Stoller
Hanford Office

DOE-EM/GJ1081-2006

299-E24-53 (A5910)
Log Data Report

Borehole Information:

Borehole: 299-E24-53 (A5910)			Site: 216-A-2 Crib		
Coordinates (WA St Plane)		GWL[1] (ft) : None		GWL Date: 10/20/05	
North	East	Drill Date	Elevation (TOC)	Total Depth (ft)	Type
135527.688	575189.278	01/55	715.98	52	Cable

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Welded steel	1.0	8 5/8	8	5/16	0	52

Borehole Notes:

Casing diameter and stickup measurements were acquired using a caliper and steel tape. Measurements are rounded to the nearest 1/16 inch. Logging data acquisition is referenced to the top of casing (TOC).

Spectral Gamma Logging System (SGLS) Equipment Information:

Logging System:	Gamma 4E		Type: SGLS (70%) SN: 34TP40587A
Effective Calibration Date:	12/21/04	Calibration Reference:	DOE/EM-GJ854-2005
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0

High Rate Logging System (HRLS) Equipment Information:

Logging System:	Gamma 1C		Type: HRLS SN: 39-A314
Effective Calibration Date:	10/06/05	Calibration Reference:	DOE/EM-GJ1019-2005
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0

Neutron Moisture Logging System (NMLS) Equipment Information:

Logging System:	Gamma 4F		Type: SN: H380932510
Effective Calibration Date:	10/24/05	Calibration Reference:	DOE/EM-GJ1020-2005
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	4	5	6	7 Repeat	
Date	10/25/05	10/25/05	10/25/05	10/25/05	
Logging Engineer	Spatz	Spatz	Spatz	Spatz	
Start Depth (ft)	51.5	37.5	31.5	20.5	
Finish Depth (ft)	36.5	30.5	1.5	10.5	
Count Time (sec)	100	20	100	100	
Live/Real	R	R	R	R	
Shield (Y/N)	N	N	N	N	
MSA Interval (ft)	1.0	1.0	1.0	1.0	
ft/min	N/A[2]	N/A	N/A	N/A	
Pre-Verification	DE951CAB	DE951CAB	DE951CAB	DE951CAB	
Start File	DE951000	DE951016	DE951024	DE951055	
Finish File	DE951015	DE951023	DE951054	DE951065	
Post-Verification	DE951CAA	DE951CAA	DE951CAA	DE951CAA	
Depth Return Error (in.)	N/A	N/A	0	0	
Comments	No fine-gain adjustment	No fine-gain adjustment	No fine-gain adjustment	No fine-gain adjustment	

High Rate Logging System (HRLS) Log Run Information:

Log Run	8				
Date	10/27/05				
Logging Engineer	Spatz				
Start Depth (ft)	37.5				
Finish Depth (ft)	31.5				
Count Time (sec)	300				
Live/Real	R				
Shield (Y/N)	N				
MSA Interval (ft)	1.0				
ft/min	N/A				
Pre-Verification	AC149CAB				
Start File	AC149000				
Finish File	AC149006				
Post-Verification	AC149CAA				
Depth Return Error (in.)	N/A				
Comments	No fine-gain adjustment				

Neutron Moisture Logging System (NMLS) Log Run Information:

Log Run	1	2	3 Repeat		
Date	10/20/05	10/20/05	10/20/05		
Logging Engineer	Spatz	Spatz	Spatz		
Start Depth (ft)	1.0	26.5	22.5		
Finish Depth (ft)	27.5	51.75	32.5		
Count Time (sec)	N/A	N/A	N/A		
Live/Real	R	R	R		
Shield (Y/N)	N	N	N		
MSA Interval (ft)	0.25	0.25	0.25		
ft/min	1.0	1.0	1.0		
Pre-Verification	DF062CAB	DF072CAB	DF072CAB		
Start File	DF062000	DF072000	DF072102		
Finish File	DF062106	DF072101	DF072142		

Log Run	1	2	3 Repeat		
Post-Verification	DF062CAA	DF072CAA	DF072CAA		
Depth Return Error (in.)	0	N/A	N/A		
Comments	None	None	None		

Logging Operation Notes:

Logging was performed in this borehole with the SGLS, HRLS, and NMLS. Logging was conducted with a centralizer on each sonde. Measurements are referenced to the top of casing. Repeat sections were collected in this borehole to evaluate the logging systems' performance.

Analysis Notes:

Analyst:	Henwood	Date:	12/19/05	Reference:	GJO-HGLP 1.6.3, Rev. 0

Pre-run and post-run verifications for the logging systems were performed before and after data acquisition. Acceptance criteria were met for all systems.

A casing correction for 5/16-in.-thick casing (8-in. casing) was applied to the spectral log data (SGLS and HRLS). For moisture corrections an 8-in. inside diameter casing was assumed.

SGLS and HRLS spectra were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated with EXCEL worksheet templates identified as G4EApr05.xls and G1COct05.xls for the SGLS and HRLS, respectively, using efficiency functions and corrections for casing, water, and dead time as determined from annual calibrations. Dead time corrections are applied where dead times exceed approximately 11 percent. Where SGLS dead time exceeds 40 percent, HRLS data are substituted. Correction for water was not needed in this borehole.

Results and Interpretations:

^{137}Cs was detected from 29 ft to the bottom of the borehole (52 ft). A zone of high ^{137}Cs exists between approximately 29 and 40 ft. The maximum concentration is approximately 4,600 pCi/g at 33.5 ft.

^{60}Co was detected at 31.5 ft and from 36.5 to 48.5 ft. The maximum concentration is approximately 4 pCi/g at 36.5 ft. It is probable ^{60}Co also exists in the high rate interval from 32 to 36.5 ft at higher concentrations.

^{154}Eu was detected at 31.5 ft and from 36.5 to 40.5 ft. The maximum concentration is approximately 6 pCi/g at 36.5 ft. It is probable ^{154}Eu also exists in the high rate interval from 32 to 36.5 ft at higher concentrations.

Gamma activity from uranium is usually dominated by emissions from ^{238}U daughters such as ^{226}Ra, ^{214}Pb, and ^{214}Bi. These isotopes occur in the lower part of the decay chain and achieve secular equilibrium with the parent ^{238}U over a time frame approaching a million years. Processed uranium refers to material that has been chemically purified. The purification process removes the daughter elements; therefore, man-made uranium can be differentiated from natural uranium by the absence of gamma rays from long-term daughters combined with the presence of less intense gamma rays from short-term daughters.

The primary gamma activity associated with man-made uranium originates from ^{234m}Pa. The 1001-keV gamma ray is the most intense (0.84% yield), and a confirming line occurs at 766 keV (0.29% yield). These lines are seldom strong enough to be detected in natural uranium at background levels, but can be detected when man-made uranium concentrations exceed 10 pCi/g. Natural uranium is most commonly detected and quantified from gamma rays at 1764 or 609 keV (yields of 15.4% and 44.8%, respectively), at

levels below 1 pCi/g. These gamma rays originate from ^{214}Bi, which is far down in the decay series and therefore not present in detectable amounts in man-made uranium. However, ^{214}Bi is a short-term daughter of ^{222}Rn, and it is possible that ^{214}Bi concentrations may be temporarily elevated as a result of radon accumulation.

Processed uranium also contains ^{235}U in various amounts according to the enrichment used for the reactor fuel at Hanford and burn up time. This radionuclide can be measured directly from energy peaks at approximately 186, 202, and 205 keV. The highest yield (57.2 %) is from the 186-keV gamma ray that is used to assay ^{235}U.

