Stoller
Hanford Office

DOE-EM/GJ671-2004

299-W22-63 (A7870)
Log Data Report

Borehole Information:

Borehole: 299-W22-63 (A7870)			**Site:** 216-S-20 Crib		
Coordinates (WA State Plane)		**GWL (ft)[1]:** Dry		**GWL Date:**	05/03/2004
North	**East**	**Drill Date**	**TOC[2] Elevation**	**Total Depth (ft)**	**Type**
133,916.39 m	567,559.1 m	Dec. 1950	208.641 m	149.7	Cable Tool

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Welded steel	+1.3	8 5/8	8	5/16	0	150
The logging engineer used a caliper to determine the outside 8-in. casing diameter. The caliper and casing stickup were both measured using a steel tape. Inside casing diameter was measured with a steel tape. All measurements were rounded to the nearest 1/16 in. Depth to bottom was measured with an e-tape.						

Borehole Notes:

Borehole coordinates, elevation, and well construction information, as shown in the above tables, are from measurements by Stoller field personnel, Chamness and Merz (1993), and HWIS[3]. Zero reference is the top of the 8-in. casing. The top of the casing was capped with a flange. This borehole is located at the east end of the crib. There appears to be approximately 1.5 ft of gravel covering the top of the crib.

Logging Equipment Information:

Logging System:	Gamma 2A		**Type:** SGLS (35%) 34TP20893A
Calibration Date:	03/2004	**Calibration Reference:**	DOE-EM/GJ642-2004
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0

Logging System:	Gamma 1C		**Type:** High Rate Detector
Calibration Date:	04/2003	**Calibration Reference:**	GJO-2003-429-TAC
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2	3t	4	5 / Repeat
Date	05/03/04	05/03/04	05/03/04	05/04/04	05/04/04
Logging Engineer	Pearson	Pearson	Pearson	Pearson	Pearson
Start Depth (ft)	2.0	26.0	35.0	149.0	50.0
Finish Depth (ft)	27.0	36.0	92.0	91.0	35.0
Count Time (sec)	200	20	200	200	200
Live/Real	R	R	R	R	R

Log Run	1	2	3t	4	5 / Repeat
Shield (Y/N)	N/A[3]	N/A	N/A	N/A	N/A
MSA Interval (ft)	1.0	1.0	1.0	1.0	1.0
ft/min	N/A	N/A	N/A	N/A	N/A
Pre-Verification	BA326CAB	BA326CAB	BA326CAB	BA327CAB	BA327CAB
Start File	BA326000	BA326026	BA326037	BA327000	BA327059
Finish File	BA326025	BA326036	BA326094	BA327058	BA327074
Post-Verification	BA326CAA	BA326CAA	BA326CAA	BA328CAA	BA328CAA
Depth Return Error (in.)	N/A	N/A	½ low	N/A	½ low
Comments	Adjusted gain after BA326010.	High rate section.	Adjusted gain after files BA326038 and BA326047.	No gain adjustments.	No gain adjustments.

High Rate Logging System (HRLS) Log Run Information:

Log Run	1	2	3	4 / Repeat	
Date	05/12/04	05/12/04	05/12/04	05/12/04	
Logging Engineer	Spatz	Spatz	Spatz	Spatz	
Start Depth (ft)	36.0	32.0	27.0	32.0	
Finish Depth (ft)	33.0	28.0	26.0	28.0	
Count Time (sec)	300	100	300	100	
Live/Real	R	R	R	R	
Shield (Y/N)	None	None	None	None	
MSA Interval (ft)	1.0	1.0	1.0	1.0	
ft/min	N/A	N/A	N/A	N/A	
Pre-Verification	AC099CAB	AC099CAB	AC099CAB	AC099CAB	
Start File	AC099000	AC099004	AC099009	AC099011	
Finish File	AC099003	AC099008	AC099010	AC099015	
Post-Verification	AC100CAA	AC100CAA	AC100CAA	AC100CAA	
Depth Return Error (in.)	N/A	N/A	N/A	0	
Comments	No fine-gain adjustment.	None	None	Repeat section.	

Logging Operation Notes:

Zero reference was top of the 8-in. casing. Logging was performed with a centralizer installed on the sonde. Pre- and post-survey verification measurements for the SGLS employed the Amersham KUT (^{40}K, ^{238}U, and ^{232}Th) verifier. Pre- and post-survey verification measurements for the HRLS employed the ^{137}Cs verifier with serial number 1013.

Analysis Notes:

Analyst:	Sobczyk	Date:	5/24/04	Reference:	GJO-HGLP 1.6.3, Rev. 0

SGLS pre-run and post-run verification spectra were collected at the beginning and end of the day. All of the verification spectra were within the acceptance criteria. The peak counts per second (cps) at the 609-keV, 1461-keV, and 2615-keV photopeaks on the post-run verification spectra as compared to the pre-run verification spectra for each day were between 8.2 percent lower and 3.6 percent higher at the end of the day. The peak counts per second at 2615 keV showed the greatest variation of the KUT photopeaks on the post-run verification spectrum as compared to the pre-run verification spectrum. Examinations of spectra indicate that the detector appears to have functioned normally during logging, and the spectra are accepted.

