	6	7 Repeat			
Date	07/18/06	07/18/06			
Logging Engineer	Spatz	Spatz			
Start Depth (ft)	3.0	9.0			
Finish Depth (ft)	30.0	27.0			
Count Time (sec)	15	15			
Live/Real	R	R			
Shield (Y/N)	N	N			
Sample Interval (ft)	0.25	0.25			
ft/min	1.0	1.0			
Pre-Verification	DH152CAB	DH152CAB			
Start File	DH152000	DH152109			
Finish File	DH152108	DH152181			
Post-Verification	DH152CAA	DH152CAA			
Depth Return Error (in.)	N/A	N/A			
Comments	None	None			

Passive Neutron Logging System (PNLS) Log Run Information:

Log Run	4	5 Repeat			
Date	07/18/06	07/18/06			
Logging Engineer	Spatz	Spatz			
Start Depth (ft)	3.0	9.0			
Finish Depth (ft)	30.0	27.0			
Count Time (sec)	60	60			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	1.0	1.0			
ft/min	N/A	N/A			
Pre-Verification	DI412CAB	DI412CAB			
Start File	DI412000	DI412028			
Finish File	DI412027	DI412046			
Post-Verification	DI412CAA	DI412CAA			
Depth Error (in.)	N/A	N/A			
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 with the SGLS were acquired at a 400 second counting time from 9 to 27 ft to provide additional detail of the highest activity zone. Because the repeat data acquired at 400 seconds are statistically more valid than data acquired at 200 seconds, the repeat data are plotted in the main logs.

Analysis Notes:

Analyst:	Henwood	Date:	09/28/06	Reference:	GJO-HGLP 1.6.3, Rev. 0

Pre-run and post-run verifications for the logging systems were performed before and after each day's data acquisition. The acceptance criteria were met.

A casing correction for 5/16-in.-thick casing was applied throughout the borehole for the SGLS.

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 G4NApr06.xls using an efficiency function and corrections for casing and dead time as determined from annual calibrations. The NMLS count rate data were converted to volumetric moisture according to calibration data for a 6-in. borehole. The passive neutron logging system data are used for qualitative purposes and do not require a calibration.

Results and Interpretations:

241Am is detected from 11 to 30 ft. The maximum concentration is measured at approximately 3,000,000 pCi/g at 13 ft. Gamma rays at approximately 662, 722, and 208 keV were detected that represent 241Am. 137Cs emits a 661.66 gamma ray that cannot be distinguished from the 662.40 gamma ray emitted from 241Am. A corroborating energy peak at 722.01 keV is used to establish the presence of 241Am rather than 137Cs. In this borehole the 722.01 keV energy peak is used to determine the 241Am concentration. There appeared to be no residual counts in the 662 keV peak that could be attributed to 137Cs.

The 241Am concentrations derived from the 208.01 keV gamma line are significantly over estimated. A 208.00 keV gamma line that results from the decay of 237U (daughter of 241Pu), interferes with the 208.01 keV gamma line caused by the decay of 241Am. For purposes of this report, it is assumed that all of the counts in the 208 keV energy peak that cannot be attributed to 241Am, reflect decay of 237U. Assuming the waste stream is aged (e.g., 40 years or more), 237U has grown into equilibrium with its parent 241Pu whereby the activity of the daughter product will equal the activity of the parent. It is determined 241Pu exists between 11 and 30 ft at concentrations ranging from 200 to 265,000 pCi/g; the maximum concentration is at 19 ft in depth. Even though 241Pu is not measured at each depth location where 239Pu is detected, it is likely the two isotopes exist together.

239Pu was detected in this borehole from 8 to 30 ft. The most prominent gamma energy peaks related to 239Pu exist at 375.05, 413.71, and 345.01 keV. Potential interferences exist from gamma rays at 376.65 keV (241Am), 375.45 keV (233Pa), 415.88 keV (241Am), 415.76 keV (233Pa). The 345.01 keV gamma ray was observed with no obvious interferences and was used to quantify 239Pu. The concentrations determined from the 345.01 keV 239Pu gamma ray ranged from 43,000 to 9,600,000 pCi/g; the maximum concentration is reported at 19 ft.

Although 240Pu was not detected with the SGLS, it almost certainly exists in this waste stream.

237Np is detected with the SGLS by measuring a daughter product (protactinium-233 (233Pa)) that emits a prominent gamma ray at an energy of 312.17 keV. 233Pa was detected from 9 to 30 ft. The maximum concentration is approximately 43 pCi/g at a 19 ft depth.

An elevated 232Th concentration as determined using the 2615 keV (208Tl) energy peak, is indicated from 12 to 30 ft. The plot of natural gamma logs shows the disruption of the equilibrium of the natural 232Th decay, where the 228Ac (911.20 keV) indicates 232Th concentrations below that calculated from the 208Tl (2615 keV) gamma line. This difference is attributed to the existence of 232U. To determine the concentration of 232U, the activity due to natural decay of 232Th must be subtracted. The 228Ac concentrations based on the 911.20 keV gamma line are subtracted from the 232Th concentrations calculated based on the 2615 keV 208Tl energy peak. The result is a concentration range from 0.3 to 4.8 pCi/g 232U.

233U almost certainly exists where 232U is detected. In a reactor using thorium target material, 233U will be generated at two to three orders of magnitude more than 232U. However, at relatively low concentrations, 233U does not emit a gamma ray that can be detected with the SGLS. Decay products that potentially could be measured, have not had sufficient time to grow into equilibrium with their parent so that detection is possible. It is inferred on the basis of the 232U concentration that 233U may exist at concentrations between 100 and 1000 pCi/g in this waste stream.

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 approximately 440 counts per second (cps) at 13 ft. It is likely Pu exists as a fluoride compound. 19F has a much higher capture cross section for alpha particles, compared to other light elements such as oxygen or nitrogen.

