SEP 22 1993 (4)

ENGINEERING DATA TRANSMITTAL

1. EDT 160857

2. To: (Receiving Organization) Distribution	3. From: (Originating Organization) Geophysics	4. Related EDT No.: N/A
5. Proj./Prog./Dept./Div.: ER	6. Cog. Engr.: J. R. Brodeur	7. Purchase Order No.: N/A
8. Originator Remarks: Release		9. Equip./Component No.: N/A
		10. System/Bldg./Facility: N/A
11. Receiver Remarks:		12. Major Assm. Dwg. No.: N/A
		13. Permit/Permit Application No.: N/A
		14. Required Response Date:

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	WHC-SD-EN-TI-021		0	Results of Spectral Gamma-Ray Logging of Select Boreholes for the Aggregate Area Management Study	4	1/2	1	

16. KEY

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1, 2, 3, or 4 (see MRP 5.43)	1. Approval 2. Release 3. Information 4. Review 5. Post-Review 6. Dist. (Receipt Acknow. Required)	1. Approved 2. Approved w/comment 3. Disapproved w/comment 4. Reviewed no/comment 5. Reviewed w/comment 6. Receipt acknowledged

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OCT 1993

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-7400-172-2 (07/91) GEF097

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Title: Results of Spectral Gamma-Ray Logging of Select Boreholes for the Aggregate Area Management Study

Unclassified Category: UC-N/A

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New or novel (patentable) subject matter? [X] No [] Yes
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Part 1

SUPPORTING DOCUMENT

1. Total Pages 551

2. Title

Results of Spectral Gamma-Ray Logging of Select Boreholes for the 200 Aggregate Area Management Study

3. Number

WHC-SD-EN-TI-021

4. Rev No.

0

5. Key Words

Aggregate Area Management Study, Vadose zone characterization, Radionuclide Contamination, Geophysical Logging, Spectral Gamma-Ray, Cribs, Radionuclide Migration

6. Author

Name: J.R. Brodeur, R.K.Price, R.D.Wilson, C.J.Koizumi

Signature

Organization/Charge Code 81234/PHB25

APPROVED FOR PUBLIC RELEASE V. Buckland 9/21/93

7. Abstract

Spectral gamma-ray borehole geophysics was completed in boreholes at select liquid disposal sites within the 200 Areas. This was a limited field investigation conducted as part of the 200 Aggregate Area Management Study for the purpose of identifying the principal sources of groundwater contamination and providing some initial site characterization data.

Gamma-ray-emitting radionuclide concentration plots were prepared for 47 boreholes at 38 waste sites. These data were assessed to identify general radionuclide migration patterns. The data will contribute to the development of conceptual models for the liquid disposal sites and focus future ER characterization activities.

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9. Impact Level 4

10. RELEASE STAMP

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1.0 INTRODUCTION

1.1 PROJECT OVERVIEW

This report describes preliminary site assessment work for several waste sites within the 200 Areas at the U.S. Department of Energy's (DOE) Hanford Site. These waste sites are regulated under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). This characterization effort involved utilizing a spectral gamma-ray borehole geophysical logging system to determine the type, location, and approximate concentration of radionuclides released at the subject waste sites. Each site was then assessed using the spectral gamma-ray data and other available data to determine if there has been any noticeable migration or if there is any potential for the site to contribute contamination to the groundwater.

This work was performed as an integral part of the 200 Aggregate Area Management Study (AAMS) and was designed to be a screening effort from which to gain general information about the waste sites and support development of more detailed, site-specific characterization plans.

This characterization effort focused specifically on the assessment of the radionuclide contamination conditions in the unsaturated zone at effluent release sites in the 200 Aggregate Areas.

1.2 PURPOSE OF REPORT

The purpose of this report is to document the spectral gamma-ray logging work and provide a description of the objectives and methodology of the characterization effort. The report is intended to provide data to be used in support of the development of remedial investigation/feasibility study (RI/FS) strategies for the waste sites. It can be used to help determine future site characterization methodology, determine additional data needs, or assist in the development of interim remediation strategies.

The information in this document is supporting information for the comprehensive AAMS process.

1.3 STUDY OBJECTIVE

Older gross gamma-ray logging suggests that the largest quantity of the radionuclides released at the various effluent discharge sites in the 200 Areas have been retained in the sediment above the groundwater table, within the unsaturated zone. Therefore, the unsaturated zone represents a very significant contaminant source. With this in mind, it was desired to provide some initial characterization data on the unsaturated zone. The principal objective of this project was to provide that initial characterization data by assessing the distributions of radionuclides within the unsaturated zone at select release sites in the 200 Areas.

This assessment involved locating the bulk of the radionuclides at each site with a downhole gamma-ray detection system and determining the current radionuclide concentrations and vertical distribution patterns through the

unsaturated zone. Only the gamma-ray-emitting radionuclides were measured with the equipment.

The data were used to assess the general site conditions to the extent possible, considering the limitations of the data quantity and quality. Assessments were made to determine if there had been any obvious recent migration or redistribution of the radionuclides, to determine whether or not the gamma-emitting radionuclides have contaminated the groundwater, and to determine if there were any obvious radionuclide transport or deposition patterns that arose from the interaction of the varied effluent discharges and the geological conditions.

2.0 PROJECT METHODOLOGY

2.1 200 AAMS PROJECT BACKGROUND

The 1991 revision to the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al. 1989) requires that an aggregate area approach be implemented in the 200 Areas based on the *Hanford Past-Practice Investigation Strategy* (DOE-RL 1991). The Hanford past-practice strategy was developed between the State of Washington Department of Ecology (Ecology), the U.S. Environmental Protection Agency (EPA), and DOE to streamline the existing RI/FS and Resource Conservation and Recovery Act of 1976 (RCRA) investigation/corrective measures study (RFI/CMS) processes and promote the use of interim actions to accelerate cleanup. For the 200 Areas, the first step in the strategy is to develop AAMS reports to support the Hanford Site past-practice decision making process.

The AAMS program for the 200 Areas consisted of a series of 10 AAMS reports for eight source and two groundwater aggregate areas, and limited field screening investigations. The studies involved the search, compilation, and evaluation of existing operational and environmental data. Based on this information, decisions were made regarding which Hanford past-practice strategy path (i.e., expedited response action [ERA], interim remedial measure limited field investigation [LFI], and final remedy selection) to pursue for further actions at individual waste sites or contaminant plumes. Decisions were made to pursue field screening investigations that included an expanded groundwater monitoring program and spectral gamma-ray borehole geophysical logging.

This geophysical logging investigation was implemented due to a general lack of information concerning the unsaturated zone contamination in the 200 Areas. Results of the field investigation will be used to refine site-specific conceptual models first established in the AAMS reports, support Hanford past-practice strategy decisions, and focus future characterization needs via work plans.

2.2 SCOPE OF SPECTRAL GAMMA LOGGING

The scope of this project was to characterize the conditions of the unsaturated zone at select waste release sites, in terms of the distribution

of the specific gamma-emitting radioisotopes. Budget and time constraints did not allow comprehensive logging of all wastes sites within the 200 Areas. Much of that work will be accomplished on a site-by-site basis when priorities dictate.

It was intended to obtain enough data to be able to make some general conclusions about the deposition of the nuclides at each of the sites, with consideration given to the type and volume of effluent released and the estimated quantities of specific isotopes. From these data, it was planned to provide some general conclusions about the behavior of the nuclides in the unsaturated zone, which can be used to help develop site-specific conceptual models and detailed site characterization programs.

The field work was limited to spectral gamma-ray logging and some gross gamma logging in existing boreholes. It was a limited characterization effort designed as a screening effort, utilizing the existing boreholes, and assessing the historical gross gamma data and the existing radionuclide release information. The study was not designed to provide a definitive baseline for future monitoring, nor was it designed to provide laboratory quality radionuclide assay data. The adequacy of the data for specific feasibility studies or remediation decisions has not yet been determined.

2.3 DATA QUALITY OBJECTIVES

Data obtained in this project were used to assess the condition of the unsaturated zone relative to the deposition of radionuclide contaminants. The intent was to provide general information that will permit the development of site-specific characterization plans. The data quality objectives (DQO) reflect that this study was undertaken as a screening level effort.

With that in mind, the following quality objectives were developed in the initial planning stages of this project:

1) Provide enough information to locate the bulk of the radionuclides released at each site.

2) Utilize the high-purity germanium (HPGe) detection system to identify the specific gamma-emitting radionuclides as opposed to a gross gamma-ray logging system.

3) Provide the best estimate of the in situ radionuclide concentration with the existing calibration, data analysis methods and quality assurance (QA) factors. If borehole conditions exist that are not covered as environmental corrections in the current calibration, the most accurate concentration information will be reported to permit a qualitative assessment of the radionuclide deposition.

4) Provide the vertical profile of the radioelement concentrations within each of the logged boreholes with a data acquisition interval of at least 0.5 ft.

5) Provide enough data to assess the relative nuclide transport or deposition patterns to help develop an understanding of transport mechanisms.

It was not intended to report the precision, accuracy and measurement uncertainty of the surveys, nor was it intended that these logs be considered to be baseline surveys. Baseline surveys establish the current conditions to which future in situ assays are compared thus quantifying the radionuclide migration rates. These surveys do not provide such laboratory quality information. In the future, a QA program will be developed to address the applicable QA standards as specified by EPA (1987).

2.4 WASTE SITE AND BOREHOLE SELECTION CRITERIA

The criteria for selecting the facilities and boreholes to be logged with the spectral gamma-ray logging system are expressed in the sampling and analysis plan found in Appendix B.

Those criteria were developed with the intent of satisfying the study objectives outlined in Section 1.3, as well as the DQO listed in Section 2.3. They are consistent with the objectives of the AAMS program.

Major consideration was given to the inventory of radionuclides associated with each disposal site within each source unit, the suitability of boreholes placed in the vicinity of chosen sites for spectral gamma-ray logging, and evidence from previous gross gamma logging of subsurface contamination.

The intent was to identify those sites that are the most contaminated, which also have boreholes that are optimally configured for logging. The selected boreholes typically fully penetrate the radioactive contamination and provide access to the entire unsaturated zone with a borehole constructed such that it is covered by the calibration. However, for some waste sites, the selected borehole was not optimally configured.

An attempt was also made to characterize as many sites as possible with limited resources by logging only one borehole per waste release site or group of sites. Consideration was also given to covering as many operable units as possible while still covering those sites with the highest levels of gamma-ray activity. A list of the assessed sites and the associated operable unit and corresponding aggregate area is provided in Table 1.

Selection of boreholes to be logged began with a review of the existing data, including the facility waste disposal/storage data, borehole construction records, and the existing gross gamma-ray logs. Specific boreholes were chosen based on the following:

- gross gamma-ray log showed evidence of contaminated intervals
- borehole fully penetrates the interval of suspected contamination
- borehole did not have a bentonite or grout seal
- borehole were in close proximity to disposal facility.

Table 1. Operable Units and Effluent Waste Site Assessed with Spectral Gamma-Ray Logging.

Aggregate area	Operable units	Effluent waste site source logged
U Plant	200-UP-1	216-S-21
	200-UP-2	216-U-1 & 2, 216-U-12
	200-UP-3	
Z Plant	200-ZP-1	216-Z-12, 216-Z-18
	200-ZP-2	216-Z-7, 216-Z-9
	200-ZP-3	
S Plant	200-RO-1	216-S-5, 216-S-6
	200-RO-2	216-S-7, 216-S-13
	200-RO-3	216-S-20
	200-RO-4	
T Plant	200-TP-1	216-T-21 to -25
	200-TP-2	216-T-18, 216-T-19, 216-T-26 to -28
	200-TP-3	216-T-6, 216-T-14 to -17
	200-TP-4	216-T-3, 216-T-34 & -35
	200-TP-5	
	200-TP-6	
	200-SS-2	
PUREX	200-PO-1	
	200-PO-2	216-A-10, 216-A-27, 216-A-36A&B
	200-PO-3	
	200-PO-4	216-A-30
	200-PO-5	216-A-24
	200-PO-6	
B Plant	200-BP-1	216-B-57, 216-B-61
	200-BP-2	216-B-14, to -19
	200-BP-3	216-B-35 to -41
	200-BP-4	216-B-7A&B, 216-B-11A&B, 216-B-51
	200-BP-5	216-B-5, 216-B-9
	200-BP-6	
	200-BP-7	
	200-BP-8	
	200-BP-9	216-B-12, 216-B-62
	200-BP-10	
	200-BP-11	
	200-IU-6	
	200-SS-1	
Semiworks	200-SO-1	216-C-9, 216-C-10

Some boreholes were never logged with the gross gamma-ray systems. Regretfully, these boreholes were not included as candidates for AAMS screening with the radionuclide logging system (RLS). These boreholes should be logged in the future.

The site selection process was biased to cribs with high concentrations of radionuclides as determined from older gross gamma-ray logs. Additionally, it was biased to nuclides with the higher specific activities such as cesium, cobalt, europium, or antimony as opposed to nuclides with low specific activities such as plutonium or uranium. The sites with boreholes that have high gross gamma-ray activity were preferentially logged with the spectral system instead of the sites with lower activity boreholes regardless of whether the relative gross gamma-ray activity is the result of either higher radionuclide concentrations or the high specific activity nuclides.

In some instances logging procedures would not provide spectra that could be used to quantify very low concentrations of radionuclides present in a borehole along with high concentrations of other radionuclides. For instance, if high concentrations of cesium were present in a borehole, the spectra data acquisition time was decreased to provide adequate count-rate statistics for this nuclide while not providing adequate counting time to assay another radionuclide present in low concentrations in that borehole. The nature of this screening technique did not allow adequate time to quantify the low activity radionuclides.

Finally, the sites selected for logging did not include any cribs at which there was a surface contamination zone and no tank farms boreholes were logged. Conditions beyond the control of the geophysics personnel and the Westinghouse Hanford Company (WHC) Environmental Division prevented access to these sites with the RLS vehicle. Review of historic gross gamma-ray logs suggest that other cribs and tank farms not logged in this study are contributing sources of groundwater contamination.

3.0 RADIONUCLIDE LOGGING SYSTEM

3.1 DESCRIPTION

The RLS has a HPGe passive gamma-ray detector configured for use as a downhole logging tool. The detector is 2-in-diameter by 2 in. long with an efficiency of 18% relative to a 3- by 3-in. sodium iodide (NaI) detector, and a nominal energy resolution of 2.2 keV for the 1,332.5-keV cobalt-60 gamma ray. The high energy resolution of this detector enables the system to acquire, in most cases, well-separated, unambiguous gamma-ray spectral peak signatures unique to each of the several radionuclides detected.

The detector must be cooled to liquid nitrogen temperatures. This is accomplished with a liquid-nitrogen-filled dewar installed in the downhole probe. A full dewar of liquid nitrogen provides about 16 hr of operating time. Nitrogen boil-off vapor is vented to the surface through a small tube located in the center of the logging cable.

The downhole logging tool assembly is approximately 80 in. long and 3.625 in-diameter. It is completely sealed to allow the system to be used in water-filled boreholes.

The RLS, including the logging tool and the supporting hardware and software, was assembled for WHC by Greenspan, Incorporated, of Houston, Texas, in 1988-89. Design specifications were formulated by the WHC Analytical Operations Group. Greenspan installed the new logging system in a refurbished logging truck that saw previous duty at the Hanford Site as the Mobile Radionuclide Analysis Laboratory (MRAL II). MRAL II was a modified Gearhart-Owen mineral logging services truck.

RLS data acquisition and equipment operations are fully controlled by an Intel 80386-microprocessor-based computer. Logging can be accomplished in either a move-stop-acquire mode (tool is stationary during data acquisition) or a fixed-velocity mode (tool moves uphole or downhole at constant speed). In the move-stop-acquire mode, the distance between spectrum acquisitions can be set as small as 0.08 ft or as large as 10 ft, and the counting time per spectrum can be adjusted between 0.02 and 20,000 sec. In the fixed-velocity mode, the logging speed can be varied from 0.3 to 10 ft/min and the sampling interval can be set from 0.1 to 10 ft.

Gamma-ray spectra are encoded on a hard disk during the logging run in a format developed by EG&G/Ortec Company of Oak Ridge, Tennessee, called PHA format. At the end of the logging run, the spectra are transferred to a permanent 400MByte WORM (write-once-read-many) optical disk recording media.

When a gamma-ray interacts with the HPGe detector, an electrical charge pulse is produced, the magnitude of which is proportional to the energy of the gamma-ray photon. This charge is counted by the system electronics by tallying the appropriate channel of a multichannel analyzer (MCA) that corresponds to the precise energy of the photon or the pulse height. This "pulse-height spectrum", which is produced from the MCA, constitutes the gamma-ray spectrum.

Several electronic features of the counting system impose upper limits on the rate of pulse production (i.e., the detector count rates) that can be accommodated. One feature is the system dead time. The dead time is the minimum time interval that must separate two pulses if the counting system is to record them as distinct gamma-ray events. When the gamma-ray flux at the detector is high, the rate of pulse output from the detector may be so rapid that the time intervals between pulses are smaller than the dead time. If several pulses emerge from the detector within one dead time interval, only one pulse will be counted. The calculated count rate will then be less than it would be if there were no dead time.

Experience with the RLS HPGe system indicates that the dead time effect begins to grow rapidly with count rate as the count rate climbs above 100,000 counts/sec. (This rate was not approached during any of the calibration measurements.)

A stringent count rate limitation is also imposed by the electronic system's 3-μsec pulse processing (shaping) time. If a pulse shaping event is in progress when another pulse is generated, the second pulse will be lost. The shaping time imposes a theoretical upper limit on the system count rate of 333,000 counts/sec (the inverse of 3 μsec). In practice, the upper limit is

closer to 250,000 counts/sec. The system is said to be saturated at rates exceeding about 250,000 counts/sec.

The downhole logging cable is contained on a cable drum that holds approximately 600 ft of logging cable. The cable was specially designed to accommodate the signal, power, and venting requirements of the sonde. The cable is encased in a polyethylene sheath and strengthened by Kevlar (a trademark of U.S. Polymeric Company) strands. The cable passes from the drum to the borehole over a sheave wheel. The revolutions of this wheel are counted by a digital encoder and translated into a depth measurement by the computer to provide the tool position information.

The relatively large diameter of the cable has led to some uncertainty in the depth measurement. Depth error is checked by comparing recorded depths at the surface before the logging operation and again after logging is completed and the tool returned to the surface. Reported depths are estimated to be accurate to 98.5% of the depth measurement, with a (repeatability) of 99%.

The logging cable was replaced on August 16, 1992, after the depth error increased to unacceptable levels due to progressive cable failure.

Most of the logging described in this report was conducted in the fixed-velocity mode with a logging speed of 0.6 ft/min and a data acquisition interval of 0.5 ft, which permitted an acquisition time of about 30 sec. A hydraulic winch failure forced a change of the logging mode to move-stop-acquire at 35 sec/0.5-ft sampling intervals on July 27, 1992. The hydraulic motor was replaced September 16, 1992, and the fixed-velocity survey mode was reinstated.

3.2 CAPABILITIES

The efficiency of the HPGe detector is relatively high for the most energetic gamma rays that are emitted by both man-made and natural nuclides. At low gamma-ray energies (less than about 80 keV) the detector efficiency falls rapidly because of attenuation effects of the 0.05-in-thick steel tool housing. Radionuclides detectable by gamma-ray spectroscopy with the RLS tool, along with approximate detection limits for the nominal acquisition time of 30 sec, are presented in Table 2. The detection limits are based on the analysts' experience with 200 AAMS spectra and a criteria built into the analysis software that a peak is not accepted for analysis unless the highest count rate is at least three times larger than the statistical uncertainty of the average background count rate.

Important man-made radionuclides that have no gamma-ray signature and hence cannot be detected by the RLS gamma-ray detector include strontium-90 and tritium (hydrogen-3).

Table 2. Nuclides Assayed by the Radionuclide Logging System.

Nuclides	Gamma-Ray energy (keV)	Approximate * detection limit (pCi/g)
Natural		
^{40}K	1,460.8	5
^{238}U (via ^{234m}Pa)	1,001.0	5
^{238}U (via daughters) or		3
^{226}Ra (via daughters)	609.3	3
^{232}Th (via daughters)	911.2, 2,164.3	2
Man-made		
^{60}Co	1,173.2, 1,332.5	0.3
^{137}Cs	661.6	0.4
^{152}Eu	964.0, 1,085.8, 1,112.7, 1,408.1	1
^{154}Eu	723.3, 873.2, 1,004.8, 1,274.8	1

*NOTE: Assumes single casing in borehole.

3.3 LIMITATIONS

3.3.1 Low-Energy Gamma Rays

Peaks associated with the gamma rays of americium-241 (59.5 keV), plutonium-239 (98.4 keV, 129.3 keV, 413.7 keV), plutonium-240 (104.2 keV, 160.3 keV) uranium-235 (185.7 keV), and protactinium-233 (311.9 keV) have been detected in the spectra, but the decay activity concentrations of these nuclides (as reported in some of the logs in Appendix A) should not be considered accurate because the gamma-ray energies are below the range over which the calibration inverse-efficiency curve was determined. Thus, the calibration of the spectra system is not accurate at these low energies.

Activity concentration curves for these nuclides cannot be considered accurate and the uncertainty of the measurements is not known. The reported values are only relative to the values within the particular borehole.

[NOTE: Protactinium-233 cannot exist in the subsurface unless constantly replenished because the half life is only 27.4 days. Therefore, the 311.9-keV signal indicates the presence of neptunium-237, the parent of protactinium-233. Neptunium itself was not detected because the peaks for the neptunium-237 gamma rays were too low in intensity and energy to detect above background.]

3.3.2 Bremsstrahlung Distortions

Some gamma-ray spectra are distorted over the low energy portions. This distortion is thought to be a manifestation of bremsstrahlung.

Electromagnetic theory indicates that charged particles emit electromagnetic radiation if accelerated. When energetic electrons travel through matter, they are accelerated by interactions with the fields of nuclei and electrons. The associated radiation is known as bremsstrahlung (German for "braking radiation"). Since beta particles are energetic electrons, beta decay by nuclides such as strontium-90 will create bremsstrahlung photons in the matter that surrounds the beta emitters.

Figure 1 shows an example of a spectrum acquired in a section of borehole 299-E33-296 where the 661.6-keV cesium-137 gamma ray was intense. This borehole is a part of the 200-BP-1 Operable Unit. The gamma-ray signatures for the naturally occurring radioelements (potassium, uranium, and thorium) in this spectrum, were weak in comparison and are not evident in the spectrum. Although the peak associated with the 661.6-keV gamma ray is prominent, the peak count rate is well within accepted limits for proper operation of the spectrometer. No evidence of bremsstrahlung is observed.

The spectrum illustrated in Figure 2 was also recorded in borehole 299-E33-296, but at a different depth. Like the spectrum in Figure 1, this spectrum has a pronounced cesium-137 peak; in addition, there is an obvious distortion of the portion of the spectrum associated with energies below 661 keV. This distortion is attributed to bremsstrahlung radiation caused by the decay of strontium-90 which is known, from sediment sampling, to surround the borehole in high concentrations.

Although bremsstrahlung distortion can severely affect the gross gamma-ray count, the impact on the nuclide assessment accuracy is usually small because the bremsstrahlung radiation is typically prominent only when the strontium concentration is high. When this is the case, we may not be able to detect or determine the concentrations of other gamma-emitting radionuclides if they are only present in low concentrations. However, if nuclides are present that produce gamma-rays of relatively high energy, or if they are found in moderately high concentrations, a quantifiable peak in the recorded spectrum will be produced.

3.3.3 Spatial Effects

If the logging tool passes through strata with varying radionuclide source concentrations, the response recorded at any given depth is influenced by the radiation field generated from the strata immediately surrounding the detector and from those layers above and below the detector. This means that a spectrum recorded at some particular depth contains a superposition of responses from the various layers near the detector. Therefore, the spectrum recorded at a particular depth may not accurately portray the gamma activity of the layer at that depth.

To quantify and remove this spatial effect, a data processing technique known as "spatial deconvolution" should be utilized. This is the most effective way to minimize the signal mixing problem. Spatial deconvolution calculations cannot be performed at present because the spatial response characteristics of the tool have not yet been measured and the deconvolution parameters in the deconvolution equations have not been determined.

9413137.0403

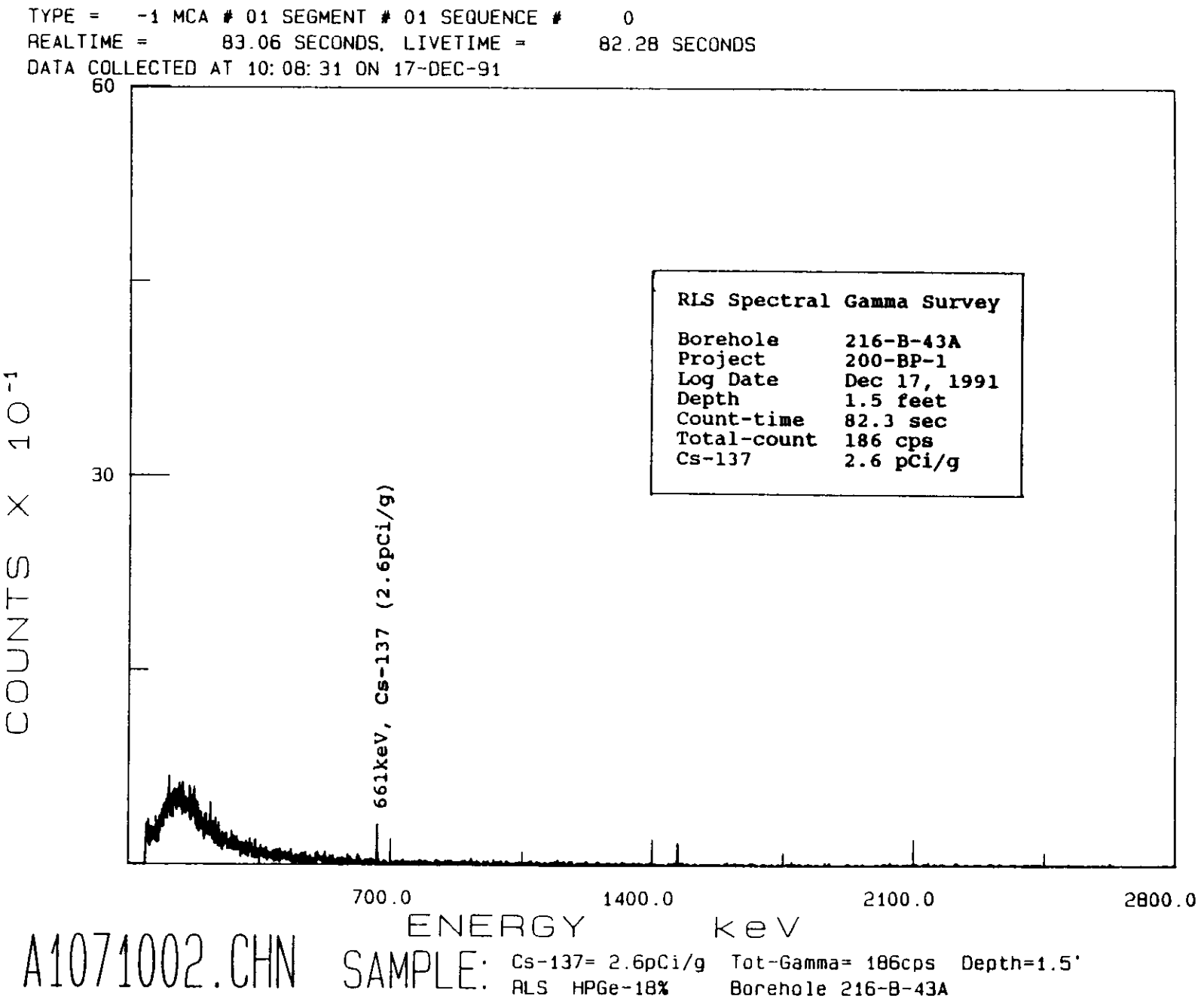

Figure 1. Cesium-137 Gamma-Ray Spectrum.

9413137.0404

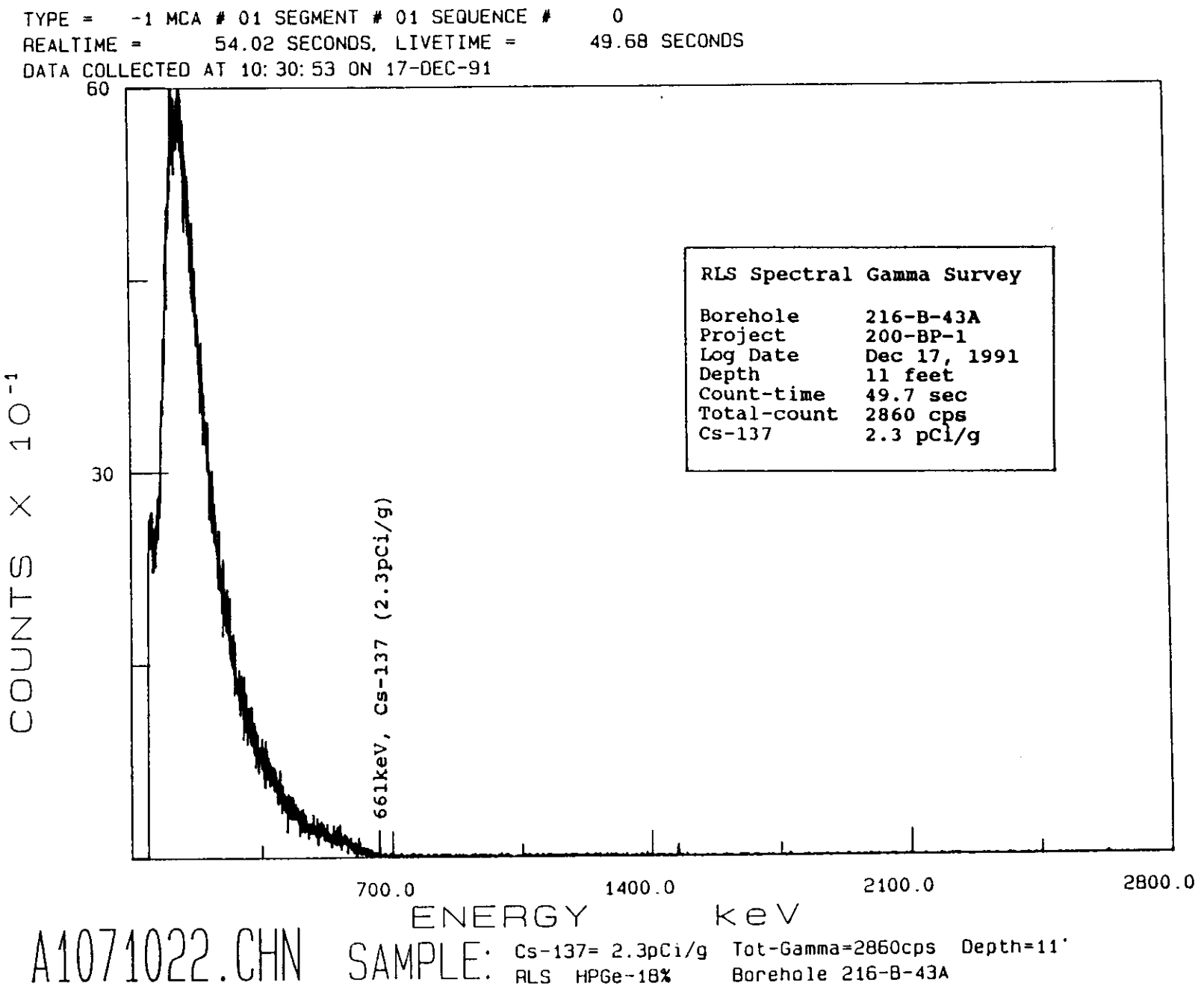

Figure 2. Cesium-137 Gamma-Ray Spectrum with Bremsstrahlung.

This was deemed as not being necessary for the screening objective of this project.

3.3.4 Borehole Environment Constraints

Some limitations of the system are created by an adverse borehole environment. When logging through a cased borehole, the casing attenuates the gamma radiation field, reducing the flux in an energy dependent manner. Lower energy gamma rays are attenuated to a greater extent than high energy gamma rays. To be accurate, the radionuclide concentration data must be correct for this attenuation.

The amount of attenuation of the gamma radiation and, thus, the magnitude of the concentration correction factor is dependent on the thickness of the casing or casings. With a thick casing or multiple casings in the borehole, the correction factor is large. The magnitude of the correction factors for the different casing thicknesses has been determined in the base calibration.

However, the thickest casing that can be accommodated and corrected for is 0.40 in. This limit is exceeded in some of the boreholes logged in this study. Some of the boreholes have three or more telescoping casings in the same boreholes, making the log data from the depths penetrated by the surface casing, outside of the correction limit.

In addition, some of the boreholes were grouted or filled with bentonite, typically by injecting grout in behind the installed casing. No corrections are available for the effects of the grout or bentonite seals and none of the data from such boreholes have been corrected for the effects of these types of borehole environments.