HRLS pre-run and post-run verification spectra were collected at the beginning and end of the day. The spectra were within the acceptance criteria for the field verification of the Gamma 1C logging system (HRLS).

Log spectra were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Verification spectra were used to determine the energy and resolution calibration for processing the data using APTEC SUPERVISOR. Concentrations were calculated in EXCEL (source files: G2AMar04.xls [SGLS] and G1CApr03.xls [HRLS]). Zero reference was the top of the 8-in. casing. On the basis of Chamness and Merz (1993) and the field measurements, the casing configuration was assumed to be a string of 8-in. casing with a thickness of 5/16 in. to total logging depth (149 ft). A water correction was not required.

Using the SGLS, dead time greater than 40 percent was encountered in the interval from 27 to 35 ft. Data from this region are considered unreliable. At SGLS dead time greater than 40 percent, peak spreading and pulse pile-up effects may result in underestimation of activities. This effect is not entirely corrected by the dead time correction, and the extent of error increases with increasing dead time. The HRLS was utilized to obtain data where the SGLS dead time exceeded 40 percent. SGLS and HRLS dead time corrections were applied when dead time surpassed 10.5 percent.

Log Plot Notes:

Separate log plots are provided for gross gamma and dead time, naturally occurring radionuclides (^{40}K, ^{238}U, and ^{232}Th), and man-made radionuclides. Plots of the repeat logs versus the original logs are included. For each radionuclide, the energy value of the spectral peak used for quantification is indicated. Unless otherwise noted, all radionuclides are plotted in picocuries per gram (pCi/g). The open circles indicate the minimum detectable level (MDL) for each radionuclide. Error bars on each plot represent error associated with counting statistics only and do not include errors associated with the inverse efficiency function, dead time correction, or casing correction. These errors are discussed in the calibration report. A combination plot is also included to facilitate correlation. The ^{214}Bi peak at 1764 keV was used to determine the naturally occurring ^{238}U concentrations on the combination plot rather than the ^{214}Bi peak at 609 keV because it is less affected by the presence of radon in the borehole.

Results and Interpretations:

^{137}Cs, ^{60}Co, and processed uranium (^{238}U and ^{235}U) were the man-made radionuclides detected in this borehole. ^{137}Cs was detected in the intervals between 3 to 9 ft and 23 to 37 ft at concentrations ranging from the MDL (0.2 pCi/g) to 74,000 pCi/g. The maximum concentration was measured at 32 ft. ^{60}Co, based on the 1333-keV photopeak, was detected in the intervals between 35 to 51 ft and 60 to 63 ft at concentrations ranging from near the MDL (0.1 pCi/g) to 2.4 pCi/g. The maximum concentration was measured at 35 ft. $^{235/238}$U was detected in the intervals between 36 to 42 ft and 62 to 63 ft, and the maximum concentrations were measured at 38 ft. The range of concentrations of ^{238}U, as inferred from the ^{234m}Pa 1001-keV energy peak, was between 38 and 330 pCi/g. ^{235}U, which is measured directly by the 186-keV photopeak, was detected at concentrations between 1.1 and 17 pCi/g. ^{235}U was also detected at 57 ft at a concentration near the MDL (1.0 pCi/g). The MDL for ^{238}U was 15 pCi/g. The MDLs for ^{60}Co, ^{238}U, and ^{235}U in the high ^{137}Cs interval between 27 and 35 ft are elevated because of high background counts. Thus, processed uranium and ^{60}Co probably exist in the high activity zone even though they were not detected.

The behavior of the ^{238}U log suggests that radon may be present inside the borehole casing. Determination of ^{238}U is based on measurement of gamma activity at 609 and/or 1764 keV associated with ^{214}Bi, under the assumption of secular equilibrium in the decay chain. However, ^{214}Bi is also a short-term daughter of ^{222}Rn. When radon is present, ^{214}Bi will tend to “plate” onto the casing wall and will quickly reach equilibrium with ^{222}Rn. Because the additional ^{214}Bi resulting from radon is on the inside of the casing, the effect of the casing correction is to amplify the 609 photopeak relative to the 1764 photopeak. (The magnitude of the casing correction factor decreases with increasing energy, but gamma rays originating inside the casing are

not attenuated.) This effect is observed on May 4, 2004, logging run 4 (149 to 91 ft), and on the repeat log run (50 to 35 ft). The effects of radon appear to be minimal in the other log runs. The reason for variations in radon content between log runs on successive days is not known. Variations in radon content in boreholes are probably related to variations in surface weather conditions. Radon daughters such as ^{214}Bi may also "plate" onto the sonde itself. When this occurs, there is a gradual increase in total counts as well as photopeak counts associated with ^{214}Bi and ^{214}Pb.

The presence of radon is not an indication of man-made contamination; it is derived from decay of naturally occurring uranium. As a gas, radon moves easily in the subsurface, and concentrations of radon and its associated progeny can change quickly.

