1250363
[0004510H]

Stoller
Hanford Office

established 1959

HGLP-LDR-068

299-E27-14 (A4812)
Log Data Report

Borehole Information:

Borehole:	299-E27-14 (A4812)		Site:	50 ft southeast of C tank farm	
Coordinates (WA St Plane)		GWL[1] (ft):	261.9	GWL Date:	03/28/07
North (m)	East (m)	Drill Date	TOC Elevation	Total Depth (ft)	Type
136498.244	575217.341	10/89	661.92 ft	270	Cable

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Stainless steel	3.0	6 5/8	6 3/8	1/8	3.0	2.0
Stainless steel	0.5	4 1/4	4	1/8	0.5	248.8
SS Screen	N/A	4 1/4	4	1/8	248.8	269.8

Borehole Notes:

This borehole has been logged by Westinghouse Hanford Company in October 1989, with a NaI total gamma detection system. Log data were acquired inside a 10-in. casing from ground surface to 137 ft and inside an 8-in. casing from 137 to 266 ft (bgs). No well completion materials had been introduced into the borehole annulus prior to logging. Depth reference for this logging was ground surface.

After the initial logging, a 4-in. stainless steel casing was placed to 245.8 ft (248.8 ft from the top of the 6-in. casing). **Note: For the purposes of this log data report, henceforth, all reported depths are from the top of the 6-in. casing. Depths reported from other log data or well completion summaries are adjusted 3.0 ft.** A 4-in. stainless steel screen was placed from 248.8 to 269.8 ft. The temporary 8- and 10-in. casings were removed from the borehole as well completion materials were introduced into the annular space around the 4-in. casings. A sand pack was placed around the screened interval from 245.7 to 269.8 ft. Volclay tablets were placed from 242.4 to 245.7 ft. Bentonite crumbles were placed from 22.8 to 242.4 ft. A surface seal consisting of cement grout was placed from 5.8 to 22.8 ft. A 4x4x0.5 ft concrete surface pad was placed, extending 5 ft into the annulus. A 6-in. protective surface casing was placed over the 4-in. casing and extends 3.0 ft above ground surface.

An HPGe spectral gamma logging system referred to as the Radionuclide Logging System (RLS) was used by Westinghouse to log this borehole in March 1994. Apparently, a log report was not created to report the results. A printout was available of the activities for natural and manmade radionuclides measured in the borehole by Westinghouse according to their calibrations. The Nez Perce Environmental Restoration & Waste Management group transcribed these data and prepared a log data report in September 2006, describing results and their interpretation of the data. In response to a recommendation by the Nez Perce, the borehole was re-logged with the Spectral Gamma Logging System (SGLS). This report presents these current data and provides comparisons with the prior log data acquired in 1989 and 1994. The log and report prepared by the Nez Perce can be found as an attachment to a letter to Keith Klein, DOE-RL, from Gabriel Bohnee, Nez Perce EWRM director, dated October 17, 2006. (DA03775436 / IDMS ID: 14042992)

The logging engineer measured the 6-in. casing diameter using a steel tape. The 4-in. casing was estimated from visual inspection. Casing depths were derived from the Well Construction and Completion Summary "As =Built." Three feet are added to the casing depths and depths of well completion materials to account for the 3.0 ft of casing stickup. SGLS log data are referenced to the top of the 6-in. casing.

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Logging Equipment Information:

Logging System:	Gamma 1G	**Type:**	SGLS (35%) HPGe SN: 34-TP10951A
Effective Calibration Date:	11/22/06	**Calibration Reference:**	HGLP-CC-003
		Logging Procedure:	HGLP-MAN-002, Rev. 0

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2	3	4 Repeat	5
Date	03/28/07	03/29/07	03/30/07	04/02/07	04/02/07
Logging Engineer	Spatz	Spatz	Spatz	Spatz	Spatz
Start Depth (ft)	270.0	185.0	102.0	150.0	34.0
Finish Depth (ft)	184.0	101.0	33.0	127.0	4.0
Count Time (sec)	200	200	200	300	200
Live/Real	R	R	R	R	R
Shield (Y/N)	N	N	N	N	N
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	AG126CAB	AG127CAB	AG128CAB	AG129CAB	AG129CAB
Start File	AG126000	AG127000	AG128000	AG129000	AG129024
Finish File	AG126086	AG127084	AG128069	AG129023	AG129054
Post-Verification	AG126CAA	AG127CAA	AG128CAA	AG129CAA	AG129CAA
Depth Return Error (in.)	2.5 low	0	0	N/A	1.5 low
Comments	Gain adjustment after files -033, -055, -80	No fine gain adjustment	No fine gain adjustment	Fine gain adjustment after file -023	No fine gain adjustment

Logging Operation Notes:

Logging was conducted with no centralizer on the sonde due to the small diameter casing. Repeat data (log run 4) were acquired at a 300 second counting time from 127 to 150 ft to provide additional detail of the highest activity zone. Because the repeat data acquired at 300 seconds are statistically more reliable than data acquired at 200 seconds, the repeat data are plotted as main log data.

Analysis Notes:

Analyst:	Henwood	**Date:**	04/26/07	**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 1/8-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 G1GNov06.xls using an efficiency function and corrections for casing and dead time as determined from annual calibrations. A water correction was applied to the data below 261.9 ft.

Results and Interpretations:

Cs-137 and Co-60 are the manmade radionuclides detected in this borehole during the current logging. Cs-137 is detected from 4 to 7 ft. Four ft is the first data point acquired and is approximately 1 ft below ground surface after subtracting the casing stickup of 3 ft. The maximum concentration is 1.2 pCi/g at 6 ft.

Co-60 is detected from 244 to 261 ft, from 130 to 150 ft, and sporadically (7 of 54 depth intervals) from 162 to 216 ft. The maximum concentrations for these intervals are 0.3 pCi/g at 250 ft, 0.1 pCi/g at 142 ft, and 0.1 pCi/g at 162 ft, respectively. The assays are underestimated by an unknown amount due to the presence of completion materials (mostly bentonite). The gamma rays detected by the logging systems are influenced by the material just outside the casing to a greater degree than from 6-12-in. into the formation. Given that 3-3.5 in. of the annular space could be comprised of completion materials, some attenuation of the Co-60 gamma rays will occur.

The naturally occurring radionuclides (K-40, U-238, and Th-232 {KUT}) and total gamma data are dominated by the completion materials residing outside the 4-in. casing. The sand pack in the interval from 245.7 to 269.8 ft that lies just below the Volclay placed from 242.4 to 245.7 ft is clearly distinguished. Bentonite crumbles placed from 22.8 to 242.4 ft reflect very little variation in KUT. The concentrations in this interval are high for the U and T and low for K relative to usual assays of Hanford sediments. The surface grout seal extending to approximately 23 ft is also clearly distinguished. One notable exception is the interval from approximately 130 to 150 ft where gamma rays from the Co-60 contamination are reflected in the total gamma log.

Comparisons are made of the 2007 (SGLS) data and prior data acquired in 1989 (NaI detector) and 1994 (RLS). Comparisons are not always straight forward. For example, as discussed in "Borehole Notes," completion materials were not in the borehole for the first logging event in 1989 with the NaI system. Logging was probably conducted in steel casing approximately 0.5-in. thick for which corrections are not made; the RLS and SGLS data are corrected for 1/8-in. thick casing and completion materials reside behind the casing.

The RLS and SGLS detection systems have different efficiencies, 18% and 35%, respectively. As can be observed by the SGLS/RLS comparison plot of total gamma, the count rate of the SGLS is about double that of the RLS. In addition, counting times of 200 and 300 seconds were used for the SGLS, while the RLS utilized an 80 second counting time. These differences result in a minimum detection limit for Co-60 of approximately 0.05 pCi/g for the SGLS and approximately 0.1 pCi/g for the RLS.

Further complicating the comparisons, is the 5.27 year half life of Co-60. Over 3 half lives have passed since 1989 and over 2 since 1994.

An evaluation of the Nez Perce log data report concludes that the data presented are reasonable and the spectra at depth locations were Co-60 is detected contain full energy peaks at 1173 and/or 1333 keV that unambiguously represent Co-60. A comparison plot of the SGLS data and RLS data decayed to 2007 indicates Co-60 contamination between approximately 130 and 150 ft at generally consistent concentrations. There are a few more detections with the SGLS between 162 and 216 ft than with the RLS. Between 244 and 261 ft, the SGLS detections far exceed that of the RLS.

The Nez Perce report asserts, "A gross gamma log collected when the hole was drilled in 1989 indicates the sediments surrounding this borehole did not contain detectable amounts of manmade radionuclides at that time." A comparison of the 1989 total gamma data with the 1994 RLS and 2007 SGLS total gamma data appears to support this conclusion. The maximum Co-60 concentration determined by the SGLS between 130 and 150 ft is approximately 0.11 pCi/g. If this contamination existed in 1989, the concentration would have been approximately 1.1 pCi/g. It is estimated 1 pCi/g of Co-60 would be reflected in the NaI system by an increase above background in the total gamma count rate on the order of 50 counts per second (cps). The total gamma log shows a possible increase above background on the order of 10-15 cps from 137 to 141 ft (140 to 144 after correcting for stickup); the sharp increase at 137 ft is the result of a casing change from a 10-in. to 8-in. casing. An increase of this magnitude (10-15 cps) could reflect a finer grained sediment rather than the existence of a contaminant. The 1994 RLS total gamma log over the same depth interval, acquired one Co-60 half life later than 1989, shows an increase of

approximately 50 cps over background and the increase is prominent relative to the 1989 log. Therefore, it is concluded the Co-60 contamination most likely reached the vicinity of this borehole between 1989 and 1994.

Groundwater levels have been reported at approximately 253, 256, and 262 ft in 1989, 1994, and 2007 respectively. The NaI system did not appear to detect any contamination at these depths and the RLS only reports contamination at 251 and 252 ft. The SGLS data indicates contamination from 250 to 261 ft. It is postulated that the groundwater is contaminated with Co-60 that adheres to the casing and/or sand pack. As the water level recedes, Co-60 can be detected with the SGLS and RLS because the water is no longer available to attenuate the gamma rays. It is expected as the water level further recedes, Co-60 will be detectable on the casing and/or sand pack at greater depths.

The origin of the sporadic Co-60 contamination between 162 and 216 ft and at approximately 244 ft is unknown. It is possible contamination has migrated to the borehole at low concentrations from a distant source. Another possibility is that contamination from the groundwater has been spread to a few locations inside the casing during well services activities such as removing pumps or groundwater sampling.