Evidence of processed uranium exists from 37.5 to 51.5 ft (total depth of the borehole). Although no detections of processed uranium exist in the high activity zone between 29 and 37.5 ft, it is likely present. The MDLs for ^{234m}Pa and ^{235}U in the high activity zone, as determined from the SGLS, are approximately 20,000 and 700 pCi/g, respectively. The maximum concentrations determined from the SGLS for ^{234m}Pa and ^{235}U were approximately 500 and 35 pCi/g, respectively.

Moisture measurements show significant variability with the maximum percent moisture of 22 percent indicated at 49 ft.

Spectral gamma and moisture data were acquired in this borehole in 1999 by Waste Management Federal Services NW using the Radionuclide Logging System (RLS). A comparison of RLS spectral data with the current SGLS and HRLS data indicates good agreement and no significant changes since 1999. The moisture profiles also indicate good agreement even though approximately 6 years have elapsed between measurements.

The repeat sections for the SGLS and NMLS indicate good agreement for the naturally occurring radionuclides and moisture.

A visual comparison of the log profiles of a total gamma log acquired by PNL in 1982 and the current SGLS total gamma indicates similar character, suggesting no significant changes in the past 23 years.

List of Plots:

^{137}Cs (662 keV)
^{60}Co and ^{154}Eu
Processed Uranium
Natural Gamma Logs
Combination Plot
Total Gamma & Moisture
Total Gamma & Dead Time
RLS/SGLS Comparison of ^{137}Cs
RLS/SGLS Comparison of ^{60}Co and ^{154}Eu
RLS/SGLS Comparison of Uranium
Moisture Comparison
Repeat Section of Natural Gamma Logs
Moisture Repeat Section

[1] GWL – groundwater level
[2] N/A – not applicable

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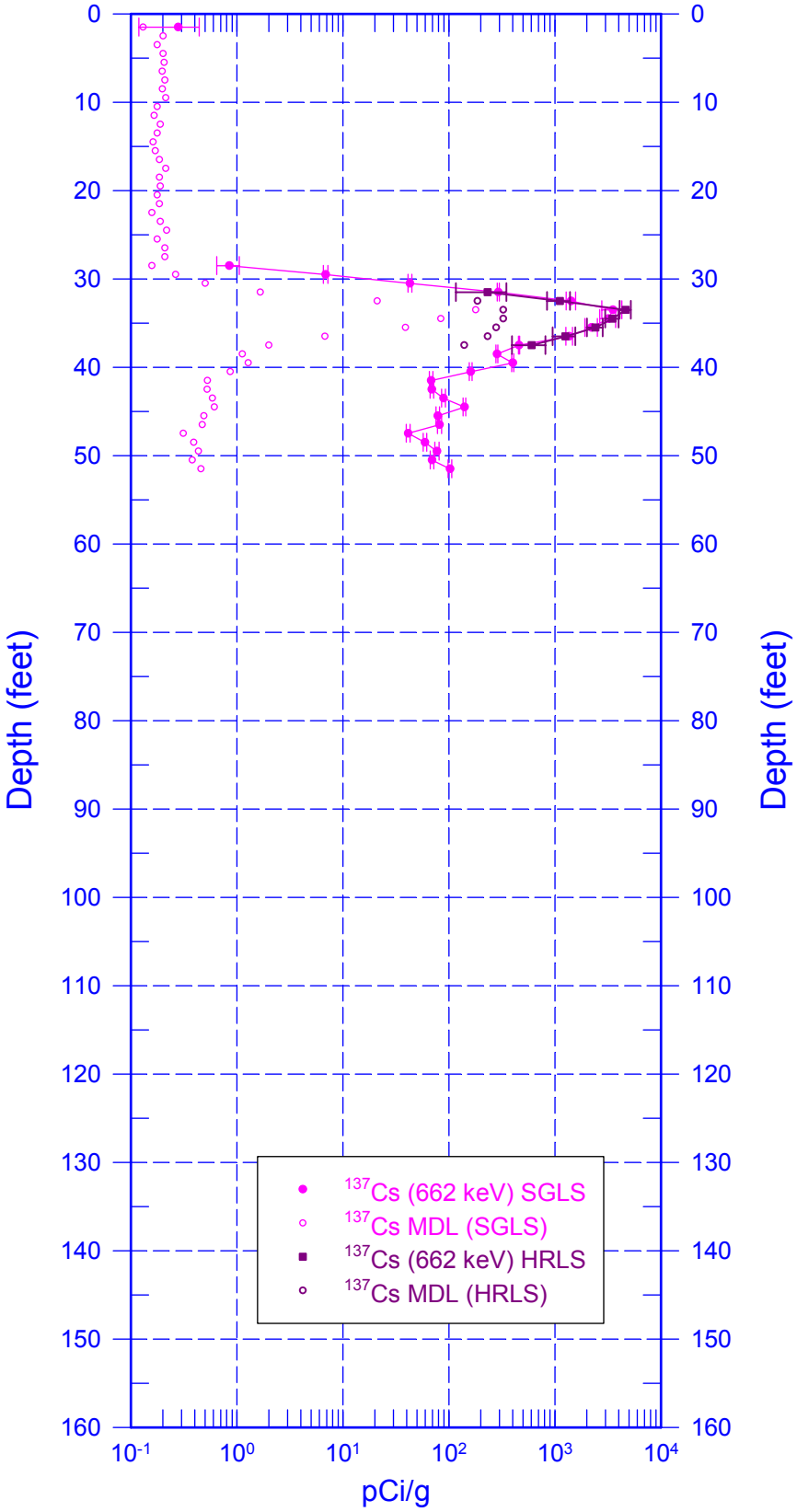
^{137}Cs (662 keV)