The plots of the repeat logs demonstrate reasonable repeatability of the HRLS and SGLS data. ^{137}Cs (662 keV) concentrations are comparable between the repeat and original HRLS log runs. The natural radionuclides at energy levels of 1461, 1764, and 2614 keV are comparable between the repeat and original SGLS log runs. The repeat log run at 609 keV is slightly elevated compared to the original log due to the buildup of radon in the borehole. The man-made radionuclides at energy levels of 186 (^{235}U), 662 (^{137}Cs), 1001 (^{238}U), and 1333 (^{60}Co) keV are comparable between the repeat and original SGLS log runs.

References:

Chamness, M.A., and J.K. Merz, 1993. *Hanford Wells*, PNL-8800, Pacific Northwest Laboratory, Richland, Washington.

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[1] GWL – groundwater level
[2] TOC – top of casing
[3] HWIS – Hanford Well Information System
[4] N/A – not applicable

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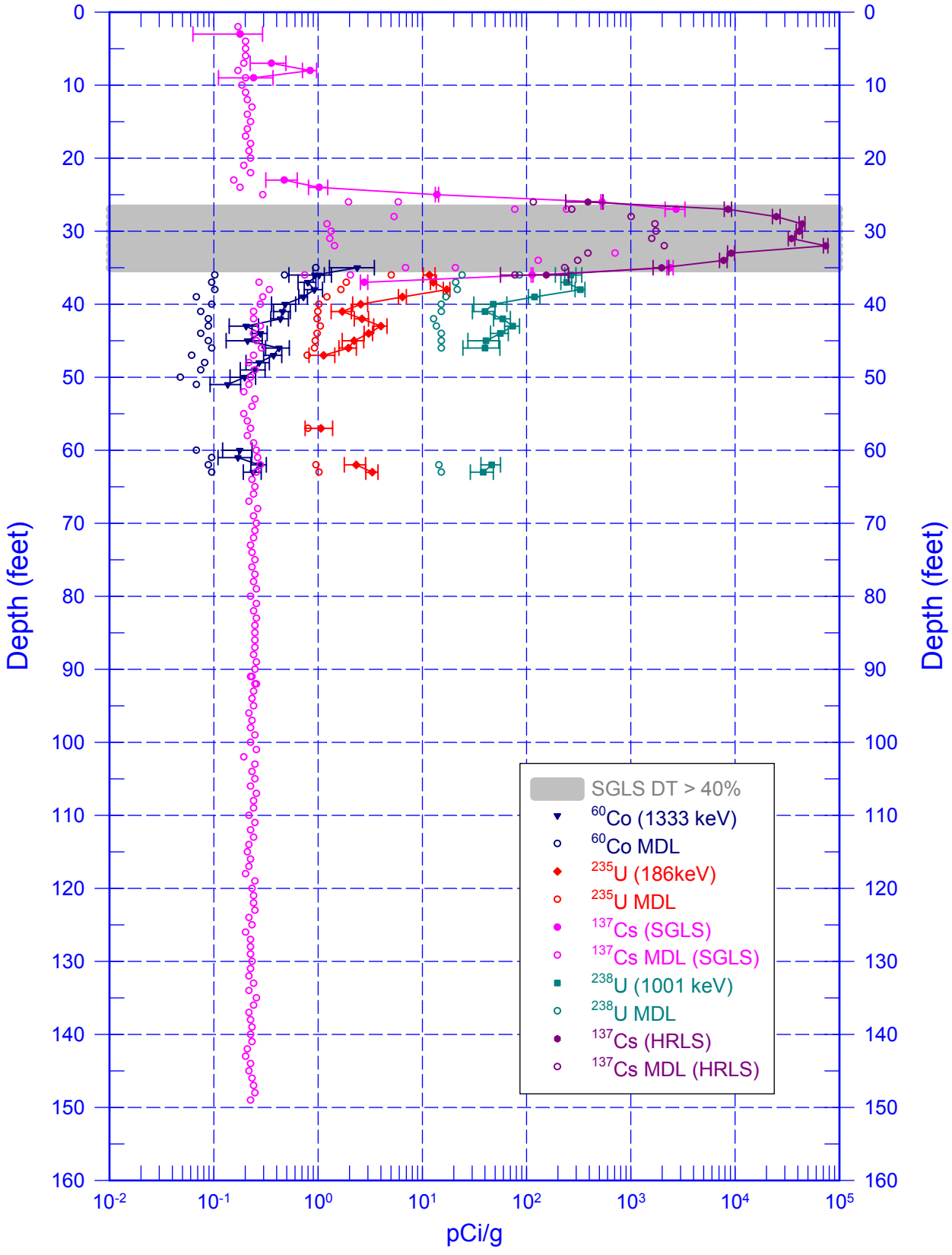
Man-Made Radionuclides