The existence of fluoride compounds is corroborated by the existence of gamma energy peaks at approximately 1275 keV. The 19F (α,nγ)22Na reaction yields a prompt 1275 keV gamma ray. In addition, 22Na that is created by this reaction also emits a decay gamma ray at approximately 1275 keV. These reactions will continue as long as sufficient fluorine and alpha activity exist. For purposes of this report, the 1275 keV gamma ray is assumed to be the result of 22Na decay in its entirety. The maximum concentration of 22Na is approximately 1 pCi/g. Fluoride compounds are also corroborated by the existence of an elevated 583 keV energy peak that also occurs from a prompt gamma ray from the 19F (α,nγ)22Na reaction.

Other energy peaks are observed in the high neutron flux interval that represent capture gamma rays from elements in the formation, steel casing, or the waste stream itself. These include a 2223.2-keV H capture □-ray, 28Al(n,g) at 1779 keV or 25Mg (α,n) at 1779 keV and others.

Moisture data indicate some variability. A relatively high moisture content exhibited at 13 ft could be influenced by the large neutron flux indicated by the passive neutron at that depth.

A comparison plot of the 1993 RLS (operated by Westinghouse Hanford Company) spectral gamma data and 2006 SGLS data is included. There is generally poor agreement in the data sets as a result of different analysis techniques. Available information from a plot of RLS data shows 239Pu is “off scale” and no concentrations are reported. The SGLS data indicates 239Pu concentrations up to 10,000,000 pCi/g. Additionally 241Pu is detected and reported.

The 241Am concentrations determined in 1993 and 2006 are different by more than an order of magnitude. It is possible the RLS analysis used the 60 keV energy peak to determine concentrations. The SGLS analysis used the 722.01 keV energy peak because the 60 keV peak falls below the calibration range of the detection system.

232U is identified by the current analysis on the basis of an elevated 208Tl energy peak; 233U is inferred to exist as well. The RLS analysis does not report the existence of these radionuclides.

237Np, based on the 312 keV energy peak of the daughter 233Pa, exhibits a similar profile in both analyses. Different calibrations for the two systems may have resulted in slightly lower concentrations (approximately 25 %) reported by the RLS. Alternatively, it is possible the apparent increase since 1993 is at least partially the result of ingrowth of 237Np from decay of the parent 241Am. Approximately 10 pCi/g of 237Np would build in from an initial 241Am activity of 3,000,000 pCi/g in 10 years. It is not believed migration of 237Np has occurred.

The RLS analysis reported 137Cs concentrations ranging from 1 to 10 pCi/g. Current analysis reports no 137Cs and attributes all the counts recorded in the 662 energy peak to the 662.40 keV gamma ray originating from 241Am.

The SGLS, NMLS, and PNLS repeat logs all show good repeatability.

List of Log Plots:

Depth Reference is top of casing
Depth Scale - 20 ft/inch except for repeat logs

Man-made Radionuclide Plot
Natural Gamma Logs
Combination Plot (20 ft/inch)
Combination Plot (10 ft/inch)
Total Gamma, Moisture, & Passive Neutron
Total Gamma & Dead Time
SGLS/RLS Manmade Comparison Plot
Manmade Radionuclides Repeat Plot
Repeat Section of Natural Gamma Logs
Repeat of Total Gamma, Moisture, & Passive Neutron