Zero Reference = Top of Casing

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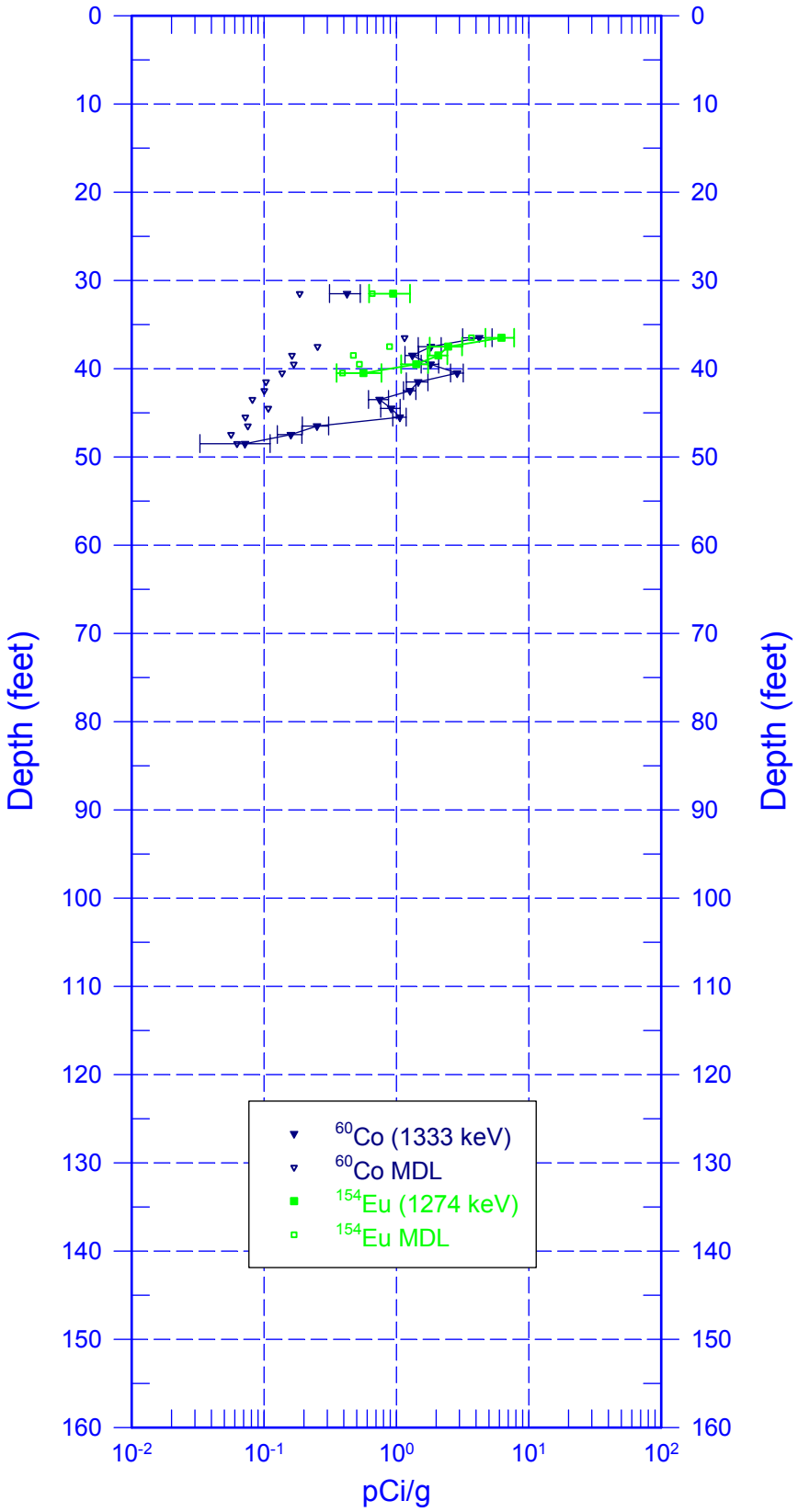
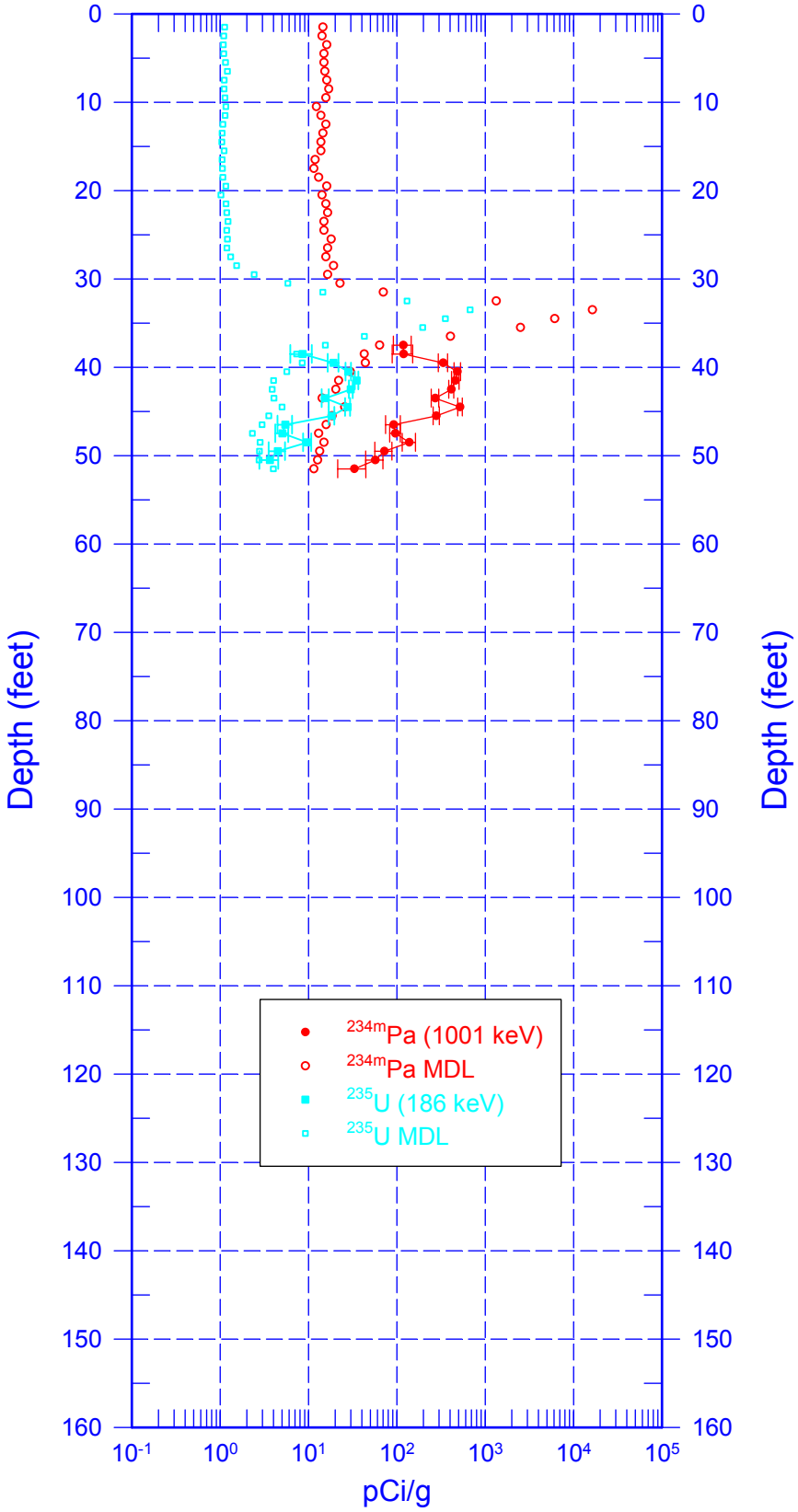
^{60}Co and ^{154}Eu