Zero Reference = Top of 8 in. Casing

Date of Last Logging Run
5/12/2004

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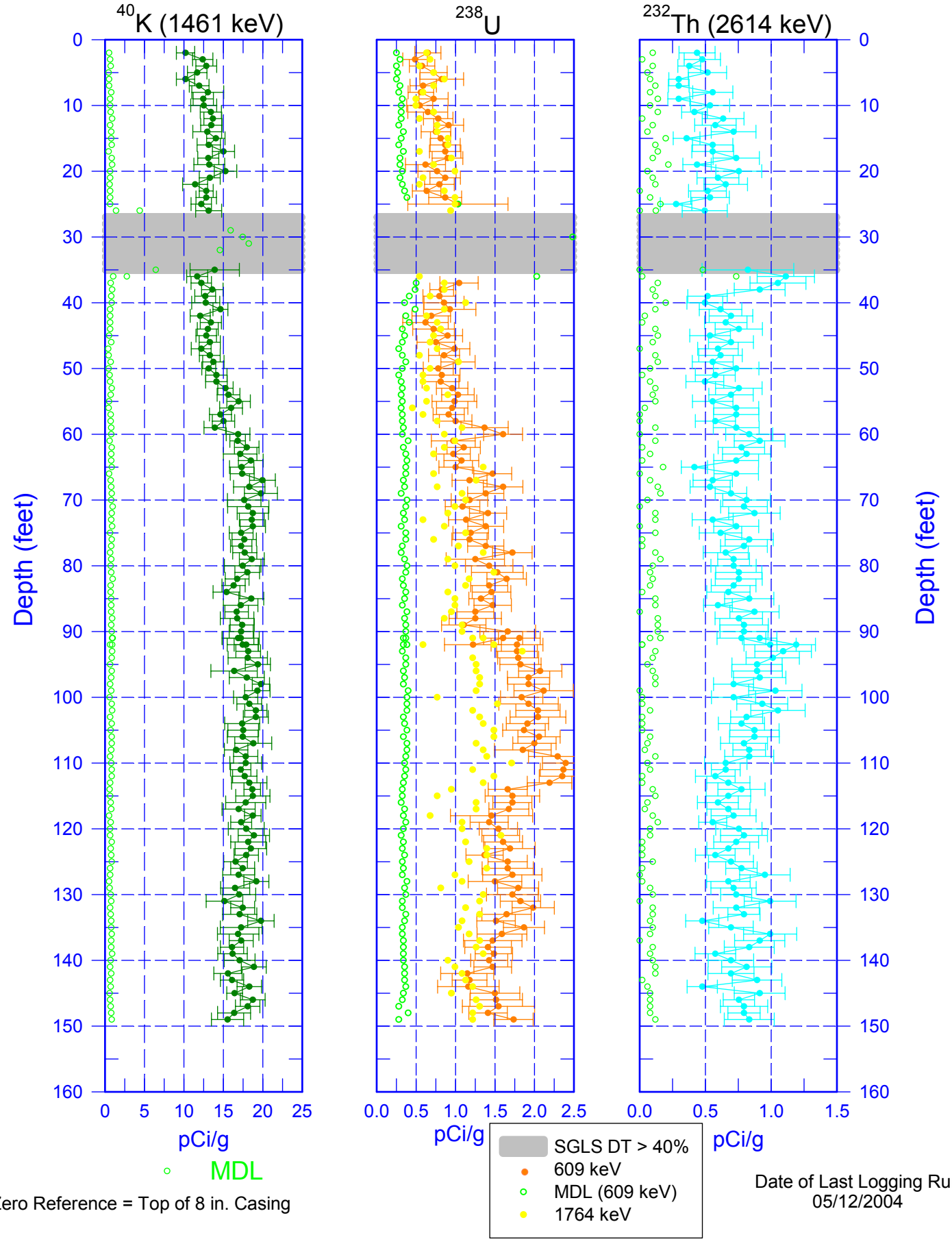
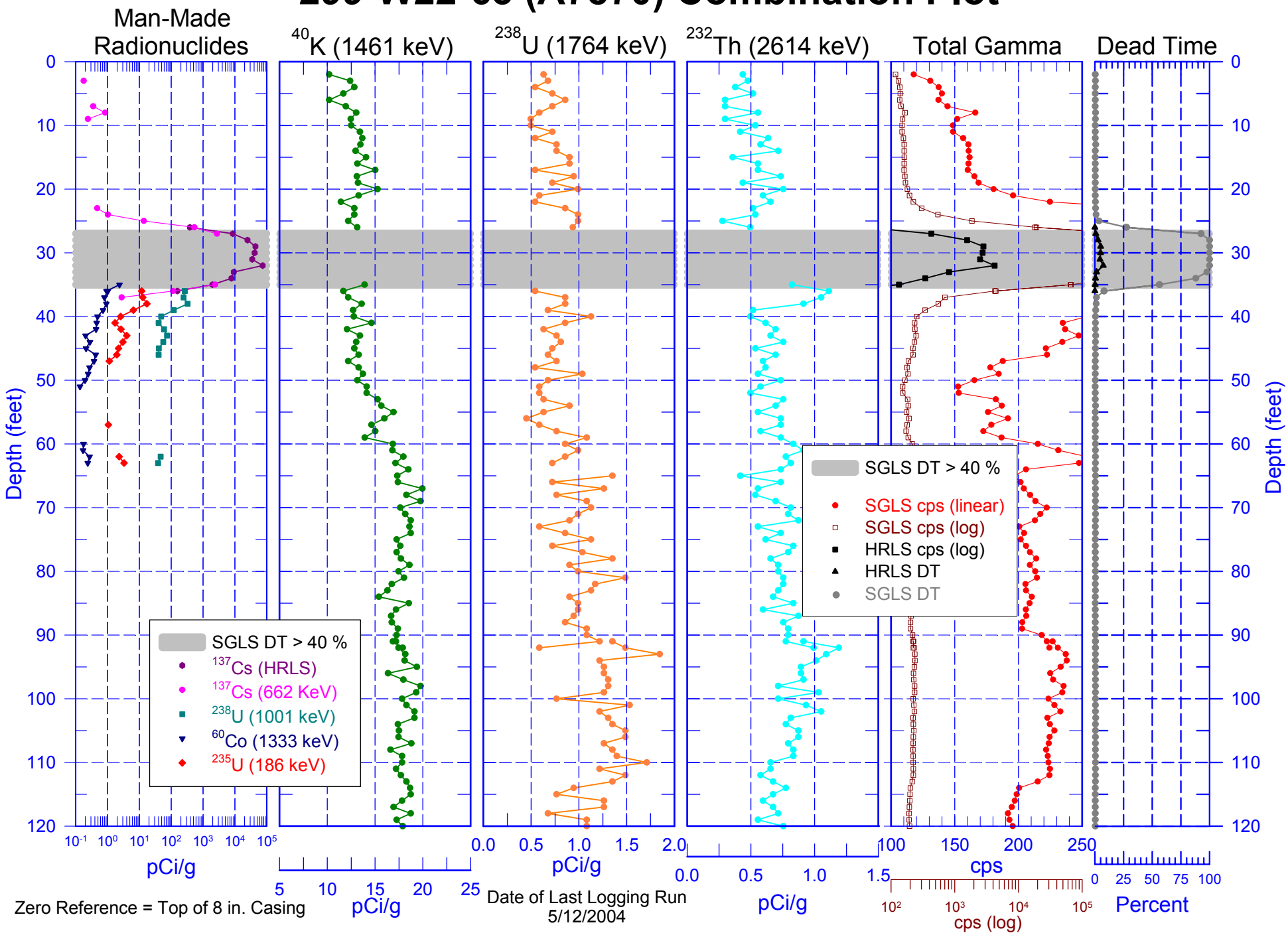
Natural Gamma Logs