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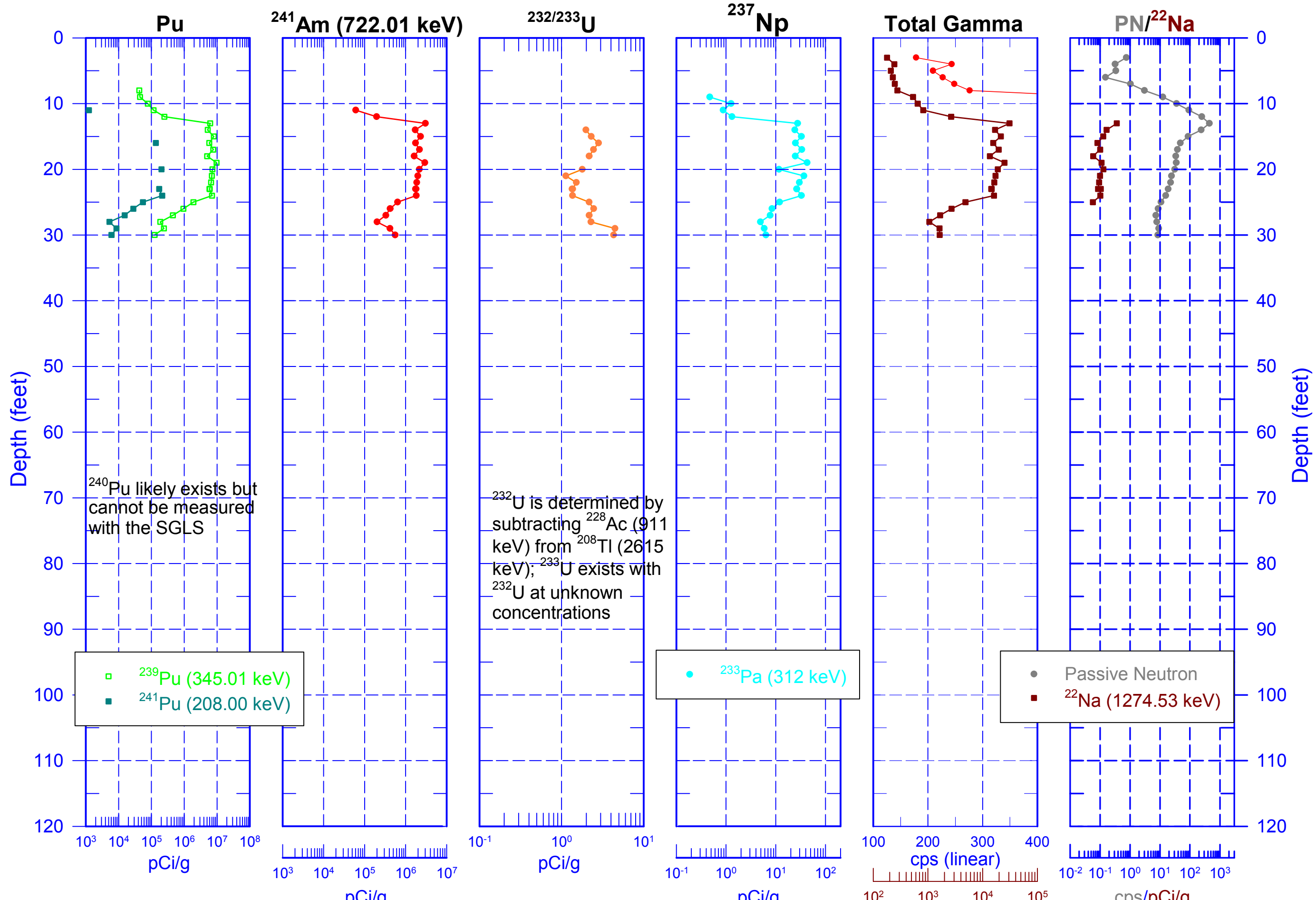
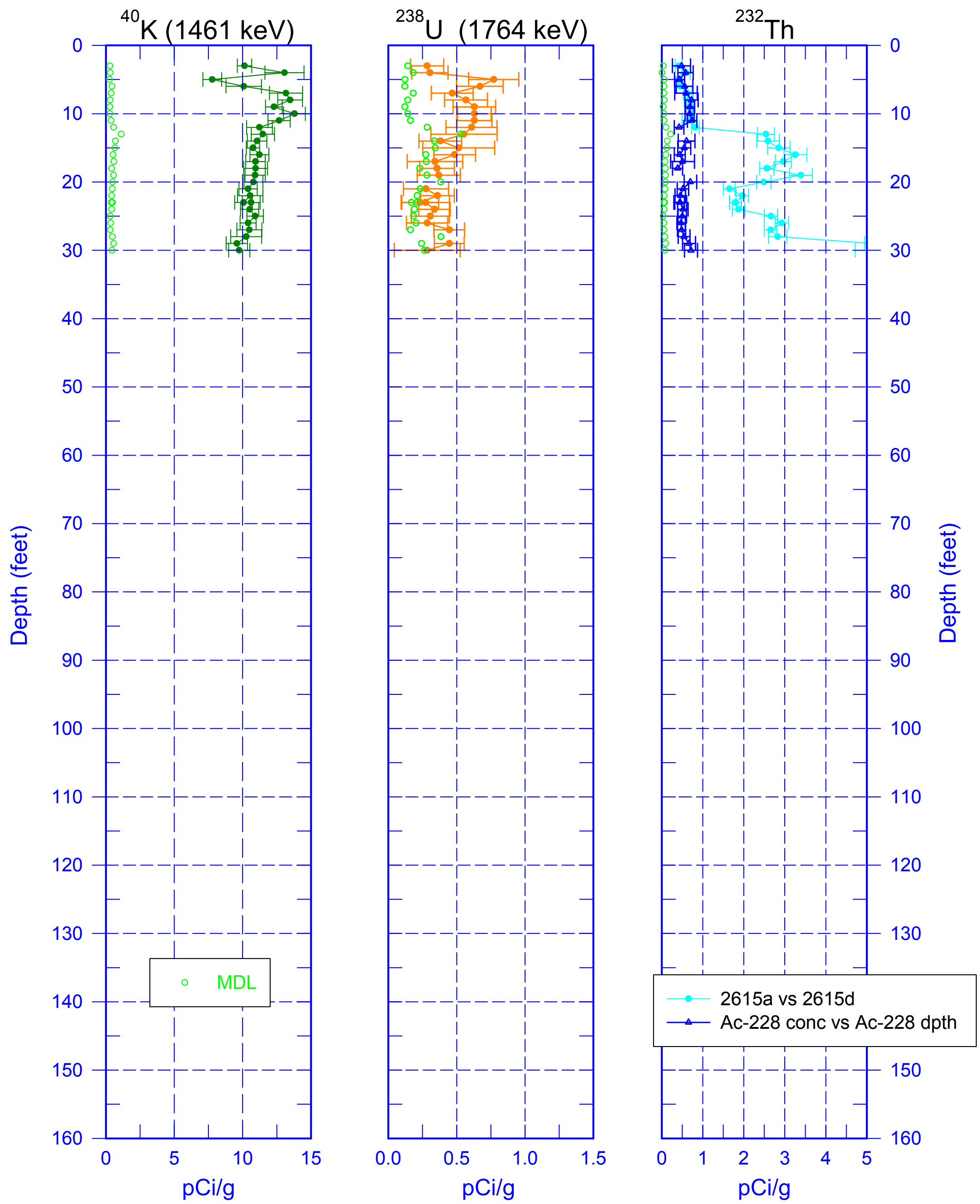
1 GWL – groundwater level