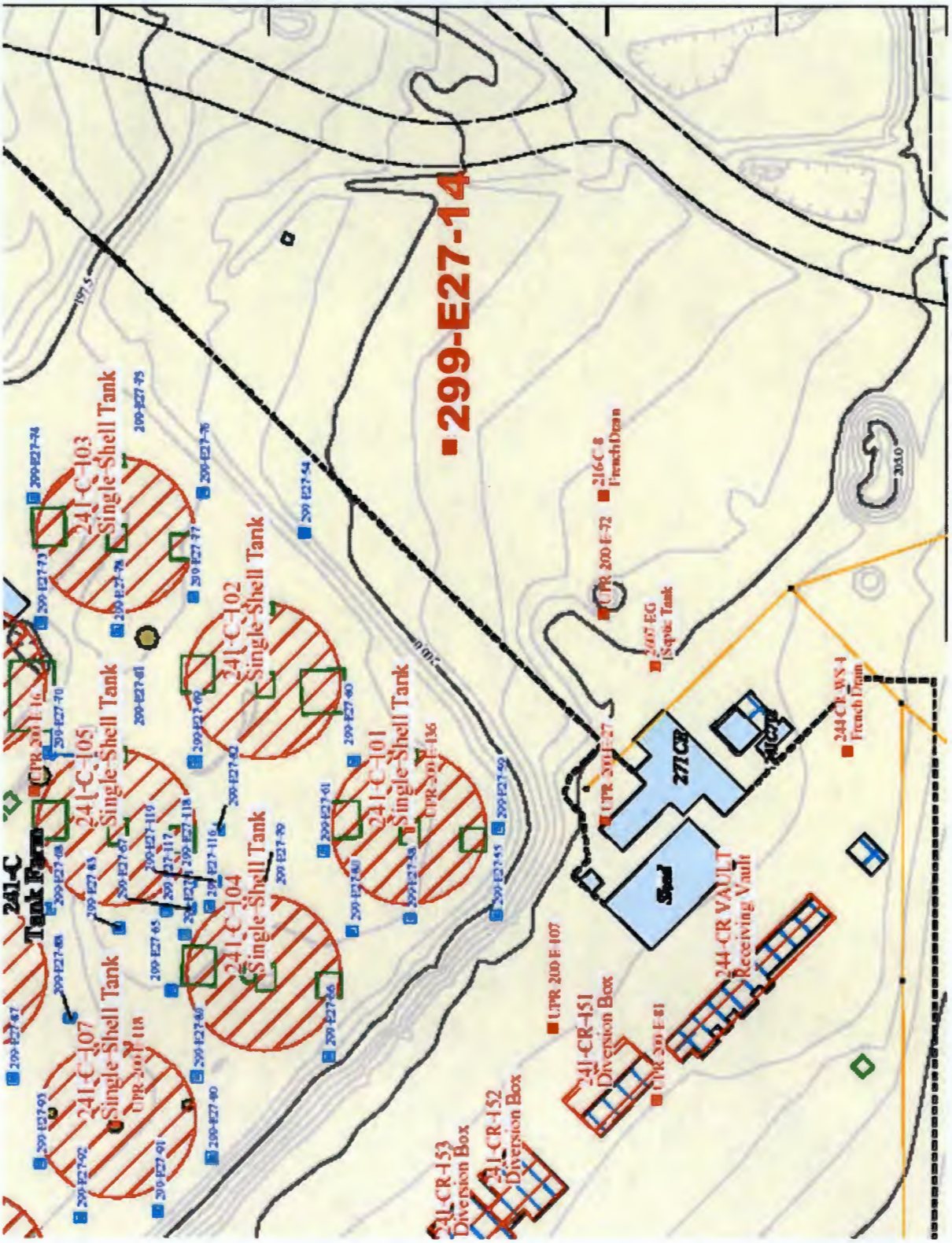
Other borehole data in C Farm, notably in boreholes 30-06-10 and 30-08-02 show evidence of active migration of Co-60 from the 1970's to the present. Available data suggest migration downward and to the east, following stratigraphic dip. It is recommended boreholes immediately outside the C Farm fence line be logged, especially 299-E27-07 on the eastward periphery. All the data, including moisture data acquired as a result of tank retrieval operations, should be integrated and contaminant plumes re-defined as new data are acquired.

Finally, groundwater and vadose zone data should be evaluated to assess any correlation between Tc-99 and Co-60 concentrations. Both contaminants have similar transport properties. Co-60, although largely decayed away, is easily detectable through steel casing and may provide important clues to determine the extent of Tc-99 in the vadose zone.

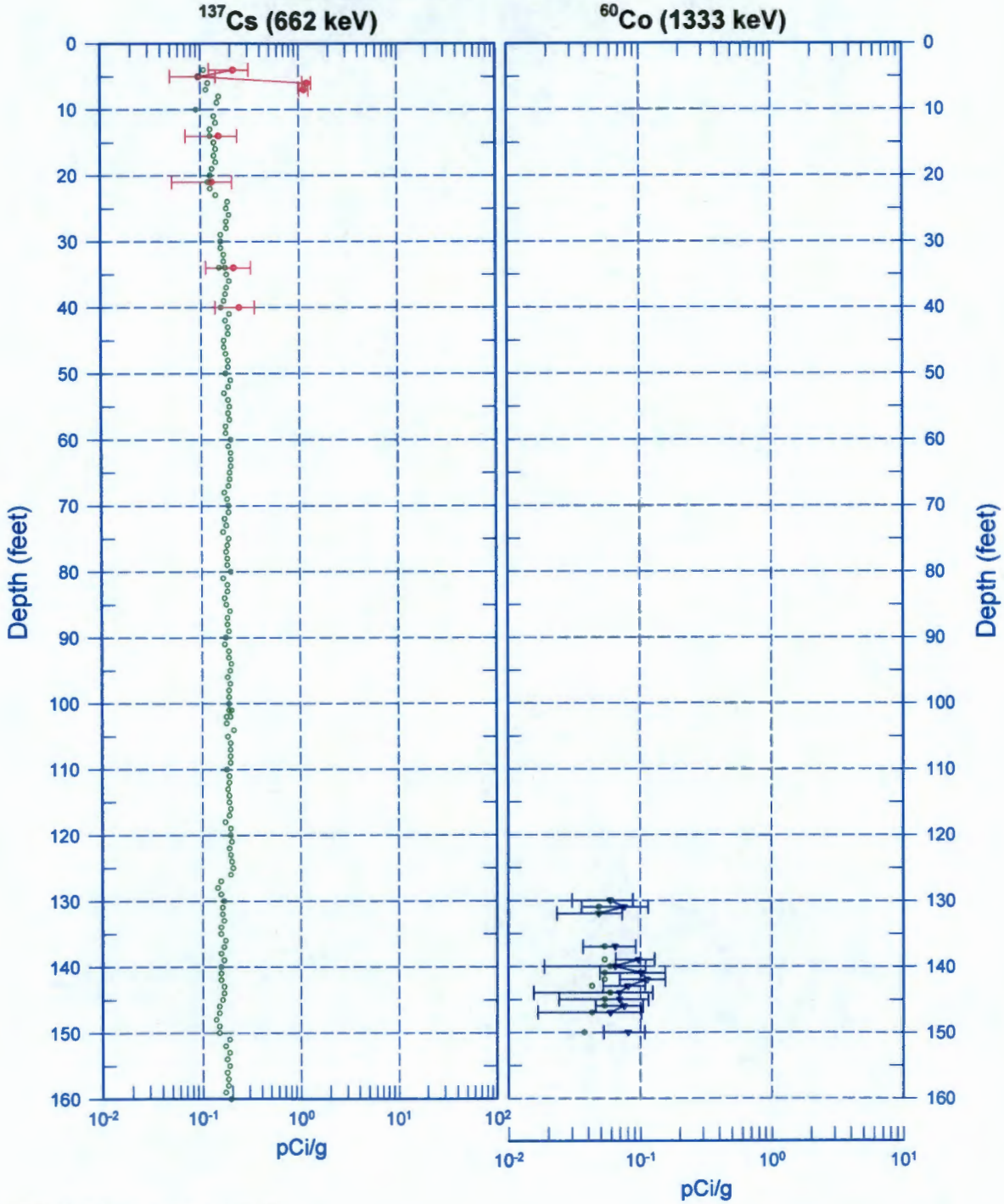
List of Log Plots:

Depth Reference is top of casing
Depth Scale - 20 ft/inch

Map Showing Location of 299-E27-14
Manmade Radionuclides
Natural Gamma Logs
Combination Plot
Combination Plot (0-280 ft)
Total Gamma (SGLS/RLS)
Comparison of RLS (1994) and SGLS (2007)
Manmade Radionuclide Repeat Section
Repeat Section of Natural Gamma Logs
Westinghouse Hanford Company Log Report

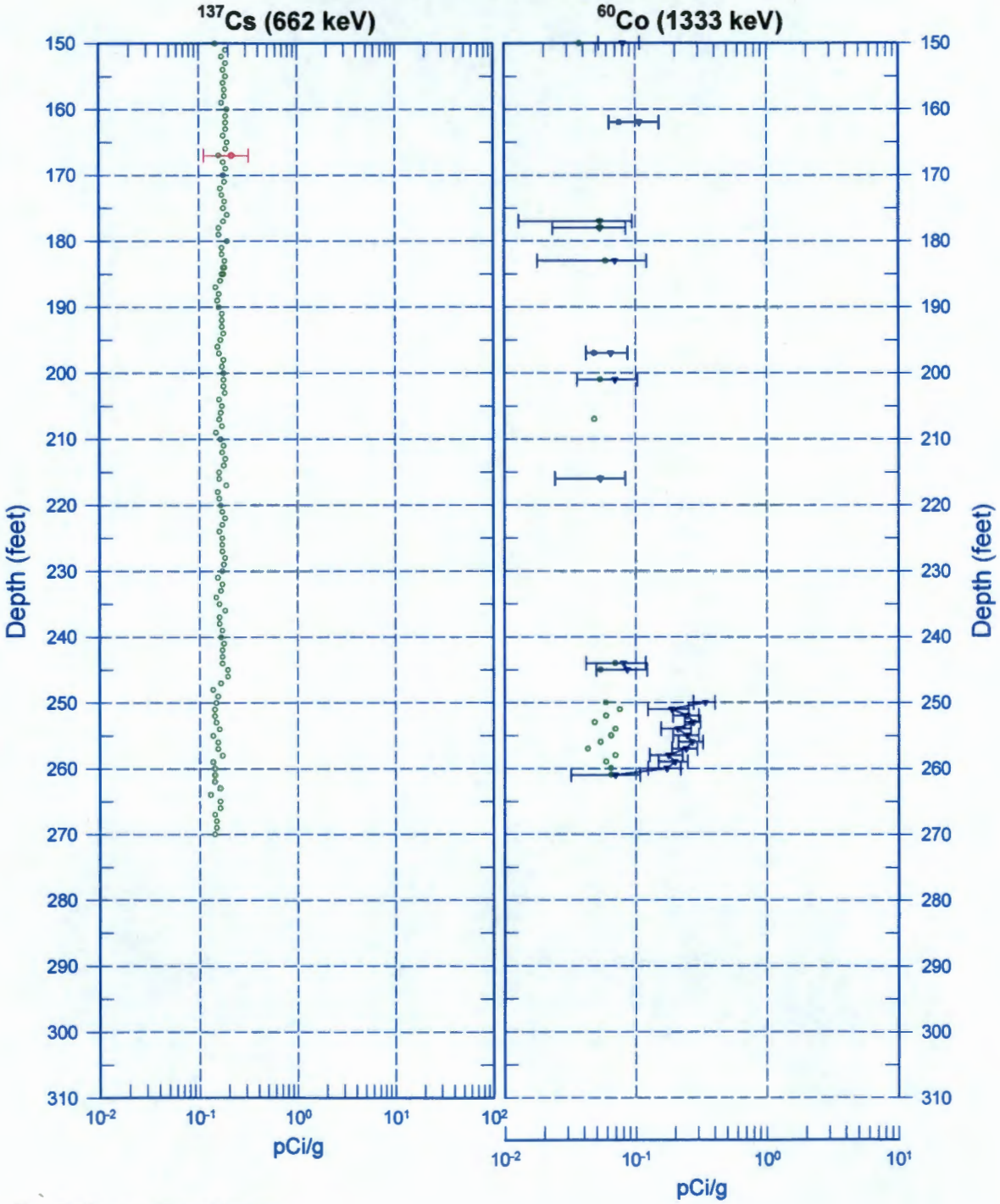

299-E27-14
241-C-103
Single-Shell Tank
241-C-102
Single-Shell Tank
241-C-105
Single-Shell Tank
241-C-101
Single-Shell Tank
241-C-104
Single-Shell Tank
241-C-107
Single-Shell Tank
241-C
Tank Farm
216-C-8
French Drain
2607-EG
Septic Tank
244-CR-WS-1
French Drain
244-CR VAULT
Receiving Vault
241-CR-151
Diversion Box
241-CR-152
Diversion Box
241-CR-153
Diversion Box
271 CR
Shed