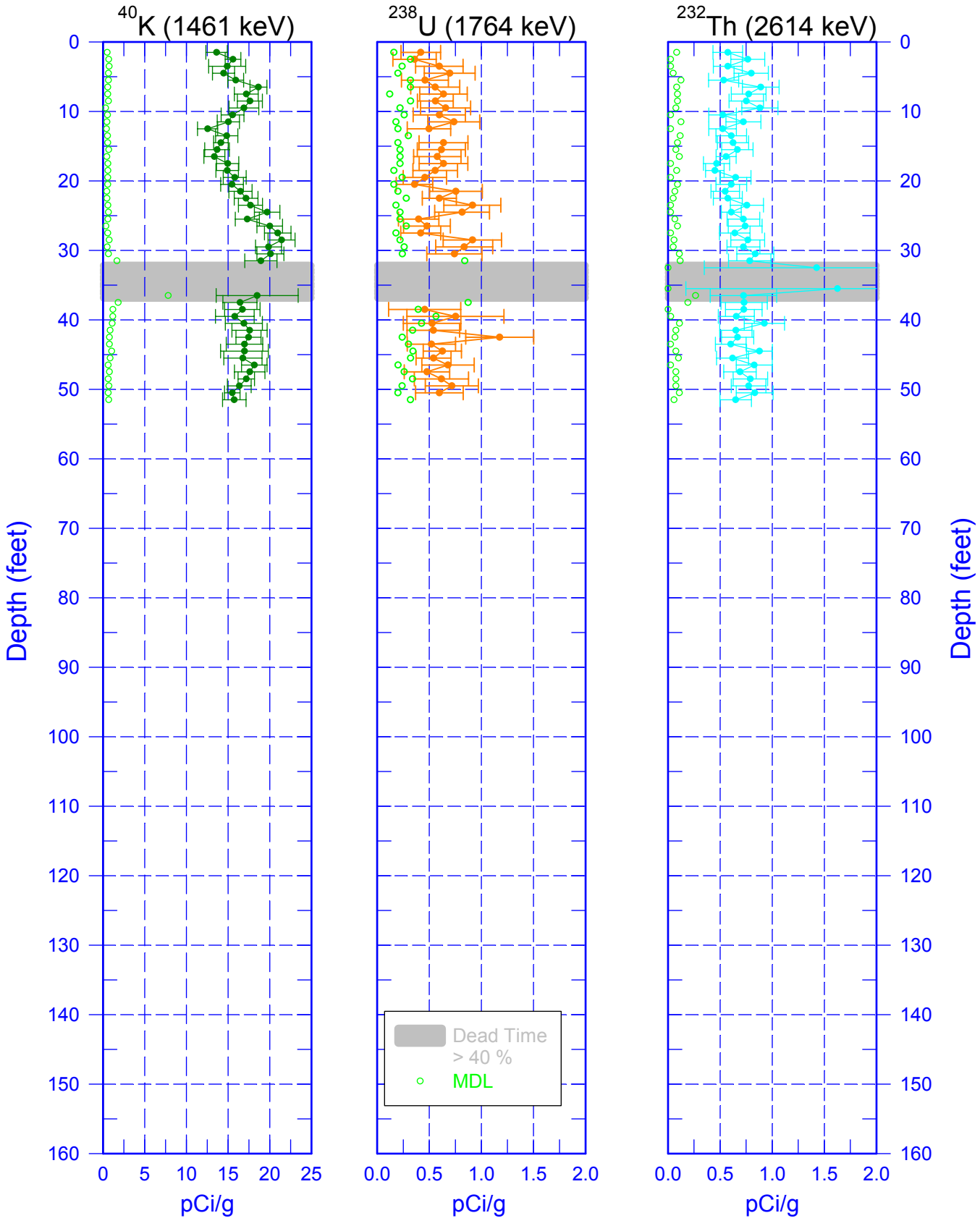
Zero Reference = Top of Casing

299-E24-53 (A5910)
Processed Uranium



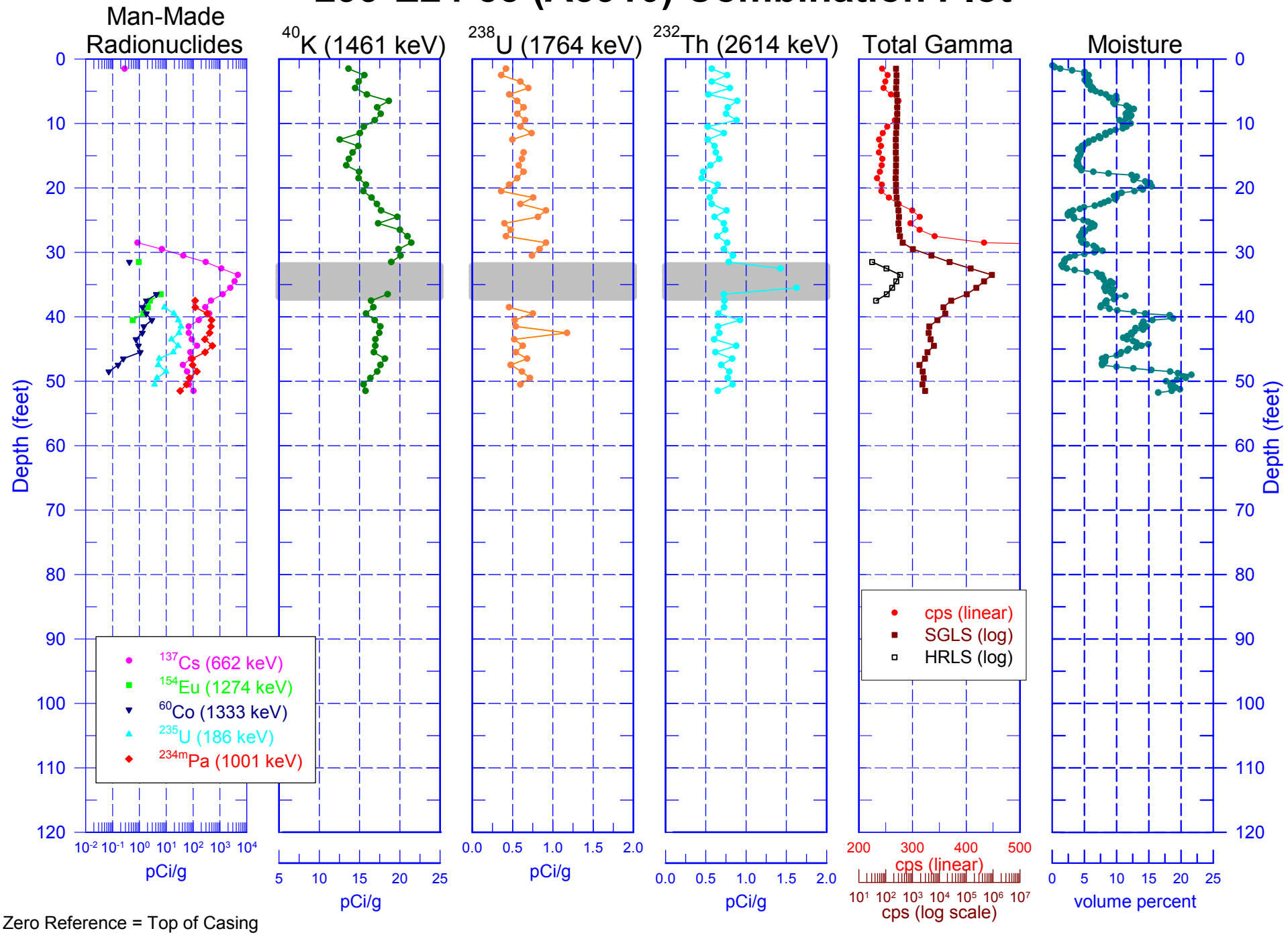
Zero Reference = Top of Casing

299-E24-53 (A5910)
Natural Gamma Logs



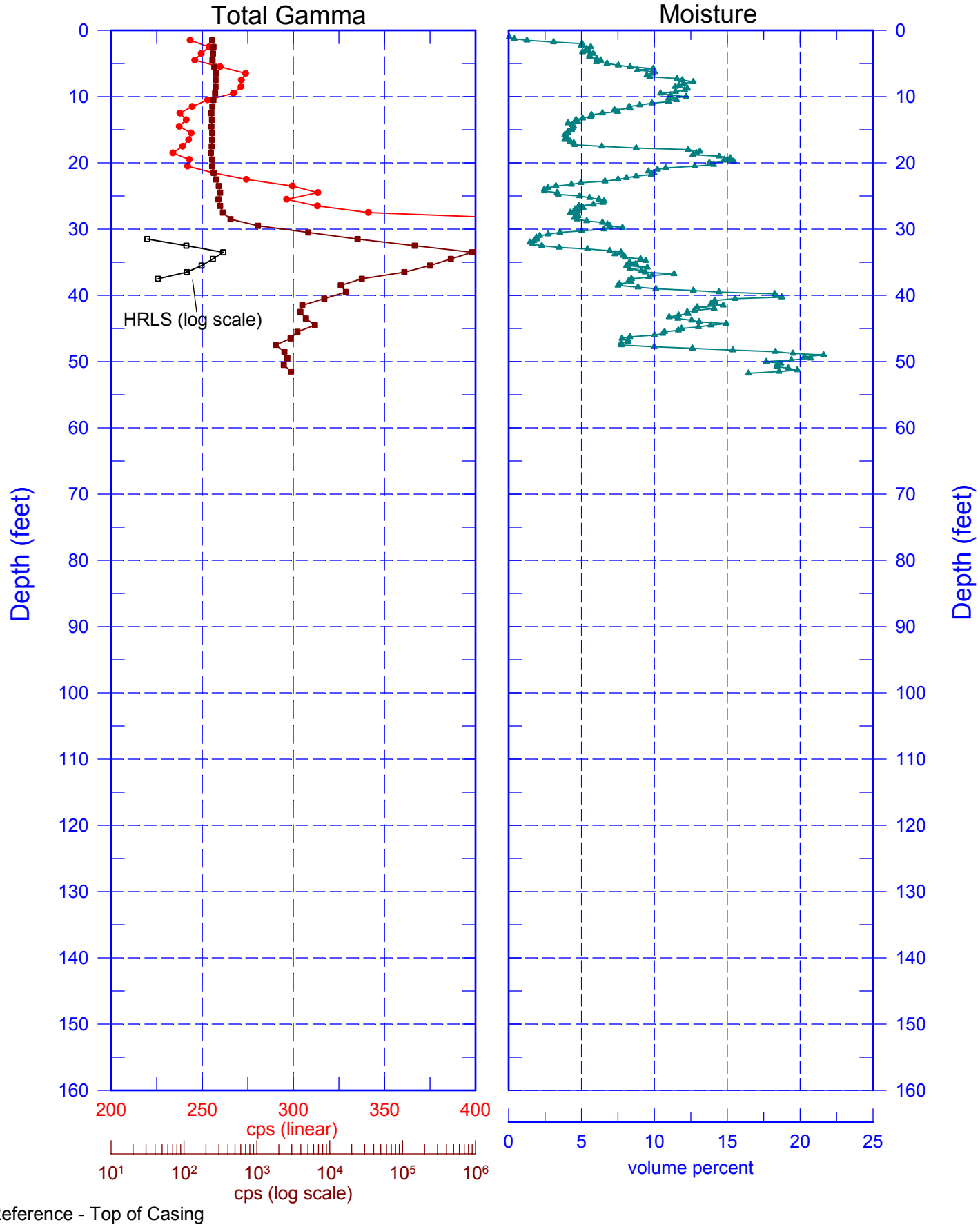