299-W18-170 (A7652) Manmade Radionuclide Plot



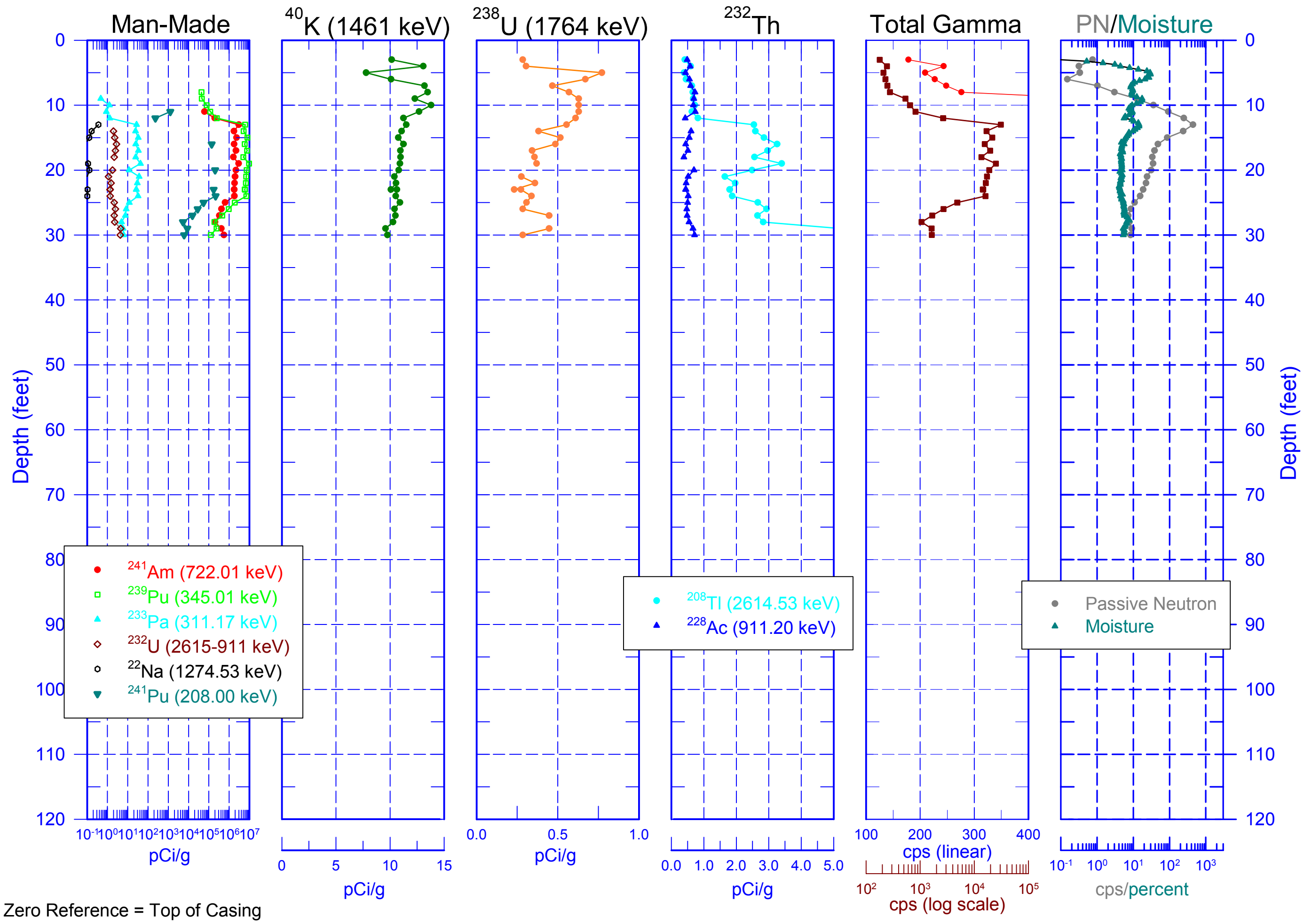
Zero Reference = Top of Casing

299-W18-170 (A7652)
Natural Gamma Logs



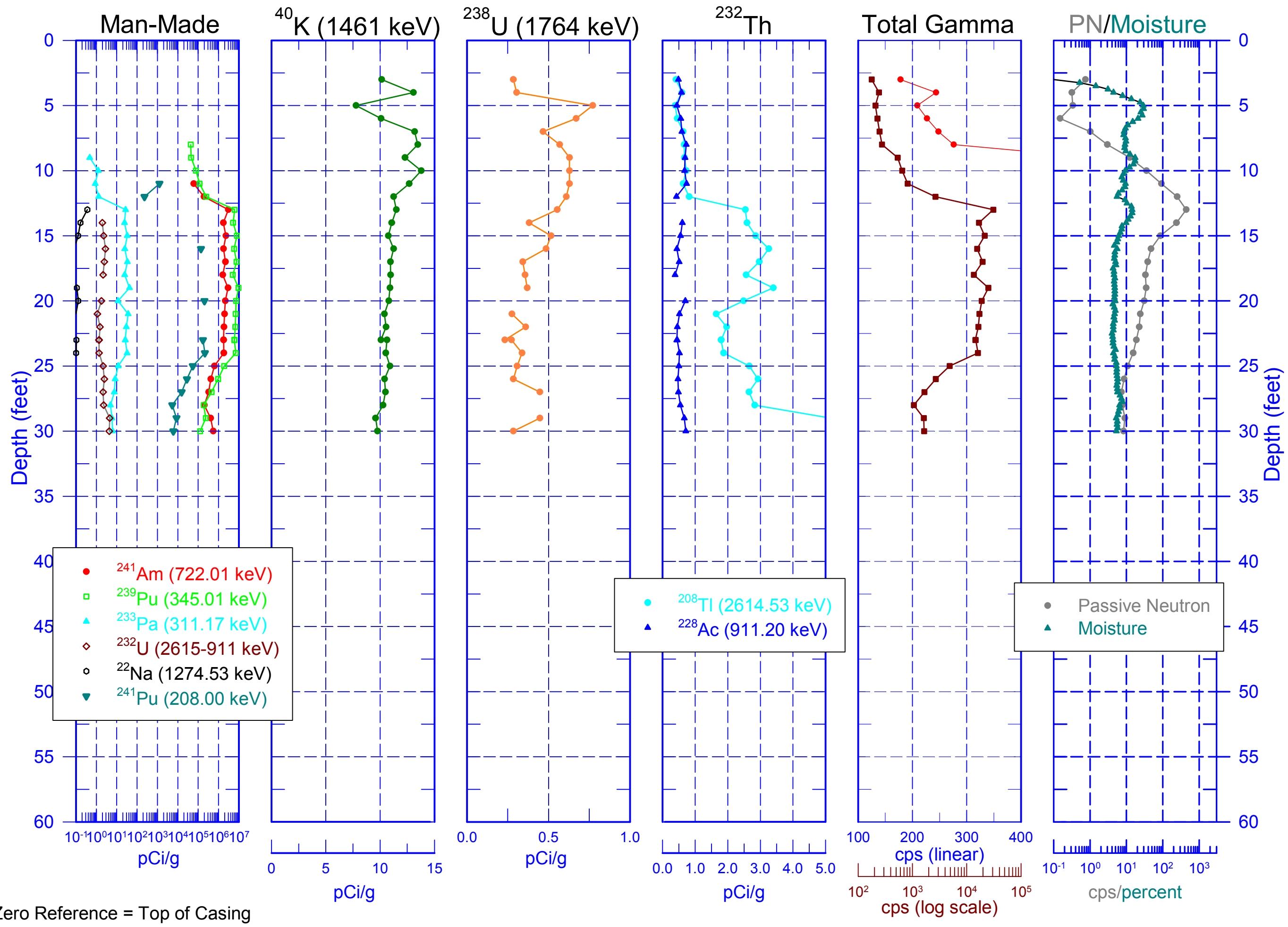