299-E27-14 (A4812)
Man-Made Radionuclides



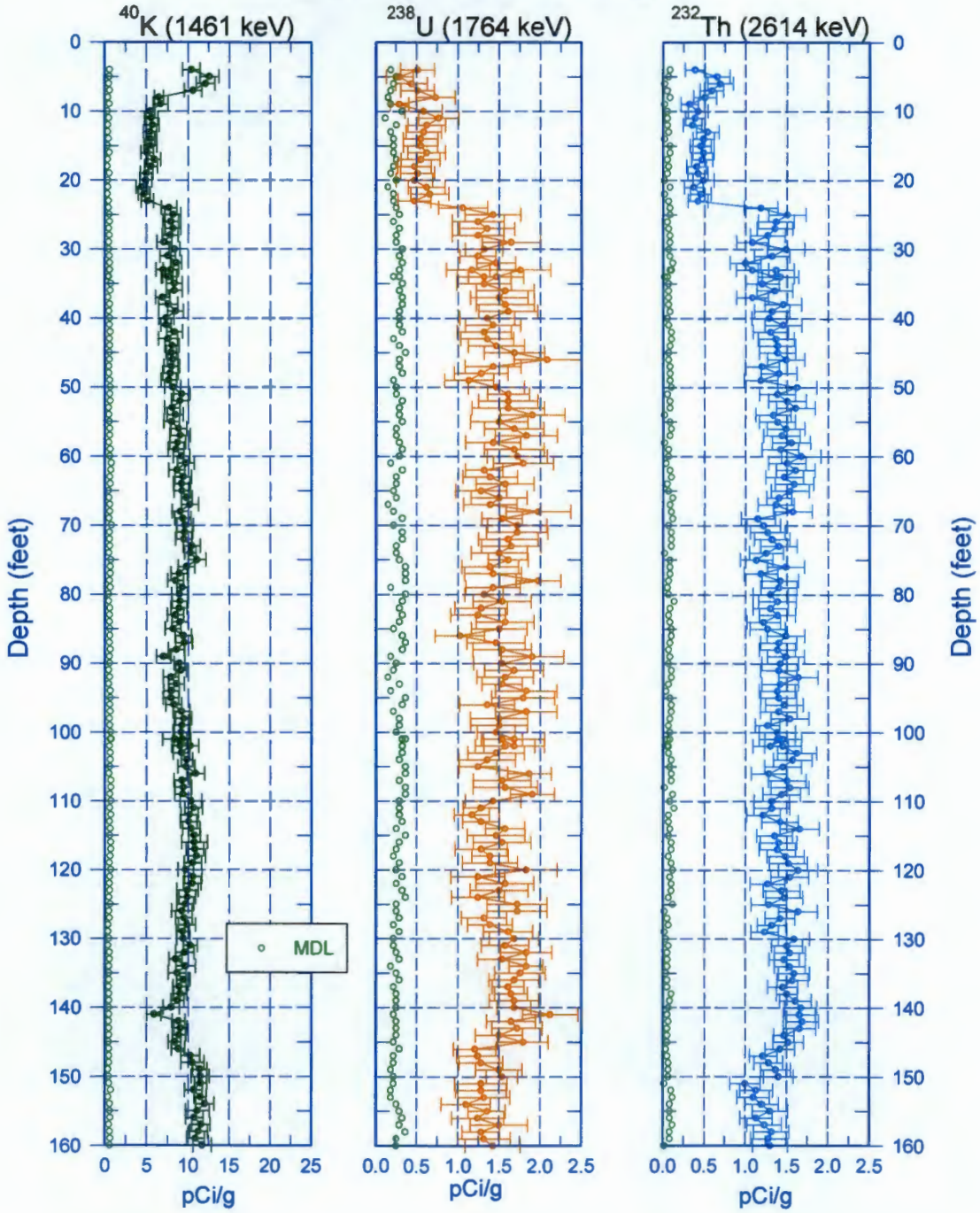
Zero Reference - Top of Casing

299-E27-14 (A4812)
Man-Made Radionuclides



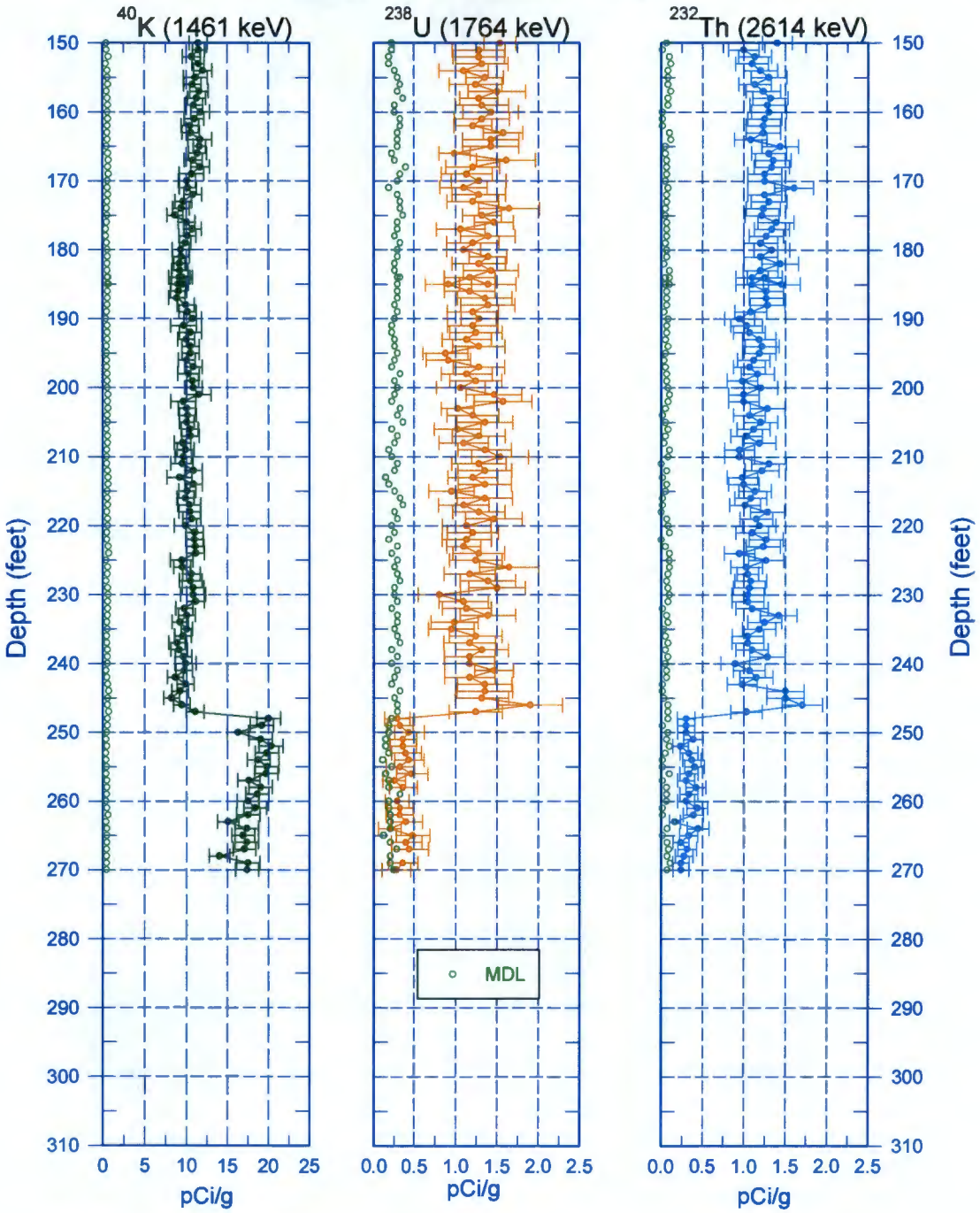
Zero Reference - Top of Casing

299-E27-14 (A4812)
Natural Gamma Logs



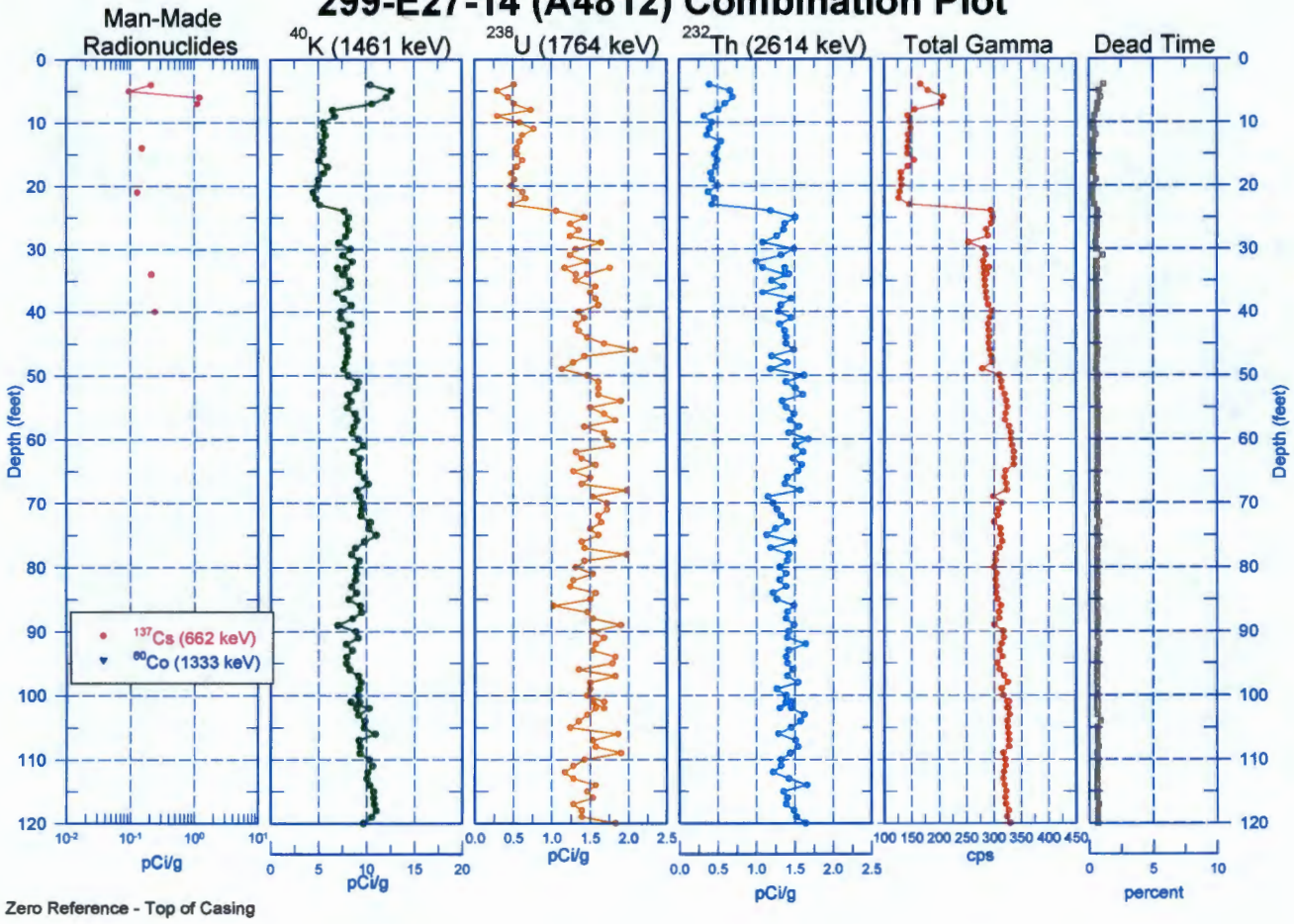
Zero Reference = Top of Casing

299-E27-14 (A4812)
Natural Gamma Logs