To further complicate matters, none of the boreholes that were grouted have a consistent grout thickness with depth. The boreholes were drilled using cable-tool drilling techniques and all have variations in the gap behind the borehole casing, which resulted in variations in the grout thickness. Even if a grout attenuation correction value were to be determined with appropriate calibration measurements, the grout thickness varies throughout the borehole in an unknown manner making it impossible to determine which grout thickness correction value to apply to the data. Thus, the spectral gamma data from boreholes with grout emplaced behind the casing cannot be considered accurate and the data cannot be considered to be correct relative to other depths within the same borehole.

4.0 RLS CALIBRATION

4.1 CALIBRATION BACKGROUND

The RLS HPGe spectroscopy hardware tallies gamma-ray counts in the channels of an MCA. The MCA channel number, in which a count is tallied, is proportional to the amount of electrical charge in the gamma-ray pulse. The size of a pulse is usually called the pulse height. Therefore, a gamma-ray

spectrum, or set of MCA channel counts collected over one counting time interval, is called a gamma-ray count versus pulse-height distribution.

Pulse height is proportional to the energy deposited by a gamma ray (or any other photon) in the HPGe crystal. Thus, a gamma-ray count versus pulse-height distribution (pulse height spectrum) is equivalent to a gamma-ray count versus gamma-ray energy distribution (energy spectrum).

Radionuclide decay produces gamma rays with well defined energies. If a number of gamma rays with the same energy enter the HPGe detector, the gamma-ray spectrum will have a peak. The center of the peak will occur in an MCA channel that corresponds to the gamma-ray energy and the intensity of the peak will be proportional to the number of gamma rays that entered the detector.

Two calibrations are required for quantitative radionuclide analysis. The first calibration establishes a relationship between MCA channel number and gamma-ray energy. With this relationship, the gamma-ray energy corresponding to a peak in the spectrum can be calculated, then the source nuclide can be identified.

The second calibration determines the relationship between the gamma-ray source intensity and the intensity of the corresponding peak in the gamma-ray spectrum. With this relationship, the source intensity, or radionuclide decay activity, can be calculated from the intensity of a peak in the spectrum.

The methods for accomplishing both calibrations are described by Koizumi et al. (1991 and 1992) or more briefly by Brodeur et al. (1991)

4.2 CALIBRATION METHOD

The energy calibration depends on either of two field check sources that contain minute quantities of gamma-ray-emitting nuclides. One source, designated by WHC as 79B40, contains minute quantities of cobalt-60, barium-133, cesium-137, radium-226, and thorium-232. On the fabrication date, April 2, 1989, the activities were 1.01 µCi (cobalt-60), 1.03 µCi (barium-133), 2.03 µCi (cesium-137), 3.03 µCi (radium-226), and 0.37 µCi (thorium-232). The use of 79B40 was discontinued in August 1991, following the discovery that radon-222, the first decay product of radium-226, was leaking from the source capsule.

The currently used (unnamed) check source is a small plastic capsule filled with lantern mantles. A thorium compound in the mantles imparts a weak but useable thorium activity to the capsule. The actual intensities of the various thorium gamma rays are immaterial since the check source spectral data are never used to calculate subsurface source intensities. Check source spectra serve only to verify the operation of the logging system and to determine the system energy calibration.

Spectra for energy calibrations are recorded with a check source attached to the logging tool housing at a specific location. The locations in the MCA of centroids of peaks that correspond to gamma rays of known energies allow an analyst to establish the relation between MCA channel number (or pulse height) and gamma-ray energy. This relation (i.e., the system energy calibration)

allows the analyst to find the gamma-ray energy associated with any peak in a pulse height spectrum.

To obtain the source intensity calibration, gamma-ray spectra are recorded by logging DOE spectral gamma-ray calibration standards at a DOE calibration center in Grand Junction, Colorado. Each standard features a 4.5-in-diameter uncased test hole passing through a homogeneous test zone with a uniform distribution of gamma-ray sources. Four standards, named K Model, U Model, T Model, and KW Model, were logged, with air as the borehole fluid, to record the spectra from which the source intensity calibration data were derived.

The calibration standard borehole configurations dictate that the source intensity calibrations are valid for logs recorded in 4.5-in-diameter, uncased, dry boreholes that penetrate homogeneous formations. Following practices adopted by all of the major petroleum service companies, the authors have formulated environmental corrections to account for borehole configurations that are different from those of the calibration test holes.

The KW Model has, in addition to a 4.5-in. hole, test holes with diameters of 3, 7, 9, and 12 in. The three largest holes have diameters wide enough to admit sections of casing and the cylindrical lead shield that can be installed over the logging tool detector to log boreholes with very intense gamma-ray fluxes. Spectra recorded without casing in the large-diameter holes verified the well known result that no borehole diameter correction is needed when the borehole fluid is air. Spectra were also recorded with the tool enclosed in casing sections or the lead shield. Differences in responses between these measurements and the open hole measurements were used to obtain corrections for casing and the lead shield.

The calibration measurements applicable to the present work were recorded in November 1991. The measurements and the calibration results are described by Koizumi et al. (1992).

4.3 CALIBRATION DATA

The equations for source intensity calibration and casing corrections are summarized in this section. The reader is referred to Koizumi et al. (1992) for the comprehensive data.

Calibrations for the natural gamma-ray sources, potassium, uranium (actually uranium decay progenies), and thorium (actually thorium decay progenies) are expressed by

$$activity = C_1 \cdot (peak\ count\ rate) + C_2 \ . \tag{1}$$

The constants C_1 and C_2 in Table 3 are applicable to intensities of peaks corresponding to the 1,461-keV gamma ray of potassium-40 (natural potassium isotope), the 609-keV gamma ray of bismuth-214 (ninth decay progeny of uranium-238), and the 2,614-keV gamma ray of thallium-208 (ninth decay progeny of thorium-232).

Table 3. Primary Calibration Constants for Potassium, Uranium, and Thorium.

Nuclide	C_1 (pCi/g)/(cps)[a]	C_2 (pCi/g)(cps)
Potassium	10.7 ± .6	-0.7 ± 1.7
Uranium	1.92 ± .05	-0.5 ± 0.6
Thorium	4.1 ± .1	0.1 ± 0.2

[a]counts/sec.

Since uranium and thorium decay progenies are sources for many gamma rays (e.g., 665-keV, 768-keV, 934-keV, 1,120-keV, 1,238-keV, 1,377-keV, 1,407-keV, 1,509-keV, 1,661-keV, 1,730-keV, 1,764-keV, 1,847-keV, 2,119-keV, 2,204-keV, 2,448-keV, and numerous other gamma rays are associated with the decay of bismuth-214), it is possible to calculate and use calibration constants based on gamma rays other than those cited above.

Uranium activities calculated from the intensities of gamma-ray peaks associated with the decay of bismuth-214 or lead-214 are subject to the following two potential sources of error stemming from disequilibrium in the uranium-238 decay chain.

Lead-214 and bismuth-214, respectively, are the eighth and ninth decay products of uranium-238. Both occur below radon-222 in the decay chain. Radon is an inert gas and, in some instances, is able to escape from the formation. If this occurs, then lead-214 and bismuth-214 will be present in smaller concentrations than would otherwise be the case. Consequently, the uranium activity will obviously be underestimated.

At the Hanford Site, processed uranium may exist in the subsurface. In such material, the decay activities of lead-214 and bismuth-214 are not commensurate with the activity of uranium-238 because the material has not lain undisturbed for a time sufficient to establish decay series equilibrium. Analyses based on the lead-214 and bismuth-214 gamma rays yield underestimates for the uranium activities.

If either of the two above situations is suspected, the log analyst may use the 1,001-keV protactinium-234m gamma ray for the uranium analysis. Protactinium-234m, the second decay product of uranium-238, is virtually always in equilibrium with uranium-238. Although the 1,001-keV gamma-ray peak is commonly prominent in spectra for processed uranium, it is usually too weak to analyze in spectra from natural background uranium concentrations.

The activities of man-made gamma-ray emitting radionuclides are calculated with the following formula:

$$activity = \frac{27.0\ pCi}{decays/s} \cdot \frac{I(E)}{N_x} \cdot A_x \ , \tag{2}$$

where:

N_x = number of gamma rays emitted per decay
A_x = intensity of the gamma-ray peak
$I(E)$ = detector inverse efficiency at the pulse-height energy E.

N_x, A_x, and I(E) are described in more detail by Koizumi et al. (1991). N_x is taken from Erdtmann and Soyka's (1979) tables of nuclear data, A_x is measured, and I(E) is determined as follows.

Experimental values for I(E) have been calculated for several discrete values of E using the 1991 RLS calibration data (Koizumi et al. 1992). Jandel Scientific's TableCurve (trademark of Jandel Scientific) least-squares curve fitting software was used to find an empirical function that fits the I(E) versus E data. The function is:

$$I(E) = K_1 + K_2 \cdot E + \frac{K_3 \cdot \ln(E)}{E} \ . \tag{3}$$

where:

K_1 = 3.23 ± 0.22
K_2 = 0.000878 ± 0.000058
K_3 = -56.9 ± 5.5

if I(E) and E are expressed, respectively, in 10^{-2} (γ/s/g)/(cps) and keV.

Equation (3) is the result of a curve-fitting routine, not basic physical principles. The function defined by Equation (3) may therefore diverge from the inverse efficiency at energies outside of the range covered by the experimental data. Equation (3) therefore should not be used to extrapolate the inverse efficiency to energies above or below the experimental range of 185.7 to 2,614 keV.

If a gamma-ray spectrum shows a peak centered at a pulse height energy E, then Equation (3) can be used to calculate I(E). Following identification of the gamma-ray source from E, the appropriate N_x is found from the Erdtmann-Soyka (1979) tables. The activity of the source nuclide can then be calculated with Equation (2).

4.4 ENVIRONMENTAL CORRECTIONS

Corrections for steel casing have been calculated using the 1991 calibration data (Koizumi et al. 1992). Corrections at several gamma-ray energies were found for casing thicknesses of 0.09, 0.33, 0.375, and 0.40 in. Analyses with TableCurve indicated that the energy dependence of the casing corrections can be summarized by:

$$S(E) = \frac{1}{P_1 + \frac{P_2}{\ln(E)}} , \tag{4}$$

where the constants P_1 and P_2 depend on the casing thickness. Values for P_1 and P_2 are shown in Table 4.

Table 4. Casing Correction Constants.

Casing thickness (in.)	P_1	P_1
0.09	1.24 ± 0.02	-2.49 ± 0.09
0.33	1.52 ± 0.03	-6.35 ± 0.16
0.375	1.53 ± 0.01	-6.49 ± 0.06
0.40	1.49 ± 0.02	-6.40 ± 0.10

Casing corrections are applied as follows:

$$\textit{corrected peak intensity} = S(E) \cdot \textit{peak intensity} . \tag{5}$$

A similar analysis for the lead shield yielded

$$\textit{correction} = P_3 + P_4 \cdot e^{-E/P_5} , \tag{6}$$

where E is the energy in keV and the constants P_3, P_4, and P_5 are

$P_3 = 2.02 \pm 0.18$, $P_4 = 567 \pm 56$, and $P_5 = 86.2 \pm 2.9$.

When the lead shield is used, the tool's effective sensitive energy range is restricted to energies greater than about 500 keV. Less energetic gamma rays are too strongly attenuated by photoelectric absorption in the lead. This is indicated by Koizumi et al. (1992, Figure 9).

Equations (4) and (6) were deduced with a curve fitting routine and do not reflect basic physical principles. The functions may therefore diverge from the quantities they represent when the gamma-ray energies fall outside the range covered by the calibration data. The casing and lead shield corrections, therefore, should not be extrapolated to energies above or below the experimental range.

When the detector is run in a water-filled borehole, the water between the formation and the detector attenuates the gamma-radiation field in a manner similar to the steel casing but to a much lesser extent (i.e., the water-filled borehole correction is much less than the steel casing correction). The magnitude of the correction depends on the borehole diameter and the gamma-ray photon energy. Thus, a family of curves similar to the casing correction is required.

Corrections for water-filled boreholes were not determined at the time the 200 West Area boreholes were logged, thus these corrections were not made to the data in those sections of the few boreholes that intercepted the groundwater.

Water-filled borehole corrections were applied to the data from the 200 East Area. The corrections were applied in a manner similar to the casing correction. The reader is referred to Koizumi et al. (1992) for additional information on the correction.

Corrections for grout, bentonite, and other perturbations have not been determined, nor is it possible to determine such corrections. Thus, radionuclide decay activities will be underestimated if calculated from spectra collected in boreholes with these features.

5.0 DATA ACQUISITION

5.1 LOGGING PROCEDURE

The logging for screening measurements was conducted under WHC procedures. In particular, all of the logging for 200 AAMS was governed by the following:

- Environmental Investigations Instruction (EII) 11.1, Rev. 1, Geophysical Logging, WHC (1988)
- Radiation Work Permit P-016 (effective January 3, 1992, to January 3, 1993.

The RLS calibration procedure is comprehensively described by Koizumi et al. (1992).

5.2 EQUIPMENT CONFIGURATION

Most logs were run with a centralizer installed on the tool. When the casing diameter was too small to accommodate the centralizer, the log was run with the tool eccentered (i.e., in contact with the borehole casing).

If radioactive contamination on the inside of the casing was known or suspected, the log was run with the tool encased in a disposable plastic sleeve. This sleeve produced a negligible gamma-ray attenuation effect.

Each borehole was surveyed from the surface to the maximum hole depth with the cable winch speed set at 0.6 ft/min. Gamma-ray spectra were continuously recorded and saved as separate disk files at every 0.5-ft increment along the depth of the borehole. Each spectral file represents the photons recorded as the detector moved through the 0.5 ft increment. The spectra were tagged with a unique name that reflected logging date, borehole identification, and depth.

The counting system was electronically set to optimize gamma-ray photopeak identification. This configuration limited the maximum count rate to about 250,000 counts/sec before system saturation occurred.

If the first survey revealed sections where the gamma-ray intensity was sufficiently high to saturate the counting system, a lead shield was installed on the logging tool and a second survey was run. The electronic configuration was also readjusted to maximize counting efficiency (this reduced the energy resolution). The lead shield usually reduced the count rates to acceptable levels for the detector and its electronics. As mentioned in Section 4.4, a correction function is available to account for the energy-dependent attenuating effect of this shield. However, if the shield was installed, the useful gamma-ray energy range was limited to energies above about 500 keV.

5.3 LOGGING SEQUENCE

Prior to each logging run the borehole parameters and survey plans were recorded on the "Logging Specifications" sheet. The logging engineer then set up the RLS at the borehole and checked all aspects of the system for proper operation. The tool was suspended on the logging cable, with the lower end just above ground level, and a spectrum was acquired for 1,000 sec with a field check source attached to a specific point on the surface of the tool housing. Next, the field check source was removed and a background spectrum was acquired for 1,000 sec. The background measurement surveyed gamma rays from radionuclides in the ground beneath the tool.

The logging engineer used a software program and the check source spectrum to establish the system's energy calibration. The logging software transferred this energy calibration to all of the spectra collected in the subsequent logging run.

A Health Physics Technician would scan a swab of the borehole to check for radioactive contaminants within the casing before the logging run began.

Accessories such as a centering device, plastic sleeve, or lead shield were mounted on the tool, if needed, and the logging engineer manually

positioned the tool so that the HPGe detector was centered on a depth reference point. The depth recording instrumentation was zeroed and the logging parameters, such as depth range to log, logging speed, and acquisition times were entered in the computer program.

Boreholes were customarily logged downward (i.e., spectral data were recorded as the tool descended) usually proceeding until the tool reached the bottom of the borehole. Borehole sections below the water table were logged, although corrections for water-filled holes were not available or applied to the surveys recorded in the 200 West Area. Water-filled borehole corrections were applied to the surveys recorded in the 200 East Area.

The 200 AAMS boreholes were typically logged in the fixed-velocity mode, whereby data were acquired as the tool moved down the hole at a constant, operator-selected speed. The nominal logging speed was 0.6 ft/min and the depth interval over which spectra were acquired was 0.5 ft.

The alternate logging mode, known as move-stop-acquire, was used from July 27, 1992 to September 15, 1992, when the cable winch was not operating properly in the fixed-velocity mode. The move-stop-acquire mode was typically reserved for studies that require highly accurate radionuclide concentrations at specific depths. The fixed-velocity mode is better suited to borehole screening measurements because it is faster. This follows from the fact that in the fixed-velocity mode, data are recorded continuously as the tool moves along the borehole, whereas in the move-stop-acquire mode, data acquisition is suspended when the tool is moving from one measurement depth station to the next.

The logging software automatically encoded all spectra, including those for the check source, in Ortec PHA format on a hard disk during each logging run. EG&G Ortec spectrum acquisition software permitted the logging engineer to display spectra in the field or print them on a Hewlett-Packard Desk Jet printer if desired.

Immediately after logging a borehole, the logging engineer repeated the acquisition of a check source spectrum and a background spectrum. These comprise records to verify that the equipment operated properly during the logging run.

If used, the disposable plastic sleeve was removed from the logging tool. The tool and logging cable were surveyed by Health Physics Technicians before the RLS was removed from the borehole site.

At the end of each day, the spectra were transferred from the RLS computer hard disk to WORM optical cartridges and then distributed to the data analysts. The optical disks comprise a "permanent" archive in the sense that the storage medium is very stable and the encoded data cannot be overwritten. The 200 AAMS data can be retrieved and reanalyzed in the future; i.e., to apply spatial deconvolution or any other new development in data reduction.

6.0 DATA ANALYSIS

6.1 DATA REDUCTION SOFTWARE

The log results presented in this report were derived by processing the gamma-ray spectra with software, named LGCALC, developed by the Geophysics Group. Prior to the adoption of the program, two commercial spectral analysis programs were subjected to considerable testing and evaluation. Testing was performed on HPGe spectra acquired by the RLS. The study indicated that these programs failed too frequently to locate gamma-ray peaks in the spectra, and in certain situations produce results that were biased by the entries in the gamma-ray library (input file).

The basic problem with commercial spectral analysis programs is that they were not designed to process the low peak intensity data acquired in these screening surveys. Specifically, three AAMS logging conditions caused problems for the commercial software: (1) the data acquisition times were relatively short, (2) some of the gamma-ray peaks were poorly defined, and (3) RLS system gain shifts caused the positions of gamma-ray peaks in the MCA to drift during some of the logging runs.

The new software is not affected by these problems and it executes much faster than the commercial software. Comparison tests showed that the new software is as accurate as the commercial software in identifying peaks, determining pulse height energies, and calculating net peak counts and the statistical uncertainties of the net counts.

6.2 DATA REDUCTION PROCEDURE

The borehole survey spectra were analyzed for radionuclide decay activity from gamma-ray peak intensity measurements. Corrections for grout or bentonite behind the casing have not been determined and were not applied. Radionuclide decay activities will be underestimated if calculated from spectra collected in boreholes with these features. The spectra files were not examined for bremsstrahlung radiation or other spectra features.

The LGCALC program is operated by experienced analysts trained in high resolution passive gamma-ray borehole spectral logging and the data results are reviewed by a spectroscopist. The steps the analyst performs to process the borehole survey spectral files and create depth profiles of gamma-ray-emitting radionuclide decay activity are summarized as follows.

- Raw spectra data files acquired from borehole survey are copied from the WORM optical cartridge to the hard disk of an analysis computer. Information from the logging data sheets and logging report are entered into the log analysis summary form "RLS Spectral Gamma-Ray Borehole Survey Log Header". The information includes analyst name, analysis date, radionuclides identified, correction parameters selected, and analysis notes. Many entries must be supplied as the analysis progresses. A blank sample form is illustrated in Figure 3.

Westinghouse Hanford Company
RLS Spectral Gamma-Ray Borehole Survey Log Header

Project: _____

Borehole	_____		
Coordinates	_____N _____W	Feet	(Plant 200 W)
Elevation	_____ feet	Top of Casing	(Plant 200 W)

Borehole Environment Information

Borehole Fluid Depth _____ (Feet) from Zero (0.0) Depth Reference of Log

Casing Size I.D. (inch)	Casing Thickness (inch)	Top Depth (feet)	Base Depth (feet)

RLS Passive Spectral Gamma Survey Information

Logging Engineers _____ _____
Log Depth Reference at Zero (0.0) depth is Ground Level

Log Date	Archive File Names	Log Mode Speed	Depth Interval (feet) Top Base Incr

Calibration and Analysis Information

RLS Calibration Date: Nov 21, 1991
Calibration Report: WHC-SD-EN-TRP-001

Analyst Names: _____ _____
Analysis Date: _____

Analysis Notes: _____
Radionuclides identified: _____

Figure 3. Sample RLS Spectral Gamma-Ray Borehole Survey Log Header.

- Several spectral files are examined using the "MAESTRO II" program (trademark of EG&G Ortec) to check energy calibration coefficients and identify the radionuclides that produce the most prominent peaks.

- The nuclides analysis library is edited to select the radionuclides that will be the target of the LGCALC analysis. The library contains the gamma-ray energies used to identify each radionuclide and the average number of gamma-rays emitted per 100 nuclide decays.

- An input processing control file is created that names each RLS spectral file on the hard disk to be analyzed by LGCALC. The first file name in the processing control file is used by LGCALC to initialize the energy recalibration algorithm. (Energy recalibration is required because the relatively short time between electrical power up and data acquisition introduces a nominal drift in the energy-to-MCA-channel conversion function. Recalibration removes the effect of drift. Accuracy in the energy-to-MCA-channel conversion is essential for identification of gamma-ray peaks and associated source radionuclides.)

- The LGCALC program is executed. The analysis control parameters are entered on a screen form; they include casing diameter, thickness, and depths. The lead shield correction is also activated by a parameter on the screen form. After the processing control parameters are entered and verified, program execution begins. The control parameters are saved in a file associated with the borehole survey and are used to reinitialize the program with subsequent executions. The program creates several files containing the analysis results.

- The LGCALC analysis results files are examined to verify that the program properly identified the gamma-ray peak energies, that the nuclides supplied from the nuclide library represent the nuclides present in the formation around the borehole, and that the computed activity of each radionuclide is correct.

  The decay activity of the natural radionuclides are reviewed for consistency with the expected ranges. Significant differences in the computed activities of the natural radionuclides; i.e., potassium, uranium, and thorium, and the expected range may indicate borehole conditions different from the as-built records used for analysis.

Analysis parameters or radionuclide library entries may be adjusted and the appropriate steps repeated.

- Once the computed results are verified by the analyst, the results are prepared for distribution, as follows:

  - The appropriate LGCALC analysis result files are printed
  - A plot data file is constructed for plotting with the "SigmaPlot" (a trademark of Jandel Scientific) software
  - Log data plots are created

- A Log Header sheet is created for the plotted results
- The "Log Analysis Summary" form is completed
- The borehole survey report of the analysis is prepared
- The result files are transferred to the archival computer
- The analysis and log survey paper records are filed in the designated file cabinet.

- Calculation results are reviewed by a spectroscopist and if accepted the analysis results files are stored on the optical WORM archive cartridge.

6.3 LGCALC PROGRAM

The data reduction software program LGCALC was developed for analysis of RLS data. The program source code is maintained by the WHC Geophysics Group and each revision is archived on optical WORM cartridges. The main functions performed by the LGCALC program are outlined as follows:

- Initialize the analysis control parameters from the previous setting if available. Accept operator changes to the screen form. Save analysis control parameters to file LGCALC.INP for reinitialization on subsequent executions.

- Read the NUCLIDES.FIL library. The library supplies the nuclide name, the identifying gamma-ray energies (in keV), and gamma-ray intensity (percent).

- Open the input processing control file containing the spectra file names to analyze.

- Open the analysis output files. Several files are created by the LGCALC program. The number will vary depending on the number of radionuclides being analyzed with multiple gamma-ray energies. All files are composed of ASCII characters, requiring no special conversion to be printed. The functions of these files and the data stored in them are described as follows:

  - <u>????.PKS File</u>: An output file for each radionuclide supplied by the NUCLIDES.FIL library with multiple gamma-ray energies will be created. The file name is composed of the nuclide name (eight characters maximum with no embedded special characters) and the file name extension ".PKS." The file contains two record types. The first record contains the borehole number, nuclide name, and each gamma-ray energy retrieved from the library. The second and all subsequent records contain the depth, spectra file sequence number, and computed decay activity and uncertainty for each gamma-ray identified in the spectral file belonging to this radionuclide. One record is created for each spectrum where at least one gamma-ray peak is identified in the channel data. If multiple gamma-ray peaks belonging to the radionuclide are

identified the program selects the one with the lowest uncertainty to be reported as the nuclide decay activity in the summary file MONO.PKS.

- MONO.PKS File: The radionuclide decay activities computed from each spectral file are compiled and written to the output file MONO.PKS. This file contains two record types. The first record contains the borehole number and name of each radionuclide supplied by the NUCLIDES.FIL library. The second and all subsequent records contain the depth, computed decay activity and uncertainty for each radionuclide, the spectral file sequence number, and total gamma-ray activity in counts per second. One record of the second type, is created for each spectrum analyzed. If there are no identifiable gamma-ray peaks for a radionuclide in a spectrum then the associated column is left blank. A zero value is not reported.

- NONMATCH.PKS File: Gamma-ray peaks that are not associated with a radionuclide supplied by the NUCLIDES.FIL library are represented semigraphically in the NONMATCH.PKS output file. The file contains two record types. The first record contains borehole number and energy scale from 0 to 3,000 keV with each character position representing 50 keV. The second record type is the depth, spectrum file name, and a sequence of up to 11 characters representing the intensity of the gamma-ray peak present in the spectrum but not associated with an analyzed radionuclide. The second record type is created for each spectrum that contains gamma-ray peaks not identified with a library radionuclide.

- LGCALC.DBG File: A detailed program operation report is written to the LGCALC.DBG output file. Several record types are present in the file whose specific contents and format will not be described here. The file contents include:

  a. Casing and lead shield correction factors for each gamma-ray energy to be analyzed

  b. Conversion factor from gamma-ray intensity to decay activity; i.e., inverse efficiency function, for each gamma-ray energy to be analyzed

  c. MCA channel to gamma-ray energy recalibration values

  d. Gamma-ray peak energies located in each spectra

  e. Detail information of gamma-ray peaks not associated with a library radionuclide for each spectrum.

- Read one spectrum file into the program memory.

- Recompute channel to gamma-ray energy calibration values. The algorithm locates gamma-ray peaks common in the spectra and adjusts the slope of the channel-number-to-energy conversion. Locate all gamma-ray peaks present in the spectra and compute the net peak intensities (count rates) and uncertainties. To identify a peak, the program first computes a background and a background uncertainty (σ) from the average of 10 MCA channels. The program then scans the next

30 channels for values that exceed the average background by 3σ. If no channel values exceed the peak detection threshold the program advances 10 channels, recomputes the background and scans the next 30 channels again. Each set of 10 channels is scanned with three background values.

If a channel has a count tally that exceeds the background-plus-3σ threshold, the program determines the extent of the peak. It then computes the high and low energy background values adjacent to the peak, without including channels belonging to the peak in the background region. The gross peak area is computed, then the background under the peak is subtracted. The difference is the net peak area, or intensity. The net peak count rate is then used to determine the radionuclide decay activity. Uncertainties in the channel counts are maintained in every calculation.

- The gamma-ray peaks located in the spectra are associated with specific radionuclides. Any peak that cannot be associated with a radionuclide is reexamined. If the peak intensity is significantly greater than the average background activity then the unmatched peak is reported in the NONMATCH.PKS file for review by the analyst.

- The intensity of each identified gamma-ray peak is corrected for casing attenuation and lead shield attenuation (if required), then entered into Equations (2) and (3) to compute the radionuclide decay activity. The correction factors and activity conversion factor are determined for each gamma-ray energy. Uncertainties in the peak count rate activity, correction factors, and efficiency function are propagated in the calculations. The uncertainty in the decay activity is reported as a percent of the computed activity.

  If a radionuclide produces multiple gamma rays, the spectral peaks are examined to determine the one with the minimum uncertainty. The selected value is reported in the MONO.PKS output report file.

6.4 DATA ANALYSIS AND SITE INTERPRETATIONS

After the spectral gamma log data sheets and the log analysis summary forms were completed, site-specific data were collected and reviewed on a site-by-site basis. These data included information on what was released at the site in terms of the specific nuclide concentrations, the volume and type of effluent, the history of the site, site construction information and geology information for the particular borehole that was logged. The data were obtained from the WIDS data base, from Maxfield (1979) and from a notebook with an historical information summary (Jungfleisch 1984).

Maps of the cribs and waste sites (provided in Appendix A) were prepared showing the position of the various boreholes at each site and the location of the site relative to other waste release sites.

Next, the spectral gamma-ray log or logs from a site were reviewed to determine the location and deposition pattern of the specific radionuclides detected by the spectral gamma-ray survey. This was correlated with the radionuclide and effluent release information to see if the major detectable

radionuclides could be accounted for, and to see that the release information is explained by the current nuclide deposition pattern.

The spectral gamma log and the current radionuclide profiles were then compared to the geology information for the particular borehole, if that information was available, to determine if there is any apparent relationship between the nuclide deposition and the lithology at the site.

Next, the spectral gamma log and the nuclide specific deposition profiles were compared to any gross gamma-ray logs obtained as a part of this study, to see which spatial peaks in the gross log were due to which specific nuclides.

The progressively older gross gamma-ray logs were then reviewed and compared to the newer gross gamma logs and the spectral gamma data in an attempt to review the nuclide deposition history to see if past log peaks can be associated with specific nuclides and to see if there have been any appreciable changes in the shapes of the gamma-ray activity profiles that could indicate the addition or redistribution of radionuclides.

On reviewing all of these data, a subjective assessment was made as to current or past effects of the site on the groundwater beneath the site. In some cases, not enough data were available to make any such assessment; in other cases, the data showed past groundwater contamination; and still in other cases, the data showed that the radionuclides released at the site being studied were retained high up in the unsaturated zone.

All of this information and the interpretations of the specific sites are provided in Appendix A on a site-by-site basis.

7.0 RESULTS

7.1 CRIB REPORTS

The data and analyses prepared in this study are provided on a crib-by-crib basis in Appendix A starting with some of the 216-A cribs in the 200 East Area and finishing with the 216-Z-18 crib in the 200 West Area.

It was intended to present as much of the data as possible from each crib in one place so the reader could review all of the data as well as the interpretation for the crib and arrive at their own conclusions about the site conditions.

The crib information in Appendix A is organized with the crib information sheet first. This includes a description of the facility and general information about what was released at the site including the type of waste and whatever radionuclide specific release quantity data are available. The radionuclide release data are the quantities at the time of release unless it is indicated otherwise. It was useful to report the original undecayed release quantities rather than the current decayed quantities because, at some sites, we can see decreases in the gross gamma-ray log activity profiles over time. These decreases can, in many of these cases, be attributed to the decay of short-lived radionuclides as opposed to radionuclide migration if the

release records show that significant quantities of short-lived radionuclides such as ruthenium-106 were released at the site.

A list of all available old gross gamma-ray logs is provided and the borehole(s) logged for this project are identified. It was not possible, practical, or necessary to include all the old gross gamma-ray logs in this report.

Finally, within the crib information summary, a review of the current log data and an assessment of the site, as described in Section 7.2, is provided on the crib information sheet under the heading "Review of Current Logging". This assessment presents conclusions about the site resulting from the assessment of all of the data including the new spectral gamma-ray data, the old gross gamma data and other data such as the release records.

Following the crib information summary, a plan view of the crib or effluent release structure is provided after the site information sheet which shows the location of the site relative to other buildings and waste sites. It also shows the location of all nearby monitoring boreholes and the facility pipelines.

Next, a single page log header form, titled "RLS Spectral Gamma-Ray Borehole Survey Log Header" is presented. This log header summarizes the borehole and spectral gamma survey information. The form contains the borehole name, disposal site, coordinates, elevation and other data. Borehole environment information on this form includes casing parameters and water depth (if present).

The borehole specific RLS survey information is also presented on the log header, including the name of the logging engineers, logging date, file names, logging mode, and survey depth interval(s).

Following the "RLS Spectral Gamma-Ray Borehole Survey Log Header" the spectral gamma-ray logs are found on the fold-out pages. They are presented on one or more pages with a uniform depth scale of 20 ft/in. The five graphic columns on the right side contain the radionuclide specific activity concentration profiles. The borehole may not contain all the radionuclides labeled on the plots but, five plot tracks are presented for uniformity. The experimental uncertainties in the computed radionuclide activities are not presented in the data plots because they were not calculated for this screening type of program.

The "Total Gamma" trace on the log sheets is the count rate total for all gamma rays detected by the RLS detector with no discrimination of gamma-ray energy. The "Total Gamma" is similar to a gross gamma log commonly used by some organizations at the Hanford Site, except that it is obtained from an HPGe detector instead of a NaI detector typically used in gross gamma-ray counting equipment.