Zero Reference = Top of Casing

299-W18-170 (A7652) Combination Plot



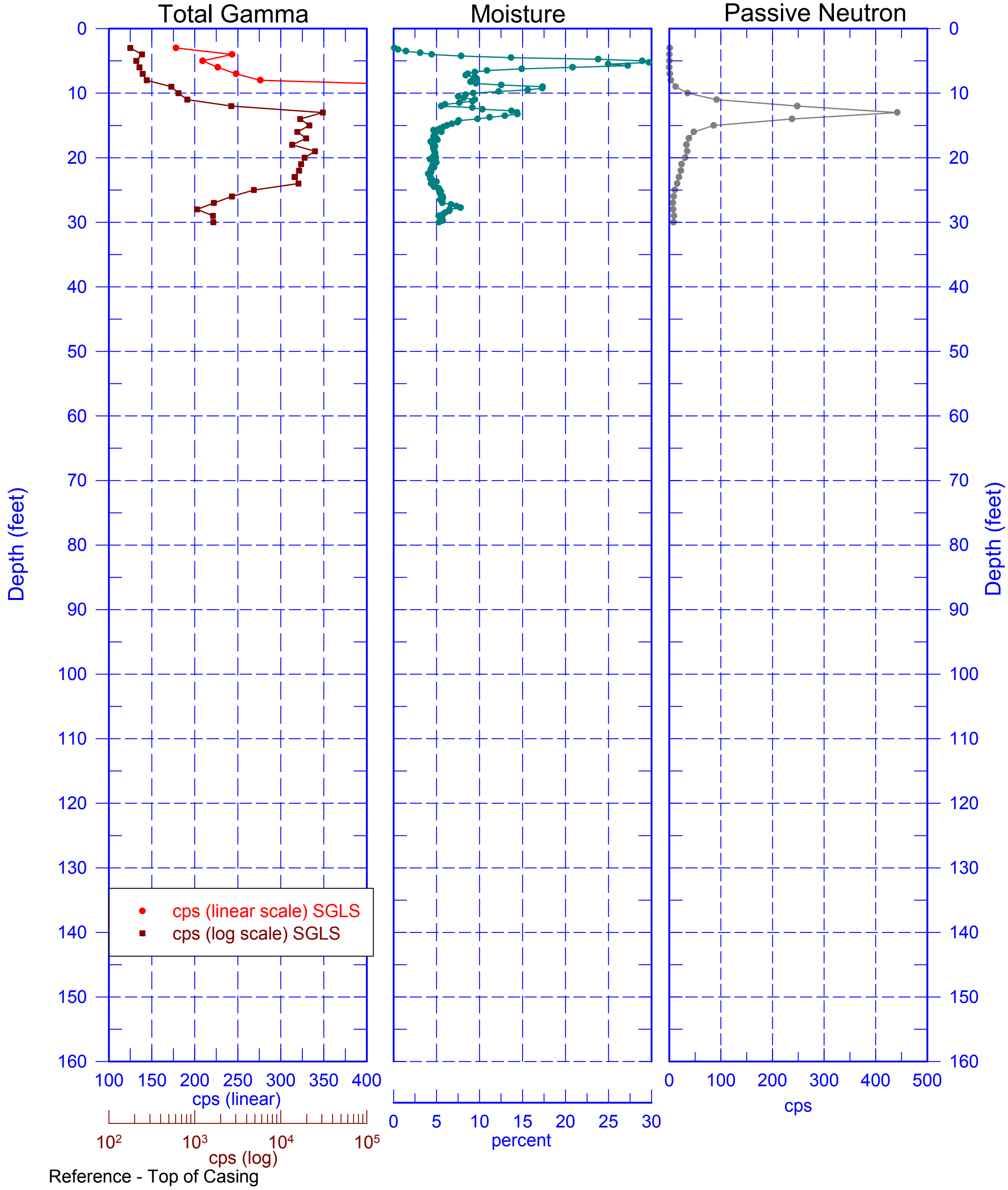
Zero Reference = Top of Casing

299-W18-170 (A7652) Combination Plot

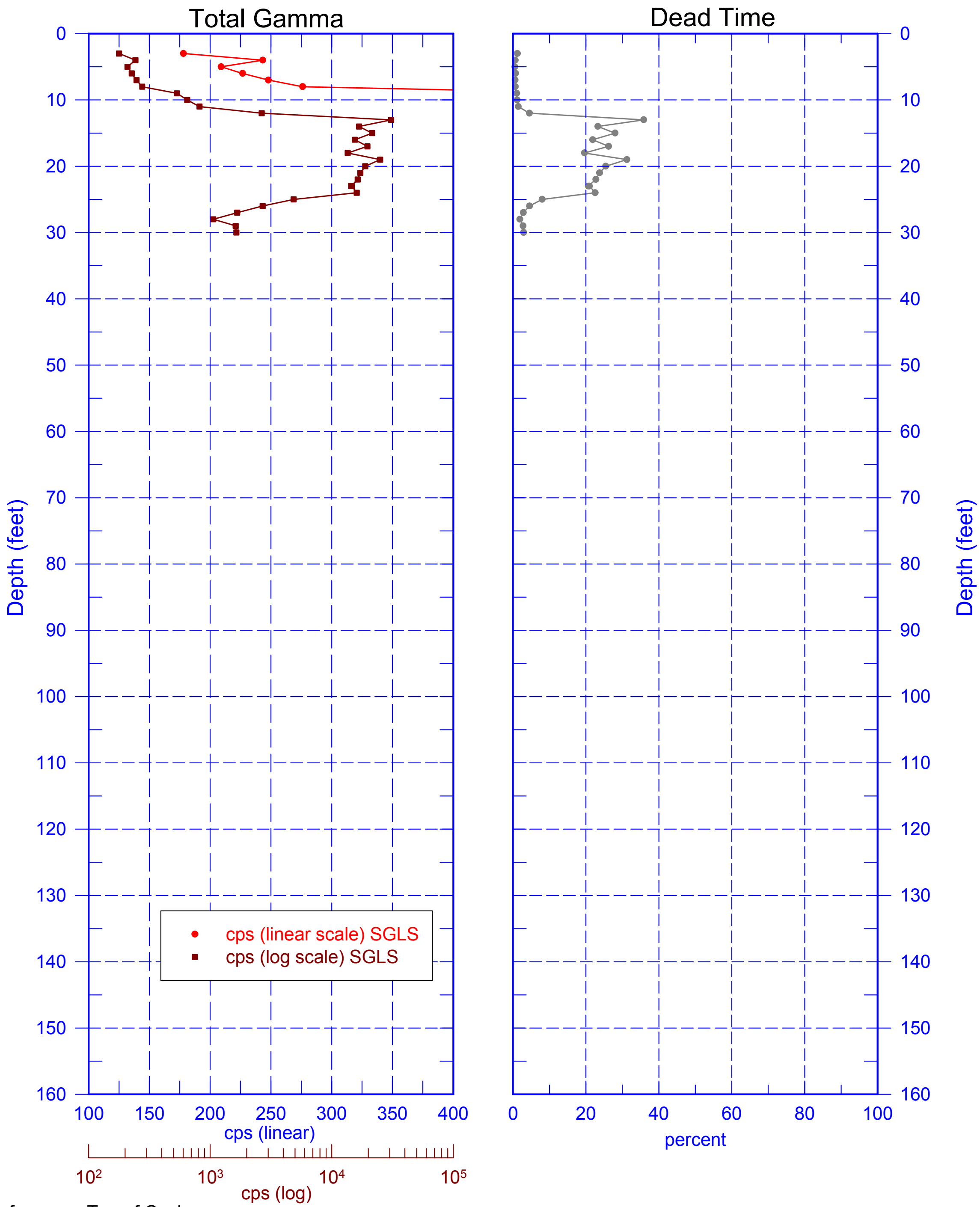