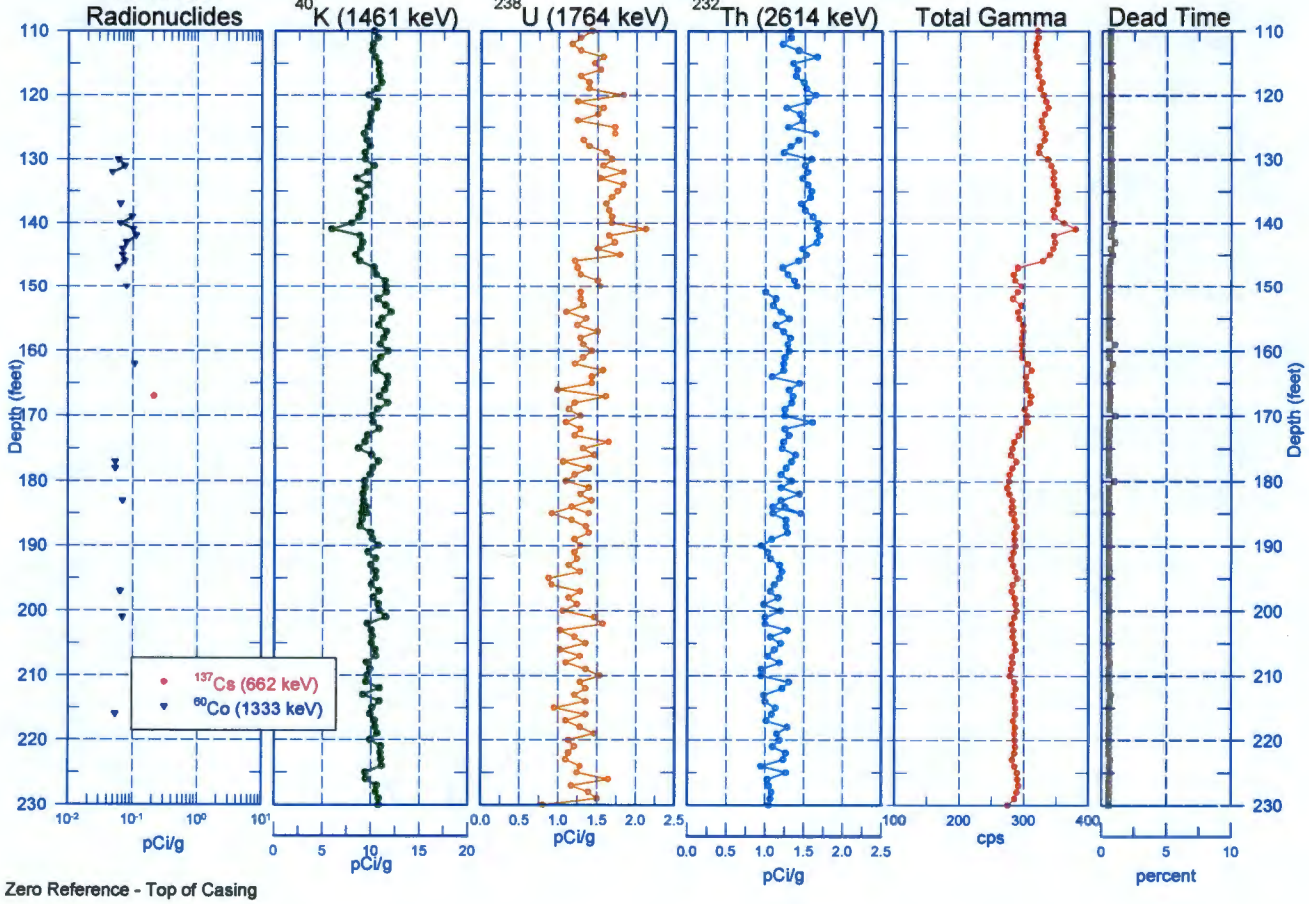


Zero Reference = Top of Casing

299-E27-14 (A4812) Combination Plot



299-E27-14 (A4812) Combination Plot



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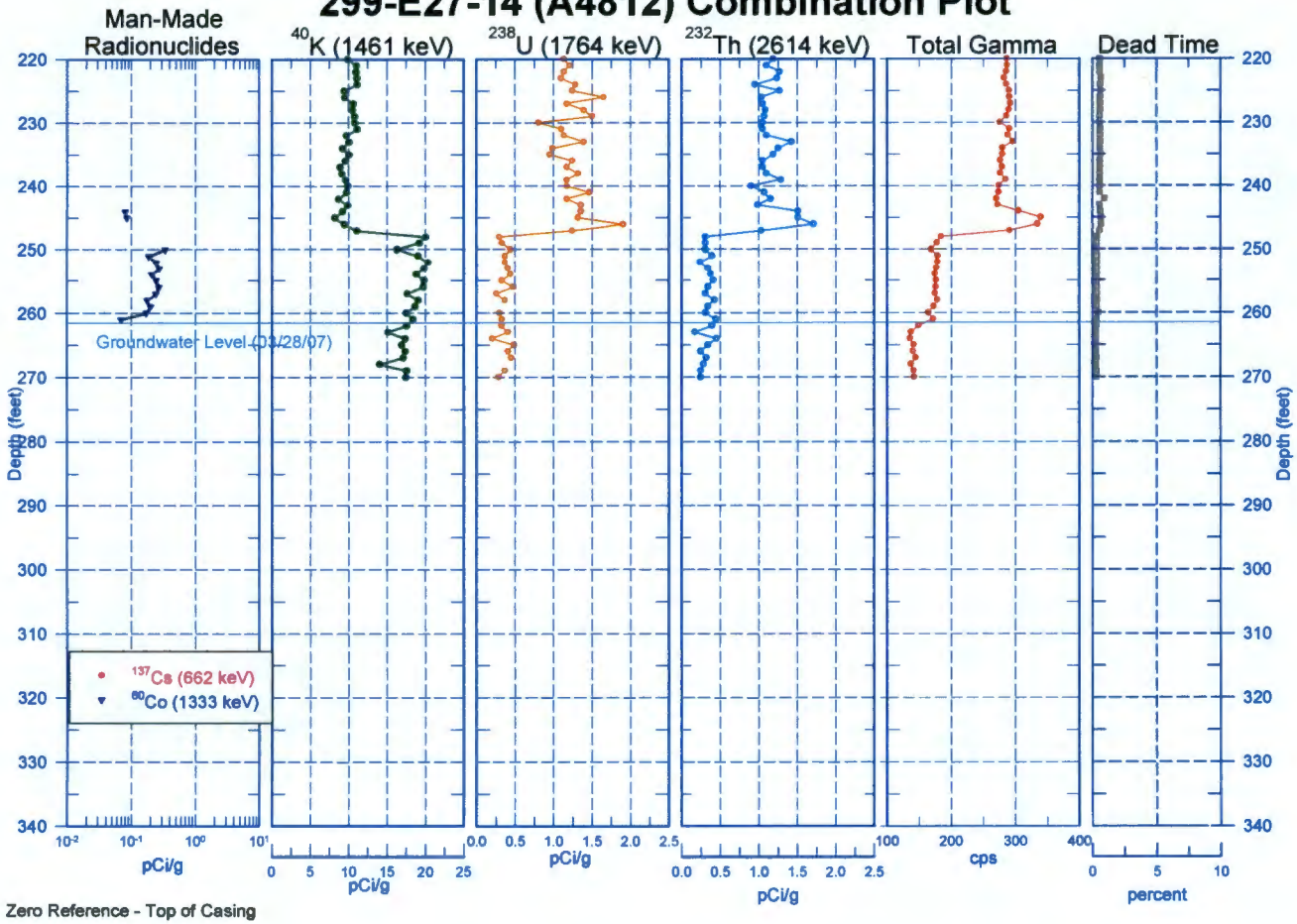
299-E27-14 (A4812) Combination Plot



Zero Reference - Top of Casing

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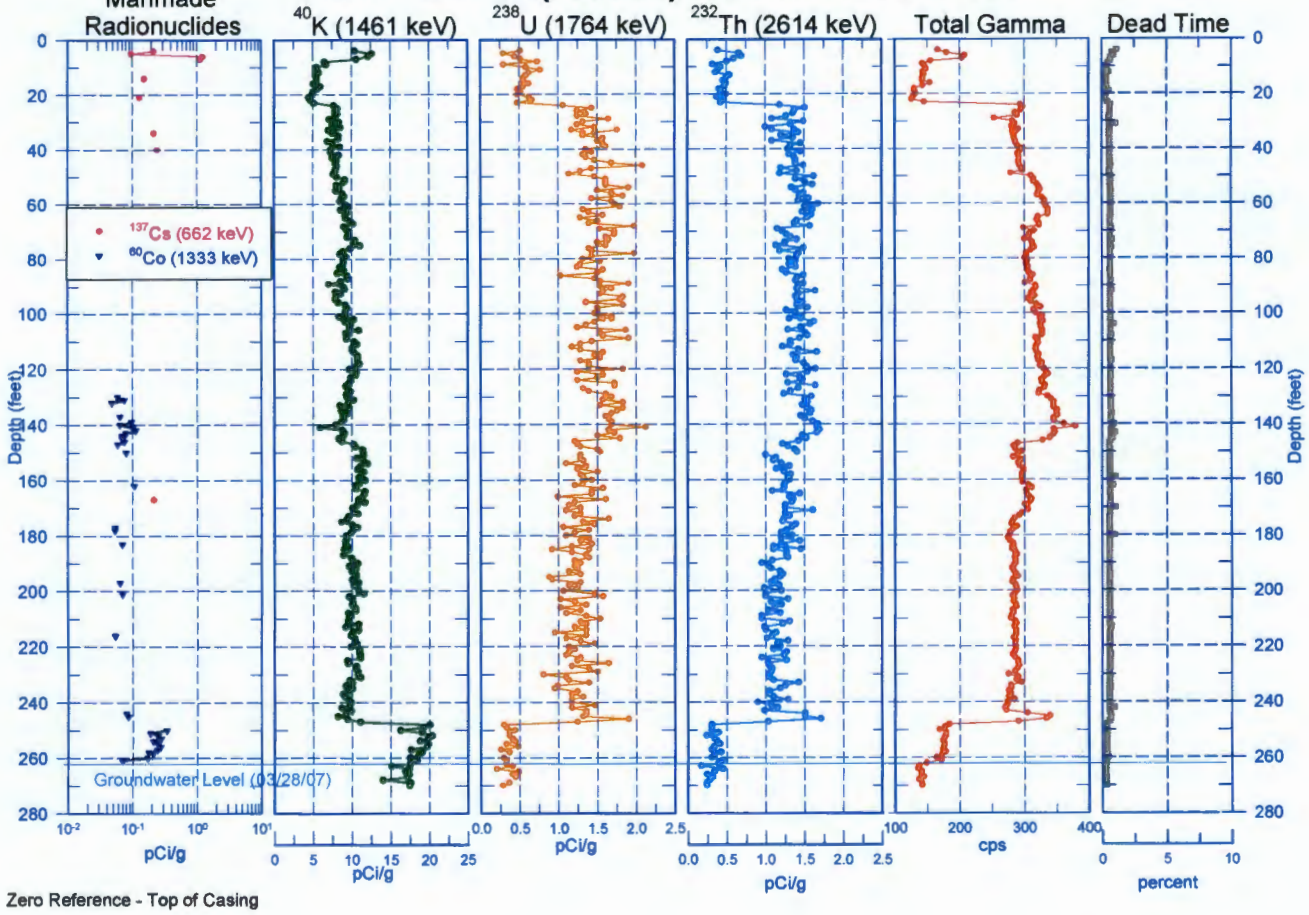
established 1959