Only one scale is presented at the bottom of the total gamma plot. In cases where data were acquired both with and without the lead shield, both plots are presented using the same scale. The lower-activity plot is the total count rate obtained with the shield while the higher-activity is that obtained without the lead shield.

The two radionuclide activity tracks adjacent to the total count profile are usually reserved for cesium-137 and cobalt-60. The radionuclide activity is plotted with two scales; the narrow line plot scale is 0 to 50 pCi/g and the wide line plot scale is 0 to 5,000 pCi/g.

The last two radionuclide activity plot tracks represent whatever other man-made nuclides were detected. This can include europium-152, europium-154, antimony-125, plutonium-239, or other nuclides.

Not all plot scales for all radionuclides in these tracks are the same. The plot scales are radionuclide-dependent. They are:

- Antimony-125, europium-152, europium-154, uranium-235, and protactinium-233 plot scales are constant. The narrow line plot scale is 0 to 50 pCi/g and the wide line plot scale is 0 to 5,000 pCi/g.

- Uranium-238 plot scales are 0 to 500 pCi/g (narrow) and 0 to 5,000 pCi/g (wide).

- Americium-241 and plutonium-239 plot scales are 0 to 500 nCi/g (narrow) and 0 to 5,000 nCi/g (wide). Note that the units are nCi/g or 1,000 pCi/g and the reported concentration values have a high uncertainty due to their low energy as discussed in Section 3.3.1.

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The well construction information is summarized in the left most column on the spectral gamma log sheets as a borehole pictograph. The lithology is also presented graphically, providing a convenient method of comparing the geology to the radionuclide deposition pattern. A lithology legend is given at the beginning of Appendix A in Figure A.1.

Analysis notes for each spectral gamma-ray borehole survey follows the spectral gamma-ray log for each crib. These notes list statistical or pertinent information for each log such as the maximum total gamma activity observed, the depths where the lead shield was required, and a list of the intervals where the detector was saturated. The depth ranges where each radionuclide was encountered in the spectral analysis files, and the maximum activity concentration for the nuclides are also reported. The analysis notes provide a summary only of the particular subject borehole log, which is useful in assessing the data. There is no crib information on this form.

7.2 SUMMARY

Because there is such a large amount of information in Appendix A, it is difficult to review all of it when attempting to understand the mechanisms at work and the conditions that result at the waste sites. Summaries of the crib analyses were prepared and are given in Table 5. This table is useful as a guide for reviewing the conditions at each crib or waste site. The comprehensive site review in Appendix A should be studied for more detailed information.

Table 5. Summary of 200 Area Waste Management Units Spectral Gamma-Ray Logging Results. (sheet 1 of 4)

Liquid discharge source	Nuclides detected	Notes	Contributes to groundwater contamination
PUREX Plant Aggregate Area			
216-A-10 Crib	cesium-137 europium-154	Cesium throughout unsaturated zone. Low pH effluent; plutonium, cobalt, uranium not found. Gross gamma does not show all cesium zones. No apparent radionuclide migration. No correlation with lithology.	probable
216-A-24 Crib	cesium-137	Cesium throughout shallow borehole. Cannot assess radionuclide migration. Not enough data to assess groundwater contamination.	possible
216-A-27 Crib	cobalt-60 antimony-125	Low concentration of cobalt throughout unsaturated zone. Cobalt not consistent with release information. Gross gamma does not show all cobalt zones. Cannot assess radionuclide migration. No correlation with lithology.	yes
216-A-30 Crib	strontium-90 cesium-137	High bremsstrahlung radiation, little cesium. Cannot assess radionuclide migration. Not enough data to assess groundwater contamination.	unknown
216-A-36A&B Cribs	cesium-137 cobalt-60 antimony-125	Nuclides throughout unsaturated zone. Cannot assess radionuclide migration. No correlation between boreholes. Groundwater Contamination is certain.	Yes
B Plant Aggregate Area			
216-B-5 Reverse Well	cesium-137	Nuclides injected directly into groundwater. Cannot assess radionuclide migration. Surface cesium contamination found.	yes
216-B-7A&B Cribs	cesium-137	Cesium found in upper unsaturated zone. Source of groundwater contamination unknown. Plutonium released but not detected. Surface cesium contamination found. Cannot assess radionuclide migration.	no
216-B-9 Crib	cesium-137	Small zone of cesium near release point. Cannot assess radionuclide migration. Groundwater contamination unlikely. More data needed for better assessment.	unlikely
216-B-11A&B Reverse Wells	Cesium-137	Several zones of cesium contamination. Surface cesium contamination found. Radionuclide migration has occurred. Data indicates groundwater contamination with cesium.	yes
216-B-12 Crib	cesium-137 uranium-235 uranium-238 thorium-232	Several zones of cesium and uranium contamination. Surface cesium contamination found. Uranium throughout unsaturated zone and into groundwater. Plutonium released but not found. Cannot assess radionuclide migration.	yes

Table 5. Summary of 200 Area Waste Management Units Spectral Gamma-Ray Logging Results. (sheet 2 of 4)

Liquid discharge source	Nuclides detected	Notes	Contributes to groundwater contamination
216-B-14 through 216-B-19 Trenches	cesium-137 cobalt-60 antimony-125 europium-154	Nuclides spread deep into unsaturated zone. Some surface cesium contamination found. No lithology control over deposition. Old gross gamma logs show groundwater contamination. Cannot assess radionuclide migration.	yes
216-B-35 through 216-B-41 Trenches	cesium-137	cesium throughout unsaturated zone and into groundwater. Surface cesium contamination found. No lithology control over deposition. Cannot assess radionuclide migration.	yes
216-B-51 French Drain	cobalt-60	Cobalt-60 in groundwater. Source of groundwater contamination unknown. Surface cesium-137 found. Natural thorium, uranium zone correlates boreholes.	no
216-B-57 Crib	cesium-137 cobalt-60	Cesium from site only in upper unsaturated zone. Surface cesium contamination found. Cesium and cobalt in groundwater likely from another site. No apparent radionuclide migration.	no
216-B-61 Crib	cesium 137 cobalt-60	Surface cesium contamination found. Cobalt in groundwater from another site. Site never used, unsaturated zone is clean.	no
216-B-62 Crib	cesium-137	Cesium found just below crib depth. Uranium in groundwater is from B-12 Crib. No apparent radionuclide migration.	no
Semiworks Plant Aggregate Area			
216-C-9 Pond	none	No nuclides detected, little released. No natural variation in profile. No groundwater contamination.	no
216-C-10 Crib	cobalt-60	Cobalt-60 detected in groundwater, source unknown. No contamination in unsaturated zone. No natural variation in profile.	no
U Plant Aggregate Area			
216-S-21 Crib	cobalt-60	Cobalt-60 in unsaturated zone from another site. No apparent radionuclide migration. Plutonium, cesium, and uranium released but not located. Lithology effected nuclide deposition.	no
216-U-1 and 216-U-2 Cribs	cesium-137 uranium-235 uranium-238	Cesium held high in unsaturated zone. Uranium throughout unsaturated zone and into groundwater. Caliche layer is hydrologic barrier. Groundwater contamination is certain.	yes
216-U-12 Crib	cesium-137 uranium-235 uranium-238	Thick cesium zone not agree with records. Uranium further down in unsaturated zone. No groundwater contamination. No correlation with lithology.	no

Table 5. Summary of 200 Area Waste Management Units Spectral Gamma-Ray Logging Results. (sheet 3 of 4)

Liquid discharge source	Nuclides detected	Notes	Contributes to groundwater contamination
Z Plant Aggregate Area			
216-Z-7 Crib	cobalt-60 europium-154	Cobalt and europium throughout borehole. Groundwater contamination certain. No correlation with lithology. No apparent radionuclide migration.	yes
216-Z-9 Trench	plutonium-239 protactinium-233 cesium-137	Plutonium, protactinium, and cesium down to caliche zone. No groundwater contamination at borehole, but possible. Caliche zone control of migration. Old logs shown contamination toward south end.	possible
216-Z-12 Crib	protactinium-233	Plutonium released, none detected. No groundwater contamination. No obvious correlation with lithology. No apparent radionuclide migration.	no
216-Z-18 Crib	protactinium-233 americium-241 cesium-137	Plutonium released, none detected. Protactinium, americium, cesium held high, little migration. No groundwater contamination. No correlation with lithology. No apparent radionuclide migration.	no
S Plant Aggregate Area			
216-S-5 Crib	cesium-137	Cesium held high in unsaturated zone. Plutonium, uranium released but not found. No apparent radionuclide migration. No correlation with lithology. Possible contamination of groundwater with uranium.	possible
216-S-6 Crib	cesium-137	Cesium held high up in unsaturated zone. Plutonium, uranium released but not found. No apparent radionuclide migration. Possible contamination of groundwater with uranium.	possible
216-S-7 Crib	cesium-137 cobalt-60	Cesium-137 found throughout borehole. Groundwater contamination with cesium, possibly uranium. Low pH release site. Cannot assess radionuclide migration.	yes
216-S-13 Crib	cesium-137	Uranium-235, uranium-238 in groundwater from 216-S-7 Crib. Cesium held high in unsaturated zone. No apparent radionuclide migration. No correlation with lithology.	no
216-S-20 Crib	cobalt-60	Little cobalt held high in unsaturated zone. No apparent radionuclide migration. No groundwater contamination.	no
216-S-21 Crib	cobalt-60	Cobalt-60 in unsaturated zone from another site. No apparent radionuclide migration. Plutonium, cesium, and uranium released but not located. Lithology effected nuclide deposition.	no

Table 5. Summary of 200 Area Waste Management Units Spectral Gamma-Ray Logging Results. (sheet 4 of 4)

Liquid discharge source	Nuclides detected	Notes	Contributes to groundwater contamination
T Plant Aggregate Area			
216-T-3 Reverse Well	cesium-137	Extensive cesium contamination. Possible groundwater contamination with cesium and strontium. Plutonium and strontium not detected. Lithology effected nuclide deposition.	possible
216-T-6 Crib	cesium-137	Cesium held up in unsaturated zone. Extensive strontium-90 released, not detected. No lithologic control over deposition. No apparent radionuclide migration.	no
216-T-14 through 216-T-17 Trenches	cesium-137	Cesium throughout shallow hole. No conclusions about groundwater contamination. No correlation with lithology. Little information on cribs.	unknown
216-T-18 Crib	cesium-137 cobalt-60	Cesium and cobalt held high in unsaturated zone. Plutonium released but not detected. No apparent radionuclide migration. No groundwater contamination.	no
216-T-19 Crib and Tile Field	cesium-137	Cesium found in upper and lower layers. Groundwater contamination possible but uncertain. Possible correlation with lithology. Cannot assess radionuclide migration.	possible
216-T-21 through 216-T-25 Trenches	cesium-137	Cesium found in upper unsaturated zone Only cesium released. Not enough information to assess groundwater contamination. Cannot assess radionuclide migration.	unknown
216-T-26 through 216-T-28 Cribs	cesium-137 europium-152 europium-154	Cesium and europium contamination to bottom of borehole. No correlation with lithology. Groundwater contamination certain from old logs. Cannot assess radionuclide migration.	yes
216-T-34 and 216-T-35 Cribs	cesium-137 cobalt-60 europium-154	Cesium held high, cobalt and europium slightly deeper. Some correlation with lithology. Groundwater contamination not likely. Cannot assess radionuclide migration.	no

It is difficult to put all of this information together because of the variations found at the sites in the waste types, the effluent radionuclide content, the geology, the site release histories, and even the site geometries. Generally, some patterns are evident and it is apparent that the project provided data about the waste sites that will be useful for future assessments of these and other 200 Area waste sites.

7.2.1 Radionuclide Migration Patterns

The log data show some common radionuclide migration patterns or specific radioelement migration characteristics.

Cesium shows minimal-migration or very low mobility and it is usually found high up in the unsaturated zone. That is, unless it is driven by acidic effluent such as is the case at the 216-A-10, 216-S-7, and 216-U-12 cribs. At 216-U-12, a very small quantity of cesium (0.056 Ci) is reported to have been released in effluent with a pH of less than 1. Yet, this cesium migrated down to a depth of 60 ft. With an acidic effluent released into the unsaturated zone, the cesium migrates much further than with a neutral or basic effluent.

The 216-T-28 crib appears to be an exception as this crib did not receive low pH effluent, yet there was considerable cesium migration. However, this crib received a variety of decontamination effluent waste that was designed to increase the mobility of the radionuclides. This may have been a factor in the cesium migration.

Release records for the 216-B-35 through 216-B-41 trenches do not indicate that acidic solutions were released with the radionuclides at these trenches but the cesium has migrated a considerable distance. Jungfleisch (1984) indicates that these cribs were flushed with acid at one time during their use to increase the percolation of the effluent released at the sites. The acid released at this site may be the cause of the cesium migration. To resolve the situation at these cribs, further investigation of the crib history and release records will be necessary.

Cobalt, antimony, and europium are much more mobile than cesium with cobalt being the most mobile of these nuclides. Apparently, the cobalt migrates readily with the effluent. The extent of cobalt distribution can, in some cases, be directly related to the volume of effluent released. This will be plotted after data from more sites are obtained. In cases where the effluent was acidic, the cobalt has apparently flushed right through to the groundwater or it has dispersed in the unsaturated zone to the point that it is no longer found in concentrations that are detectable with the screening logging configuration.

The antimony and europium tend to migrate further than cesium, but their deposition patterns vary considerably from site to site, making it difficult to understand exactly what factors are controlling their distribution. Adding to that difficulty is the fact that antimony and europium were not measured or reported in the old radionuclide release information shown in Appendix A. Therefore, it is not possible to correlate the release quantities to the migration distances.

Uranium was the most mobile nuclide detected in this study. In some cases, according to release records, significant quantities of uranium were released at a site, and none was detected. This may be due to the relative difficulty in detecting the low energy uranium gamma-ray lines in the presence of other strong gamma-ray-emitting radionuclides while using the screening data acquisition techniques. But, it may also be that the uranium has flushed through the unsaturated zone to a point that it is no longer intercepted by the monitoring boreholes. Eh-pH diagrams for uranium compounds should be

studied and more uranium-laden sites must be logged to try to better understand the uranium transport mechanisms.

The mobility of strontium is impossible to assess because it is difficult to detect. It can only be detected when it is found in zones of very high concentrations such as at the A-30 crib where bremsstrahlung radiation is found. There is currently no way to quantify strontium with the RLS equipment.

Neptunium, the parent radionuclide of protactinium-233, and americium both have a moderate mobility. Neptunium is affected by acidic solutions, i.e., the mobility is increased by acidic solutions as seen at the 216-Z-9 trench as compared to the 216-Z-12 and 216-Z-18 cribs.

Little can be said about americium at this point, because it was only found at one site, the 216-Z-18 crib, where an extensive amount of carbon tetrachloride was released. Little is known about the affect of carbon tetrachloride on the mobility of americium or any of the other radionuclides at this site.

No ruthenium was found in any of the logged boreholes because ruthenium-106 has a short half-life (372 days) and essentially all of the ruthenium has decayed to levels that are undetectable when the RLS is operated for screening purposes. It is likely that ruthenium-106 will never be detected at any of the sites.

7.2.2 Correlation with Release Records

The RLS survey data did not always agree with the historical release records. In a some cases radionuclides were found with the spectral gamma-ray logging that are not reported in the release records and in other cases release records reported large quantities of specific radionuclides that should have been found with the spectral gamma-ray logging and were not.

The discrepancies may be explained in several ways. If certain radionuclides are reported to have been released and they are not detected in the unsaturated zone, this may be due to the migration of nuclides beyond the borehole if the nuclides are mobile in the unsaturated zone. Also, if the radionuclide of concern is short lived it could have decayed to less-than-detectable levels.

On the other hand, for instance, if cesium-137 is found by the spectral gamma-ray log and none is reported to have been released, it is probable that the release records are not complete or correct. A good example of this is the discovery of man-made uranium at the 216-U-12 crib when release records indicate that essentially no uranium was released at this site. Such discrepancies should be resolved in comprehensive site characterization work.

7.2.3 Near Surface Cesium

A review of the data also shows that there is an extensive amount of near-surface cesium-137 in the vicinity of the B Plant, with the highest concentrations closer to the BX and BY tank farms. This contamination

typically was only slightly detectable at the surface, if at all, but just below the surface, increased in concentration to a maximum located anywhere from 10 to 20 ft deep. Thus, a surface survey would not necessarily detect this contamination. Cribs where it was found by the logging operation include 216-B-7, 216-B-11, 216-B-12, 216-B-14 through 216-B-19, 216-B-35 through 216-B-41, B-57 and B-61.

In all of the boreholes where the near-surface cesium was detected, if there is any cesium in the unsaturated zone that was released from the waste site itself, that cesium is always found below the surface contamination and a barren zone is found between the near surface contamination and the cesium that was released with the effluent in the subsurface.

It is most likely that this near surface contamination was deposited on the surface as airborne contamination and, as a result of precipitation infiltration, it was flushed into the near-surface unsaturated zone. This is supported by the fact that there is a barren zone between the near-surface and subsurface contamination showing a lack of upward migration. In addition, this contamination is so extensive in terms of it's areal distribution and it's moderately high concentration, that it is not likely that it was transported from the subsurface to the surface by deep rooting plants.

The areal extent of the data from this study is limited, however it suggests that the highest concentrations of the near-surface cesium are found around the BX and BY tank farms, implicating these tanks as a possible source of this assumed, airborne contamination. A shallow, subsurface investigation program would be required to confirm or quantify the areal distribution of this cesium and support any conclusions as to it's source.

7.2.4 Correlation with Gross Gamma Logs

In the analysis of the data for each facility, an attempt was made to correlate the vertical spatial peaks of the spectral gamma-ray log with the peaks from the gross gamma-ray logs. This was usually done with the new gross gamma log obtained at the site which was, in most cases, from the same borehole as the spectral gamma-ray log. Except for a thick zone of very high concentrations of radionuclides immediately at or below the bottom depth of each crib, there was often good separation of the radionuclides with depth, allowing the association of a specific nuclide with a specific high count rate anomaly in the gross gamma-ray log.

Next, an attempt was made to compare the old gross gamma-ray logs with the new gross gamma-ray log and the spectral gamma-ray log, to determine if there has been any appreciable migration of the radionuclides through the unsaturated zone. The progressively older gross gamma-ray logs were reviewed to see if the shapes of the peaks or the overall count rate profiles have changed.

This task was complicated by the fact that the old gross gamma-ray logs were not calibrated, did not have good spatial resolution, and did not properly record the peak shapes because of recorder scale changes during data acquisition.

The result was that differences in peak shapes or changes in the count rates are usually attributed to differences in the instrumentation or data acquisition techniques. Yet, from the location of the high activity peaks, it can still be shown that there is little migration of the radionuclides through the unsaturated zone after cessation of the discharges.

Clearly, there was no way to determine the rates of migration or the distance of movement of a contamination zone from the log comparisons, but it is still possible to assess the sites to determine whether or not there have been drastic changes such as the movement of a contamination front through the site or a redistribution of the radionuclides.

In some cases, the gross gamma logs did not identify all of the zones of man-made contamination in a borehole that were identified by the spectral gamma-ray log. This is strictly due to the fact that the spectral gamma-ray detector is much more sensitive than the gross gamma-ray detectors, especially to mono-energetic radionuclides such as cesium-137. Man-made nuclides were not detected by the gross gamma-ray surveys in zones of near-background activity in boreholes E24-160, E17-3, E17-9, E33-24, W22-21, W15-210 and W14-4. This study has demonstrated that the gross gamma-ray surveys are not appropriate for detecting the presence of man-made radionuclides.

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In other cases, significant decreases in the gross gamma-ray logs over time could be attributed to the decay of short-lived radionuclides (primarily ruthenium-106). It is surmised that ruthenium was a major contributor to the gross count tally because of it's very high specific activity, especially in the lower portions of the unsaturated zone (ruthenium is very mobile in the unsaturated zone). High activity zones showing up in some of the older logs were absent in the recent ones making it impossible to "assess" the migration of the radionuclides in that particular zone of the borehole when we have such. No ruthenium-106 was detected in any of the spectral gamma-ray logs because it has all decayed away to less than detectable concentrations.

Regardless of the differences in the gross gamma-ray logs, a visual comparison of historic gross gamma-ray logs with the recent gross gamma-ray logs and the recent spectral gamma-ray logs suggest that the large scale downward movement of radionuclides through the vadose zone is not a problem. Significant changes in the activity profiles are attributed to one of the factors discussed above and it can be demonstrated that the long-lived radionuclides are not migrating through the unsaturated zone to any significant degree. The exact rate of migration cannot be determined from the available data.

It is likely that the radionuclides at most of the sites have been stable over the years. Continued monitoring with calibrated geophysical instruments can prove this and provide a defensible record for appropriate remediation decisions. Also, future monitoring can quantify the radionuclide migration rates.

7.2.5 Groundwater Contamination Sources

A primary objective of this study was to help identify sources of groundwater contamination at the cribs and waste sites. The RLS only measures gamma-emitting radionuclides and a "not detected" indication of groundwater

contamination at a site is not necessarily indicative of no groundwater contamination. However, if the RLS data show that the gamma emitters have migrated to the groundwater, we can be certain that the site is a source of groundwater contamination.

The log data showed that the greatest portion of radionuclides released at the waste sites were retained in the unsaturated zone sediment. In cases where contaminants were detected below the water table, the concentrations were several orders of magnitude less than those in the unsaturated zone. This is likely the result of an increase in the radionuclide migration rate once the nuclides reach the groundwater, and the resulting dilution of the radionuclides by the groundwater. However, it is still apparent that the thick unsaturated zone retarded the migration of the radionuclides and retained the largest mass quantity.

Several sites were identified as sources of groundwater contamination while at others, the radionuclides were retained high up in the unsaturated zone. Due to the lack of deep monitoring boreholes there were not enough data at some sites to determine if the contaminants had migrated to the groundwater; such was the case with site 216-A-30. At this site, only a single shallow borehole was logged and no data exist for the deeper unsaturated zone.

Conclusions about each site as to whether or not it has contributed to groundwater contamination are provided in Table 5. If there was uncertainty about whether or not the site did contribute to groundwater contamination, it was listed as "possible" in Table 5 and in the assessments in Appendix A.

7.2.6 Lithology Correlation and Effect

The data showed that there is usually little correlation between the lithology and the deposition of the radionuclides. This may be due to the lack of such correlation or it may entirely be the result of a lack of adequate lithologic or geologic data. Some general observations or correlations are apparent though.

First, it is apparent that the lithology had a greater influence on the deposition of the radionuclides and there was more horizontal migration beneath the 200 West Area as compared to the 200 East Area. In the 200 East Area and specifically at cribs such as the BC cribs, we may find one borehole containing very high concentrations of radionuclides, while in another borehole, which is just 50 to 100 ft away, we find almost no activity.

The reason for this apparent difference in the deposition patterns may be due to the fact that the Hanford formation is much thicker beneath the 200 East Area and most of the radionuclides are retained within this formation. The Hanford formation is classified as gravel dominated, sand dominated, or silt dominate, but it is relatively uniform in terms of it's hydrologic transport properties. The uniformity of the Hanford formation sediment is reflected in a lower variability of the gross gamma-ray, background count rate, primarily in the logs from the 200 East Area.

In the 200 West Area, the radionuclides reach the Palouse soils, the Plio-plistocene Unit and the underlying Ringold Formation. These formations contain sharply contrasting strata in terms of hydrologic properties. A highly impermeable calcium carbonate cemented silt can be found in these formations that is overlain by a highly permeable fluvial sand or gravel. Such hydrologically contrasting strata promote horizontal migration. Because the Hanford formation is thinner in the 200 West Area, more of the radionuclides are transported to these older formations, which may be the primary reason for the more extensive horizontal migration.

However, in the 200 West Area, the compositional and textural changes in the lithology are usually very discontinuous and cannot be traced from borehole to borehole. This is a result of the glaciofluvial origin of much of the sediment; highly discontinuous. Therefore, although there is more apparent horizontal migration, it is often difficult to extend specific contamination profiles between boreholes. Thus, it is difficult to find any extensive correlation between the radionuclide deposition pattern and the lithology.

Exceptions to this arise from the relatively thick, very continuous Plio-plistocene caliche zone beneath the Z and U Plant cribs. This impermeable zone acts as a significant hydrologic barrier creating localized perched zones.

7.3 IMPLICATIONS FOR 200 AREA GROUNDWATER AAMS

Two AAMS source reports focused on the groundwater beneath the 200 Areas; one report for the East Area and one report for the 200 West Area (DOE-RL 1992a and 1992b). A primary objective of these AAMS groundwater source studies was to identify which sites were sources or potential sources of groundwater contamination. This was done by assessing the site's pore space volume and by reviewing all of the old gross gamma-ray logs from the sites.

Table 6 was adapted from Tables 2-4 of the 200 East and 200 West groundwater source AAMS reports (DOE-RL 1992a and 1992b). In this table, the effluent release sites are grouped according to aggregate areas. Only those sites that were logged as a part of this study were taken from the AAMS reports. The conclusions of the AAMS reports regarding the potential to contaminate the groundwater based on pore volume screening and on gross gamma-ray log analysis are unchanged as shown.

A conservative approach was taken in the pore volume calculations. The total volume of pore space in the sediment beneath each site was calculated and compared to the volume of effluent released at the site. If the effluent release volume was greater than the pore volume, the site was considered to be a potential groundwater contamination source. This is shown in column 3 of Table 6.

Table 6. Summary of Screening for Potential to Contribute Contaminants to the Unconfined Aquifer. (sheet 1 of 3)

Liquid discharge source	Service years	Potential based on pore volume screening	Potential based on gross gamma logs	Potential based on spectral gamma-ray logs	Potential to contribute contaminants to groundwater
PUREX Aggregate Area					
216-A-10 Crib	1956-1987	yes	yes	yes	yes
216-A-24 Crib	1958-1966	yes	yes	yes	yes
216-A-26 Crib	1965-1970	yes	yes	yes	yes
216-A-30 Crib	1961-1991	yes	no	-	yes
216-A-36A Crib	1965-1966	yes	yes	yes	yes
216-A-36B Crib	1966-1987	yes	no	yes	yes
B Plant Aggregate Area					
216-B-7A&B Cribs	1946-1967	yes	no	no	yes
216-B-9 Crib	1948-1951	yes	no	no	yes
216-B-12 Crib	1952-1973	yes	yes	yes	yes
216-B-14 Crib	1956	yes	yes	yes	yes
216-B-15 Crib	1956	yes	no	yes	yes
216-B-16 Crib	1956	yes	yes	yes	yes
216-B-17 Crib	1956	no	no	yes	no
216-B-18 Crib	1956	yes	no	yes	yes
216-B-19 Crib	1957	yes	no	yes	yes
216-B-57 Crib	1968-1973	yes	no	no	yes
216-B-62 Crib	1973-present	yes	no	no	yes
216-B-51 French Drain	1956-1958	no	no	no	no
216-B-5 Reverse Well	1945-1947	yes	yes	yes	yes
216-B-11A&B Reverse Wells	1951-1954	yes	no	yes	yes
216-B-35 Trench	1954	no	no	yes	no
216-B-36 Trench	1954	yes	no	yes	yes
216-B-37 Trench	1954	yes	no	yes	yes
216-B-38 Trench	1954	no	no	yes	no
216-B-39 Trench	1953-1954	no	no	yes	no
216-B-40 Trench	1954	yes	no	yes	yes
216-B-41 Trench	1954	no	no	yes	no
Semiworks Aggregate Area					
216-C-9 Pond	1953-1985	yes	no	no	yes
216-C-10 Crib	1964-1969	yes	no	no	yes

Table 6. Summary of Screening for Potential to Contribute Contaminants to the Unconfined Aquifer. (sheet 2 of 3)

Liquid discharge source	Service years	Potential based on pore volume screening	Potential based on gross gamma logs	Potential based on spectral gamma-ray logs	Potential to contribute contaminants to groundwater
U Plant Aggregate Area					
216-S-21 Crib	1954-1969	yes	no	no	yes
216-U-1 and 216-U-2 Cribs	1951-1968	yes	no	yes	yes
216-U-12 Crib	1960-1968	yes	no	no	yes
Z Plant Aggregate Area					
216-Z-7 Crib	1946-1967	yes	yes	yes	yes
216-Z-9 Trench	1955-1962	yes	no	yes	yes
216-Z-12 Crib	1959-1973	yes	no	no	yes
216-Z-18 Crib	1969-1973	yes	no	no	yes
S Plant Aggregate Area					
216-S-5 Crib	1954-1957	yes	no	yes	yes
216-S-6 Crib	1954-1972	yes	no	yes	yes
216-S-7 Crib	1956-1965	yes	yes	yes	yes
216-S-13 Crib	1952-1972	yes	no	no	yes
216-S-20 Crib	1952-1973	yes	no	no	yes
T Plant Aggregate Area					
216-T-6 Crib	1946-1952	yes	no	no	yes
216-T-18 Crib	1953	yes	no logs	no	yes
216-T-19 Crib and Tile Field	1951-1980	yes	no log	yes	yes
216-T-26 Crib	1955-1956	yes	yes	yes	yes
216-T-27 Crib	1965	yes	yes	yes	yes
216-T-28 Crib	1960-1966	yes	yes	yes	yes
216-T-34 Crib	1966-1967	yes	no	no	yes
216-T-35 Crib	1967-1968	yes	no	no	yes
216-T-3 Reverse Well	1945-1946	yes	no	yes	yes
216-T-14 Trench	1954	no	no	-	no
216-T-15 Trench	1954	no	no	-	no
216-T-16 Trench	1954	no	no	-	no
216-T-17 Trench	1954	no	no	-	no
216-T-21 Trench	1954	no	no logs	-	no
216-T-22 Trench	1954	yes	no	-	yes
216-T-23 Trench	1954	yes	no	-	yes

Table 6. Summary of Screening for Potential to Contribute Contaminants to the Unconfined Aquifer. (sheet 3 of 3)

Liquid discharge source	Service years	Potential based on pore volume screening	Potential based on gross gamma logs	Potential based on spectral gamma-ray logs	Potential to contribute contaminants to groundwater
216-T-24 Trench	1954	yes	no	-	yes
216-T-25 Trench	1954	yes	no	-	yes

The old gross gamma-ray logs were then reviewed for each site in the AAMS groundwater source study. If the data showed elevated gross activity down to the groundwater, this was considered confirmation of the pore volume analysis. Column 4 of Table 6 shows the result of the previous analysis of the old gross gamma-ray logs.

The last column of Table 6, is also from the AAMS groundwater source report. It shows conclusion about groundwater contamination at each of the sites, based on the pore volume analysis and the old gross gamma-ray log analysis. These entries are unchanged from the AAMS groundwater source report.

This spectral gamma-ray log data and site analysis now provide new information that was not available at the time of the groundwater source studies. Each site was evaluated as discussed previously, to determine if there was any potential that the site was or had contaminated the groundwater. A new column (column 5) was added to Table 6, indicating whether or not the new data confirmed groundwater contamination. If the new spectral gamma-ray data as reported in Appendix A and summarized in Table 5, confirmed that the site had or could contribute contaminants to the groundwater, it was labeled "Yes" in column 5 in Table 6. If there were no data showing or even suggesting possible groundwater contamination, or if there simply were not enough data to make any conclusions about the site, it was labeled "No".

Some of the sites were grouped together in this study. This is noted in Table 6 by boxing the entries of column 5 together that were so grouped. This is shown by the grouping of 216-B-14 through 216-B-19 as an example.

The sites were grouped together in this study because limited resources allowed only one borehole to be logged at each group of sites. Grouping the sites together and assessing the groundwater contamination potential based on these data was not necessarily inappropriate. Additional spectral gamma-ray log data showing the horizontal spatial continuity will be used at a later date to either justify or reject each disposal site subgroupings.

Generally, the spectral gamma-ray log data and the comprehensive site reviews presented in Appendix A, agreed with the preliminary conclusions in the groundwater AAMS source reports.

The information presented in Appendix A did not significantly alter the conclusions of the AAMS groundwater source study. The last column of Table 6 and Table 2-4 of the AAMS groundwater source reports (DOE-RL 1992a and 1992b) did not agree with the results of this study only in cases where this report

grouped certain sites together and this study came up with a positive general conclusion about groundwater contamination for the entire group of sites while the AAMS reports did not group the sites together and came up with a negative conclusion about a specific site in the group. This is the case for 216-B-17, 216-B-35, 216-B-38, 216-B-39, and 216-B-41.

Additional spectral gamma-ray logging at all of these sites may provide data specific to each of these cribs that will show that the sites have not contaminated the groundwater.

At 216-B-11A&B, 216-U-1 and U-2, 216-Z-9, 216-S-5, 216-S-6, and 216-T-3 the review from this report provided enough evidence to indicate that there was a potential for groundwater contamination even though the previous review of the old gross gamma-ray log data did not indicate so. In these cases, the pore-volume-calculation-based conclusion was confirmed by this spectral gamma-ray logging study.