Zero Reference = Top of Casing

299-W18-170 (A7652)
Total Gamma, Moisture, and Passive Neutron

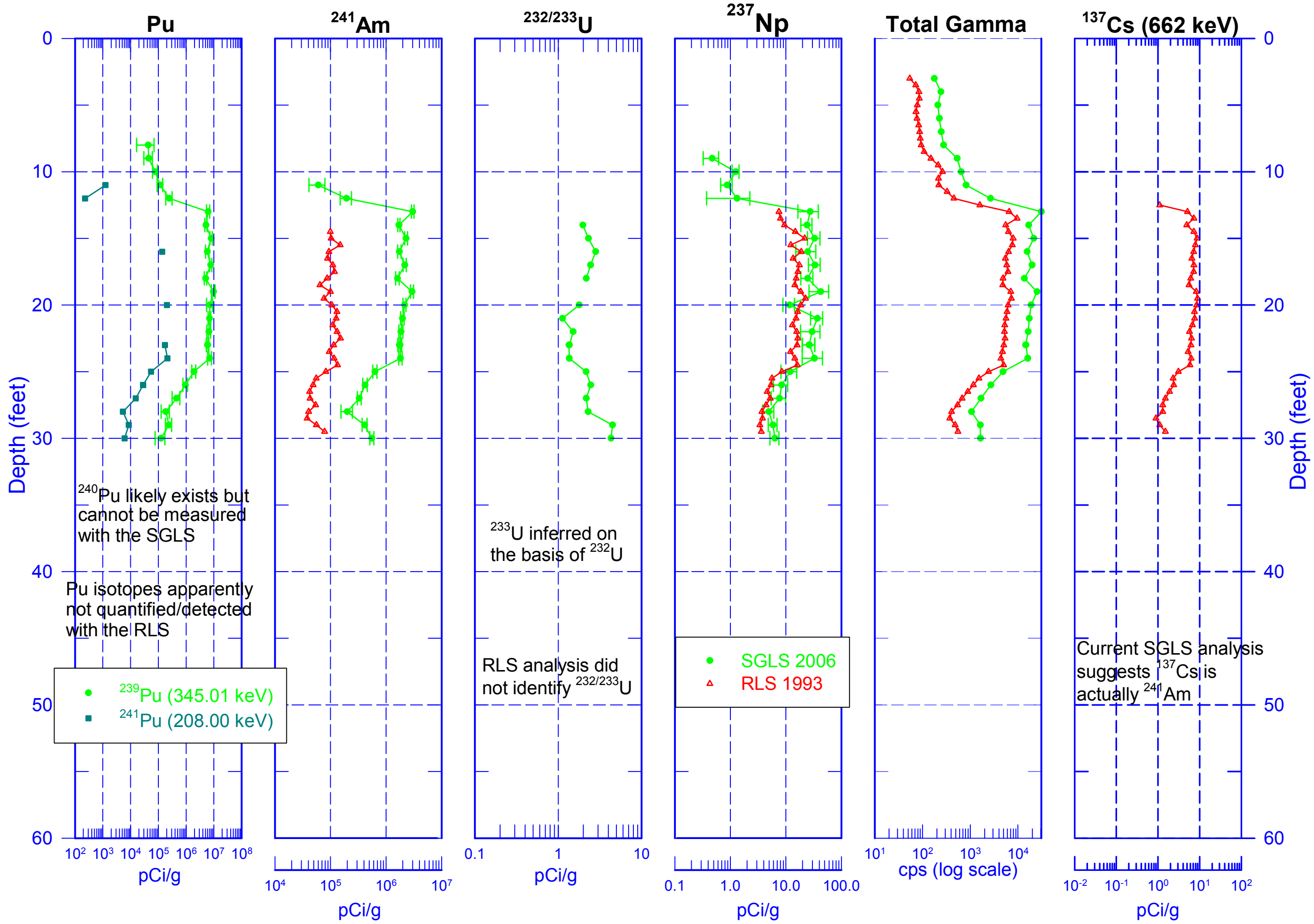


299-W18-170 (A7652)
Total Gamma & Dead Time



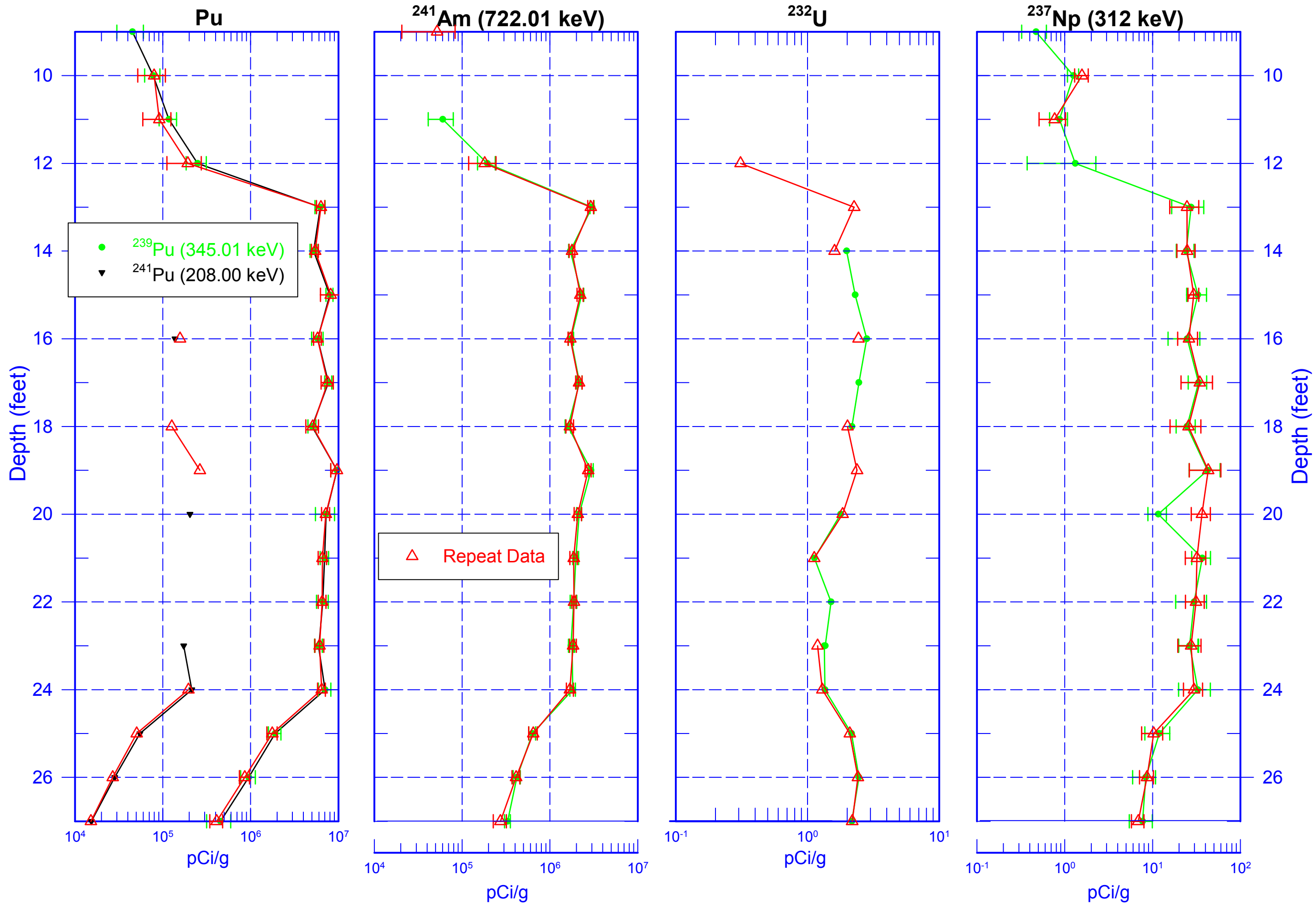