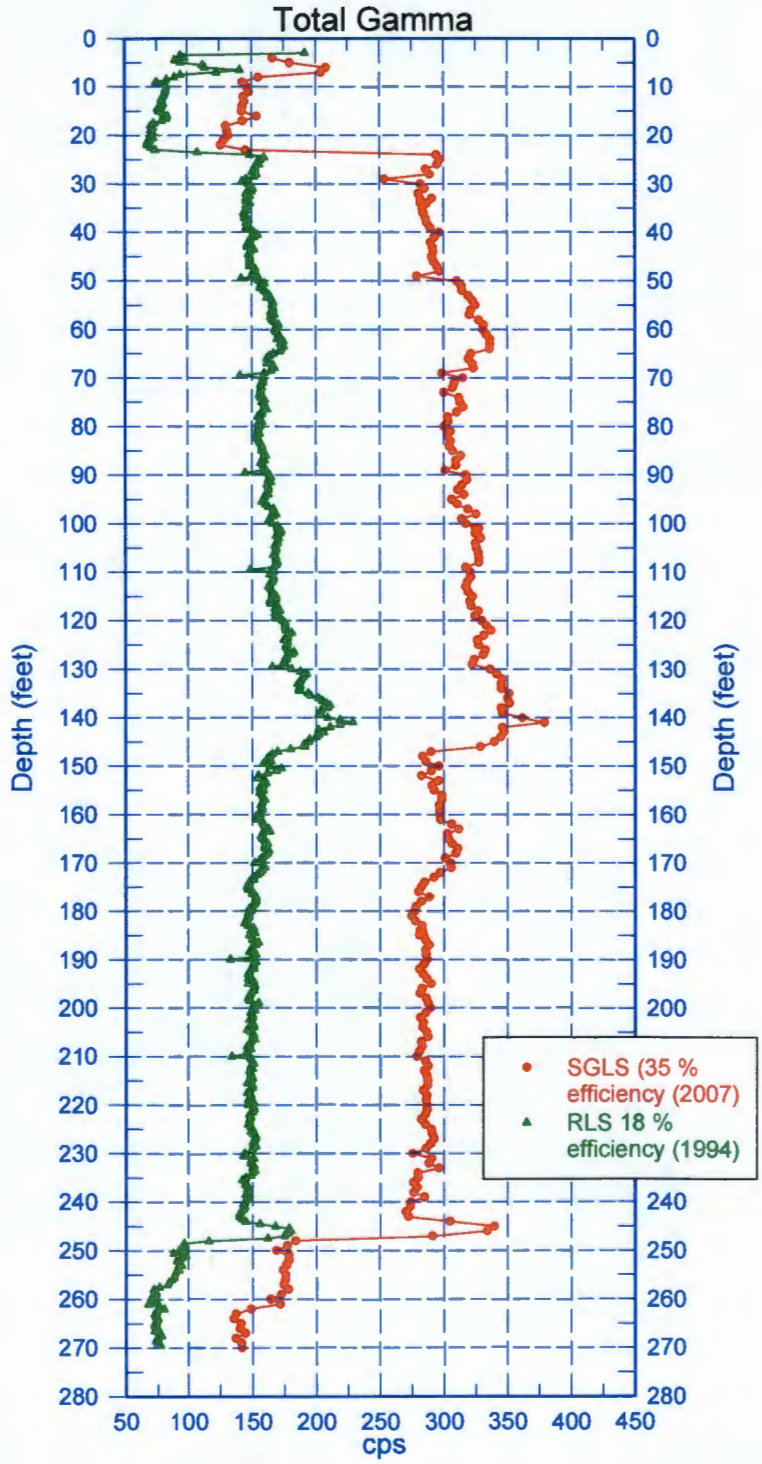
HGLP-LDR-068

299-E27-14 (A4812) Combination Plot

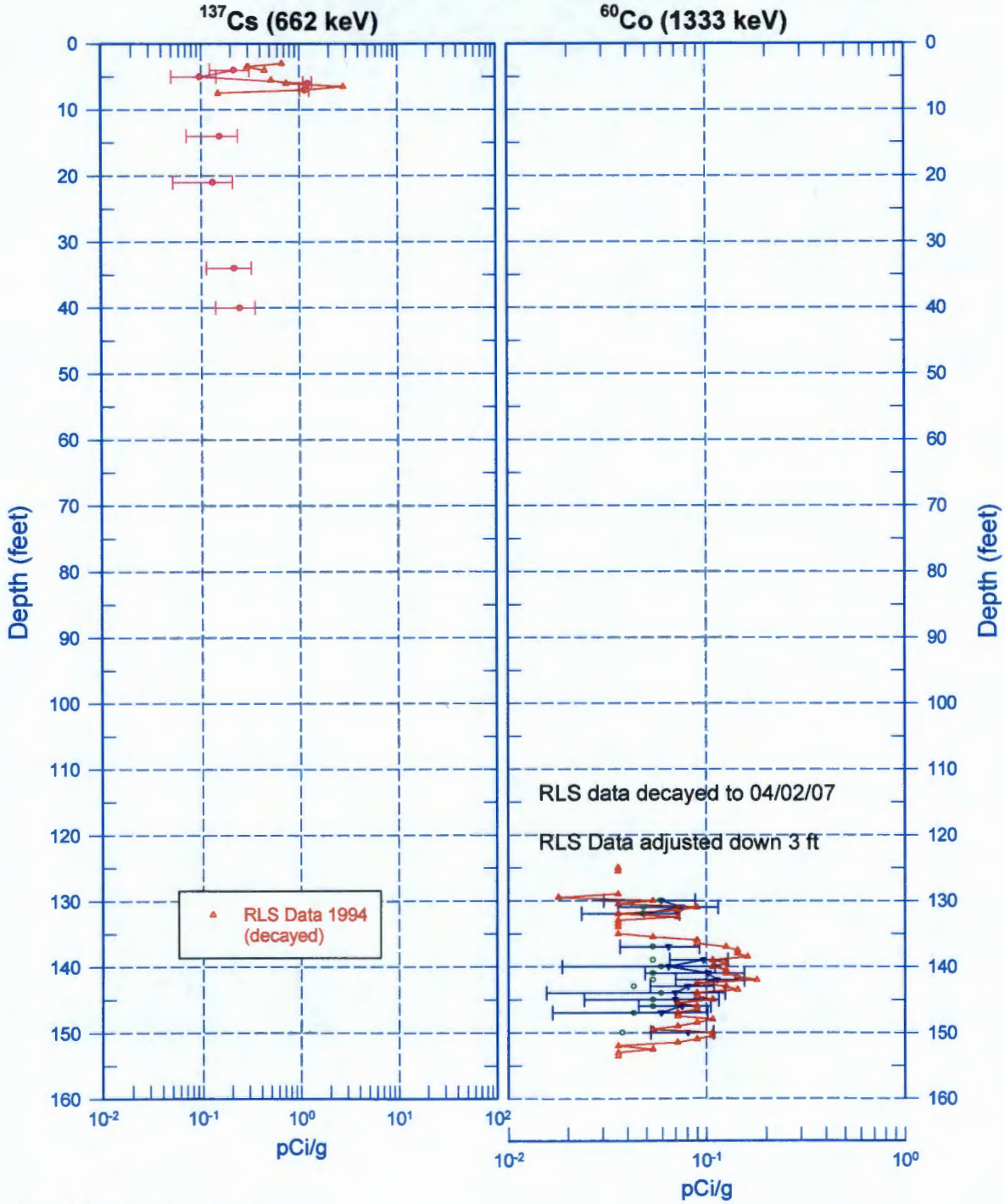


Zero Reference - Top of Casing

299-E27-14 (A4812)
Total Gamma (SGLS/RLS)

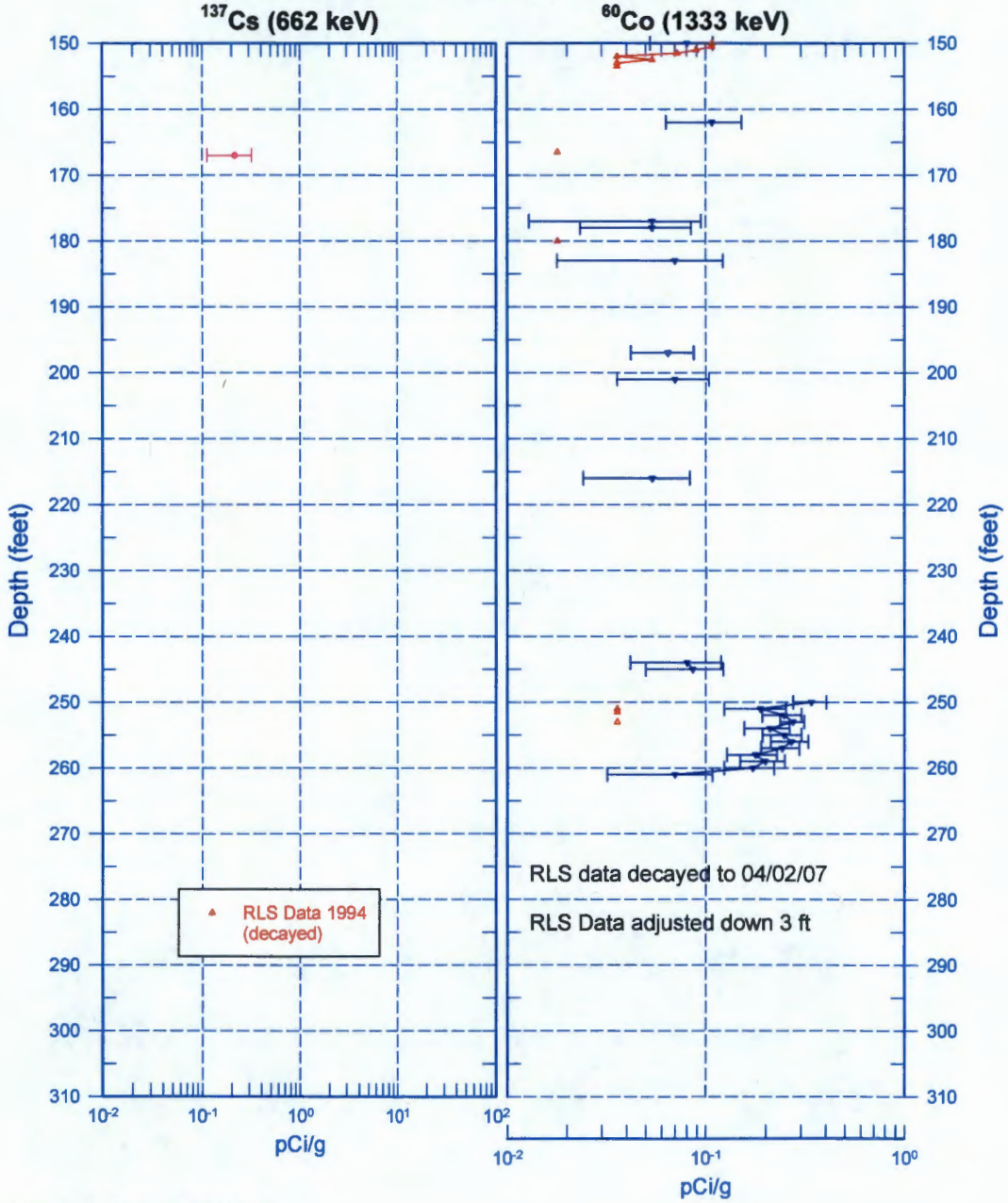


299-E27-14 (A4812)
Comparison of RLS (1994) and SGLS (2007)