Zero Reference = Top of Casing

299-E24-53 (A5910) Combination Plot



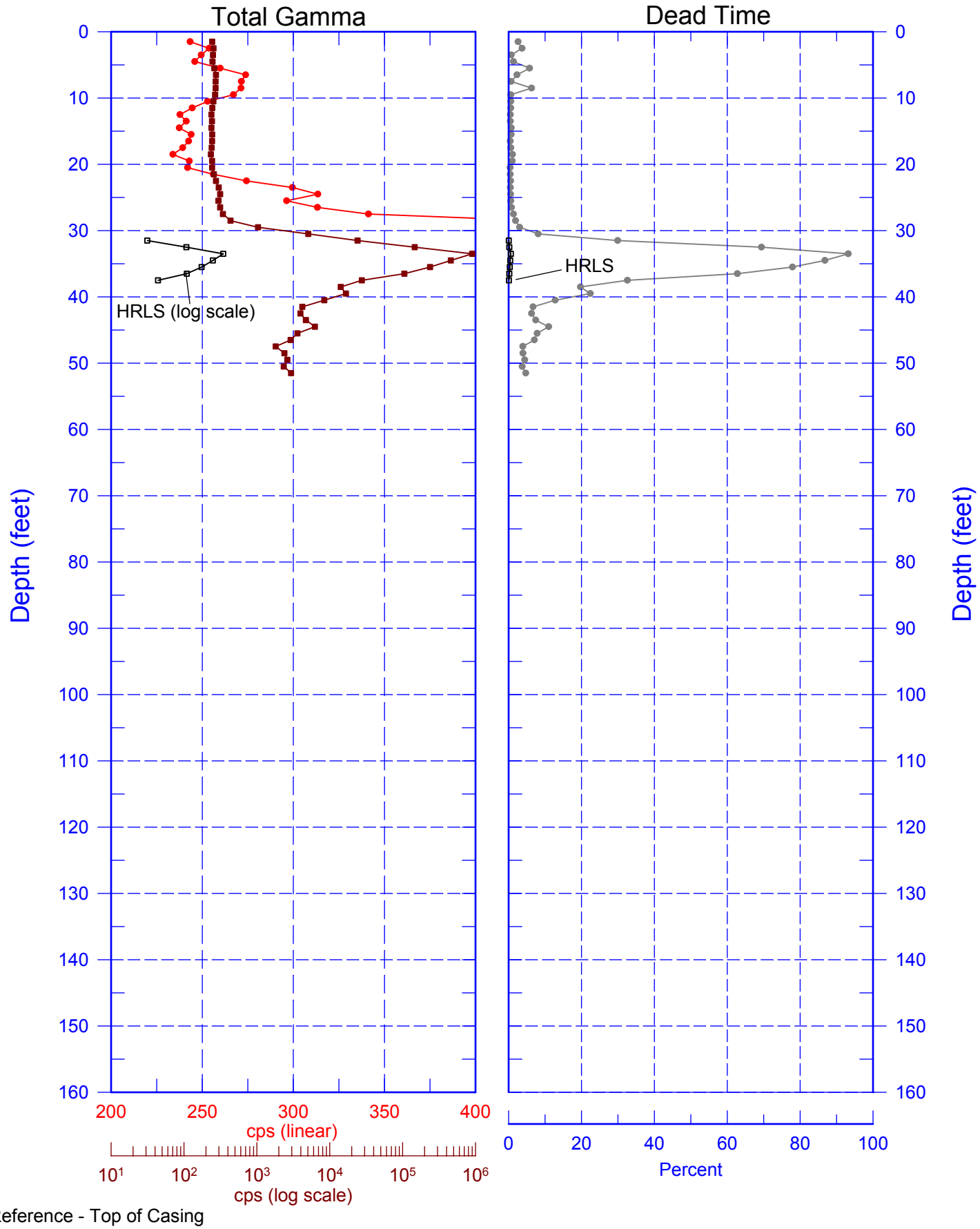
Zero Reference = Top of Casing

299-E24-53 (A5910)
Total Gamma & Moisture



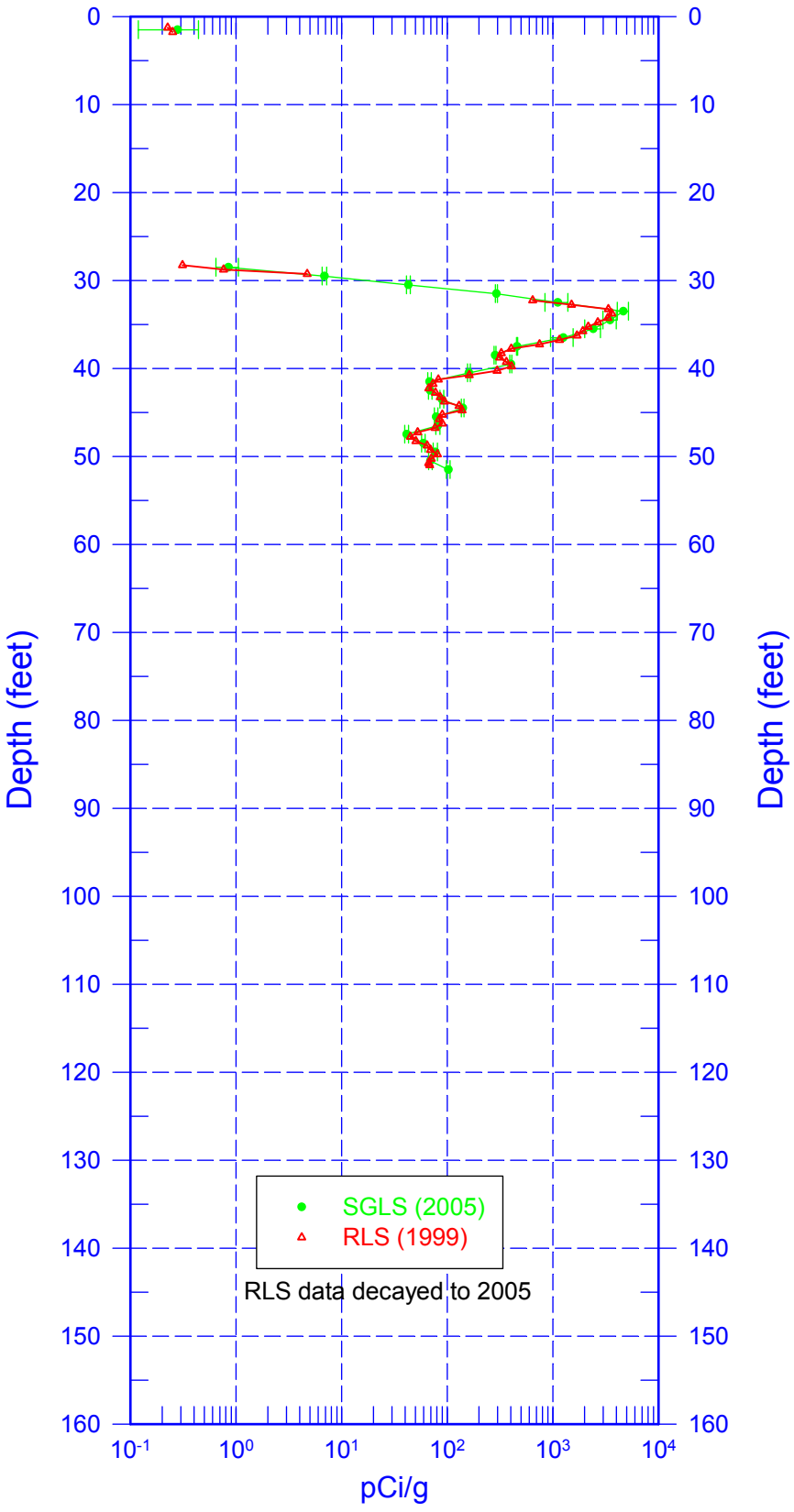
Reference - Top of Casing

299-E24-53 (A5910)