The results of this study basically confirmed the conclusions reached in the groundwater AAMS source report about contamination of the groundwater for the sites that were logged with the spectral gamma-ray logging system. The greatest utility of the RLS log data is in the use of the data provided in Appendix A for the refinement of the groundwater conceptual models. Those sites, which are the greatest contributors to the groundwater contamination and the greatest contamination risk, will receive relatively high site characterization and remediation priority.

8.0 CONCLUSIONS

The intent of this study was to utilize the spectral gamma-ray logging system to provide some initial site characterization data that would be useful to the AAMS program. A screening characterization approach was taken utilizing limited resources and a limited QA program to obtain new data on the unsaturated zone radionuclides.

Forty-seven boreholes were logged with the spectral gamma-ray logging system at 38 selected waste sites, and the condition of the unsaturated zone at these sites was assessed. The logs identified the primary gamma-emitting nuclides and, in most cases, provided radioelement specific, in situ concentration profiles. Nuclides identified include: cesium-137, cobalt-60, antimony-125, europium-152, europium-154, uranium-235, uranium-238, protactinium-233 (^{237}Np), strontium-90, americium-241, and plutonium-239.

From the profiles and other site information, it was possible in most cases, to determine or confirm which sites were or were not contributing to the groundwater contamination beneath the 200 East and 200 West Areas.

Some determinations were made about characteristic behavior of various radionuclides in the unsaturated zone and a better understanding was obtained of the role played by the effluent chemistry (primarily the pH) in the final deposition of the nuclides. Data were provided that show the relative elemental migration distances.

Also, a better understanding was developed of the utility of both the new and older gross gamma-ray logs. At many of the sites, the old gross gamma-ray logs still constitute the only unsaturated zone database and it is important to understand the limitations of these data.

Additional information was obtained regarding the stratigraphic influence on the radionuclide migration.

At some of the sites, it was possible to determine if there had been extensive migration of the radionuclides through the unsaturated zone since the mid 1980's.

The level of this study proved to be appropriate in that it provides enough data to prioritize the sites for more comprehensive characterization studies, it provides a starting point for developing the site-specific characterization plans, and it allows refinement of the groundwater conceptual models by identifying sources of groundwater contamination.

In some cases, the data fell short of satisfying all of the objectives of this study. In those cases, the limitations of the equipment and/or constraints imposed by the borehole environment prevented accurate nuclide concentration determinations or complete unsaturated zone assessments. For instance, it was not possible in all cases to determine if a site had or had not contaminated the groundwater and it was not possible in all cases to assess the radionuclide migration.

The reasons for this are not enough spectral gamma-ray logs from a site, not enough boreholes that could be logged or a less-than-ideal borehole environment. A lack of access to the unsaturated zone sediment through boreholes constructed in a manner that they are conducive to passive gamma-ray measurements, is sometimes a problem.

This study shows that it will be difficult to develop a single conceptual model or a set of conceptual models to explain or demonstrate the fate of the radionuclides released from the waste sites. The nuclide migration and ultimate deposition in the unsaturated zone has been shown to be a function of the chemical behavior of the elements released, the chemical makeup and pH of the effluent in which the radionuclides were released, the lithology and geologic variability, the release history, the waste site construction, and the waste site location relative to other sites. Each of these items can have a significant effect on the resulting radionuclide deposition and it is even difficult to determine if any of these have a dominating influence. Each site will have unique characteristics and it will be difficult to establish any common rules to follow in a site characterization program.

However, the data provided in Appendix A will prove to be extremely useful for developing and defining the 200 East Area and the 200 West Area groundwater conceptual models. These data and future RLS data will identify the principal sources of groundwater contamination.

9.0 RECOMMENDATIONS

9.1 ADDITIONAL CRIB SCREENING

Only 38 waste sites out of a few hundred within or around the 200 East and West Areas were assessed with this screening analysis study. The site selection process focused the study toward the contaminated sites in each area and specifically on characterizing the higher concentration radionuclides. However, because there are so many contaminated sites in the 200 Areas, not even 50% of the total waste sites were assessed in this study.

Additional logging in a similar screening mode is recommended at other waste sites within the 200 Areas to identify other sources of groundwater contamination and to further refine the groundwater conceptual model. This type of characterization is recommended as the next step in the AAMS work, before more detailed site-specific characterization work. The data are needed to prioritize the waste sites and determine what additional characterization and/or interim remedial measures are necessary.

Over three hundred boreholes apparently were never logged with the gross gamma-ray equipment and were not included as candidates for field screening. All boreholes that have not been destroyed and not logged since effluent to the facility was terminated or not logged within the last 20 yr should be surveyed with a gamma-ray detector.

9.2 SITE CHARACTERIZATION

This study provides an example of the potential of in situ spectral gamma-ray logging for site characterization. Because of the relatively low cost, easy access and little personnel exposure, it should be useful for detailed site characterization work.

A number of improvements to the existing systems are required to bring the logging work up to an acceptable level for site characterization and "Record of Decision" work. These include development of a comprehensive QA program, development of a sodium-iodide-based detector system, and refinements of the data acquisition and analysis techniques to permit more comprehensive assays. These improvements should be made with the intent of obtaining EPA approved, laboratory quality data for the site characterization work.

Spectral gamma-ray log data could be obtained from all of the boreholes at the sites, thus taking advantage of the existing subsurface access at the sites. The system could also could work effectively with a fast and inexpensive drilling technique such as the in situ characterization probe described in Myers (1992).

The data provided by the spectral gamma-ray systems would be used to develop and refine site specific conceptual models describing the radionuclide and other contaminant migration.

9.3 MIGRATION MONITORING

It is recommended that the RLS or other intrinsic germanium spectral gamma-ray logging systems be used to carefully baseline the radionuclides at various waste sites and measure the radionuclide migration rates over the long term. These data will be needed to provide input to contaminant migration models which help predict future health and safety risks and permit the determination of remediation options.

One likely remediation option, the "leave in place" option, will require long-term monitoring. Developing a baseline for the measurement of long-term radionuclide migration rates will be required to implement that option.

Because the radionuclides migrate at a very slow rate, in situ measurement of those rates can only be accomplished with a long-term monitoring program. The sooner the radionuclide baseline is established, the sooner the data will be available to permit the determination of the actual in situ migration rates.

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APPENDIX A

CRIB REPORTS

CONTENTS

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1.0 INTRODUCTION

This appendix contains the composited information for each crib or other disposal facility screened by spectral gamma-ray logging for the 200 AAMS field investigation. The contents are organized by crib or other disposal facility in alphabetical order. Within each disposal facility several types of information are present. The first page or two of each disposal facility contains:

- Disposal site service dates
- Radionuclide inventory from release records
- Borehole log history
- Interpretation of spectral gamma ray and other information for indication of groundwater contamination.

The borehole log history (summary of past logging) utilizes nonpublished copies of gross gamma-ray borehole surveys acquired since 1977 and uses the reference "geophysics files." Additional information on the historical gross gamma-ray surveys acquired to date are available in separate reports for each 200 AAMS:

- U Plant, WHC-SD-EN-DP-019
- Z Plant, WHC-SD-EN-DP-020
- S Plant, WHC-SD-EN-DP-021
- T Plant, WHC-SD-EN-DP-022
- PUREX, WHC-SD-EN-DP-025
- B Plant, WHC-SD-EN-DP-026
- 200 North, WHC-SD-EN-DP-027
- Semiworks, WHC-SD-EN-DP-028

Following the disposal facility history and interpretation of the first page or two the RLS spectral gamma-ray borehole surveys are available for review. Each borehole survey contains three sections. There will be at least one RLS log for each disposal facility. Each survey is composed of:

- Spectral gamma-ray borehole survey log header
- RLS Borehole survey report discussing the radionuclides detected
- Depth range and decay activity levels
- Plot(s) containing well construction, lithologic facies, and estimated radionuclide concentrations from the gamma-ray activity.

A legend of the descriptions of the lithologic facilities represented on the RLS borehole survey plots is given in Figure 1.

Following the RLS surveys the gross gamma-ray log acquired by PNL will be present for those logs acquired in support of the AAMS field investigation.

Grain Size Scale, Indicates
Dominant Grain Size in an Interval

S P
C/Z C/B

C/Z	Clay and silt
S	Sand
P	Pebble Gravel
C/B	Cobble and boulder gravel

Additional Lithologic Symbols,
Includes Subordinate Lithologies

	Silt rich		Backfill
	Clay rich		Basalt
	Sandy		Well Cemented
	Pebbly to cobbly		Caliche
	Bouldery		

Other Symbols

——?——?——	Formational contact, ? where inferred
— —?—?—?— —	Unit or sequence contact, ? where inferred
▽	Initial water level measured
▼	Latest water level measured

GEOSCI\071692-A

Figure 1. Explanation of Symbols Used.

Crib Designation: 216-A-10

Type of Facility: 275 ft. by 45 ft. rock filled crib

Location: N 39090 to N 39370, W 48952

Service Dates: 11/61 to 1984

Description of Waste: Acidic process condensate from 202-A

Radionuclide Release Summary:

Note: Total decayed values asof 1984

Radionuclide	Quantity
Pu	366 g
Sr-90	93.3 Ci
Ru-106	2.67 Ci
Cs-137	90.3 Ci
Co-60	11.7 Ci
U-238	214 kg

Summary of Past Logging:

Boreholes	Date	Reference
299-E17-1	1976	Fecht, et al., 1977
	1982	Geophysics files
299-E24-2	1976	Fecht, et al., 1977
	1982	Geophysics files
299-E24-15	1982	"
299-E24-59	1976	Fecht, et al., 1977
	1982	Geophysics files
299-E24-60	1976	Fecht, et al., 1977
	1982	Geophysics files
299-E24-160	1986	Geophysics files

Review of Current Logging:

Boreholes: 299-E24-2, 299-E24-160

Both boreholes were logged with the gross gamma and spectral gamma logging systems.

Borehole E24-2 is at the north end of this long crib. It shows a thick zone of Cs-137 contamination from 55 feet to 95 feet and a detectable concentration of Eu-154 near 90 feet. No other man-made radionuclides were detected in this borehole and outside of the cesium contamination zone, no anomalies are seen in the gross gamma-ray log. There isn't any variability in the natural background, indicating little compositional variation in the formation.

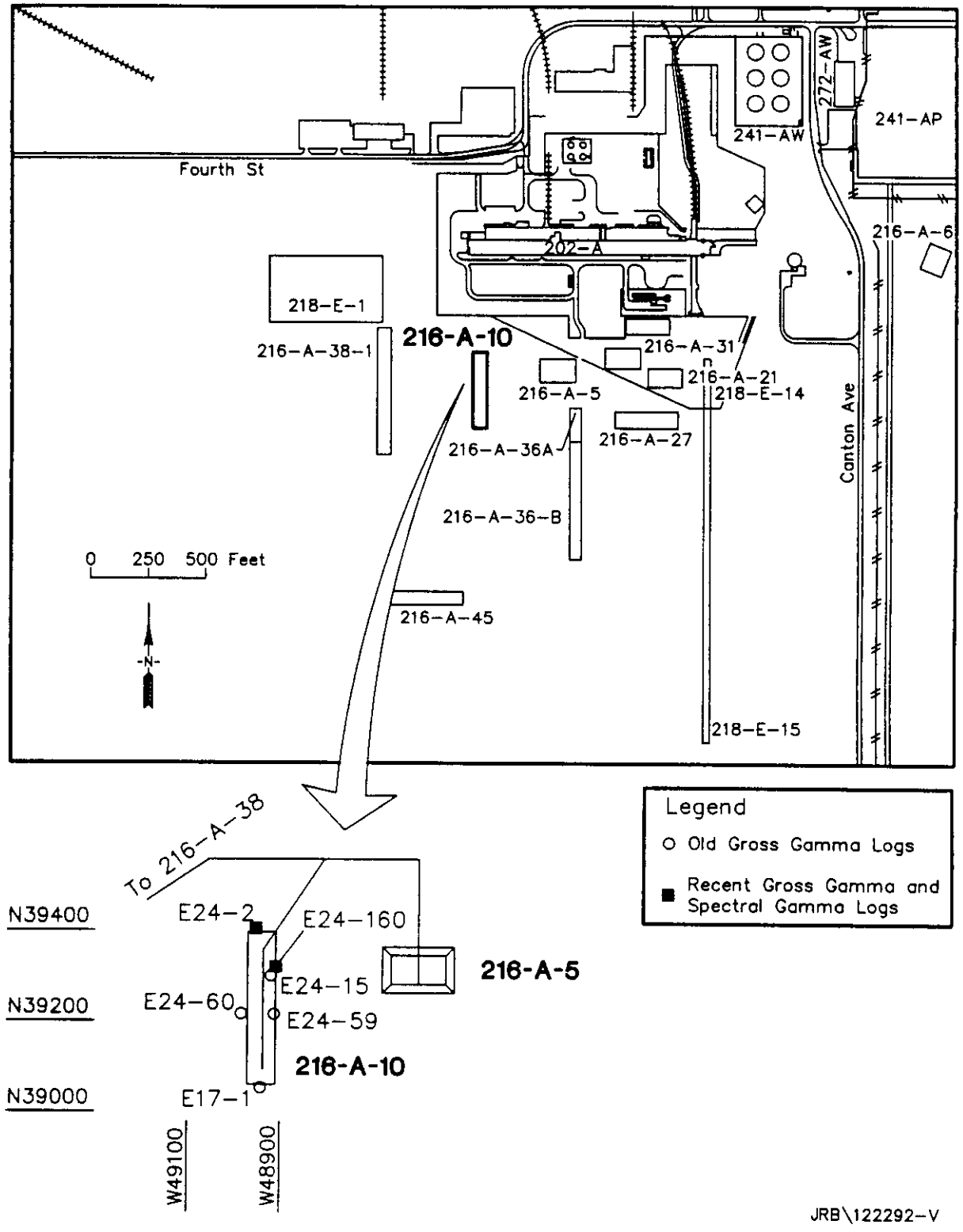
Borehole E24-160 has a high concentration of cesium from about 40 feet to about 150 feet, and another zone at about 190 feet. Everywhere else there are low concentrations of Cs-137. It is somewhat unusual to find cesium so widely distributed. It is virtually throughout the entire length of the borehole except in the very top 40 feet. The cesium may have migrated so readilly because of the large volumes of very low pH effluent

released at this crib.

It is significant to note that on the gross gamma log from this borehole, the zones of low cesium concentration do not have a gross activity that is higher than background. This indicates that the gross gamma-ray logs do not provide a reliable detection low concentrations of Cs-137. This also indicates that the gross gamma-ray logs cannot be used to reliably identify which crib sites have or are contaminating the groundwater.

Borehole E24-160 is not deep enough to reach the groundwater, however, considering the wide distribution of such a relatively immobile radioactive element (cesium), it is likely that cesium or other more mobile nuclides have migrated to the groundwater at this site.

Comparison of the spatial peak shapes between the older gross gamma-ray logs and the newer ones, suggests that there has not been any appreciable change in the gross activity profile and thus there has not been any significant redistribution of nuclides at this site.


Fourth St
272-AW
241-AP
241-AW
216-A-6
202-A
218-E-1
216-A-38-1
216-A-10
216-A-31
216-A-21
218-E-14
216-A-5
216-A-27
216-A-36A
216-A-36-B
Canton Ave
0 250 500 Feet
N
216-A-45
218-E-15
Legend
Old Gross Gamma Logs
Recent Gross Gamma and Spectral Gamma Logs
To 216-A-38
N39400
N39200
N39000
E24-2
E24-160
E24-15
E24-60
E24-59
E17-1
216-A-5
216-A-10
W49100
W48900
JRB\122292-V

Westinghouse Hanford Company
RLS Spectral Gamma-Ray Borehole Survey Log Header

Project: 200 East AAMS 216-A-10 Crib

Borehole	299-E24-2		
Coordinates	39,404 N 48,952 W	Feet	(Plant 200 E)
Elevation	717.47 feet	Top of Casing	(Plant 200 E)

Borehole Environment Information

Borehole Fluid Depth 312 (Feet) from Zero (0.0) Depth Reference of Log

Casing Size I.D. (inch)	Casing Thickness (inch)	Top Depth (feet)	Base Depth (feet)
8	0.33	0.0	350.
6	0.26	0.0	278.

RLS Passive Spectral Gamma Survey Information

Logging Engineers R. V. Cram S. E. Kos
Log Depth Reference at Zero (0.0) depth is Ground Level

Log Date	Archive File Names	Log Mode, Speed	Depth Interval (feet) Top	Base	Incr
Sept 18, 92	H2E2402\A247	FIXED 0.7 fpm	0.	10.	0.5
		FIXED 0.6 fpm	40.	100.	0.5
			275.	329.	0.5
		Station 300 s	150,200,226,250,280,313ft		

[1]FIXED: Fixed velocity of Cable Speed: fpm: Feet per minute
MSA: Move-Stop-Acquire LT: Live Time

Calibration and Analysis Information

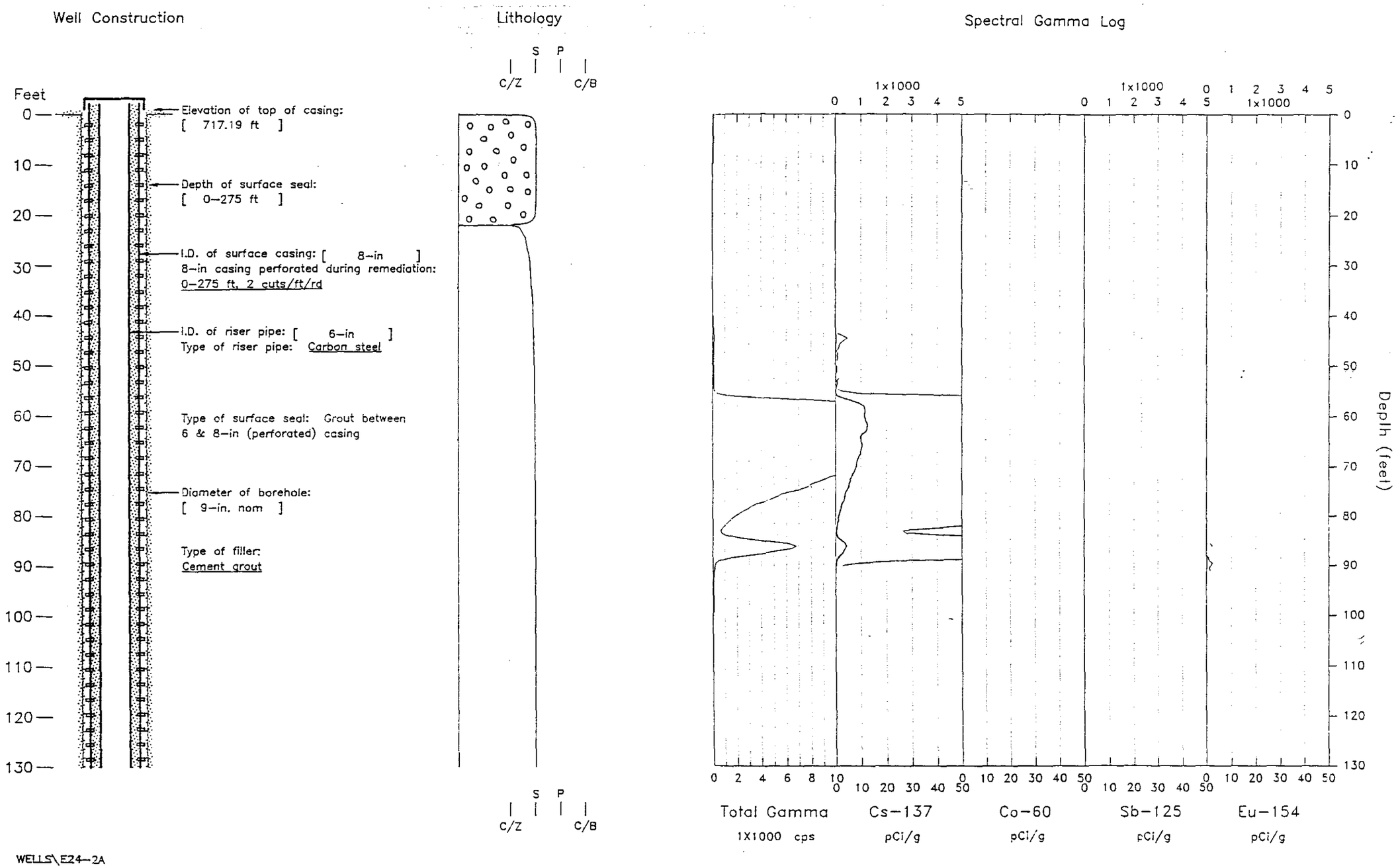
RLS Calibration Date: Nov 21, 1991
Calibration Report: WHC-SD-EN-TRP-001

Analyst Names: J. P. Kiesler
Analysis Date: Sept 28, 1992

Analysis Notes: Possible trace of Co-60 at 313 ft
Radionuclides identified: Cs-137, Eu-154

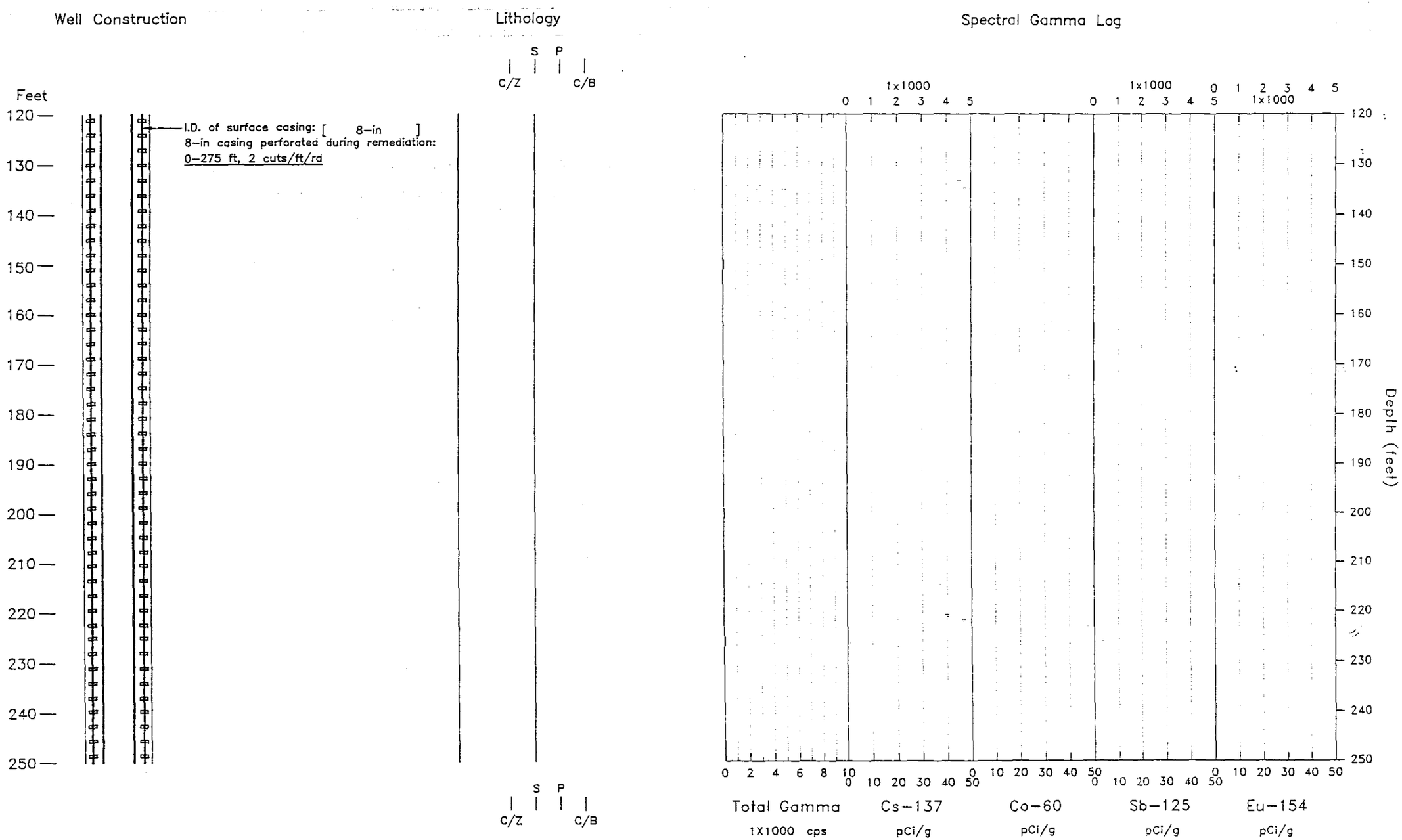
RLS Spectral Gamma Ray Borehole Survey

Well 299-E24-2 | Crib 216-A-10 | Log Date 9/18/92



RLS Spectral Gamma Ray Borehole Survey (Page 2)

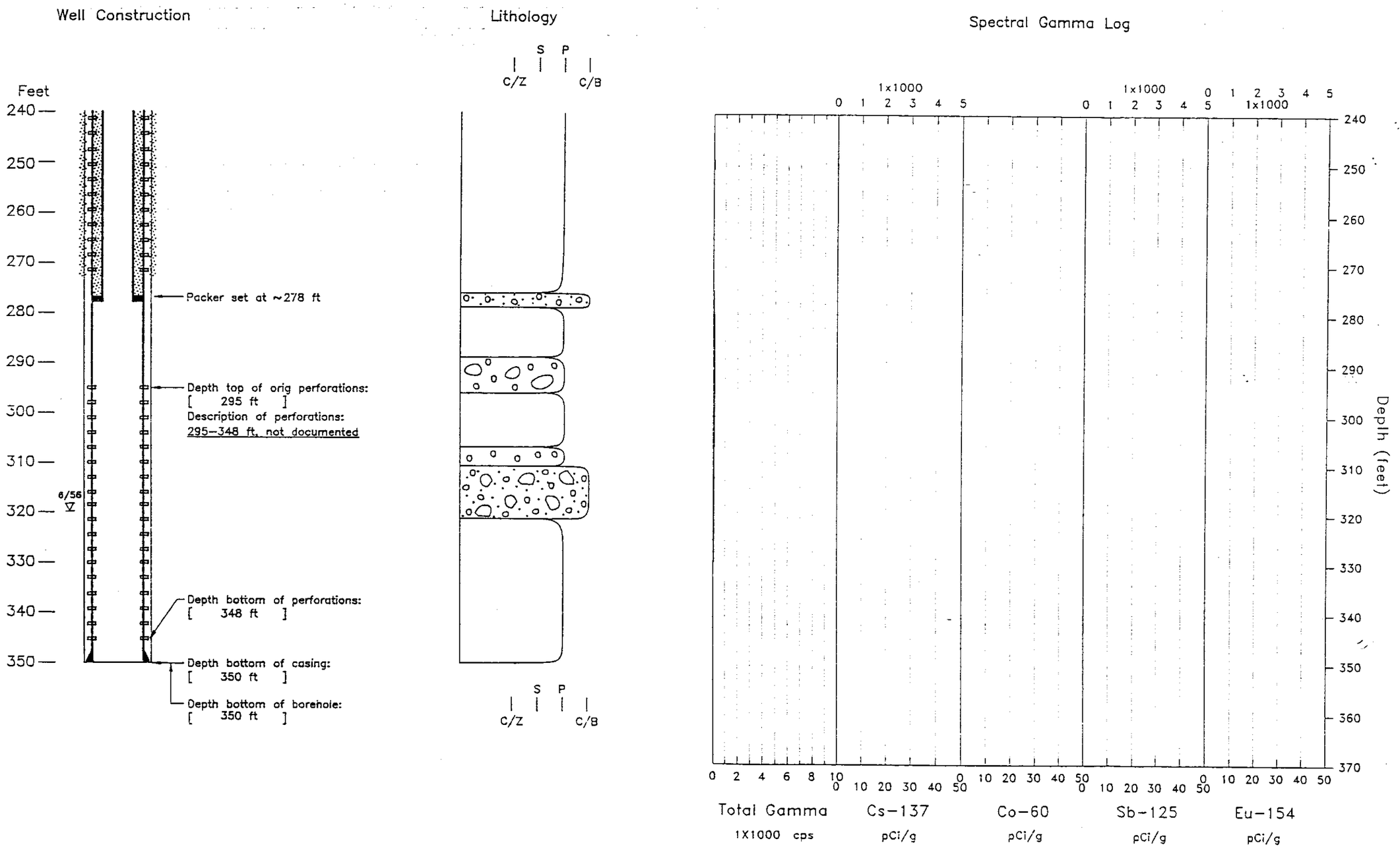
Well 299-E24-2 | Crib 216-A-10 | Log Date 9/18/92



WELLS\E24-2B

RLS Spectral Gamma Ray Borehole Survey (Page 3)

Well 299-E24-2 | Crib 216-A-10 | Log Date 9/18/92



WELLS\E24-2C

RLS Borehole Survey Report

299-E24-2 216-A-10 Crib

Casing	Depth: 350 ft	Size: 8 in	Thickness: 0.33 in
	Depth: 278 ft	Size: 6 in	Thickness: 0.26 in
Water	Depth: 312 ft		
Survey	Depth: 0 - 10 ft	Mode: Fixed 0.7 fpm	Date: 9/18/92
	40 - 100 ft	Mode: Fixed 0.6 fpm	
	275 - 329 ft	Mode: Fixed 0.6 fpm	

General Notes:
The screening survey depth intervals were determined from a review of the PNL gross gamma survey acquired earlier.

Stationary spectral gamma ray measurements were taken at 150, 200, 226, 250, 280 and 313 feet. No manmade radionuclides were identified in the stationary spectra acquired.

Detector depth was checked every 50 feet to 250 feet with at steel tape. The tool depth was not adjusted. The maximum depth error is 0.44% (ie. 1.1 ft at 250 ft).

The maximum calibrated casing correction of 0.40 inches was applied to the survey data. The computed activity for data recorded through multiple casing strings will be underestimated.

Man-made Radionuclides:
Cesium (Cs-137) was encountered in the borehole survey from 43 feet to 90 feet. The cesium decay activity exceeded 200 pCi/g from 56 to 79 feet and from 85 to 88 feet.

No continuous indications of Cobalt (Co-60) were encountered in the borehole survey. The plot track is present only for uniformity of the displayed data. A trace amount was detected in the 300 second long spectra measurement acquired at 313 feet. The water depth is 313 feet.

No Antimony (Sb-125) was encountered in the borehole survey. The plot track is present only for uniformity of the displayed data.

Europium-154 (Eu-154) was encountered in the borehole survey from 85 feet to 91 feet. The europium decay activity detected was less than 3 pCi/g.

Westinghouse Hanford Company
RLS Spectral Gamma-Ray Borehole Survey Log Header

Project: 200 East AAMS 216-A-10 Crib

Borehole	299-E24-160			
Coordinates	39,320 N	48,910 W	Feet	(Plant 200 E)
Elevation	717.79 feet		Top of Casing	(Plant 200 E)

Borehole Environment Information

Borehole Fluid Depth none (Feet) from Zero (0.0) Depth Reference of Log

Casing Size I.D. (inch)	Casing Thickness (inch)	Top Depth (feet)	Base Depth (feet)
6	0.29	0.0	217.