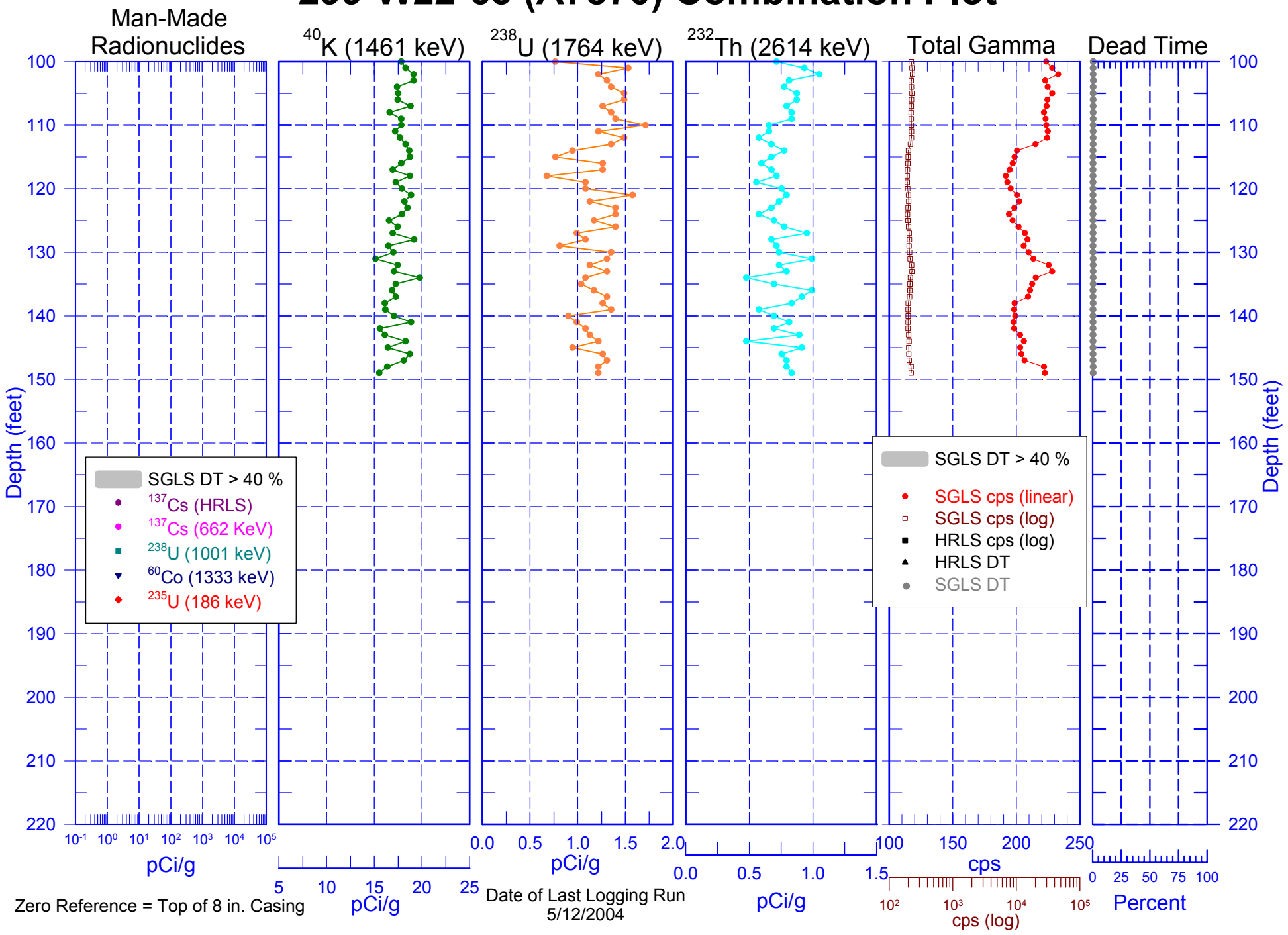
Zero Reference = Top of 8 in. Casing

Date of Last Logging Run
05/12/2004

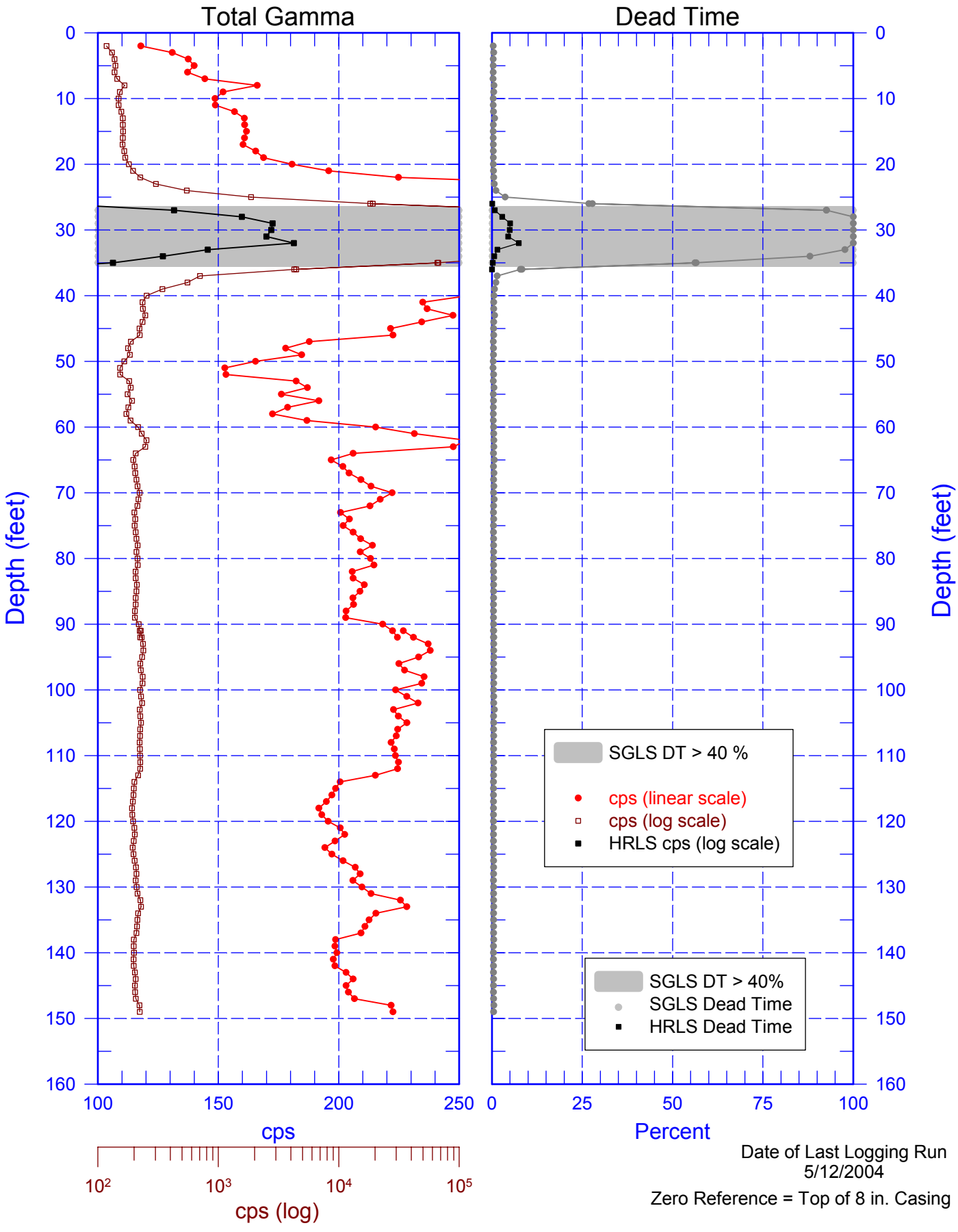
299-W22-63 (A7870) Combination Plot



299-W22-63 (A7870) Combination Plot