Total Gamma & Dead Time



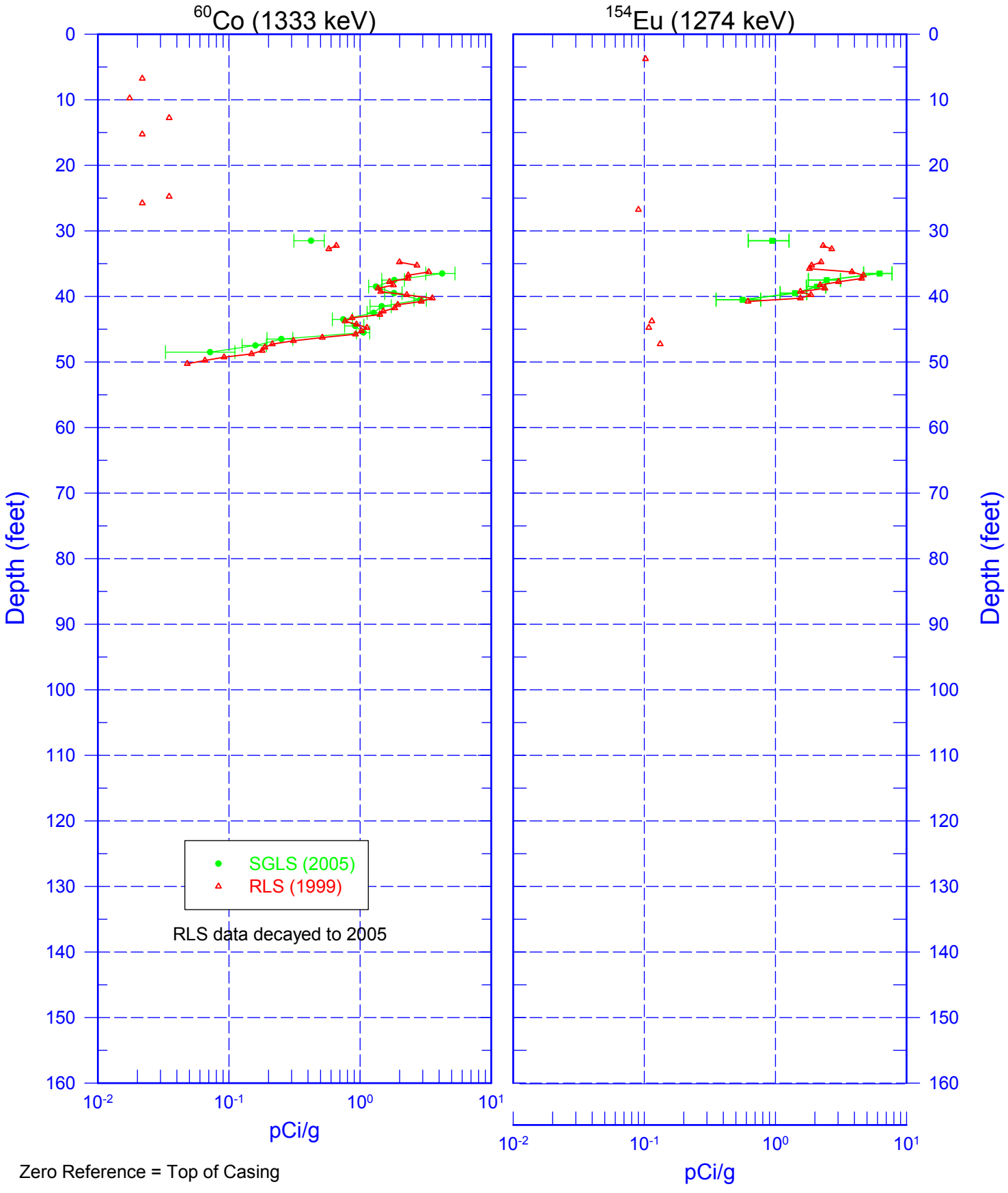
Reference - Top of Casing

299-E24-53 (A5910)
RLS/SGLS Comparison of ^{137}Cs



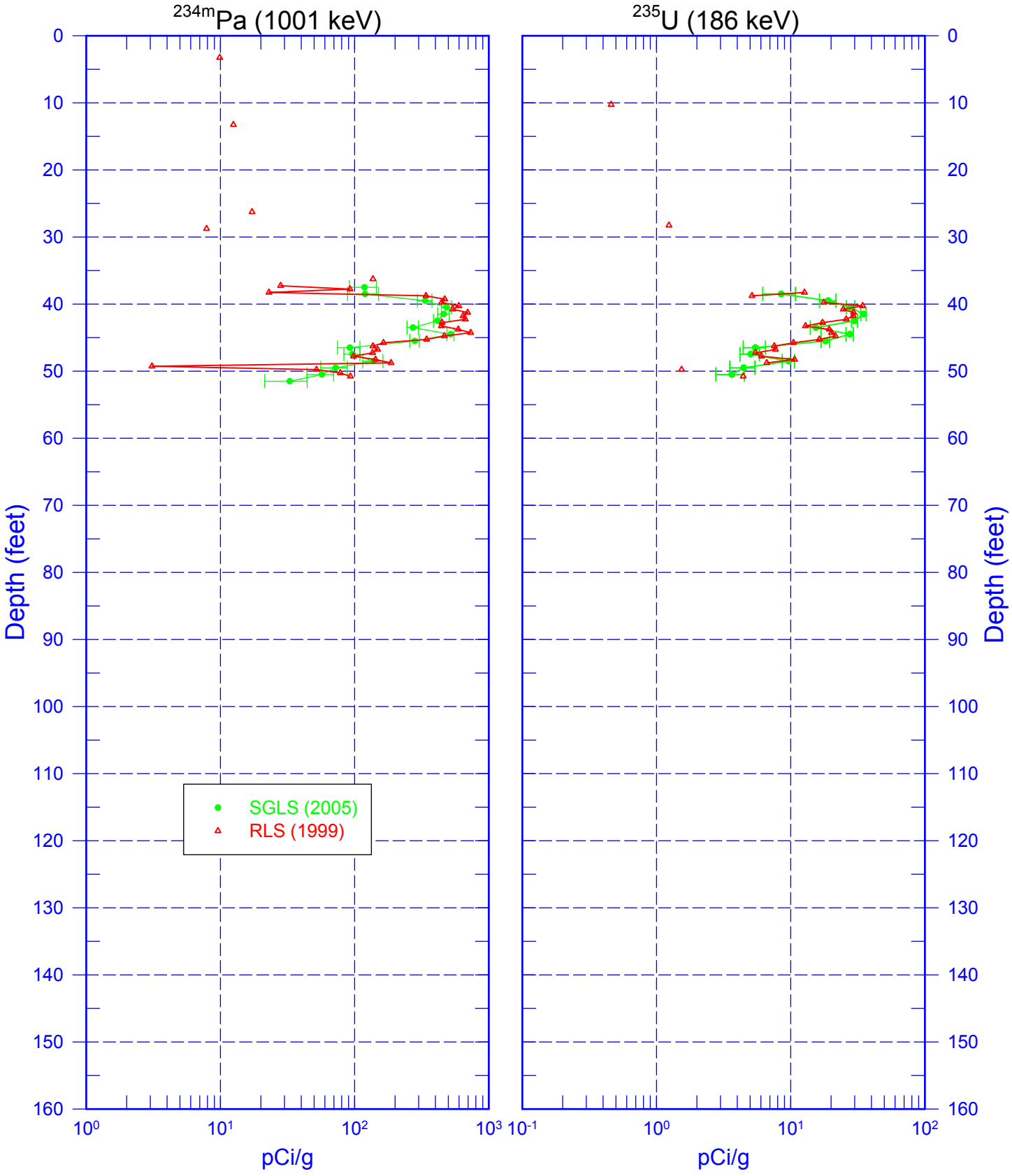
Zero Reference = Top of Casing

299-E24-53 (A5910)