RLS Passive Spectral Gamma Survey Information

Logging Engineers R. V. Cram S. E. Kos
Log Depth Reference at Zero (0.0) depth is Ground Level

Log Date	Archive File Names	Log Mode[1], Speed	Depth Interval (feet) Top	Base	Incr
July 23, 92	H2E24160\A211	FIXED 0.6 fpm	0.	24.	0.5
July 23, 92	H2E24160\A212	FIXED 0.6 fpm	24.	150.	0.5
July 24, 92	H2E24160\A213	FIXED 0.6 fpm	148.	214.	0.5

[1] FIXED: Fixed velocity of Cable Speed: fpm: Feet per minute

Calibration and Analysis Information

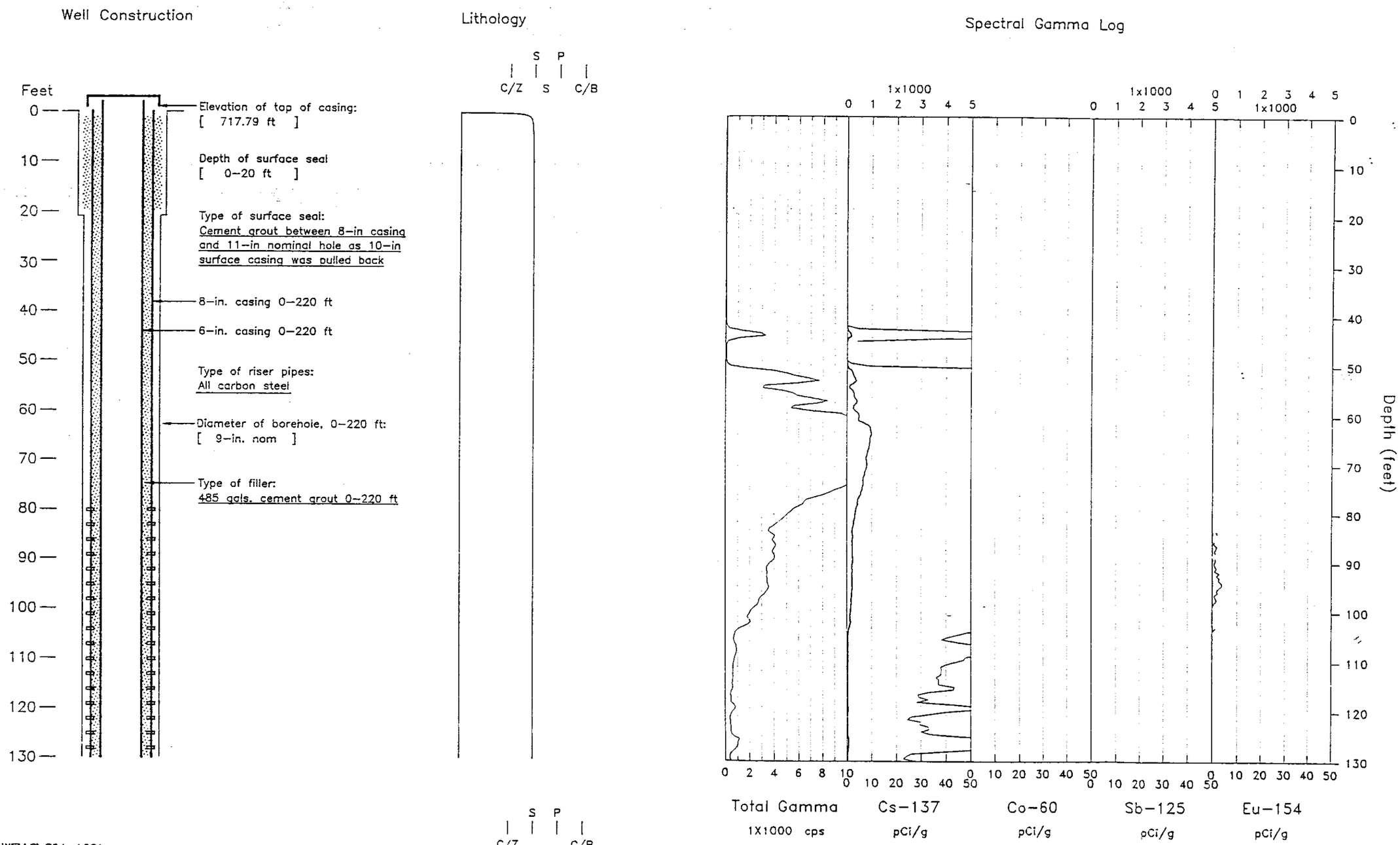
RLS Calibration Date: Nov 21, 1991
Calibration Report: WHC-SD-EN-TRP-001

Analyst Names: J. P. Kiesler R. K. Price
Analysis Date: July 29, 1992

Analysis Notes: Tool run away on July 23, 1992 at 24 feet; Restarted
Radionuclides identified: Cs-137, Eu-154

RLS Spectral Gamma Ray Borehole Survey

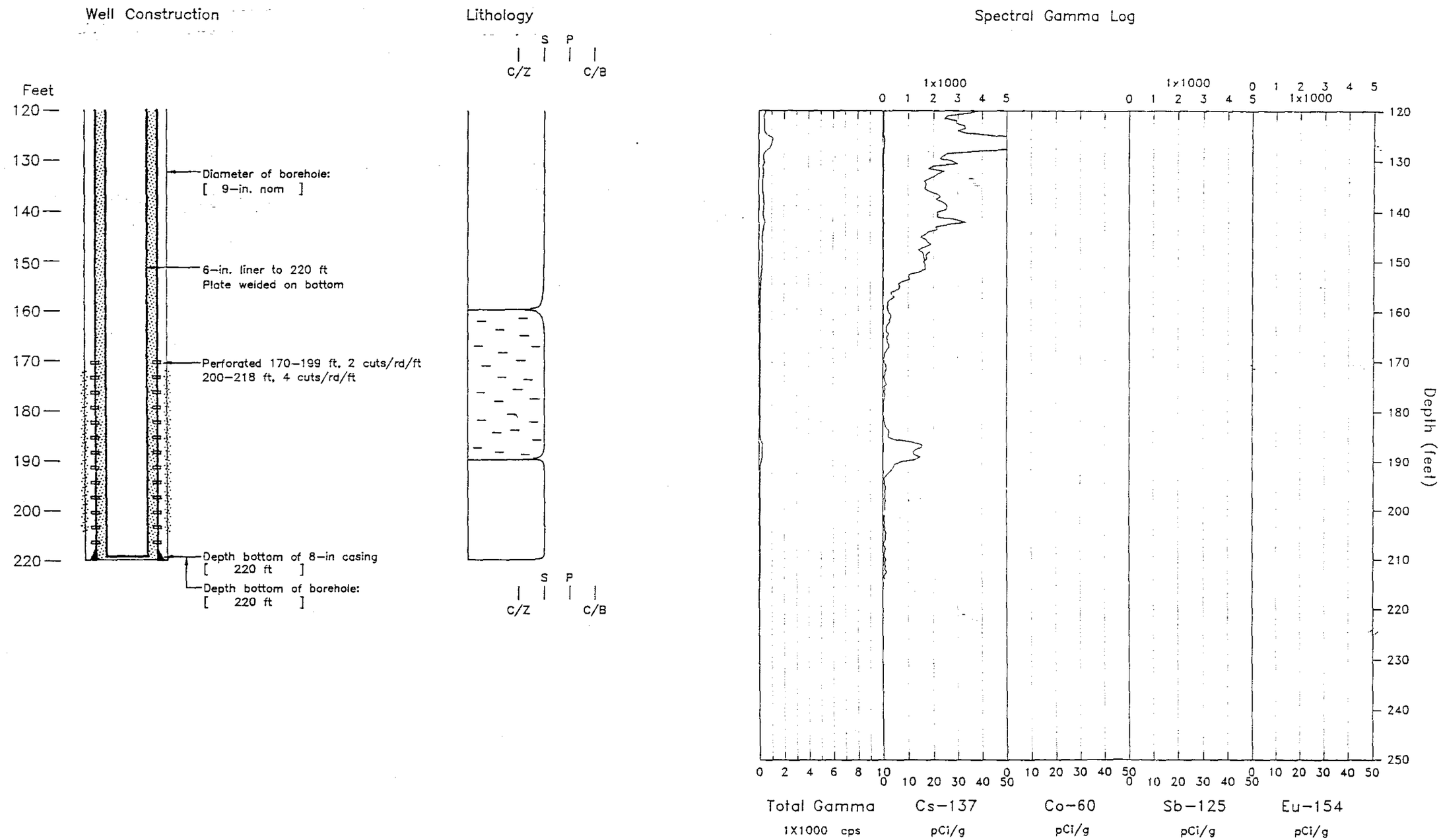
Well 299-E24-160 | Crib 216-A-10 | Log Date 7/23/92



WELLS\E24-160A

RLS Spectral Gamma Ray Borehole Survey (Page 2)

Well 299-E24-160 | Crib 216-A-10 | Log Date 7/23/92



WELLS\E24-160B

RLS Borehole Survey Report

299-E24-160 216-A-10 Crib

Casing	Depth: 217 ft	Size: 6 in	Thickness: 0.29 in
Water	Depth: none		
Survey	Depth: 0 - 24 ft	Mode: Fixed 0.6 fpm	Date: 7/23/92
	24 - 150 ft	Mode: Fixed 0.6 fpm	(Winch malfunction)
	148 - 214 ft	Mode: Fixec 0.6 fpm	Date: 7/24/92

General Notes:
The logging probe, cable near the probe and steel measuring tape were unusually warm (thermally) at the end of the 7/24/92 survey after raising the tool from 214 feet.

Malfunction of the cable winch at 24 feet, ie. tool run away, on 7/23/92 required restart of the computer program. The problem has been identified and corrected.

Limited borehole access time and extended borehole depth required more than one day for screening survey of borehole.

Detector depth was checked every 50 feet to 150 feet with at steel tape. The tool depth was not adjusted. The maximum depth error is 0.4% (ie. 0.53 ft at 150 ft).

Man-made Radionuclides:
Cesium (Cs-137) was encountered in the borehole survey from 42 feet to the maximum survey depth of 214 feet. The cesium decay activity exceeded 200 pCi/g from 51 to 97 feet.

No Cobalt (Co-60) was encountered in the borehole survey. The plot track is present only for uniformity of the displayed data.

No Antimony (Sb-125) was encountered in the borehole survey. The plot track is present only for uniformity of the displayed data.

Europium-154 (Eu-154) was encountered in the borehole survey from 83 feet to 105 feet. The europium decay activity detected was less than 4 pCi/g.

299-E24-2

Washington Hanford Company | LOG HEADER | Page 1 of 2

Well No. 299-E24-2 Area 200East Date 9/20/92
Log Run #1 Log Type Gross Gamma
Drillhole Depth 334.0' Elevation 717.79
Survey Coordinates N 39464 W 04575
Log Measured From Ground Surface
Logging Company PNL
Surface Temperature N/A Weather Clear - Warm

BOREHOLE INFORMATION

Drilled By
Drill Bay Type
Borehole Diameter/From 6" / 2.5'
Drill Type/Diameter
Drill Bay Type ?
Borehole Diameter/Depth 8" / 350'
Bit Type/Diameter ?
Drawn Down 350'
Drawn Down Logger 334.0'
Liquid Level N/A (dry)
Liquid Level Operator
Temperature N/A

CASING RECORD

Type 5" Carbon Steel Interval +2.5 - 350
Type 6" Carbon Steel Interval +2.4 - 2.5'

Type
Interval
Type
Interval
Type
Interval
Type
Interval

Well Screen Interval 335' - 345'
Comments: Return Error = +0.25' high
Centralizer used
Tube from Unused Wells

LOG HEADER | Page 2 of 2

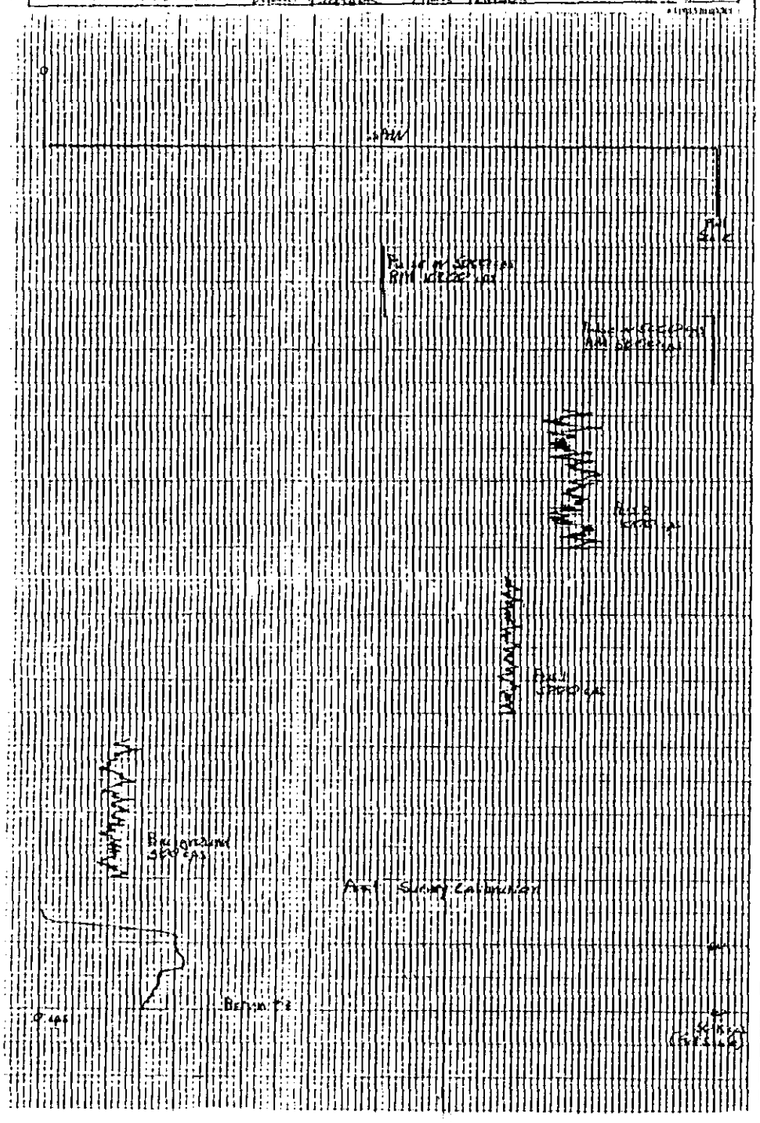
EQUIPMENT DATA

Logging Company PNL
Operator(s) Alan Pearson
Equipment Brand MIS Equipment Type Analog
Tool Type Gamma Rat Serial No. C627A71
Base Calibration Date 5/92 Calibration Reference PNL-8220 HC-6016
Calibration/Probe Factor 9.00 x 10^2 Calibration Datum (cu): Position 1 315.1 cu Position 2 65.1 cu
Dead Time 12.3 usec Warm Up Time > 15 min

LOGGING INFORMATION

Log Interval from 334.0' to 2.5'
Return(s) 50' to 200' @ 50 cps, 950' to 500' @ 10k cps, 700' to 550' @ 50k cps
Pre Survey Verification: Position 1 310.1 cu Position 2 64.9 cu Background 60 cps
Base Calibration Difference: Position 1 .5 cu Position 2 .03 cu
Logging Speed 5ft/min Return Scales, CPS/in 50 CPS/in
Start Time 1015 Completion Time 1200
Chart Speed(s), in/hr 10ft/in
Chart Recorder Horizontal Scale, CPS/in 50 CPS/in Time Constant(s) TC-1
Post Survey Verification: Position 1 310.5 cu Position 2 65.8 cu Background 55 cps
Percent Change: Position 1 0.1% Position 2 1.4%
Comments: Return Error = +0.25' high
Centralizer used

Witnessed and Verified by (sign and print name) Alan Pearson Alan Pearson Date: 9/20/92



299-E24-160

Washington Hanford Company | LOG HEADER | Page 1 of 2

Well No. 299-E24-160 Area 200East Date 7/30/92
Log Run #1 Log Type Gross Gamma
Drillhole Depth 717.79 Elevation 717.79
Survey Coordinates N 39320 W 04210
Log Measured From Ground Surface
Logging Company PNL
Surface Temperature N/A Weather Clear - Hot

BOREHOLE INFORMATION

Drilled By
Drill Bay Type
Borehole Diameter/From 6" / 2.5'
Drill Type/Diameter
Drill Bay Type
Borehole Diameter/Depth 8" / 220'
Bit Type/Diameter
Drawn Down 220'
Drawn Down Logger 213.7'
Liquid Level N/A (dry)
Liquid Level Operator N/A
Temperature N/A

CASING RECORD

Type 5" Carbon Steel Interval +2.5 - 220
Type 6" Carbon Steel Interval +2.4 - 2.5'

Type
Interval
Type
Interval
Type
Interval
Type
Interval

Well Screen Interval 210' - 220'
Comments: Return Error = +0.2' high
Centralizer used

LOG HEADER | Page 2 of 2

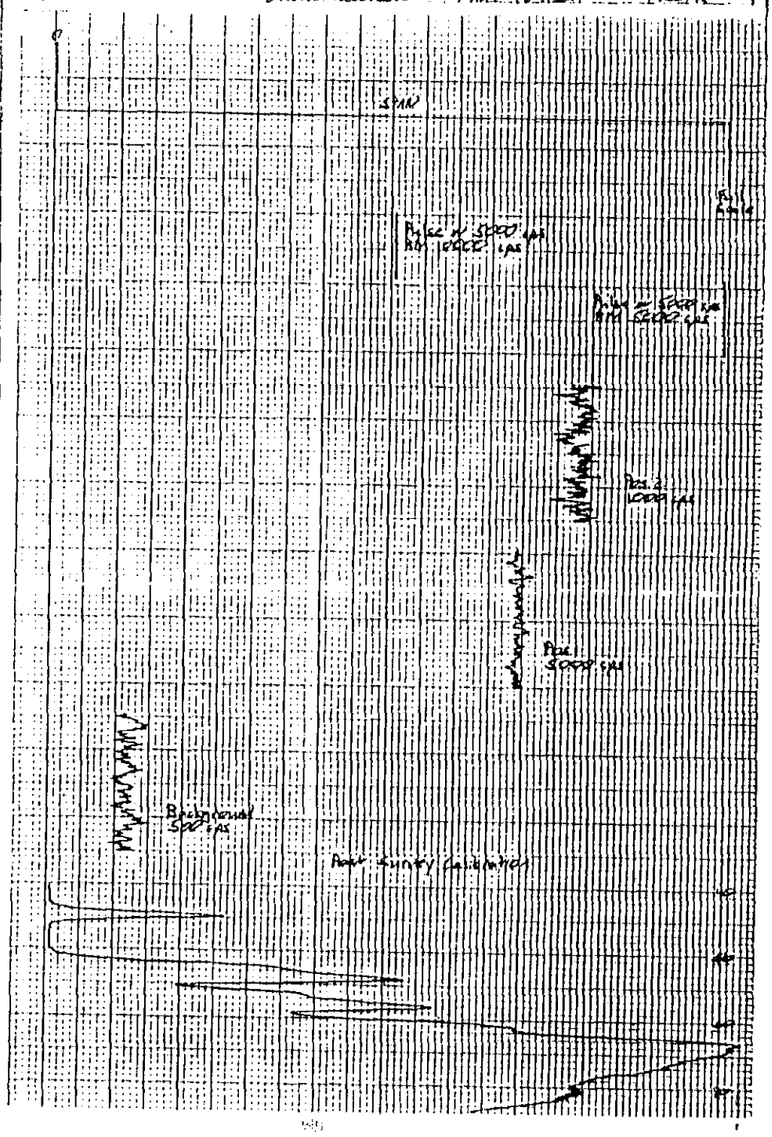
EQUIPMENT DATA

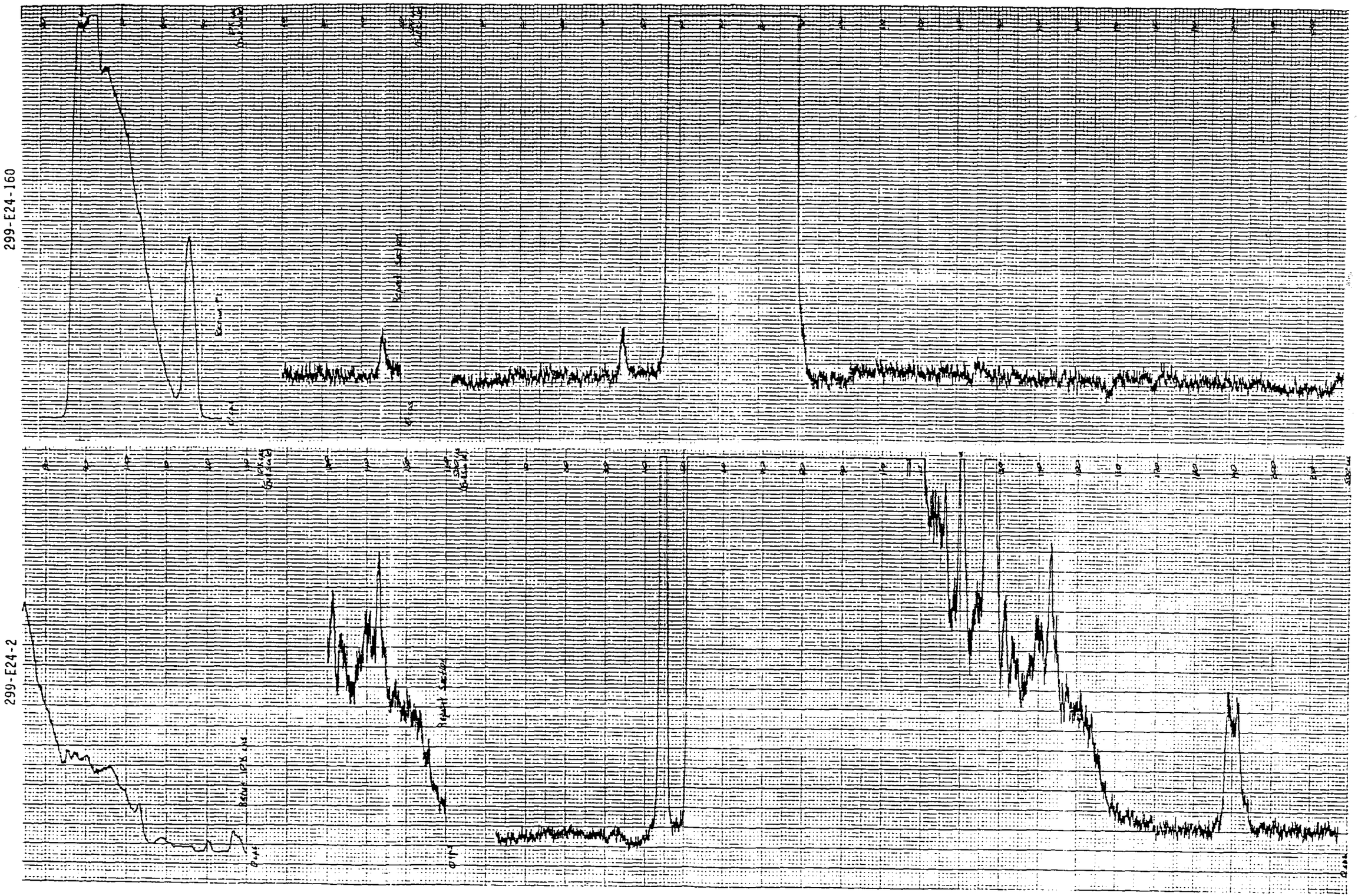
Logging Company PNL
Operator(s) Alan Pearson
Equipment Brand MIS Equipment Type Analog
Tool Type Gamma Rat Serial No. C627A71
Base Calibration Date 5/92 Calibration Reference PNL-8220 HC-6016
Calibration/Probe Factor 9.00 x 10^2 Calibration Datum (cu): Position 1 315.1 cu Position 2 65.1 cu
Dead Time 12.3 usec Warm Up Time > 15 min

LOGGING INFORMATION

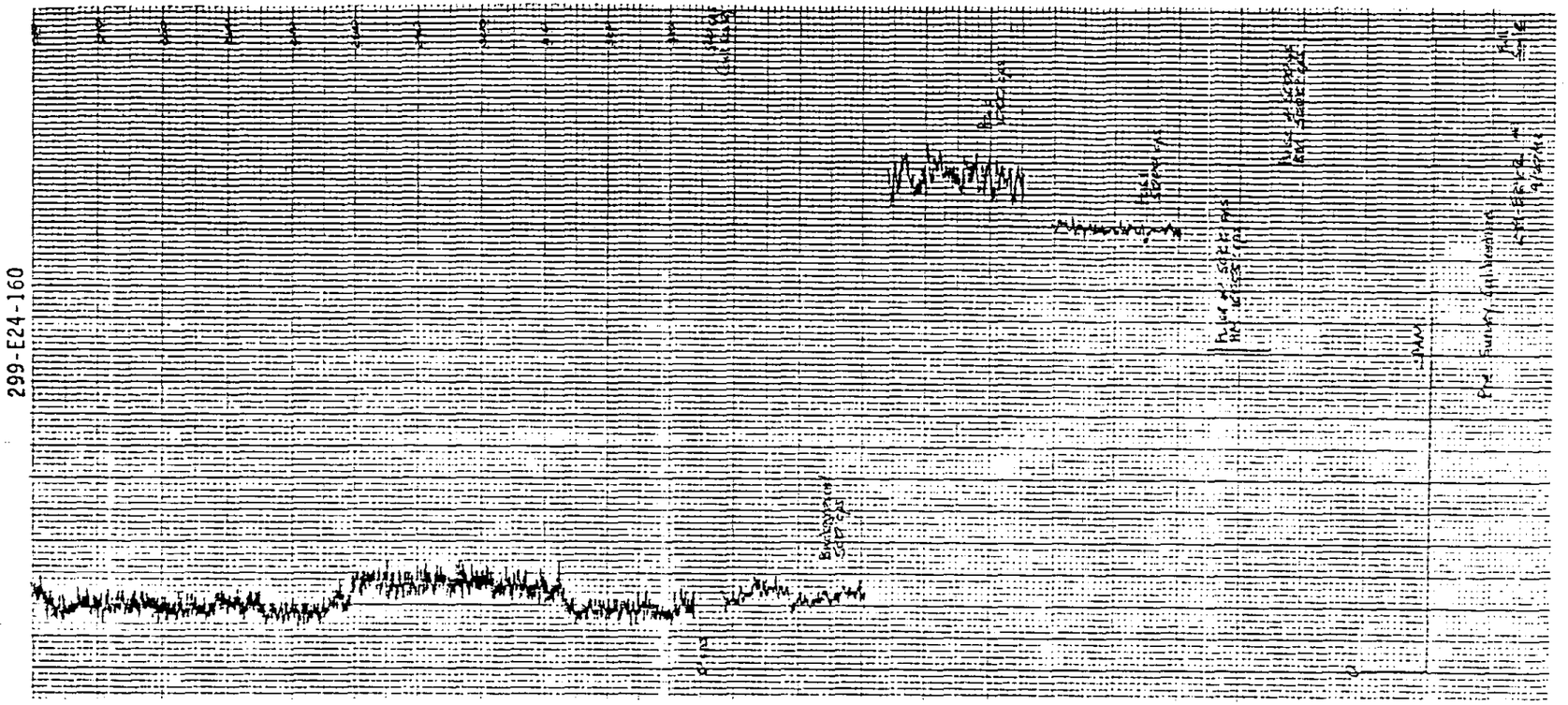
Log Interval from 213.7' to 2.6'
Return(s) 110.0' to 1320' @ 50 cps 1320' to 400' @ 10k cps
Pre Survey Verification: Position 1 314.4 cu Position 2 66.6 cu Background 62 cps
Base Calibration Difference: Position 1 0.7 cu Position 2 1.5 cu
Logging Speed 5ft/min Return Scales, CPS/in 50 CPS/in
Start Time 0700 Completion Time 0940
Chart Speed(s), in/hr 10ft/in
Chart Recorder Horizontal Scale, CPS/in 50 CPS/in Time Constant(s) TC-1
Post Survey Verification: Position 1 310.1 cu Position 2 65.8 cu Background 60 cps
Percent Change: Position 1 1.4% Position 2 1.2%
Comments: Return Error = +0.2' high
Centralizer used

Witnessed and Verified by (sign and print name) Alan Pearson Alan Pearson Date: 7/30/92

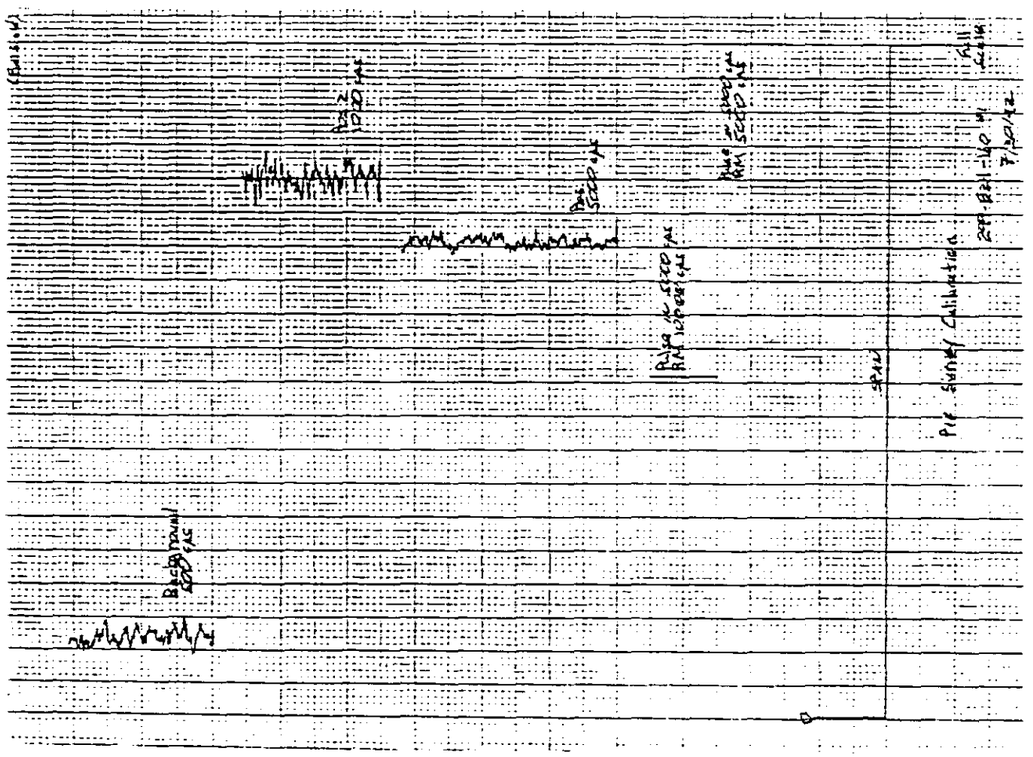



299-E24-160
299-E24-2

299-E24-160



299-E24-2



Crib Designation: 216-A-24

Type of Facility: 1400 ft by 20 ft rock filled crib

Location: N42206 to N42494, W 45328 to W 46854, 500 ft east of the 241-AZ tan farms

Service Dates: 5/58 to 1/66

Description of Waste: 820 x 10^6 liters of low-salt, neutral to basic condensate from 241-A and 241-AX tank farms

Radionuclide Release Summary:

Radionuclide	Quantity
Cs-137	268 Ci
Ru-106	1.32 x 10^-6 Ci
Sr-90	18.3 Ci
Pu	5.06 g
U	0.017 Ci

Summary of Past Logging:

Boreholes	Date	Reference
299-E26-2	1976	Fecht, et al., 1977
	1984	Geophysics files
	1986	"
	1987	"
299-E26-3	1976	Fecht, et al., 1977
	1984	Geophysics files
	1986	"
	1987	"
299-E26-4	1976	Fecht, et al., 1977
	1984	Geophysics files
	1986	"
	1987	"
299-E26-5	1976	Fecht, et al., 1977
	1984	Geophysics files
	1986	"
	1987	"
299-E26-7	1976	Fecht, et al., 1977
	1984	Geophysics files
299-E26-53	1984	"

Review of Current Logging:

Boreholes: 299-E26-7, 299-E26-53

Borehole E26-7 was logged with the PNL gross gamma-ray logging system which subsequently produced a log that showed the system was saturated throughout most of the borehole due to an excessively high gamma-ray flux. This log is only useful as an indicator that there is gamma-emitting contaminants throughout the borehole.

Borehole E26-53 was logged with the RLS spectral system. Because this hole is very shallow, this log does not provide much

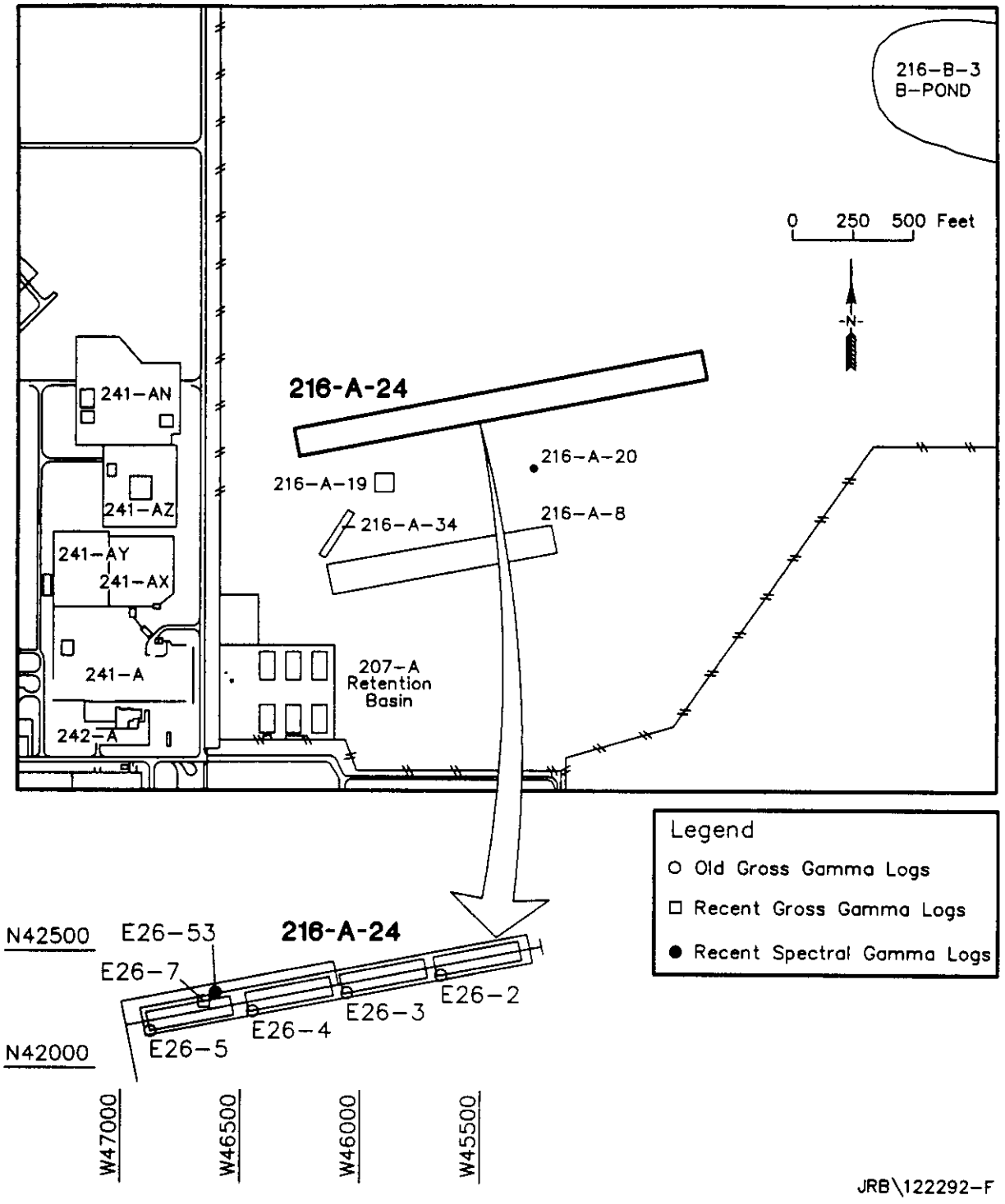
in the way of data useful for interpreting site conditions. It did show that the only gamma-emitting nuclide in the borehole is Cs-137.