Reference - Top of Casing

299-W18-170 (A7652) SGLS/RLS Manmade Comparison Plot



Zero Reference = Top of Casing

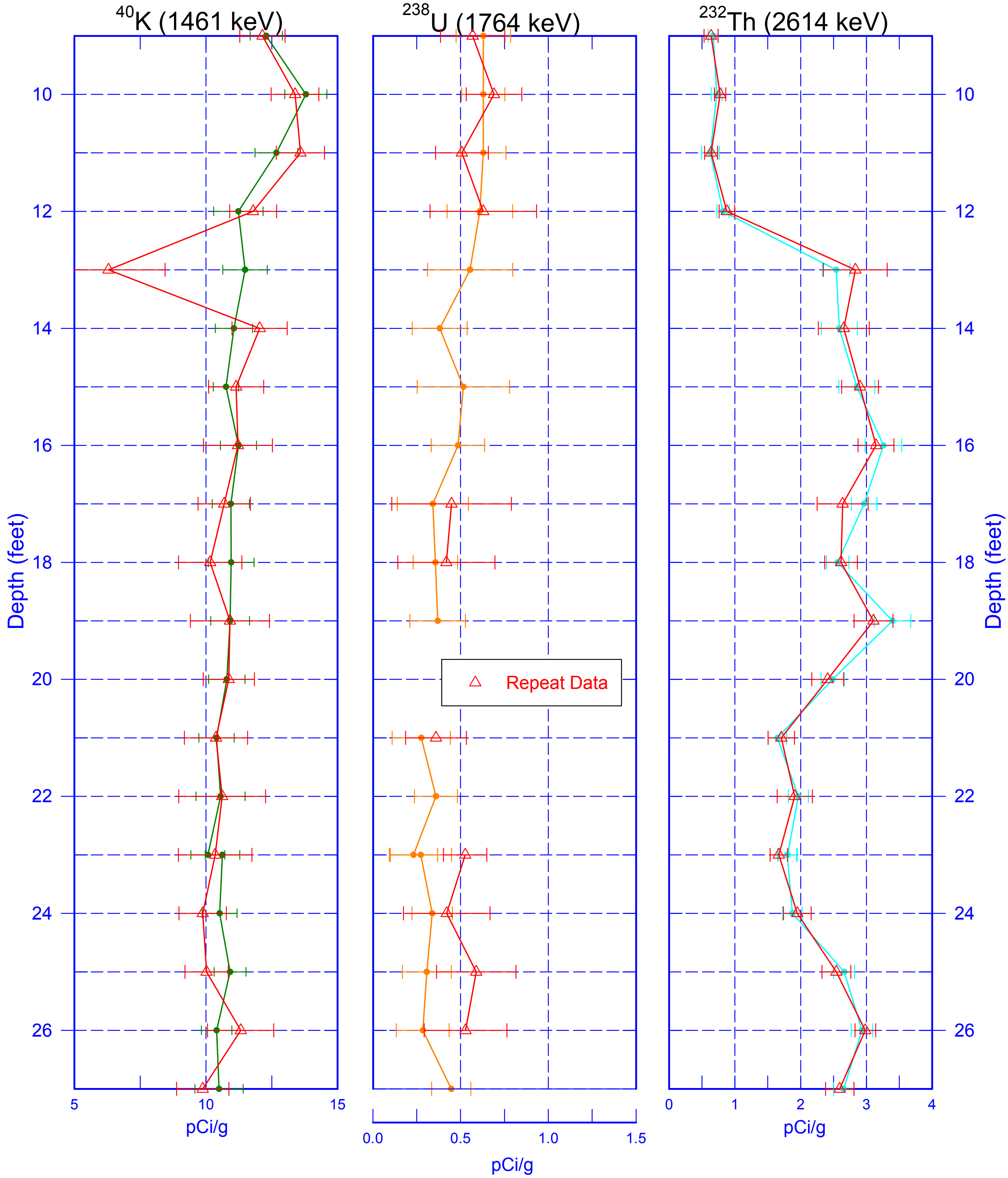
299-W18-170 (A7652) Manmade Radionuclides Repeat Plot