RLS/SGLS Comparison of ^{60}Co and ^{154}Eu



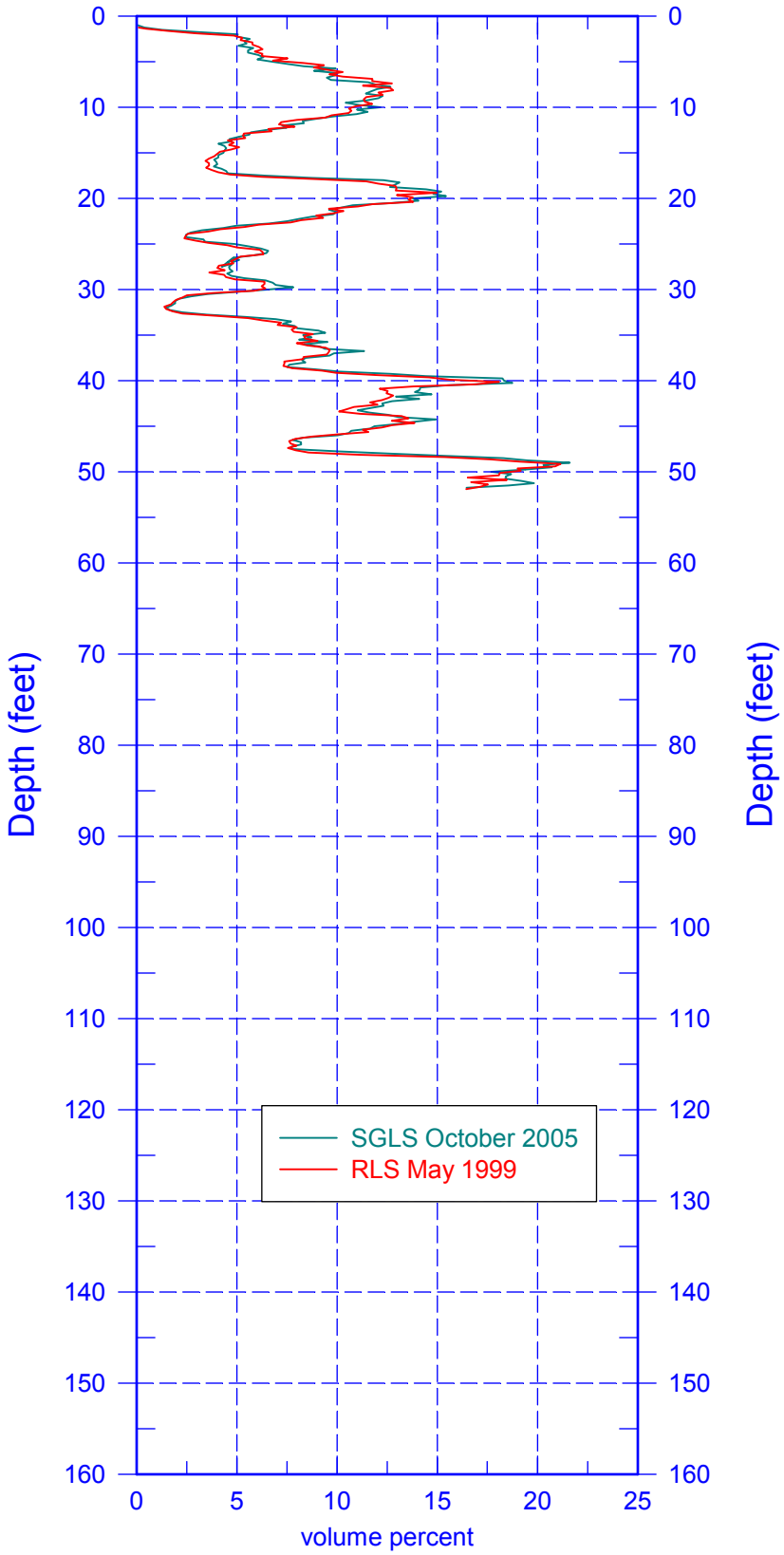
Zero Reference = Top of Casing

299-E24-53 (A5910)
RLS/SGLS Comparison of Uranium



Zero Reference = Top of Casing

299-E24-53 (A5910)
Moisture Comparison



Reference - Top of Casing