The oldest gross gamma logs show extensive activity high up in the unsaturated zone, but no data are provided for the deeper portions of the boreholes.

Some of the gross gamma logs from the 1980's show a zone of slightly elevated activity just above the groundwater table at 240 feet. It is not known if that is due to man-made nuclides or if it is natural.

We have little information on this crib that can provide conclusive information about whether or not this site has contaminated the groundwater. We also cannot be certain if there is any contamination throughout the unsaturated zone at this site.

Clearly we need additional spectral gamma-ray logging of the deeper boreholes at this site.


216-B-3
B-POND
0 250 500 Feet
-N-
216-A-24
241-AN
241-AZ
241-AY
241-AX
241-A
242-A
216-A-19
216-A-20
216-A-34
216-A-8
207-A
Retention
Basin
Legend
Old Gross Gamma Logs
Recent Gross Gamma Logs
Recent Spectral Gamma Logs
N42500
N42000
E26-53
E26-7
E26-5
E26-4
E26-3
E26-2
216-A-24
W47000
W46500
W46000
W45500
JRB\122292-F

Westinghouse Hanford Company
RLS Spectral Gamma-Ray Borehole Survey Log Header

Project: 200 East AAMS 216-A-24 Crib

Borehole	299-E26-53		
Coordinates	42,325 N 46,605 W	Feet	(Plant 200 E)
Elevation	. feet	Top of Casing	(Plant 200 E)

Borehole Environment Information

Borehole Fluid Depth none (Feet) from Zero (0.0) Depth Reference of Log

Casing Size I.D. (inch)	Casing Thickness (inch)	Top Depth (feet)	Base Depth (feet)
6	0.25	0.0	50.3

RLS Passive Spectral Gamma Survey Information

Logging Engineers R. V. Cram S. E. Kos
Log Depth Reference at Zero (0.0) depth is Ground Level

Log Date	Archive File Names	Log Mode[1], Speed	Depth Interval (feet) Top	Base	Incr
Aug 14, 92	H2E2653\A227	MSA 35 sec LT	0.	47.	0.5

[1]MSA: Move-Stop-Acquire LT: Live time

Calibration and Analysis Information

RLS Calibration Date: Nov 21, 1991
Calibration Report: WHC-SD-EN-TRP-001

Analyst Names: G. K. Jaeger R. K. Price
Analysis Date: Sep 1, 1992

Analysis Notes: High gamma activity from 25 to 30 ft may indicate Sr-90
Radionuclides identified: Cs-137

RLS Spectral Gamma Ray Borehole Survey

Well 299-E26-53 | Crib 216-A-24 | Log Date 8/14/92

Well Construction

Feet

0, 10, 20, 30, 40, 50

Elevation of top of casing: [ND]

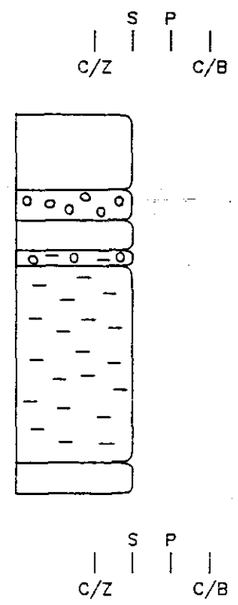
I.D. of riser pipe: [6-in.]
Type of riser pipe: Carbon steel

Diameter of borehole: [7-in. nom]

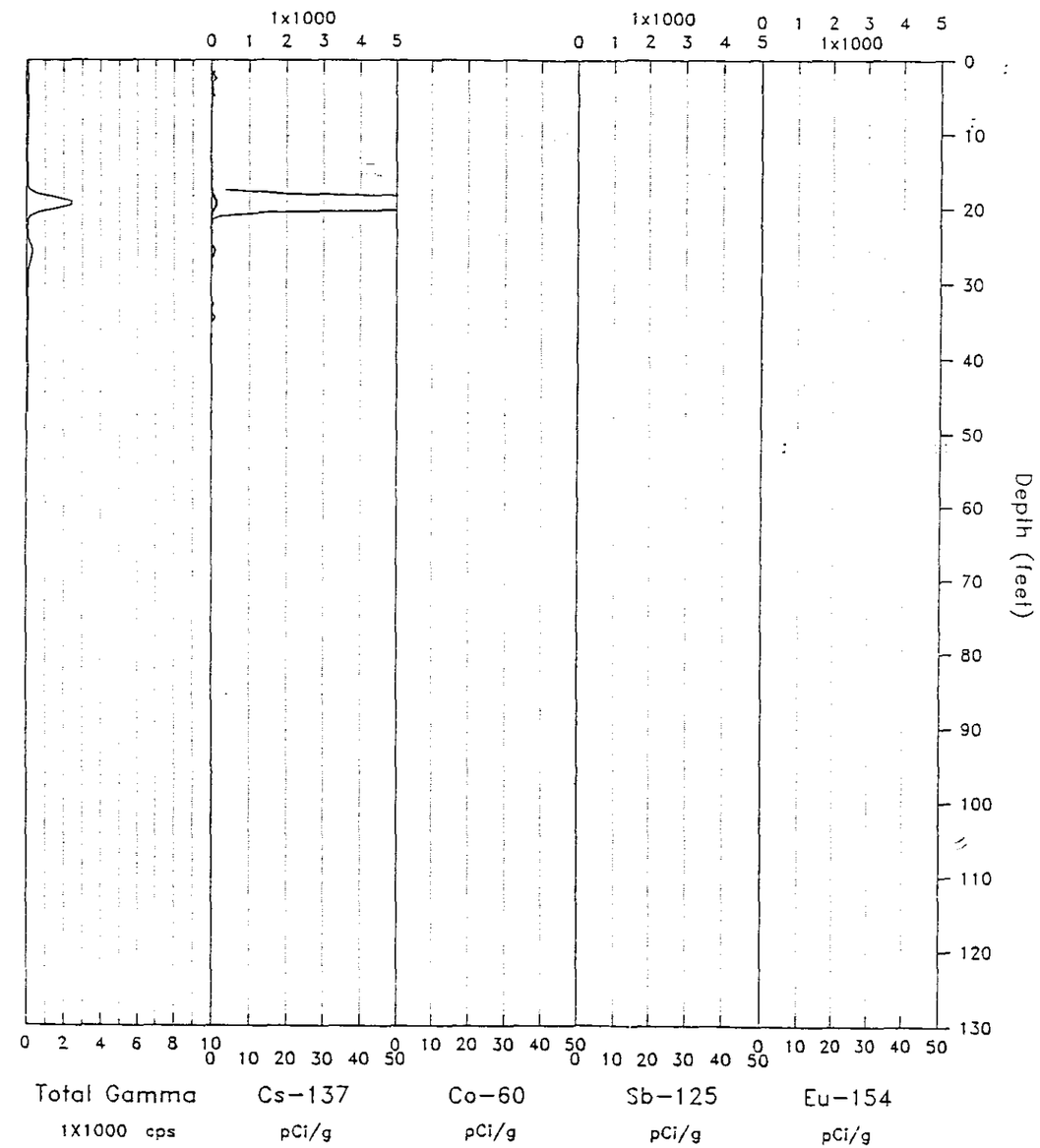
Depth bottom of casing: [50 ft]

Depth bottom of borehole: [50 ft]

Lithology



Spectral Gamma Log



WELLS\E26-53A

RLS Borehole Survey Report

299-E26-53 216-A-24 Crib

Casing	Depth: 50 ft	Size: 6 in	Thickness: 0.25 in
Water	Depth: none		
Survey	Depth: 0 - 47 ft	Mode: MSA 35 sec	Date: 8/14/92

General Notes:
This survey has a high gamma activity with lower than expected photo peaks from 25 feet to 30 feet. The spectra shows an elevated gamma activity in the lower energy range less than 300 keV. This may indicate the presence of strontium-90 (Sr-90) in the formation.

Man-made Radionuclides:
Cesium (Cs-137) was encountered in the borehole survey from 0.5 feet to the maximum survey depth of 47.2 feet. The cesium activity is not continuous through this depth range. The maximum cesium decay activity detected was 140 pCi/g at 19 feet.

No Cobalt (Co-60) was encountered in the borehole survey. The plot track is present only for uniformity of the displayed data.

No Antimony (Sb-125) was encountered in the borehole survey. The plot track is present only for uniformity of the displayed data.

No Europium-154 (Eu-154) was encountered in the borehole survey. The plot track is present only for uniformity of the displayed data.

299-E26-7

Westinghouse Hanford Company | LOG HEADER | Page 1 of 2

Well No. 299-E26-7 Area 200 East Date 8/4/92
Log Run #1 Log Type Gross Gamma
Elevation Datum Top of Casing Elevation 647.0
Survey Coordinates N 47245 W 46650
Log Measured From Ground Surface
Location Description A-24 Crib
Ground Surface Elevation
Surface Temperature N/A Weather Clear - Hot

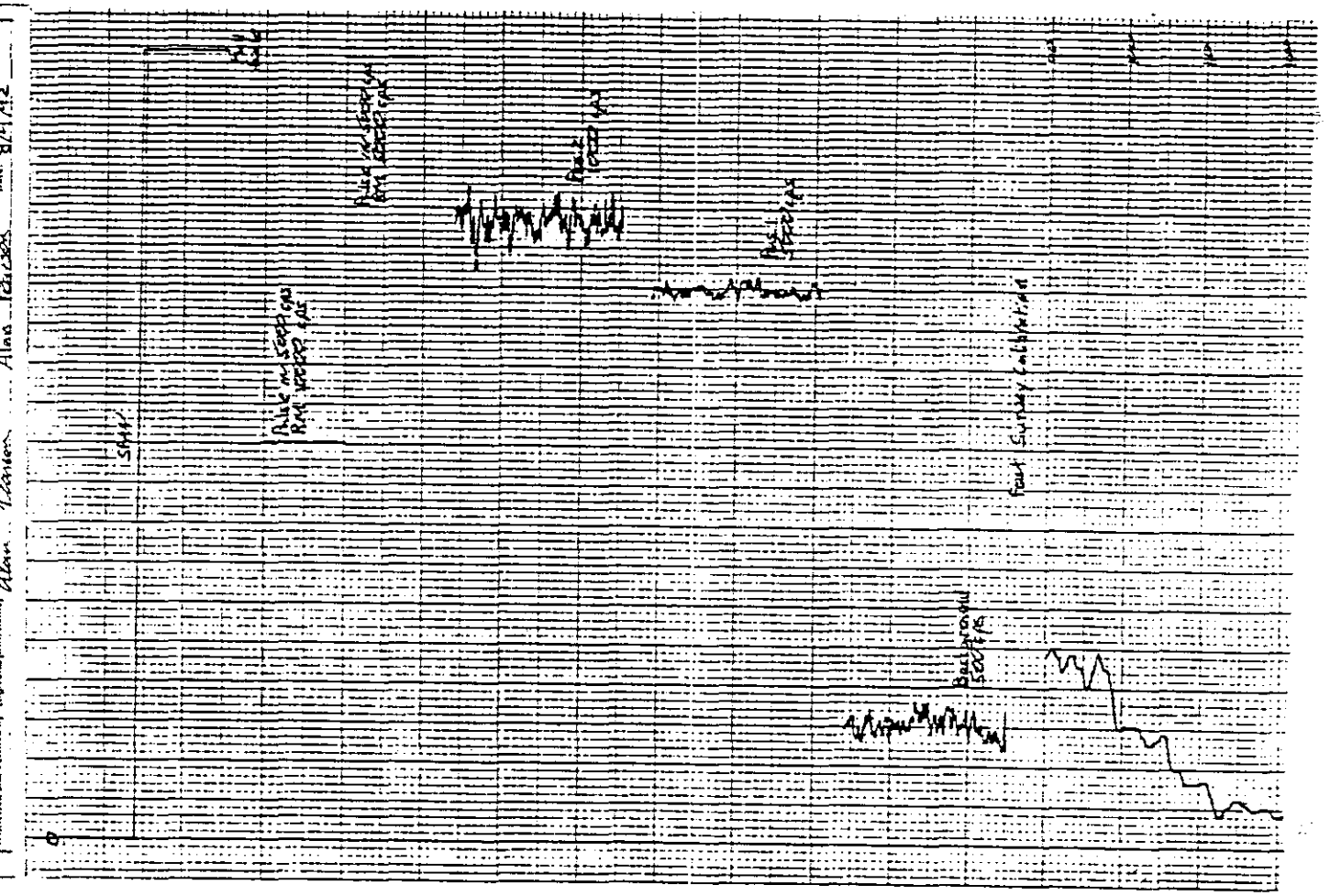
BOREHOLE INFORMATION
Driller
Drill Rig Type: Bit Type/Diameter
Borehole Diameter/Depth 6"/127'
Depth Driller 127' Depth Logger 129.5'
Liquid Level N/A (none) Liquid Density N/A
Temperature N/A

CASING RECORD
Type 6" Carbon Steel Sch.40 Interval +1.7' - 127'
Type Interval
Type Interval
Type Interval
Well Screen Interval N/A
Comments: Pump from 102' high
Centralizer used

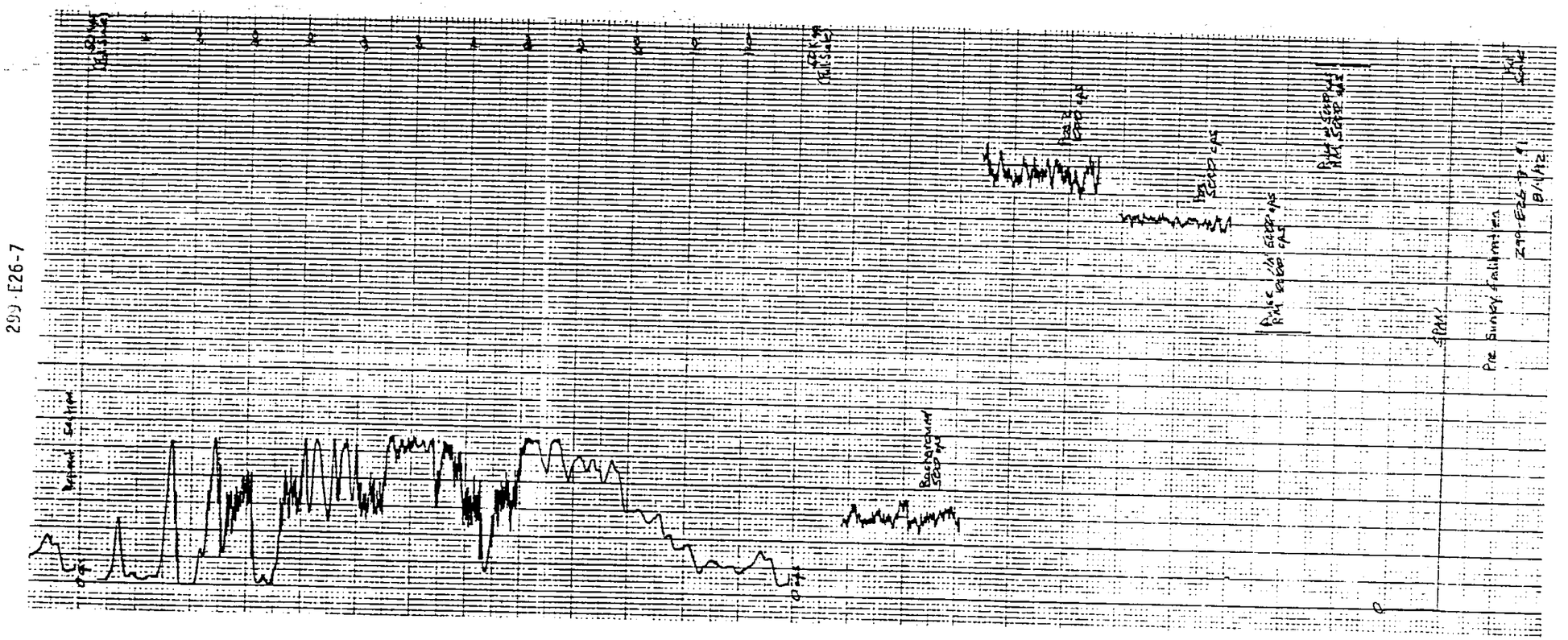
Page 2 of 2

LOG HEADER
EQUIPMENT DATA

Logging Company PNL
Operator(s) Alan Pearson
Equipment Brand NIS
Tool Type Gamma Rat.
Date Calibration Date 5/92
Calibration Probe Factor 200 cps/R Calibration Datum 100 cps
Total Time 1.3 min.
Equipment Type Analog
Serial No. CA27MT
Calibration Reference PNL-SR220 WC-SC216
Datum (cps) Position 1 315 cps Position 2 651 cps
Wireline Type 715 cable
LOGGING INFORMATION
Logging Speed 30'/min
Logging Interval From 129.5' to 90.0' @ 50K cps Background 73 cps
Recorder(s) 129.5' to 312.4' cps Position 1 614 cps Position 2 0 cps
Pre Survey Verification: Position 1 312.4 cps Position 2
Post Survey Verification: Position 1 Position 2
Date Calibration Difference: Position 1 1.7 cps Position 2
Return Static (cps) 50 cps Background 50K cps
Logging Speed 5'/min
Completion Time 1115
Start Time 1230
Chart Speed (in/min) 10'/in. Time Constant(s) 1 sec
Chart Recorder Identification Serial No. PC-1154 Range 5000 cps
Chart Recorder Identification Serial No. PC-1154 Range 5000 cps
Post Survey Verification: Position 1 308.7 cps Position 2 64.5 cps
Percent Change: Position 1 1.5% Position 2 -4.2%
Comments: Return Static: +0.2' high
Centralizer used
Only run log on 50K cps scale
Witnessed and Verified by (signature and print name) Alan Pearson Date: 8/4/92



299-E26-7



Crib Designation: 216-A-27

Type of Facility: 200 ft x 10 ft sand filled crib

Location: N 39100, W 48118 to W 48318

Service Dates: 6/65 to 7/70

Description of Waste: 23 x 10^6 liters of: sump waste from 293-A building, laboratory cell drainage from 202-A building, and 291-A-1 stack drainage

Radionuclide Release Summary:

Radionuclide	Quantity
Pu	97 g
Sr-90	41 Ci
Ru-106	63 Ci
Cs-137	53 Ci
Co-60	<2.7 Ci

Summary of Past Logging:

Boreholes	Date	Reference
299-E17-2	1976	Fecht, et al., 1977
	1984	Geophysics files
	1986	Geophysics files
299-E17-3	1976	Fecth, et al., 1977
	1984	Geophysics files
	1987	"

Review of Current Logging:

Borehole: 299-E17-3

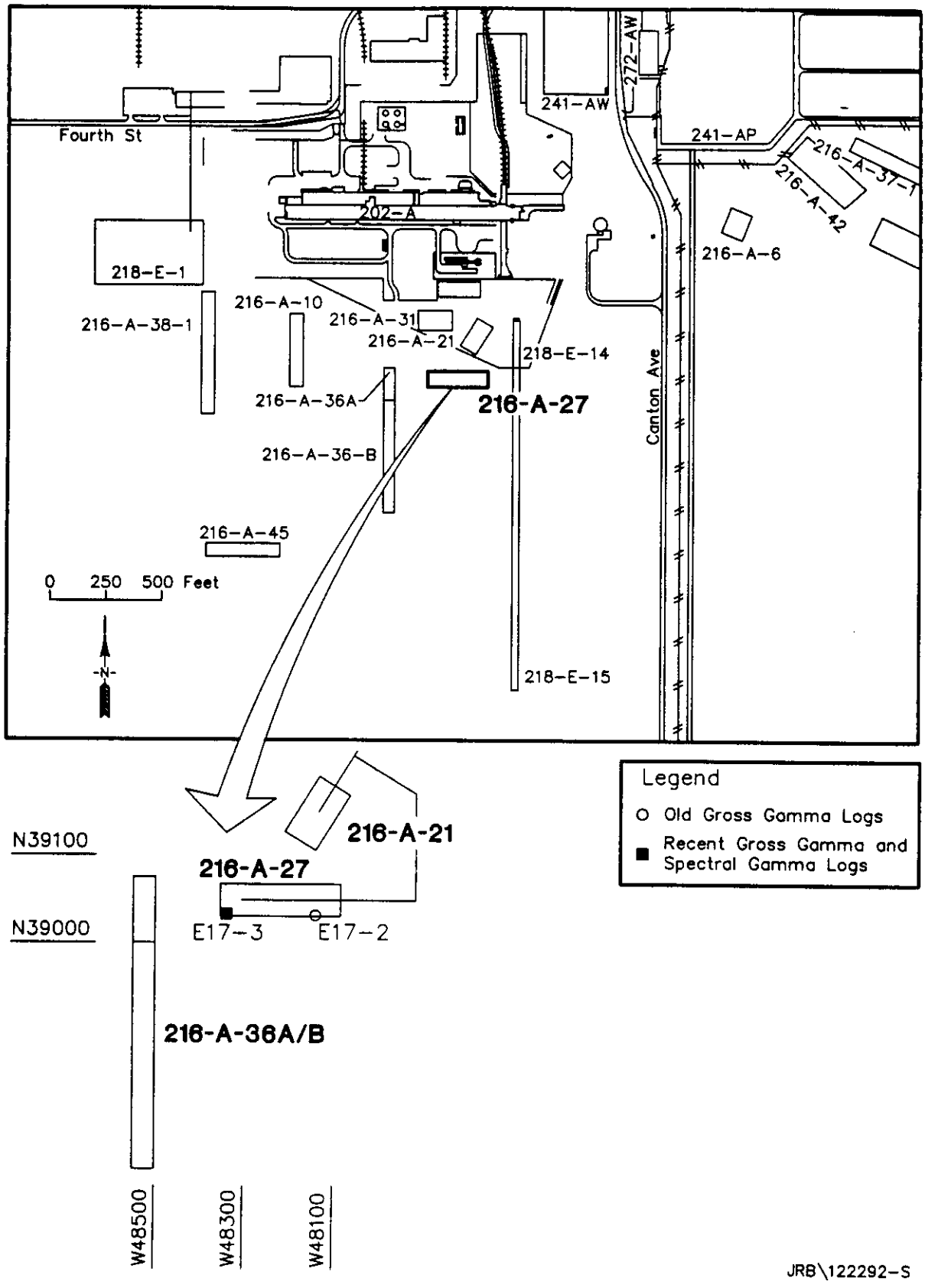
This borehole was logged with the PNL gross gamma and the RLS spectral gamma logging systems. The spectral gamma-ray log shows Sb-125 found in the borehole from about 80 feet to about 120 feet. In addition, Co-60 is found in the borehole from 80 feet all the way down and into the groundwater. This cobalt is in very low concentration levels, but it is present and easilly identified in the spectra.

However, the low levels of cobalt do not show up in the new gross gamma-ray log nor do they show up in any of the old gross gamma logs. The gross gamma logs simply show two anomalies high up in the borehole at 85 feet and 110 feet and a contamination zone from 280 to 315. As shown by the spectral gamma log, the upper zones are due to antimony and cobalt while the lower zone is strictly due to the presence of cobalt. No elevated activity is seen in the gross logs between the upper and lower contamination zones.

Fecht, et al., 1977 state that the source of the radionuclides in this borehole is probably the nearby 216-A-36A crib. Considering the gross gamma profiles alone, one could easilly support such a conclusion. However, the spectral gamma log provides evidence that the cobalt has in fact migrated from

the upper portion of the unsaturated zone, downward, leaving trace cobalt in it's migration path. These data suggest that the source of the cobalt is the A-27 crib and not the A-36a crib.

The data from this one borehole shows that this crib has contaminated the groundwater beneath this site with Co-60. A spectral gamma-ray log of the E17-2 borehole would be useful to see if it also has cobalt distributed throughout. The gross gamma logs do not adequately identify the presence of man-made nuclides at this site and this borehole provides proof of the need for spectral gamma-ray logging of all of the boreholes used to monitor the waste sites.


Fourth St
241-AW
272-AW
241-AP
216-A-37-1
216-A-42
216-A-6
202-A
218-E-1
216-A-10
216-A-38-1
216-A-31
216-A-21
218-E-14
216-A-36A
216-A-27
216-A-36-B
Canton Ave
216-A-45
0 250 500 Feet
N
218-E-15
Legend
Old Gross Gamma Logs
Recent Gross Gamma and Spectral Gamma Logs
N39100
216-A-21
216-A-27
N39000
E17-3
E17-2
216-A-36A/B
W48500
W48300
W48100
JRB\122292-S

Westinghouse Hanford Company
RLS Spectral Gamma-Ray Borehole Survey Log Header

Project: 200 East AAMS, 216-A-27 Crib

Borehole	299-E17-3			
Coordinates	39,066 N	48,340 W	Feet	(Plant 200 E)
Elevation	715.83 feet		Top of Casing	(Plant 200 E)

Borehole Environment Information

Borehole Fluid Depth 312 (Feet) from Zero (0.0) Depth Reference of Log

Casing Size I.D. (inch)	Casing Thickness (inch)	Top Depth (feet)	Base Depth (feet)
8	0.27	0	400

RLS Passive Spectral Gamma Survey Information

Logging Engineers R. V. Cram S. E. Kos
Log Depth Reference at Zero (0.0) depth is Ground Level

Log Date	Archive File Names	Log Mode[1], Speed	Depth Interval (feet) Top	Base	Incr
Jul 27, 92	H2E1703\A214	FIXED 0.6 fpm	0	58	0.5
		MSA 35 sec LT	50	192	0.5
Jul 28, 92	H2E1703\A215	MSA 35 sec LT	190	361	0.5
Jul 29, 92	H2E1703\A216	MSA 35 sec LT	0	50	0.5
		NSA 35 sec LT	360	397	0.5

[1]FIXED: Fixed cable speed velocity fpm: Feet per minute
MSA: Move-Stop-Acquire LT: Live Time

Calibration and Analysis Information

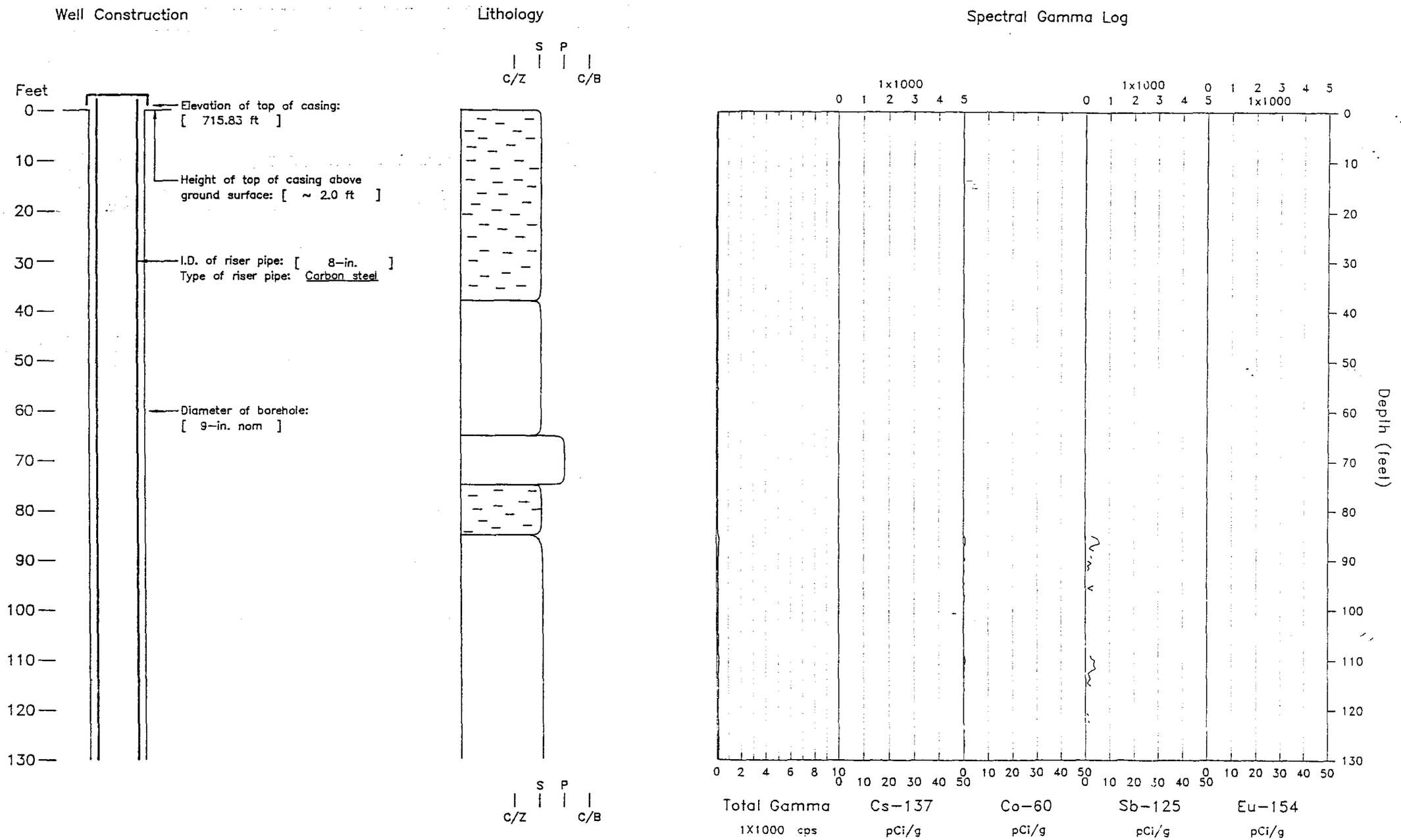
RLS Calibration Date: Nov 21, 1991
Calibration Report: WHC-SD-EN-TRP-001

Analyst Names: G. K. Jaeger R. K. Price
Analysis Date: Sept 1, 1992

Analysis Notes: Depth 0-50 ft logged twice to establish uniform log mode
Radionuclides identified: Co-60, Sb-125