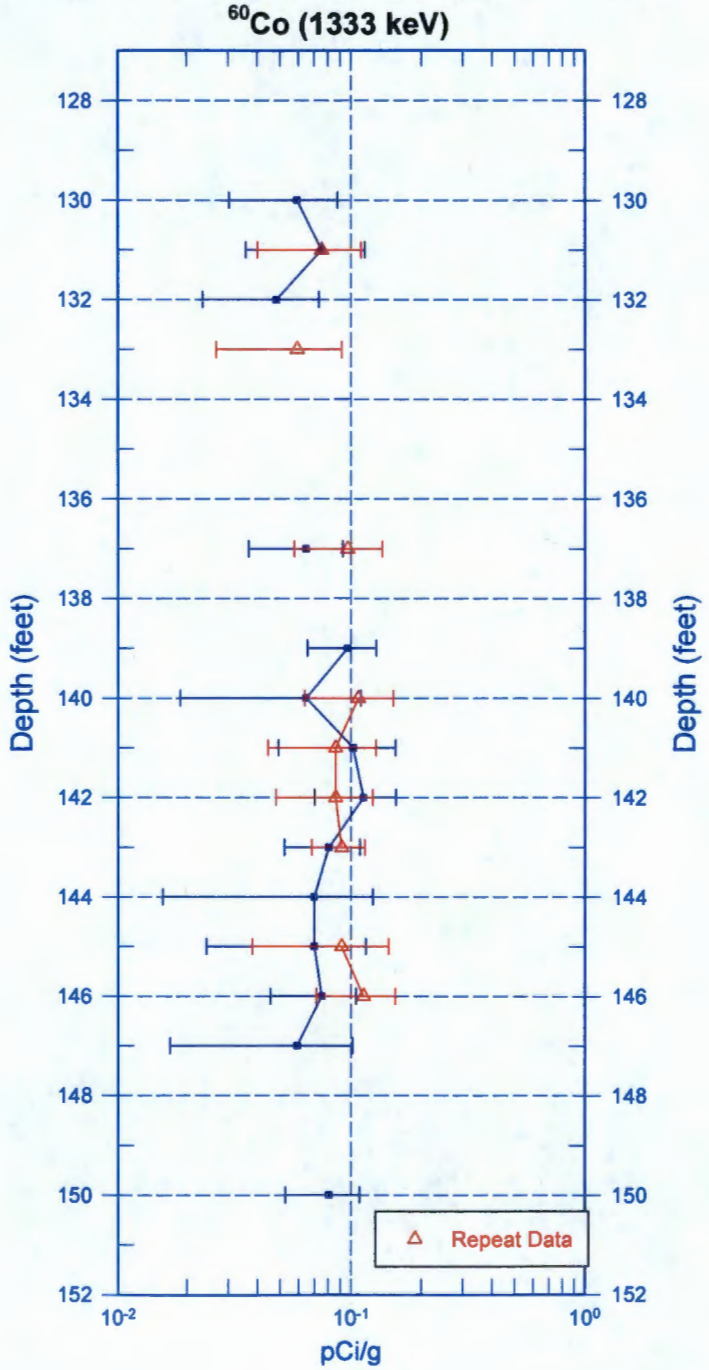
Zero Reference - Top of Casing

299-E27-14 (A4812)
Comparison of RLS (1994) and SGLS (2007)



Zero Reference - Top of Casing

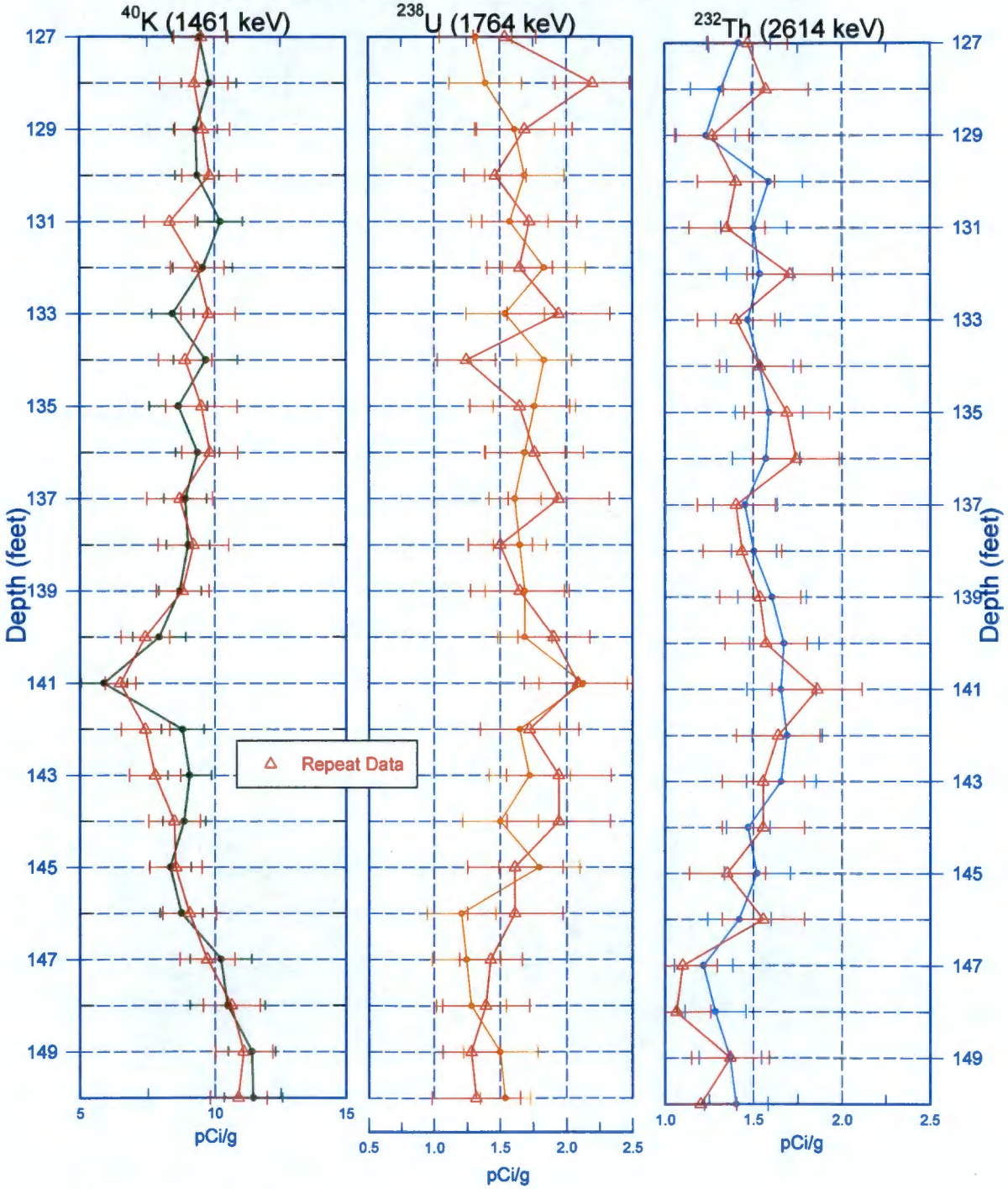
299-E27-14 (A4812)
Manmade Radionuclide Repeat Section



Zero Reference - Top of Casing

299-E27-14 (A4812)

Repeat Section of Natural Gamma Logs



Zero Reference - Top of Casing

WESTINGHOUSE HANFORD COMPANY

WELL NUMBER 299-E27-14 AREA 200-EAST

DATE 10-11-89

LOG RUN #2 LOG TYPE GAMMA RAY

SURVEY COORDINATES 42,700 N 48,144 E

ELEVATION DATUM Top of 8" CASING ELEVATION 658.43

LOG MEASURED FROM GROUND SURFACE

LOCATION DESCRIPTION S.E. SIDE 241-C TANK FARM

GROUND SURFACE ELEVATION 655.34

SURFACE TEMPERATURE 14.7°C WEATHER Cloudy

BOREHOLE INFORMATION

DRILLER LOUIS WATKINS KEH

DRILL RIG TYPE CABLE TOOL	BIT TYPE/DIAMETER REGULAR PATTERN 8"
BOREHOLE DIAMETER(S)/DEPTH 10" – 137' & 8" – 266'	
DEPTH DRILLER 266'	DEPTH LOGGER 265.6'
LIQUID LEVEL 250.02' G.S.	LIQUID APPEARANCE CLEAR
TEMPERATURE	

CASING RECORD

TYPE 10" CARBON STEEL	INTERVAL 137' – SURFACE
TYPE 8" CARBON STEEL	INTERVAL 8", 266' – SURFACE 2.1' STICKUP
TYPE	INTERVAL
TYPE	INTERVAL

WELL SCREEN INTERVAL: NA

COMMENTS: DEPTH RETURN ERROR 2".

EQUIPMENT DATA

LOGGING COMPANY PNL

OPERATOR(S) V.L. McGhan

EQUIPMENT BRAND MLS — EQUIPMENT TYPE ANALOG

TOOL TYPE GAMMA RAY — BASE CALIBRATION DATE 12/88

SERIAL NO. CG 27A97 — CALIBRATION REFERENCE WHC-EP-0246

CALIBRATION / PROBE FACTOR 8.53×10^{-2} eU ppm/c/s

DEAD TIME 7.4 μ SEC — WARM UP TIME 20 MIN.

LOGGING INFORMATION

LOG INTERVAL FROM 265.6' TO 100'

RERUN(S) 265.6' - 230'

PRE SURVEY CALIBRATION: POSITION 1 250 eU ppm/c/s POSITION 2 61 eU ppm/c/s BACKGROUND 265 c/s

LOGGING SPEED 5'/MIN.

START TIME 0915 — COMPLETION TIME 1000

CHART SPEED(S), FT/IN. 10'/IN.

CHART RECORDER HORIZONTAL SCALE, CPS/IN. 500 c/s, 50 c/s/IN.

RERUN SCALES, CPS/IN. 500 c/s, 50 c/s/IN.