299-W22-63 (A7870)
Total Gamma & Dead Time



Date of Last Logging Run
5/12/2004

Zero Reference = Top of 8 in. Casing

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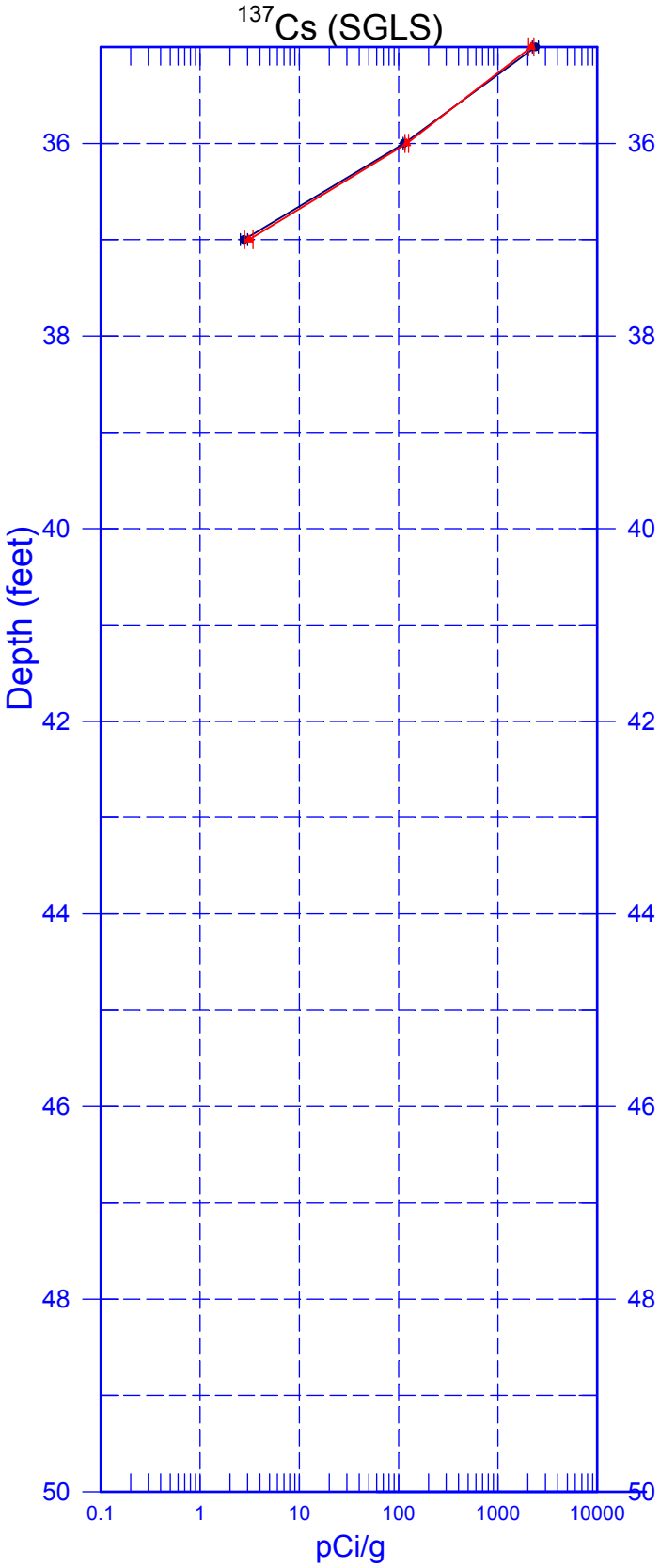
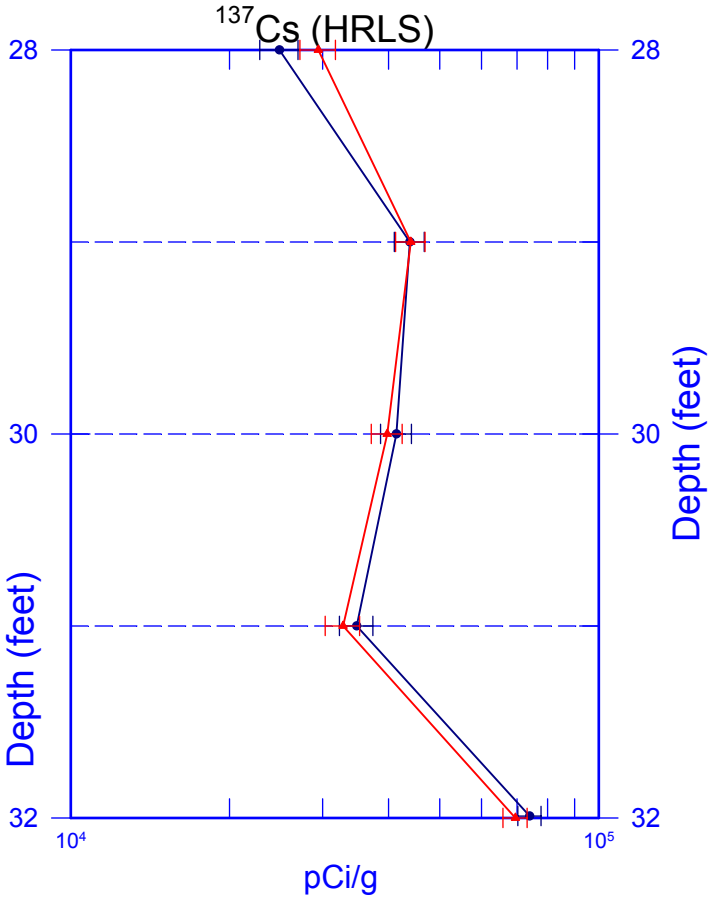