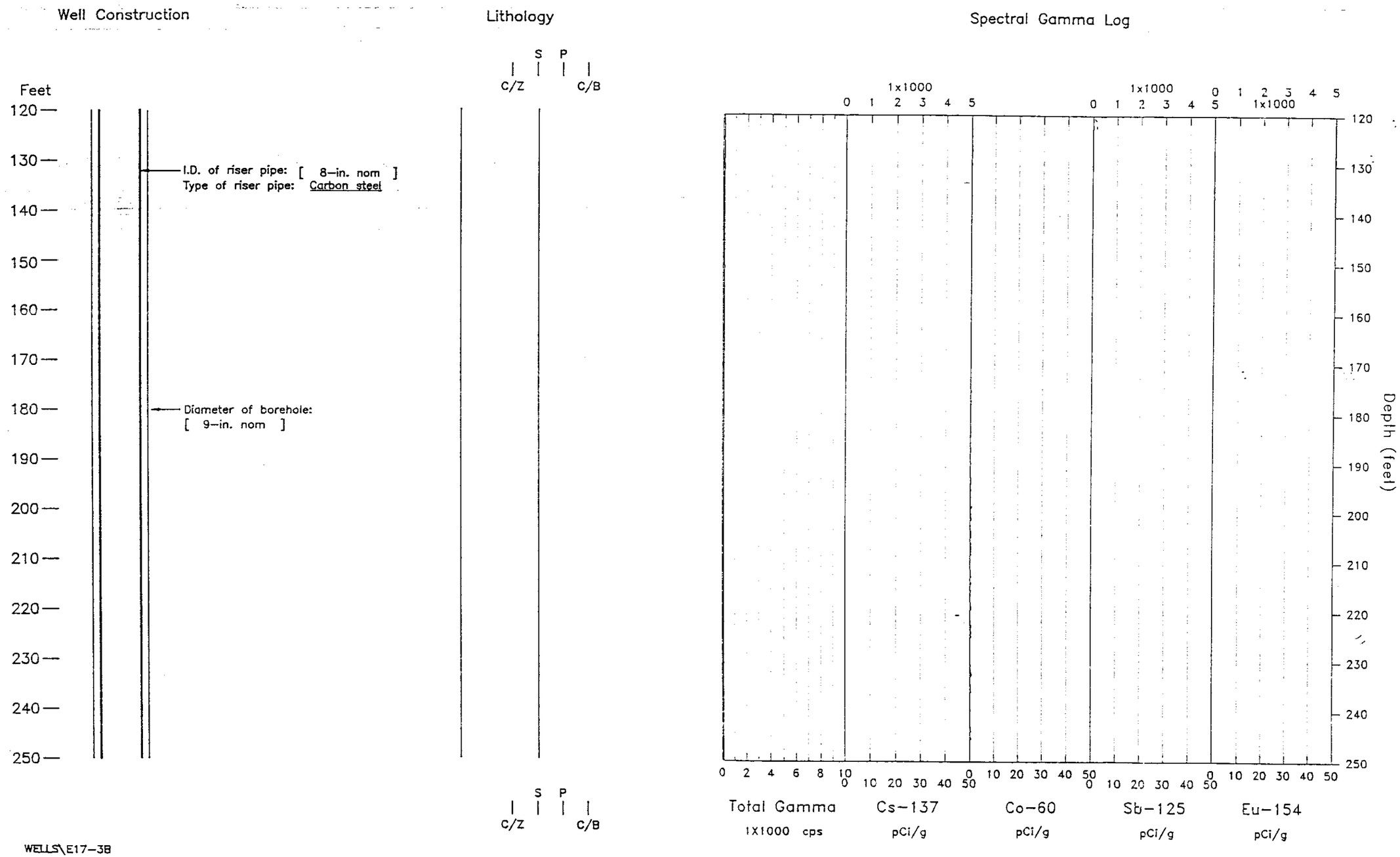
RLS Spectral Gamma Ray Borehole Survey

Well 299-E17-3 | Crib 216-A-27 | Log Date 9/1/92



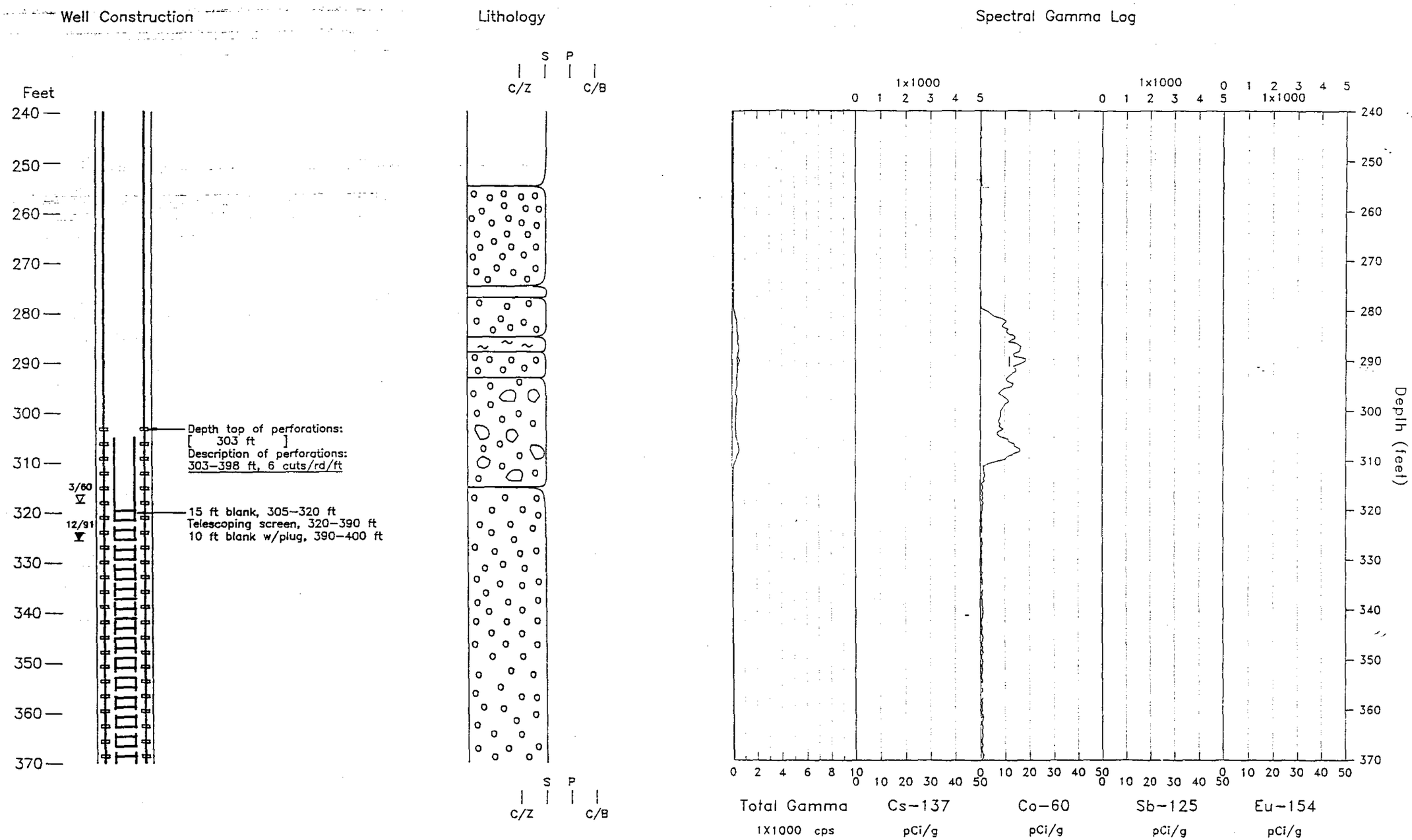
RLS Spectral Gamma Ray Borehole Survey (Page 2)

Well 299-E17-3 | Crib 216-A-27 | Log Date 9/1/92



RLS Spectral Gamma Ray Borehole Survey (Page 3)

Well 299-E17-3 | Crib 216-A-27 | Log Date 9/1/92



WELLS\E17-3C

RLS Borehole Survey Report

299-E17-3 216-A-27 Crib

Casing	Depth: 400 ft	Size: 8 in	Thickness: 0.27 in
Water	Depth: 312 ft		
Survey	Depth: 0 - 56 ft	Mode: Fixed 0.6 fpm	Date: 7/27/92
	50 - 192 ft	Mode: MSA 35 sec	(Winch malfunction)
	190 - 361 ft	Mode: MSA 35 sec	Date: 7/28/92
	0 - 50 ft	Mode: MSA 35 sec	Date: 7/29/92
	360 - 397 ft	Mode: MSA 35 sec	Date: 7/29/92

General Notes:
Limited borehole access time and extended borehole depth required more than one day for screening survey of borehole.

The cable winch malfunction in the FIXED velocity logging mode on 7/27/92 forced the survey to continue in the Move-Stop-Acquire (MSA) logging mode. Time availability on 7/29/92 permitted the interval from 0 feet to 50 feet to be surveyed in the MSA logging mode for uniformity. Both data sets are plotted. There were no manmade radionuclided identified in this interval and the total gamma curve appears as one line.

Detector depth was checked every 50 feet to 300 feet with at steel tape. The tool depth was not adjusted. The logging cable was failing. The maximum depth error is 1.8% on 7/29/92 (ie. 4.44 ft at 250 ft).

The stationary measurement acquired at 290 feet may have actually been acquired at 293 feet due to the progressive and nonuniform failure of the logging cable. The logging cable has been replaced with one of better design.

Man-made Radionuclides:
No Cesium (Cs-137) was encountered in the borehole survey. The plot track is present only for uniformity of the displayed data.

Cobalt (Co-60) was encountered in the borehole survey from 85 feet to the maximum survey depth of 397 feet. The maximum cobalt decay activity detected was 20 pCi/g at 290.

Antimony (Sb-125) was encountered in the borehole survey from 84 feet to 125 feet. The antimony decay activity detected was less than 6 pCi/g.

No Europium-154 (Eu-154) was encountered in the borehole survey. The plot track is present only for uniformity of the displayed data.

299-E17-3

Westinghouse Hanford Company — LOG HEADER — Page 1 of 2

Well No. 299-E17-3 Area 200 East Date 8/4/92
Log Run #1 Log Type Gross Gamma
Elevation Datum Top of Casing Elevation 715.47
Survey Coordinates N 77066 W 49740
Log Measures From Ground Surface
Location Description A-77 Crib
Ground Surface Elevation
Surface Temperature N/A Weather Partly Cloudy - Warm

BOREHOLE INFORMATION

Driller
Drill Rig Type | Bit Type/Diameter
Borehole Diameter/Depth 8"/400'
Depth Driller 400' | Depth Logger 402.1'
Liquid Level 312' | Liquid Type Clean
Temperature N/A

CASING RECORD

Type 5" Carbon Steel Sch 40 | Interval +0.6 - 400'
Type | Interval
Type | Interval
Type | Interval
Well Screen Interval Perforated 310' - 400'
Comments: Drop in Frame +0.15' high
Centralizer used

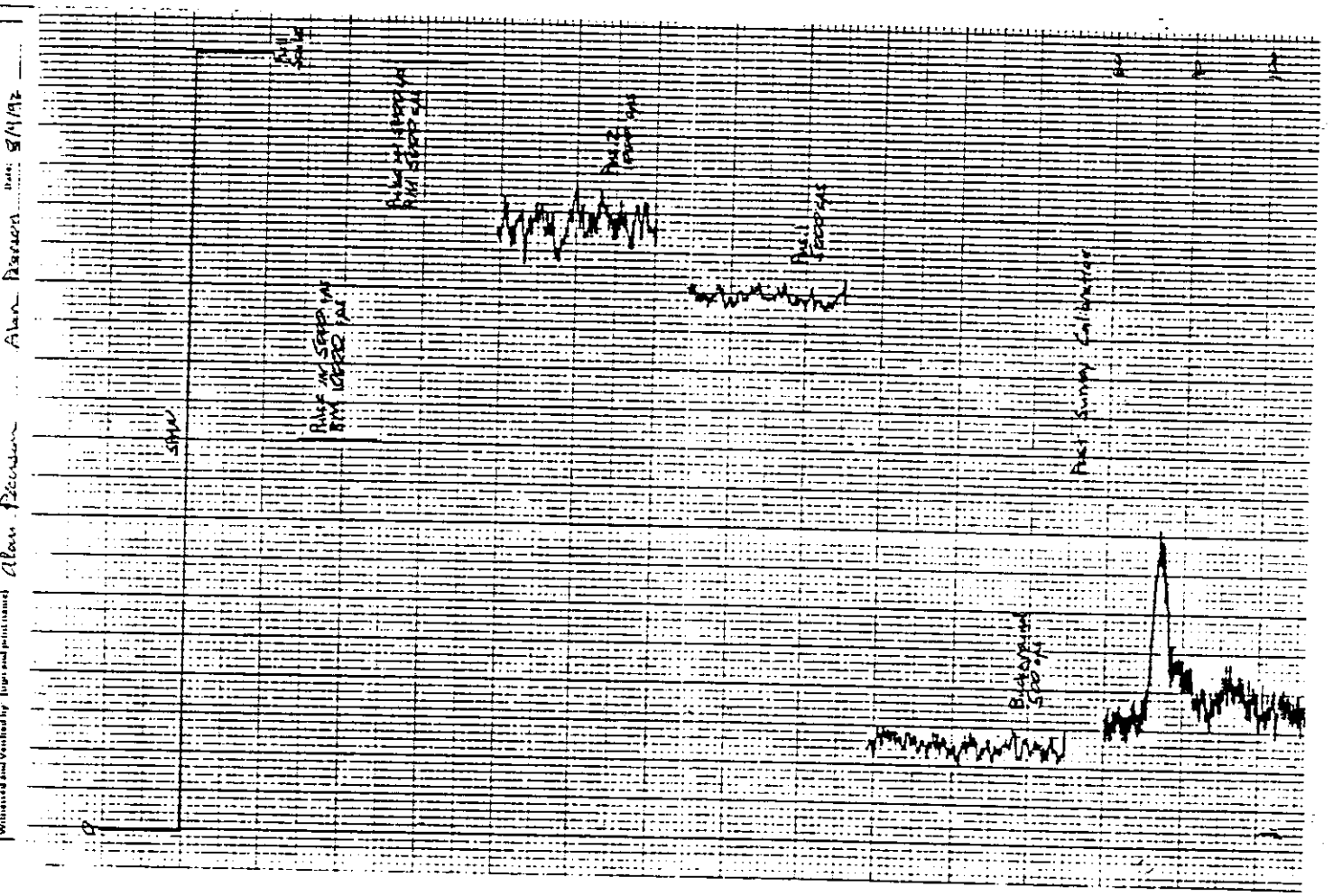
LOG HEADER — Page 2 of 2

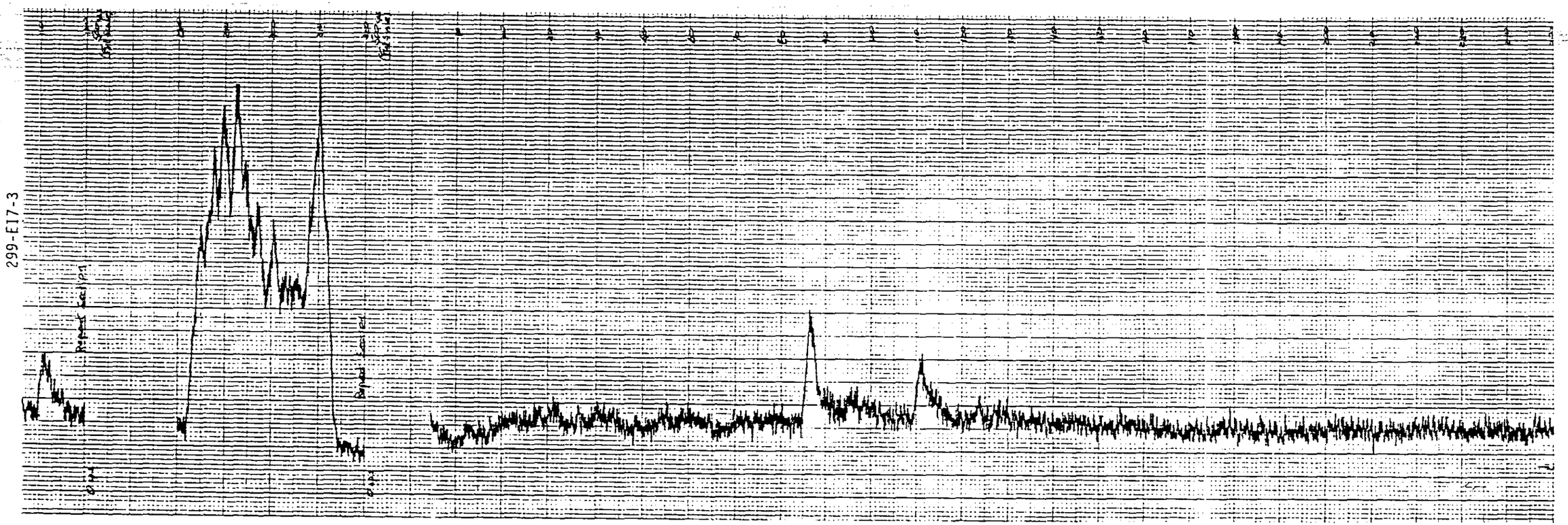
EQUIPMENT DATA

Logging Company PNL
Operator(s) Alan Pearson
Equipment Brand EMS
Tool Type Gamma Ray
Date Calibration Date 5/92
Calibration Factor(s) 1.0 x 1000 Calibration Interval
Grad Date 12-3-91
Log Entered From 402.1' to 200.0'
Run(s) 1 to 200.0'
Pre Survey Verification: Position 1 3.12 cell
Gain Calibration Differences: Position 1 .09 cell
Logging Speed 5 ft/min
Start Time 0632
Chart Speed(s), Date 10 in/hr
Chart Recorder Horizontal Scale 50 cps/in
Post Survey Verification: Position 1 3.29 cell
Percent Change: Position 1 1.4%
Comments: Drops times +0.15' high
Centralizer used

Equipment Type Analog
Tool No. GGD7N11
Calibration Reference DOE-RL-88-30 IK-4012
Position 1 315.1 cell Position 2 65.1 cell
Weather/Sky Cond. 75 deg
LOGGING HISTORY (DO NOT EDIT)
From 4.5' to 200.0' Background 65 cps
Position 1 6.67 cell Position 2 1.12 cell
Recorder Scale (Full) 50 cps/in
Completion Time 0930
Tool Constant(s) 1.0:1
Position 1 6.62 cell Position 2 1.02
Background 63 cps

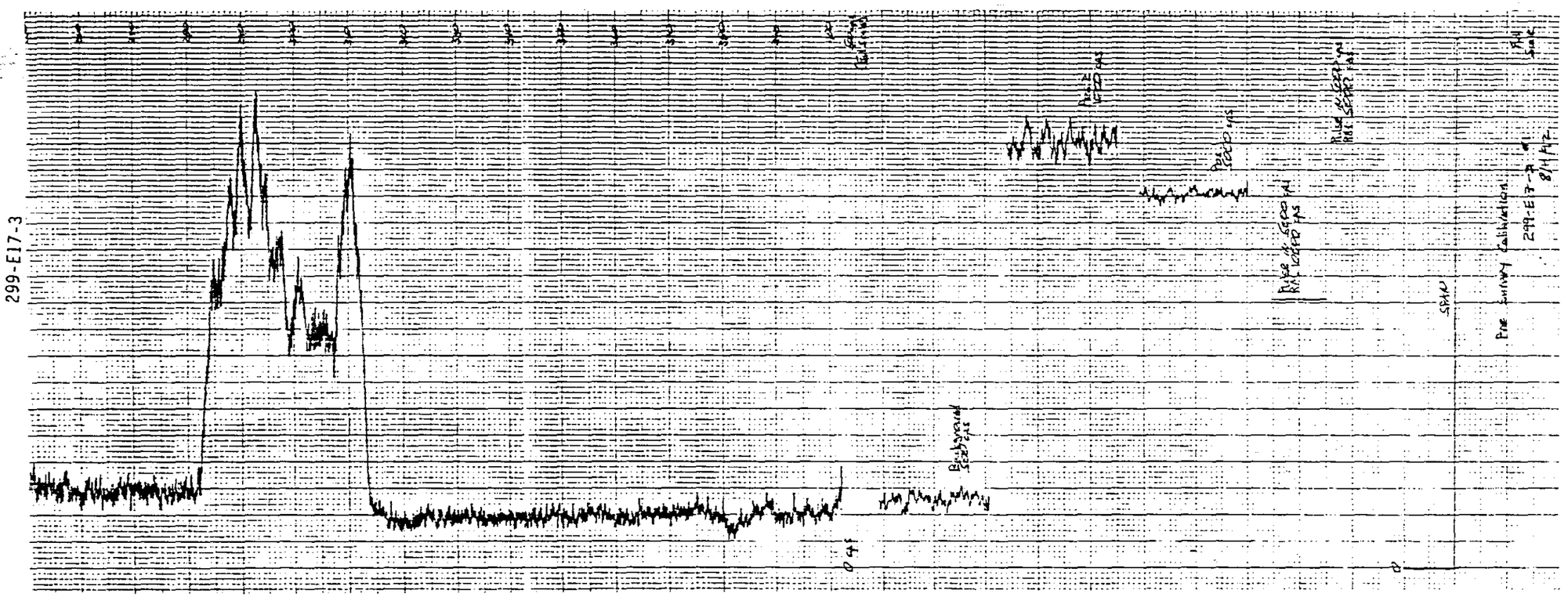
Witnessed and Verified by (Logs and print issued) Alan Pearson Date 8/4/92





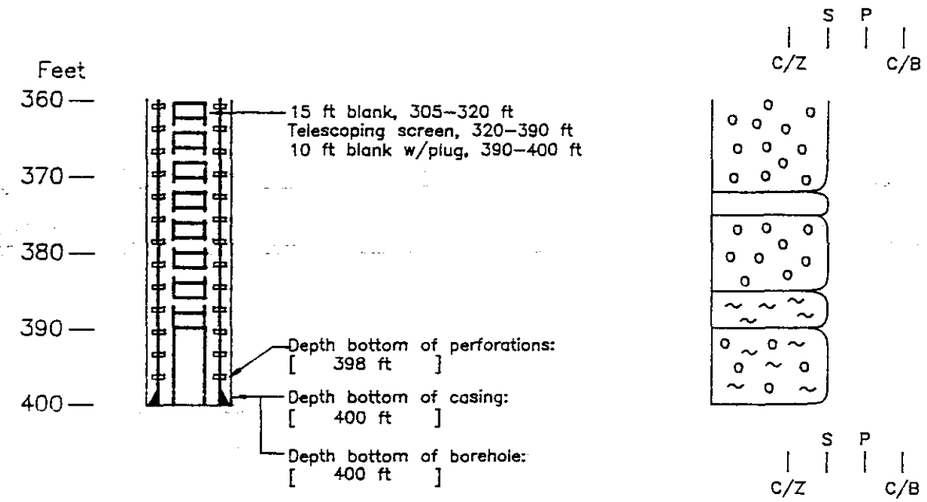
299-E17-3

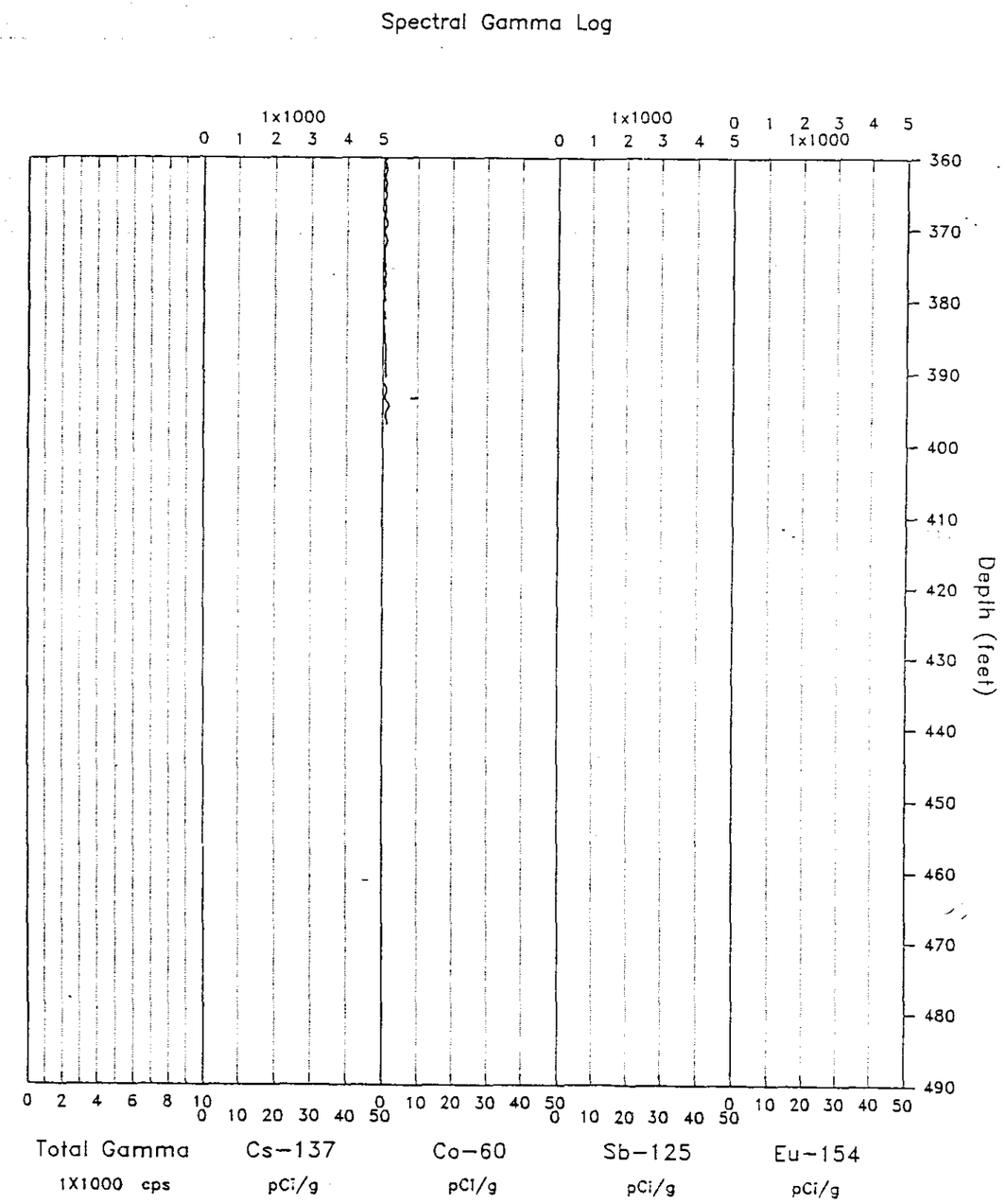
299-E17-3



RLS Spectral Gamma Ray Borehole Survey (Page 4)

Well 299-E17-3 | Crib 216-A-27 | Log Date 9/1/92





WELLS\E17-3D

Crib Designation: 216-A-30

Type of Facility: 1400 ft by 10 ft gravel filled crib

Location: N 39150 to N 39735, W 44990 to W 46260, Just east of the 200 east area perimeter fence

Service Dates: Started receiving waste on 1/61, currently listed as active

Description of Waste:

Radionuclide Release Summary:

As of 12/31/89

Radionuclide	Quantity
Am-241	0.198 Ci
Cs-137	117 Ci
H-3	16.4 Ci
Pm-147	0.429 Ci
Pu-239	751. Ci
Ru-106	0.081 Ci
Sn-113	0.003 Ci
Sr-90	102 Ci
Pu	73.1 g
U	0.10 Ci

Summary of Past Logging:

Boreholes	Date	Reference
299-E16-2	1976	Fecht, et al., 1977
	1982	Geophysics files
299-E25-11	1976	Fecht, et al., 1977
	1980	Geophysics files
	1982	"
299-E25-12	1976	Fecht, et al., 1977
	1982	Geophysics files
299-E25-191	1982	"

Review of Current Logging:

Borehole: 299-E25-191

This borehole was logged with the PNL gross gamma and the RLS spectral gamma systems. The spectra recorded in this borehole were heavily influenced by bremsstrahlung radiation caused by a high flux of beta particle radiation from Sr-90. This borehole is only 50 feet deep but it is clear that Sr-90 is present throughout the borehole below 10 feet.

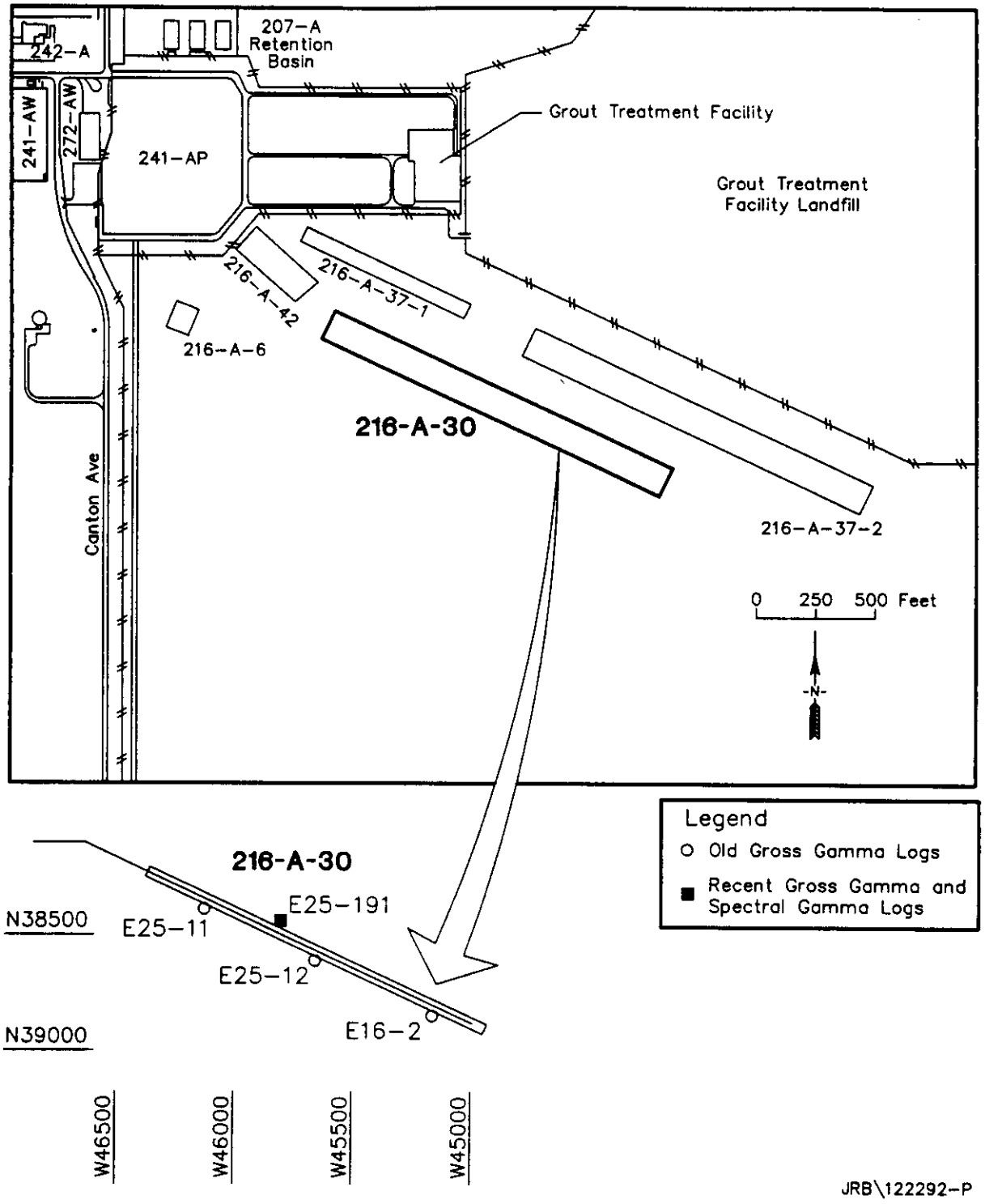
The 662 keV peak from Cs-137 was identified only in one region of the borehole at about 12 feet. The reported concentration is no doubt inaccurate due to the unknown effects of the high bremsstrahlung radiation and the unknown effects of the grout surrounding the casing.

The latest gross gamma-ray log provides good spatial definition of the gamma-ray peaks but the old log from this borehole does not have good spatial definition and a comparison

of the peak shapes is not possible.

There is no elevated activity shown in any of older gross gamma-ray logs except for the one older log from E25-191. It is likely that there is no contamination in these areas of the crib.

Because borehole E25-191 is very shallow, there is no way to determine if the nuclides released at this site have reached the groundwater or even the lower portions of the unsaturated zone.