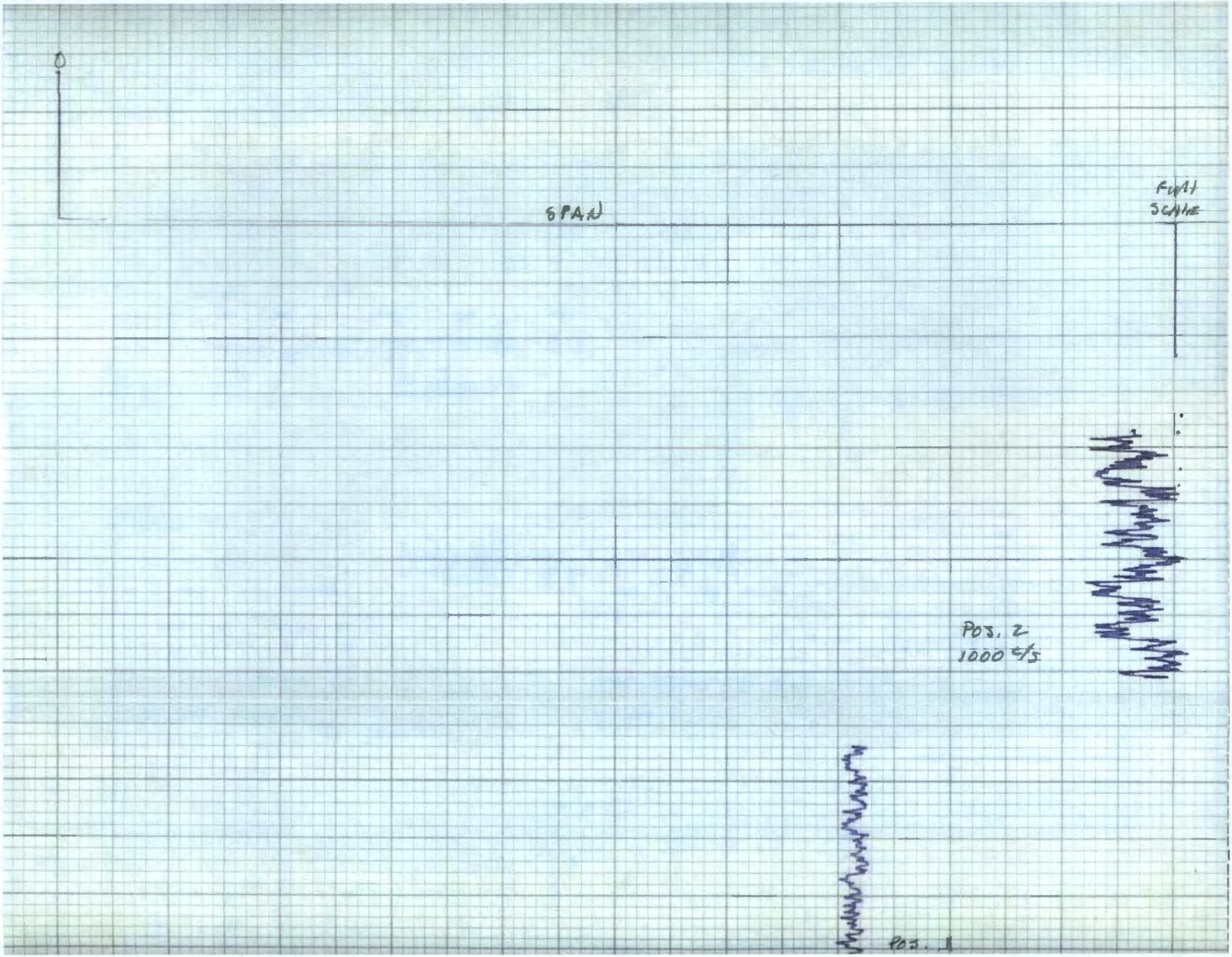
TIME CONSTANT(S) 1 SEC.

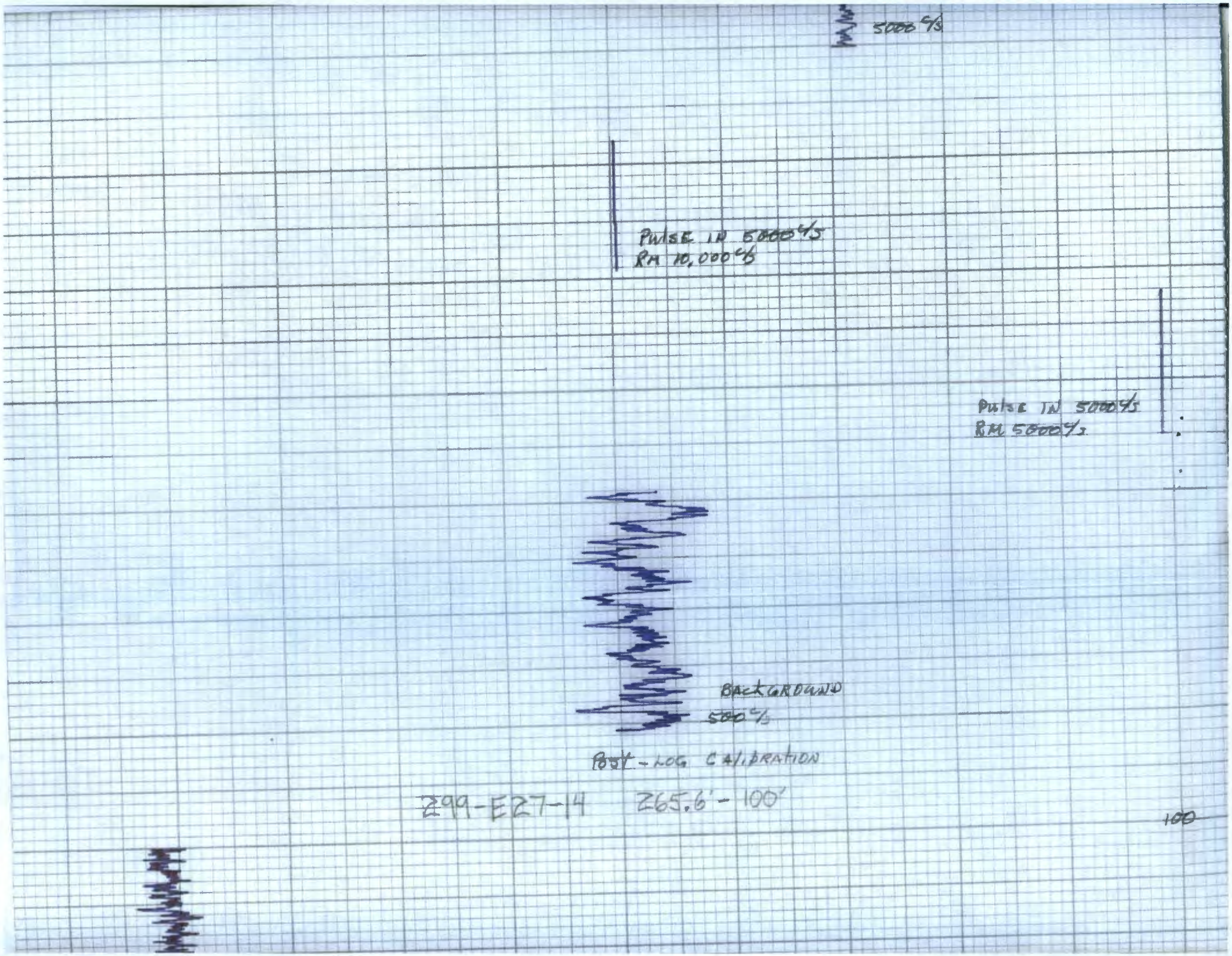
POST SURVEY CALIBRATION: POSITION 1 280 eU ppm/c/s POSITION 2 61 eU ppm/c/s BACKGROUND 260 c/s

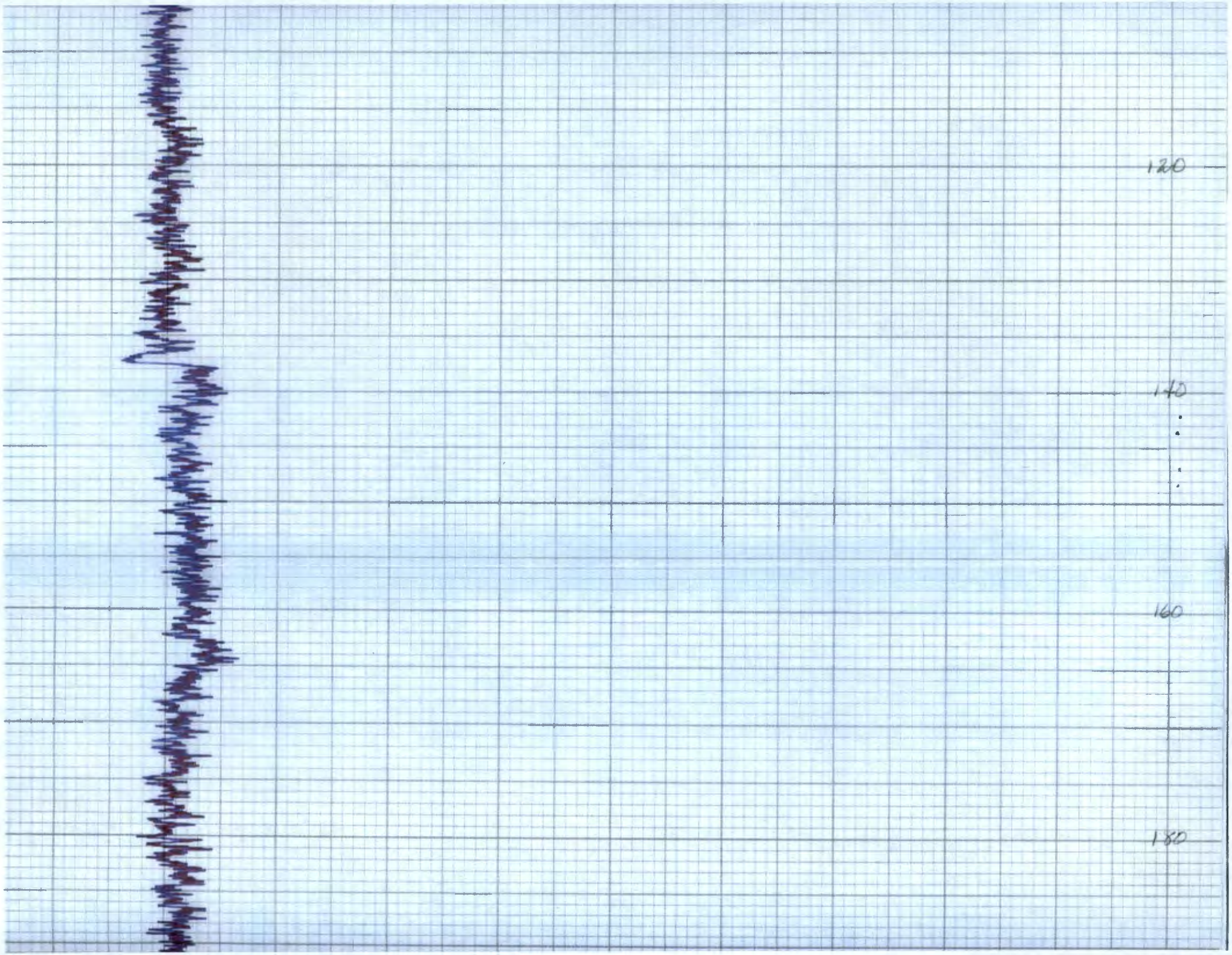
PERCENT CHANGE: POSITION 1 10.7% POSITION 2 0 %

COMMENTS:

WITNESSED AND VERIFIED BY: J. R. Broeder 10-11-89


0
SPAN
FULL SCALE
POS. 2
1000 c/s
POS. 1


5000 c/s
PULSE IN 5000 c/s
RM 10,000 c/s
PULSE IN 5000 c/s
RM 5000 c/s
BACKGROUND
500 c/s
POST-LOG CALIBRATION
Z99-EZ7-14 Z65.6'-100'
100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160
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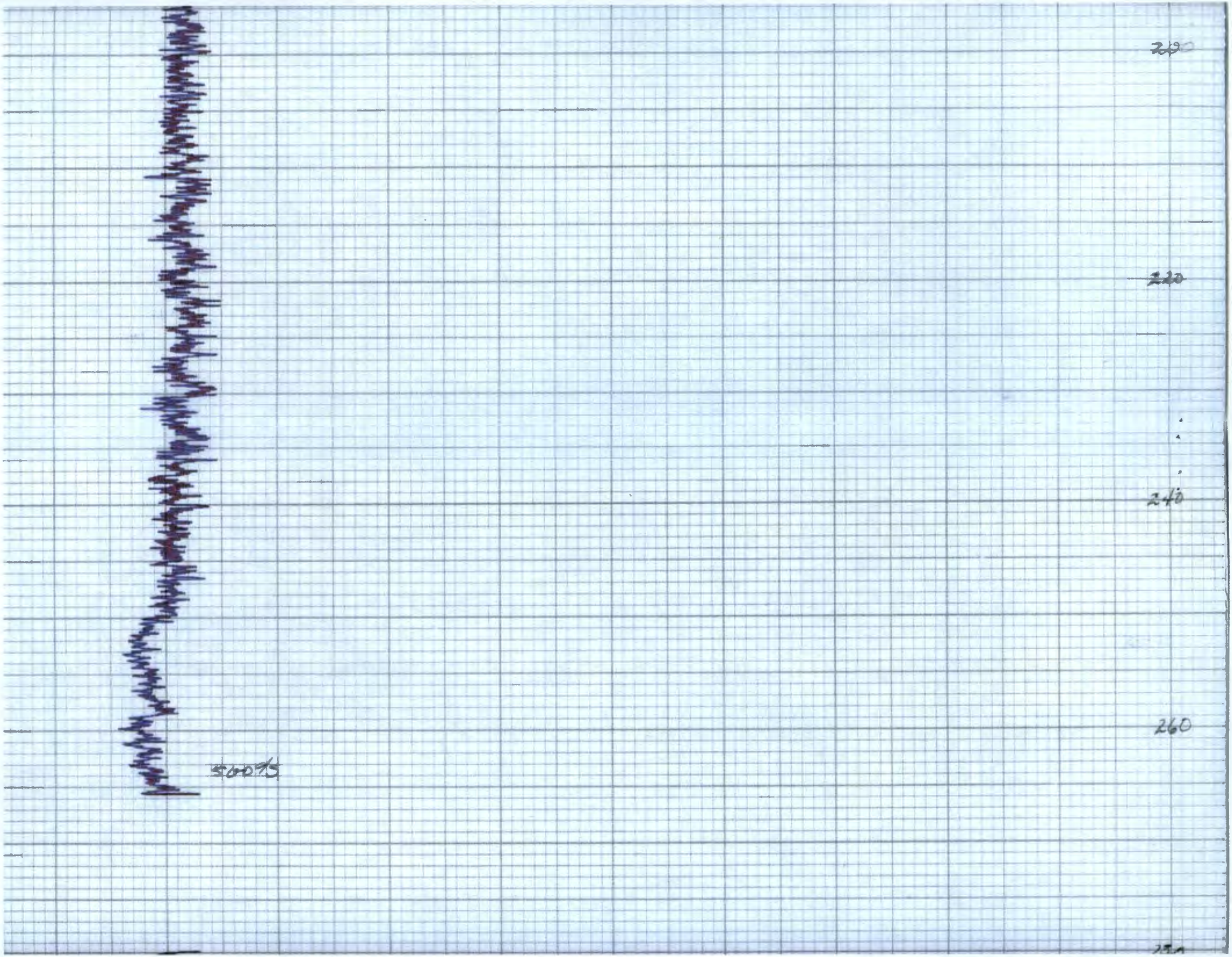
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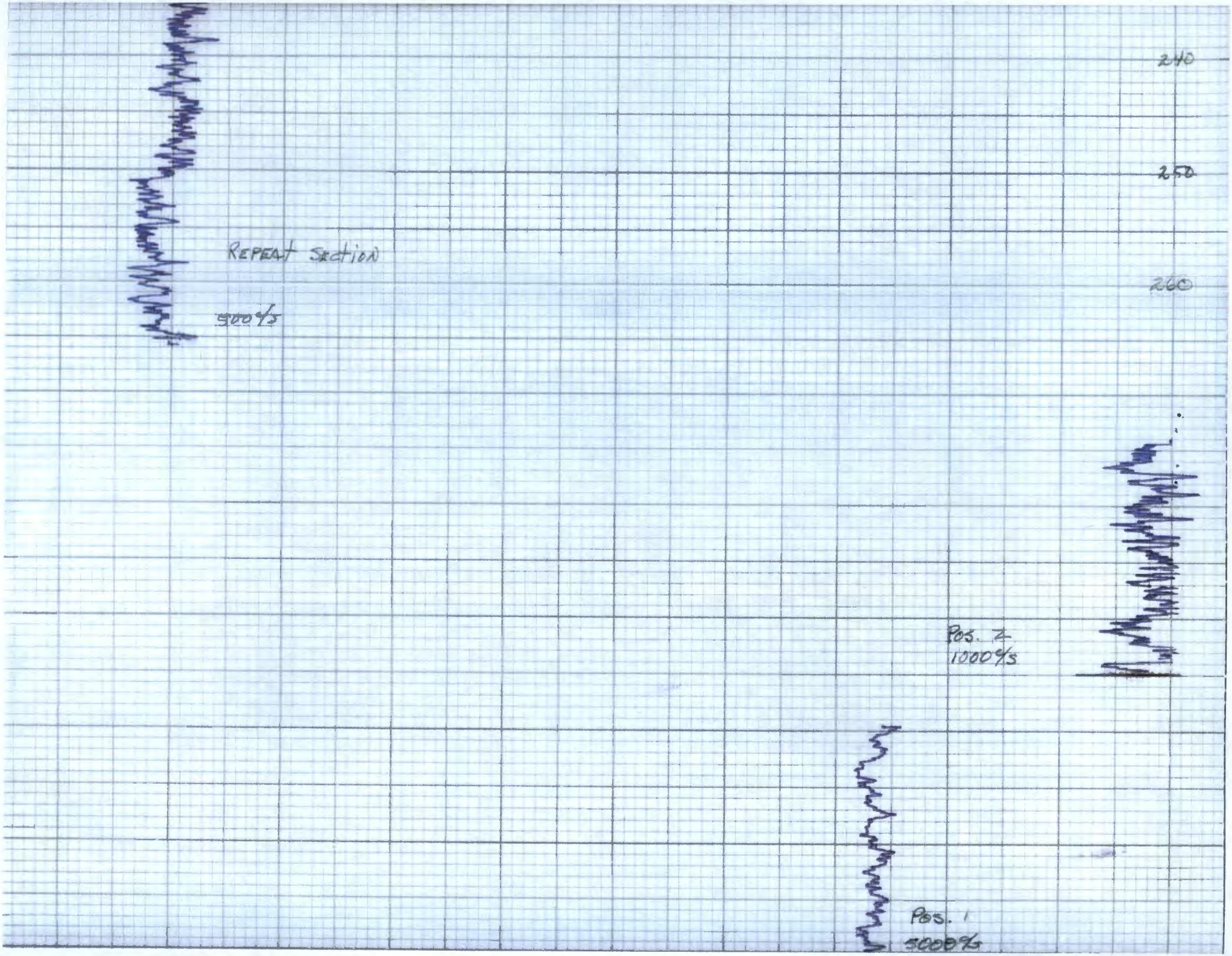
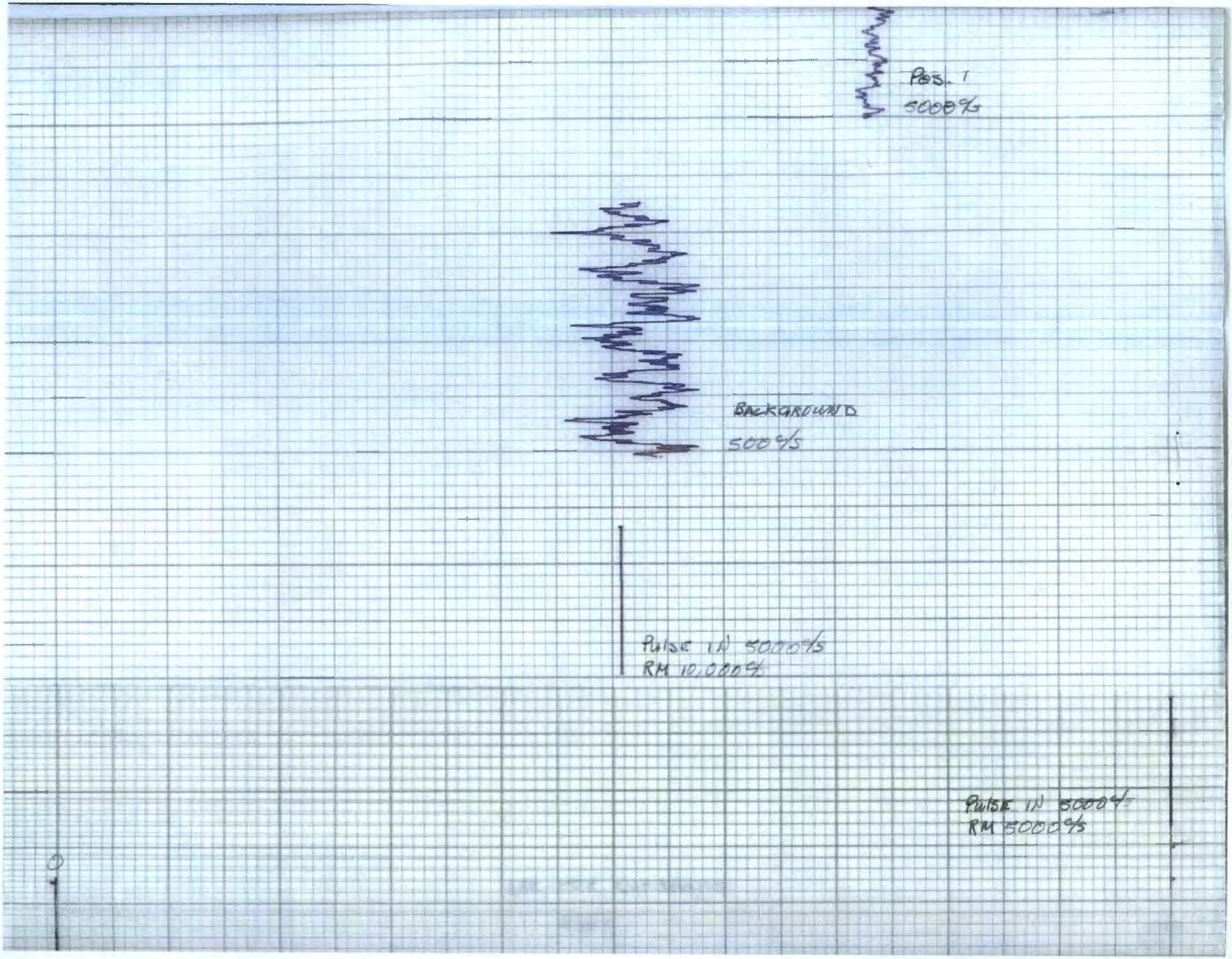
240
260


240
250
260
REPEAT SECTION
500%
Pos. 2
1000%
Pos. 1
500%


POS. 1
5000 c/s
BACKGROUND
500 c/s
PULSE IN 5000 c/s
RM 10,000 c/s
PULSE IN 5000 c/s
RM 5000 c/s
0