Zero Reference = Top of Casing

299-W18-170 (A7652)

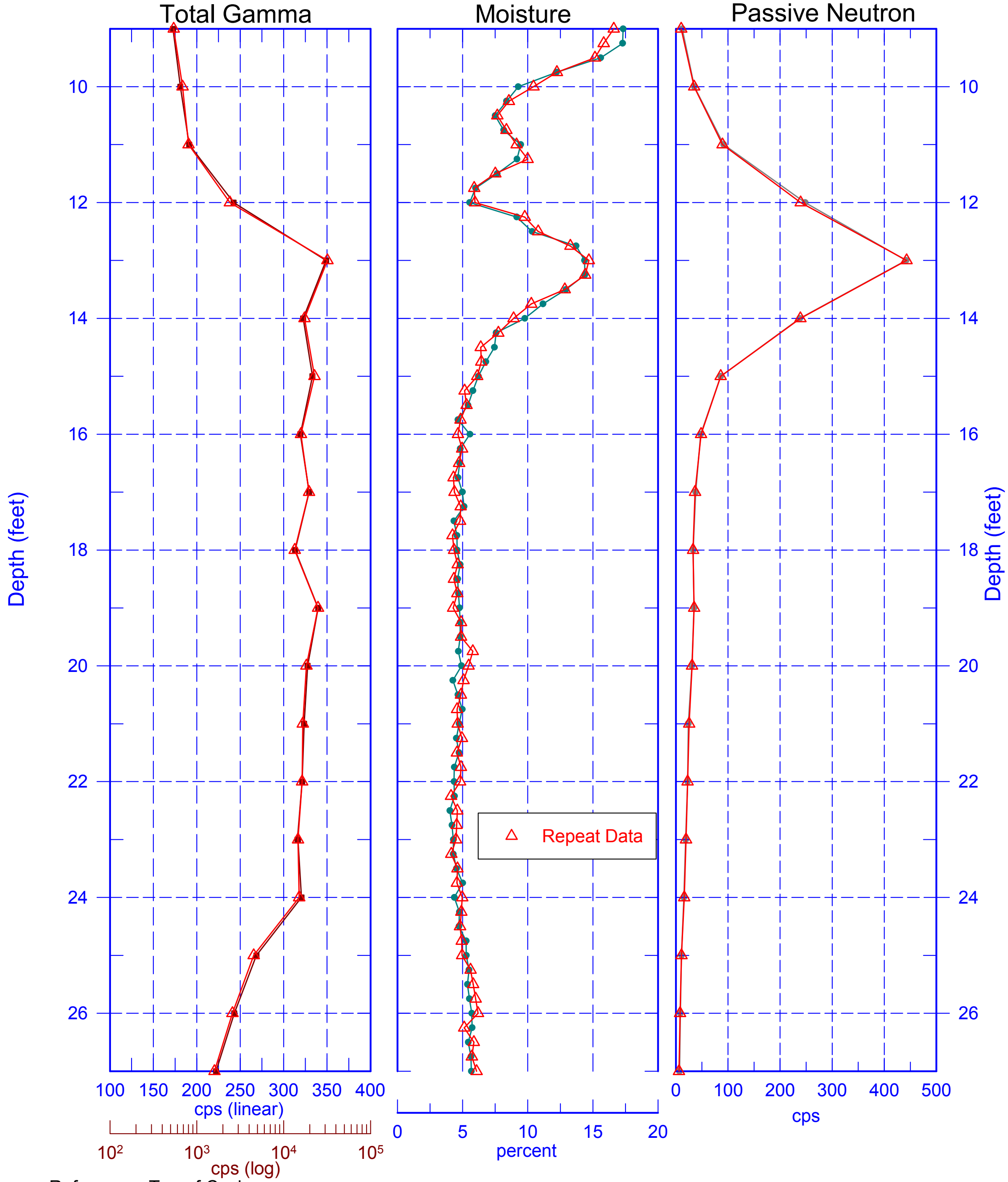
Repeat Section of Natural Gamma Logs



Zero Reference = Top of Casing

299-W18-170 (A7652)

Repeat of Total Gamma, Moisture, and Passive Neutron



Reference - Top of Casing