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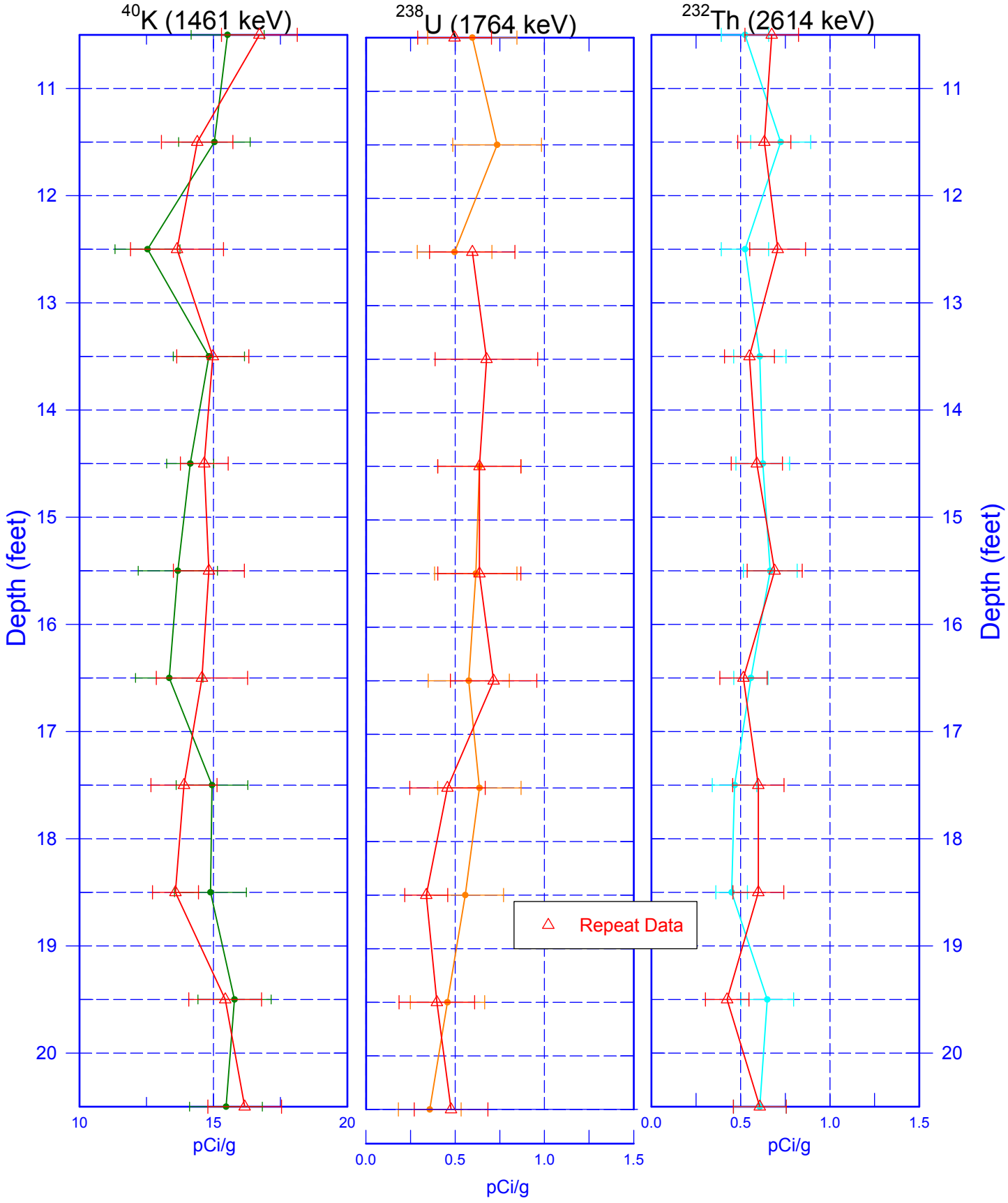
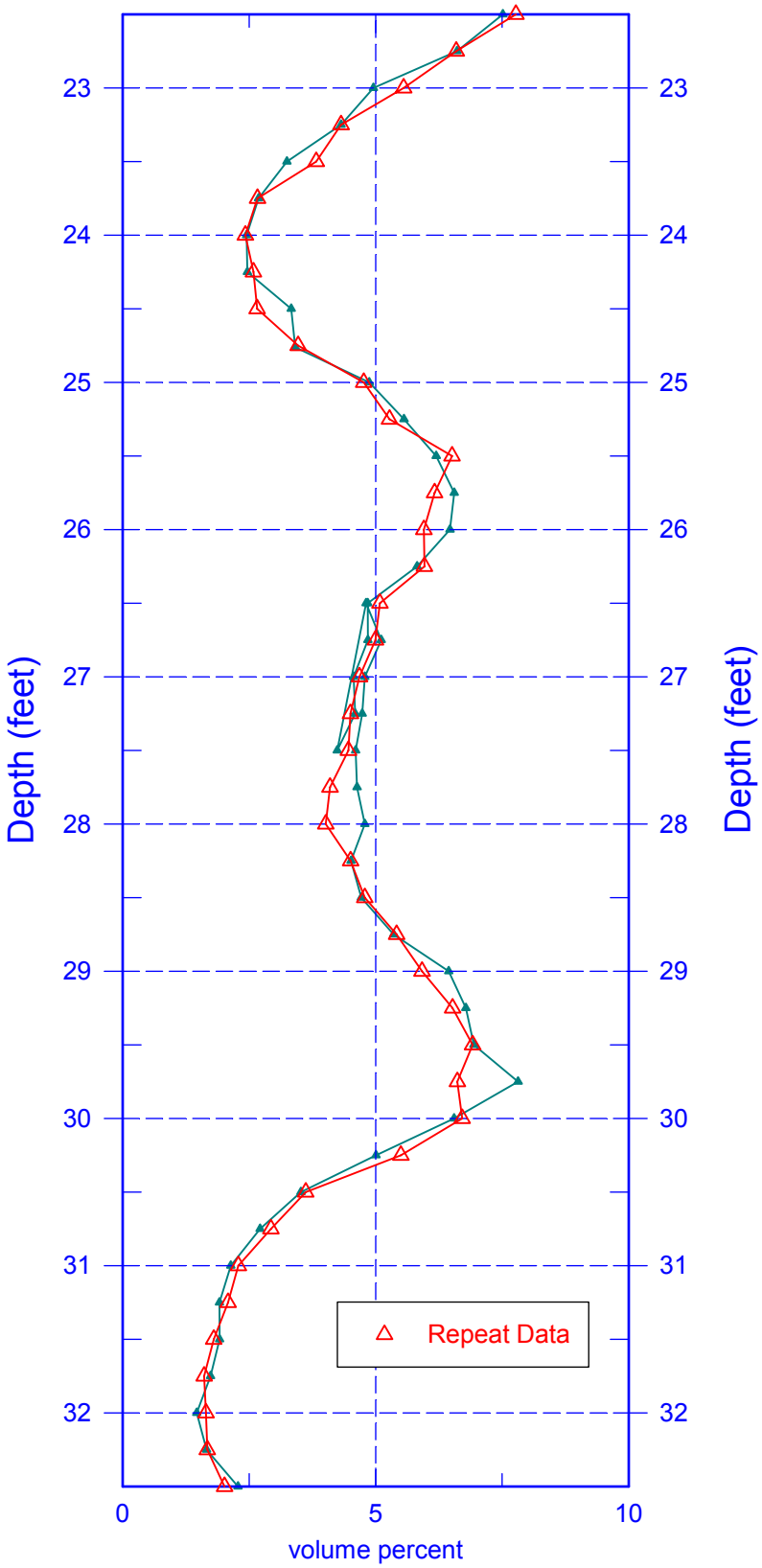
Repeat Section of Natural Gamma Logs



Zero Reference = Top of Casing

299-E24-53 (A5910)
Moisture Repeat Section



Reference - Top of Casing