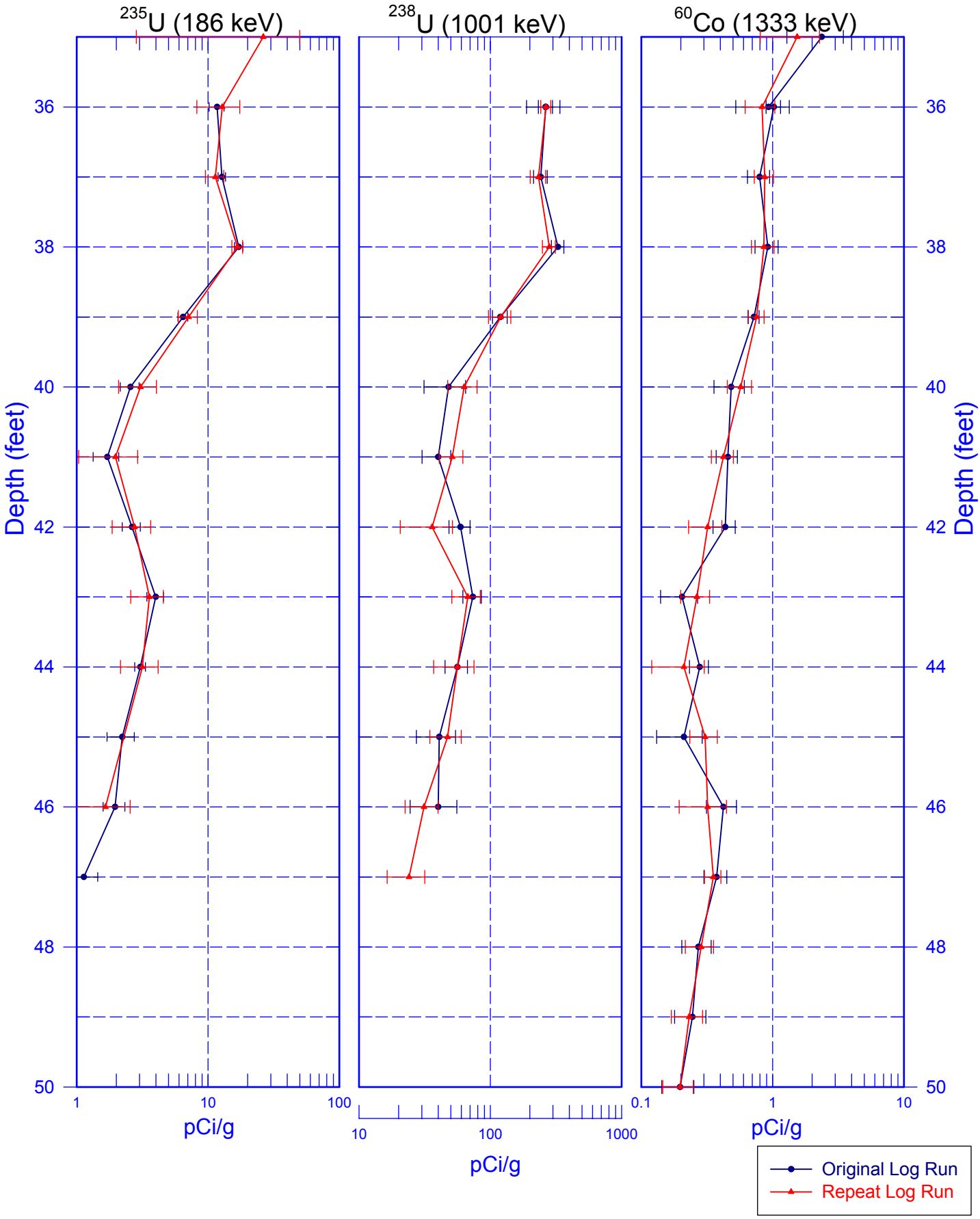
Rerun of ^{137}Cs (SGLS & HRLS)





299-W22-63 (A7870)

Rerun of Man-Made Radionuclides (50.0 to 35.0 ft)



299-W22-63 (A7870)

Rerun of Natural Gamma Logs (50.0 to 35.0 ft)