207-A
Retention
Basin
242-A
241-AW
272-AW
241-AP
Grout Treatment Facility
Grout Treatment
Facility Landfill
216-A-42
216-A-37-1
216-A-6
216-A-30
216-A-37-2
Canton Ave
0 250 500 Feet
-N-
Legend
Old Gross Gamma Logs
Recent Gross Gamma and
Spectral Gamma Logs
216-A-30
N38500
E25-191
E25-11
E25-12
E16-2
N39000
W46500
W46000
W45500
W45000
JRB\122292-P

Westinghouse Hanford Company
RLS Spectral Gamma-Ray Borehole Survey Log Header

Project: 200 East AAMS 216-A-30 Crib

Borehole	299-E25-191		
Coordinates	39,700 N 45,775 W	Feet	(Plant 200 E)
Elevation	. feet	Top of Casing	(Plant 200 E)

Borehole Environment Information

Borehole Fluid Depth none (Feet) from Zero (0.0) Depth Reference of Log

Casing Size I.D. (inch)	Casing Thickness (inch)	Top Depth (feet)	Base Depth (feet)
8	0.32	0.0	48.3

RLS Passive Spectral Gamma Survey Information

Logging Engineers R. V. Cram S. E. Kos
Log Depth Reference at Zero (0.0) depth is Ground Level

Log Date	Archive File Names	Log Mode[1], Speed	Depth Interval (feet) Top	Base	Incr
July 31, 92	H2E25191\A218	MSA 35 sec LT	0.	48.	0.5

[1] MSA: Move-Stop-Acquire LT: Live time

Calibration and Analysis Information

RLS Calibration Date: Nov 21, 1991
Calibration Report: WHC-SD-EN-TRP-001

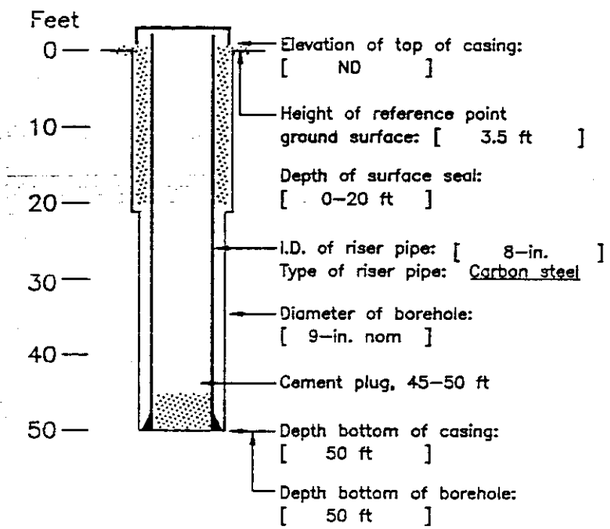
Analyst Names: G. K. Jaeger R. K. Price
Analysis Date: Sep 1, 1992

Analysis Notes: High gamma activity from 11 to 41 ft may indicate Sr-90
Radionuclides identified: Cs-137

RLS Spectral Gamma Ray Borehole Survey

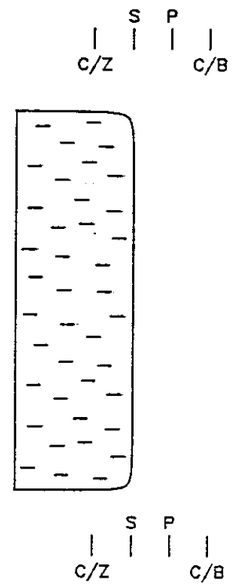
Well 299-E25-191 | Crib 216-A-30 | Log Date 7/31/92

Well Construction

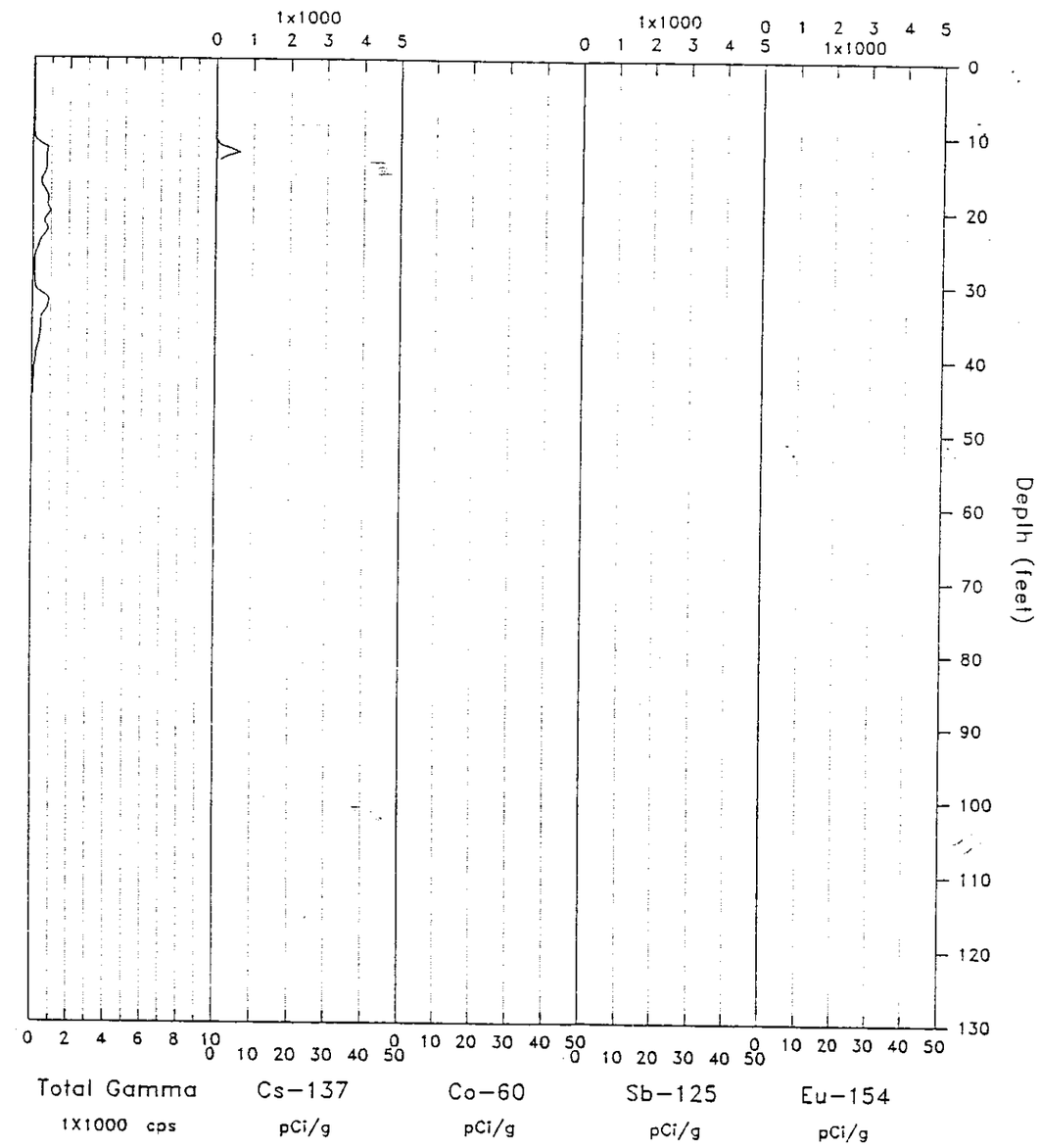


Type of surface seal:
Cement grout between 8-in casing and 11-in nominal hole as 10-in surface casing to 20-ft was pulled back. Collar was also poured

Lithology



Spectral Gamma Log



WELLS\E25-191A

RLS Borehole Survey Report

299-E25-191 216-A-30 Crib

Casing	Depth: 48.3 ft	Size: 8 in	Thickness: 0.32 in
Water	Depth: none		
Survey	Depth: 0 - 48 ft	Mode: MSA 35 sec	Date: 7/31/92

General Notes:
This survey has a high gamma activity with no photo peaks from 11 feet to 42 feet. The spectra shows an elevated gamma activity in the lower energy range less than 300 keV. This may indicate the presence of strontium-90 (Sr-90) in the formation.

Man-made Radionuclides:
Cesium (Cs-137) was encountered in the borehole survey from 11 feet to 14 feet. The cesium decay activity detected was less than 7 pCi/g.

No Cobalt (Co-60) was encountered in the borehole survey. The plot track is present only for uniformity of the displayed data.

No Antimony (Sb-125) was encountered in the borehole survey. The plot track is present only for uniformity of the displayed data.

No Europium-154 (Eu-154) was encountered in the borehole survey. The plot track is present only for uniformity of the displayed data.

299-E25-191

Westinghouse Hanford Company | LOG HEADER | Page 1 of 2

Well No. 299-E25-191 Area 200 East Date 8/19/92
Log Run #1 Log Type Gross Gamma
Elevation Datum ____ Elevation ____
Survey Coordinates N: 73514 W: 45400
Log Measured from Ground Surface
Location Orientation 2-30 Crib
Ground Surface Elevation ____
Surface Temperature N/A Weather Clear - Hot

BOREHOLE INFORMATION

Driller ____
Drill Rig Type ____ Bit From/Diameter ____
Borehole Diameter/Depth 8"/49'
Depth Driller 49' Depth Logger 49'
Liquid Level N/A (none) Liquid Density N/A
Temperature N/A

CASING RECORD

Type 8" Carbon Steel Sch 40 Interval -13' - 49'
Type ____ Interval ____
Type ____ Interval ____
Type ____ Interval ____
Well Screen Interval N/A
Comments: Grade Stake = +0.2' high
Centralizer used

LOG HEADER | Page 1 of 2

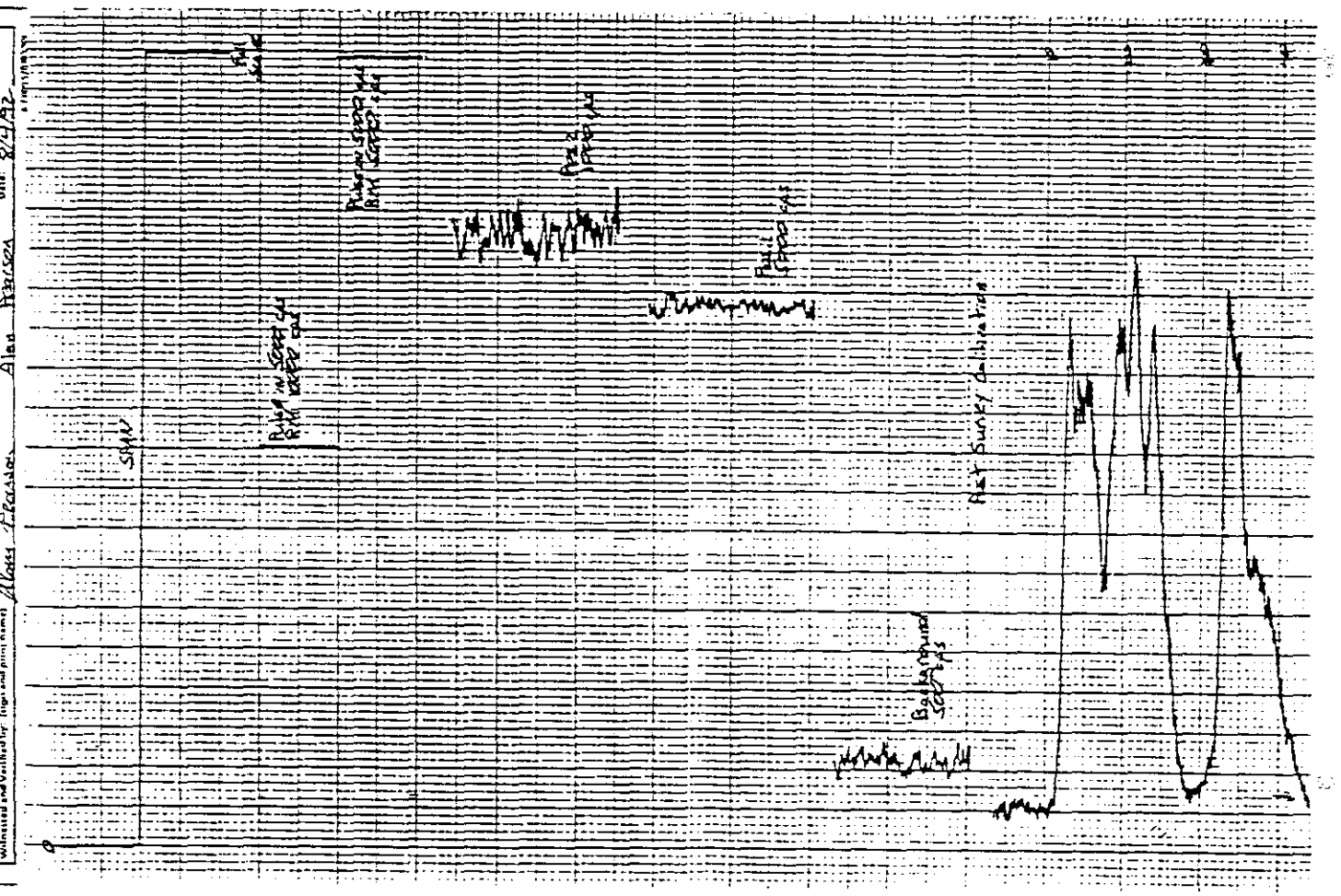
EQUIPMENT DATA

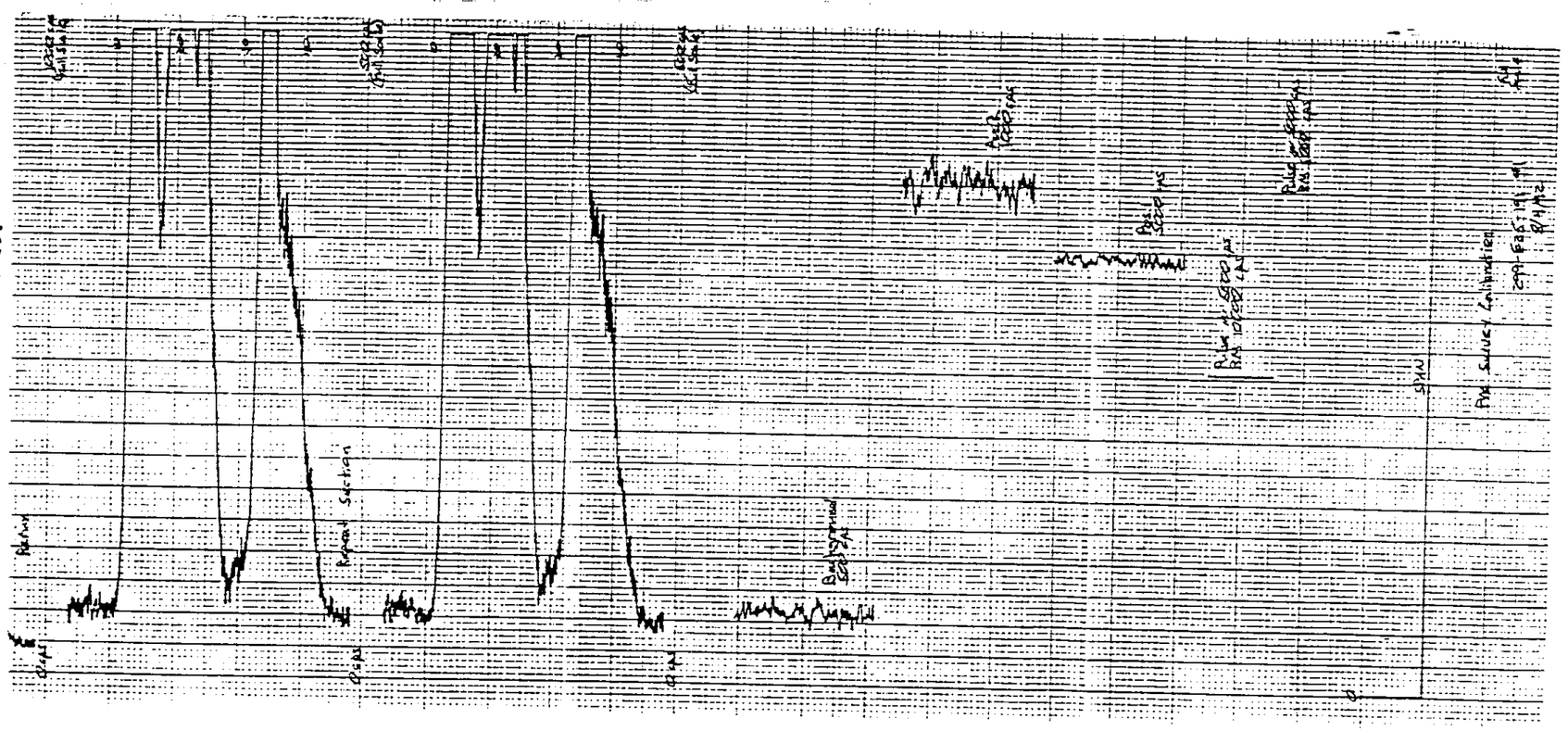
Logging Company PNL
Operator(s) Alan Benson
Equipment Brand NMS
Tool Type Gamma Ray
Base Calibration Date 5/92
Calibration Reference 299-E25-191 Position 1 65.1 cts
Calibration Reference 299-E25-191 Position 2 15 cts
Dead Time 12.3 nsec
Wave Shaping Time 2 μsec
Detector Type Analog
Serial No. CG27MI
Calibration Reference NH-GRSC-KC-KC16 Position 1 65.1 cts
Position 2 15 cts
Background 58 cps
Background 55 cps
Background 50 cps/in
Background 1200
Background 65 cps
Background 29 cps

LOGGING INFORMATION

Log Interval from 48' to 3.4' @ 500 fpm
Remarks 48' to 3.4' @ 500 fpm
Pre Survey Verification: Position 1 48' to 3.4' @ 500 fpm
Base Calibration Differences: Position 1 3057 cts
Logging Speed 9.1 cts
Chart Time 1037
Chart Speed(s), Min 10 cm/m
Chart Recorder Instrument Scale, CPS/in 50 cps/in
Post Survey Verification: Position 1 3060 cts
Percent Changes: Position 1 0.1%
Comments: Grade Stake = +0.2' high
Centralizer used

Witnessed and Verified by: (Sign and print name) Alan Benson Date: 8/19/92




Pulse Section
Bolt System
5MV
PM Survey Calibration
2791 FASTIN #1
8/14/92

Crib Designation: 216-A-36 A & B

Type of Facility: A double crib, A-36A is a 100 ft x 11 ft gravel crib, A-36B is a 500 ft x 11 ft gravel crib, a concrete dam separates the two

Location: N 38500 to N 39105, W48525

Service Dates: A-36A 9/65 to 3/66, A-36B 3/66 to 1972

Description of Waste: Ammonia scrubber waste from Purex, low-salt, neutral to basic, A-36A 1.07 x 10^6 liters, A-36B 94. x 10^6 liters

Radionuclide Release Summary:

Crib 216-A-36A

Radionuclide	Quantity
Pu	80 g
Sr-90	1800 Ci
Ru-106	3000 Ci
Cs-137	1500 Ci
Co-60	10 Ci
U	145 kg

Crib 216-A-36B

Radionuclide	Quantity
Pu	<180 g
Sr-90	550 Ci
Ru-106	6500 Ci
Cs-137	<560 Ci
Co-60	<51 Ci
U	120 kg

Summary of Past Logging:

Boreholes	Date	Reference
299-E17-4	1976	Fecht, et al., 1977
	1982	Geophysics files
	1984	"
	1987	"
299-E17-5	1976	Fecht, et al., 1977
	1982	Geophysics files
299-E17-7	1976	Fecht, et al., 1977
	1984	Geophysics files
	1987	"
299-E17-9		

Review of Current Logging:

Borehole: 299-E17-4, 299-E17-9

Borehole 299-E17-4 was logged with the PNL gross gamma logging system while 299-E17-9 was logged with the RLS spectral

gamma system.

The spectral gamma-ray log shows a very high concentration zone of Cs-137 from 30 feet to about 50 feet. Cesium is also found in low concentrations at 270 feet and at 300 feet which is just above the groundwater.

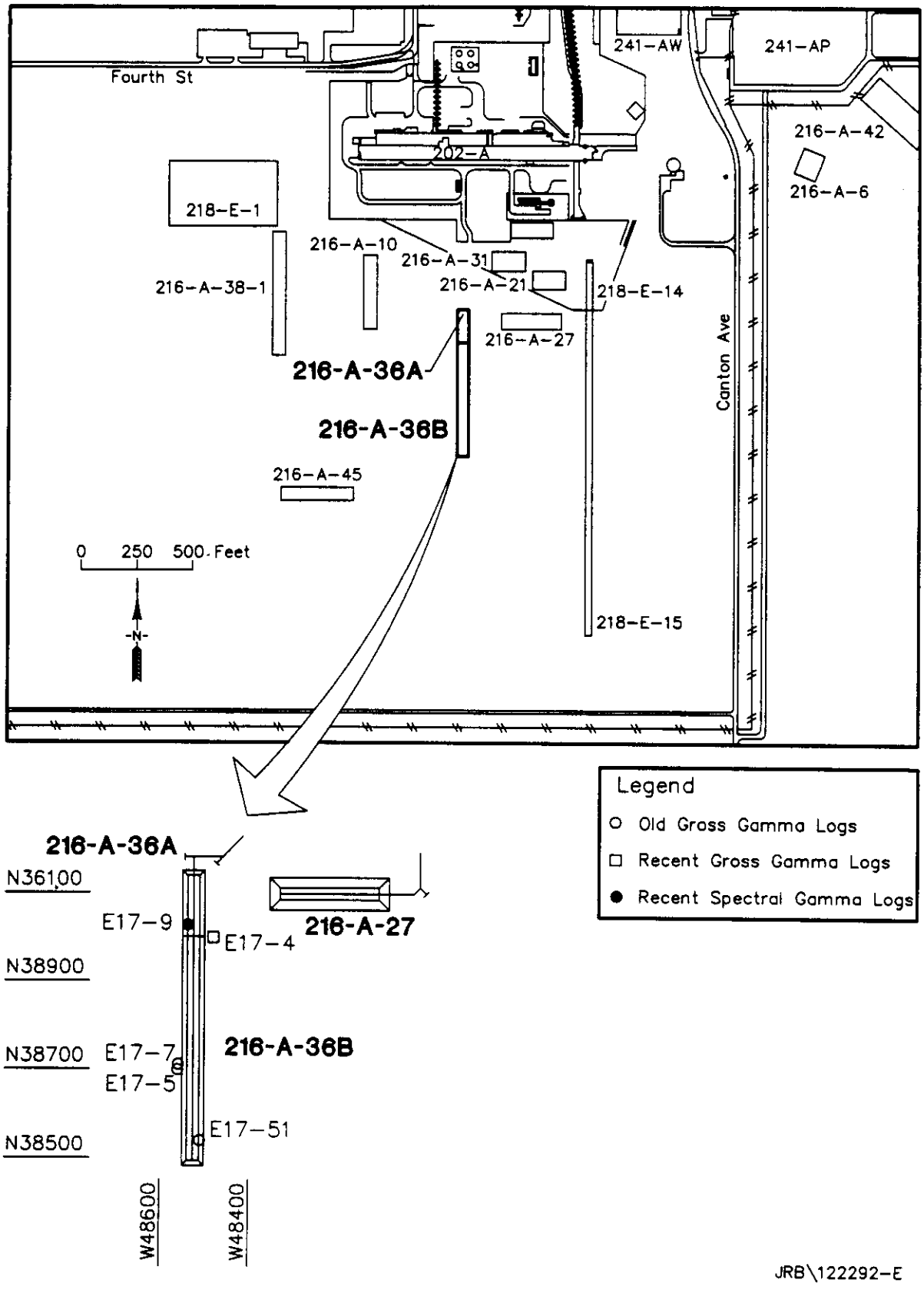
Co-60 is found in varying concentrations throughout the borehole and Sb-125 is found at the depth of the highest concentrations of cobalt.

It is certain that man-made radionuclides release from this site have migrated to the groundwater. The data provide clear evidence of at least cesium and cobalt reaching the groundwater.

The gross gamma log from E17-4 shows two principal zones of contamination, one from 75 feet to about 105 feet and another from 280 feet to about 315 feet. The contamination zones cannot be correlated with those from E17-9 so that it is not possible to relate the peaks to specific radionuclides.

This borehole probably has low concentrations of cesium and cobalt at other depths, but they do not show up in the gross gamma log.

The shapes of the peaks from the recent gross gamma log are similar to the peak shapes from the older logs indicating suggesting that the site is stable. However, it would be very useful to have spectral gamma data to assess the situation at this site.


Fourth St
241-AW
241-AP
216-A-42
216-A-6
202-A
218-E-1
216-A-10
216-A-31
216-A-21
218-E-14
216-A-38-1
216-A-27
216-A-36A
216-A-36B
Canton Ave
216-A-45
0 250 500 Feet
-N-
218-E-15
Legend
Old Gross Gamma Logs
Recent Gross Gamma Logs
Recent Spectral Gamma Logs
216-A-36A
N36100
E17-9
E17-4
216-A-27
N38900
N38700
E17-7
E17-5
216-A-36B
E17-51
N38500
W48600
W48400
JRB\122292-E

Westinghouse Hanford Company
RLS Spectral Gamma-Ray Borehole Survey Log Header

Project: 200 East AAMS Purex, 216-A-36 Crib

Borehole	299-E17-9		
Coordinates	39,027 N	48,538 W	Feet (Plant 200 E)
Elevation	717.64 feet		Top of Casing (Plant 200 E)

Borehole Environment Information

Borehole Fluid Depth 315.75 (Feet) from Zero (0.0) Depth Reference of Log

Casing Size I.D. (inch)	Casing Thickness (inch)	Top Depth (feet)	Base Depth (feet)
6	0.36	0	320
4	0.24	0	305

RLS Passive Spectral Gamma Survey Information

Logging Engineers R. V. Cram S. E. Kos
Log Depth Reference at Zero (0.0) depth is Ground Level

Log Date	Archive File Names	Log Mode, Speed	Depth Interval (feet) Top	Base	Incr
Aug 26, 92	H2E1709\A230	MSA 35sec LT	0.0	31.0	0.5
	GI & no lead	MSA 75sec RT	31.5	47.0	0.5
	Std config.	MSA 35sec LT	47.5	169.0	0.5
Aug 27, 92	H2E1709\A231	MSA 35sec LT	167.0	299.5	0.5

[1] MSA: Move-Stop-Acquire Lt: Live Time Rt: Real Time

Calibration and Analysis Information

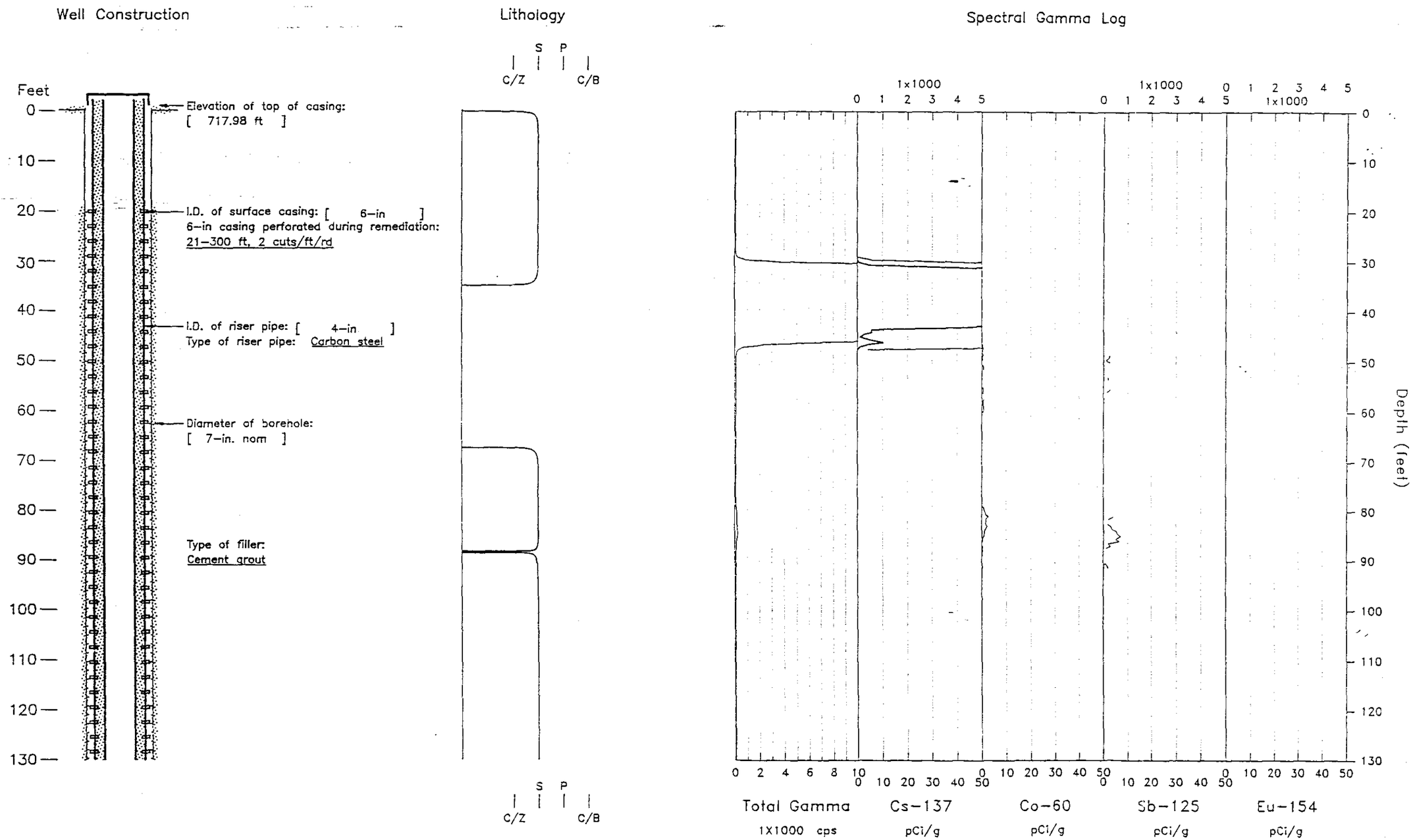
RLS Calibration Date: Nov 21, 1991
Calibration Report: WHC-SD-EN-TRP-001

Analyst Names: J. P. Kiesler _____
Analysis Date: Sept 17, 1992

Analysis Notes: High activity 31.5-47 ft surveyed in GI configuration
Radionuclides identified: Cs-137, Co-60, Sb-125

RLS Spectral Gamma Ray Borehole Survey

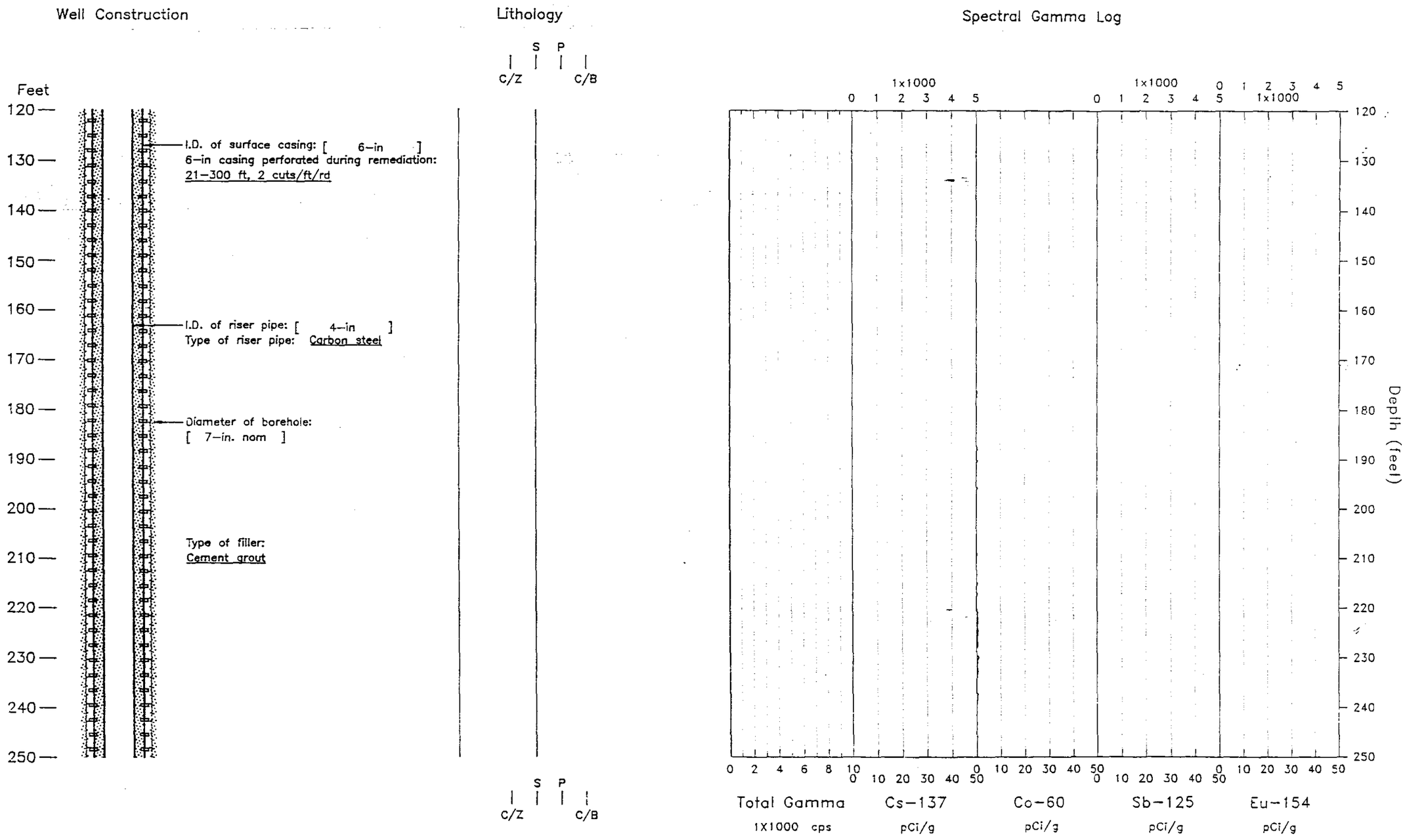
Well 299-E17-9 | Crib 216-A-36 | Log Date 8/26/92



WELLS\E17-9A

RLS Spectral Gamma Ray Borehole Survey (Page 2)

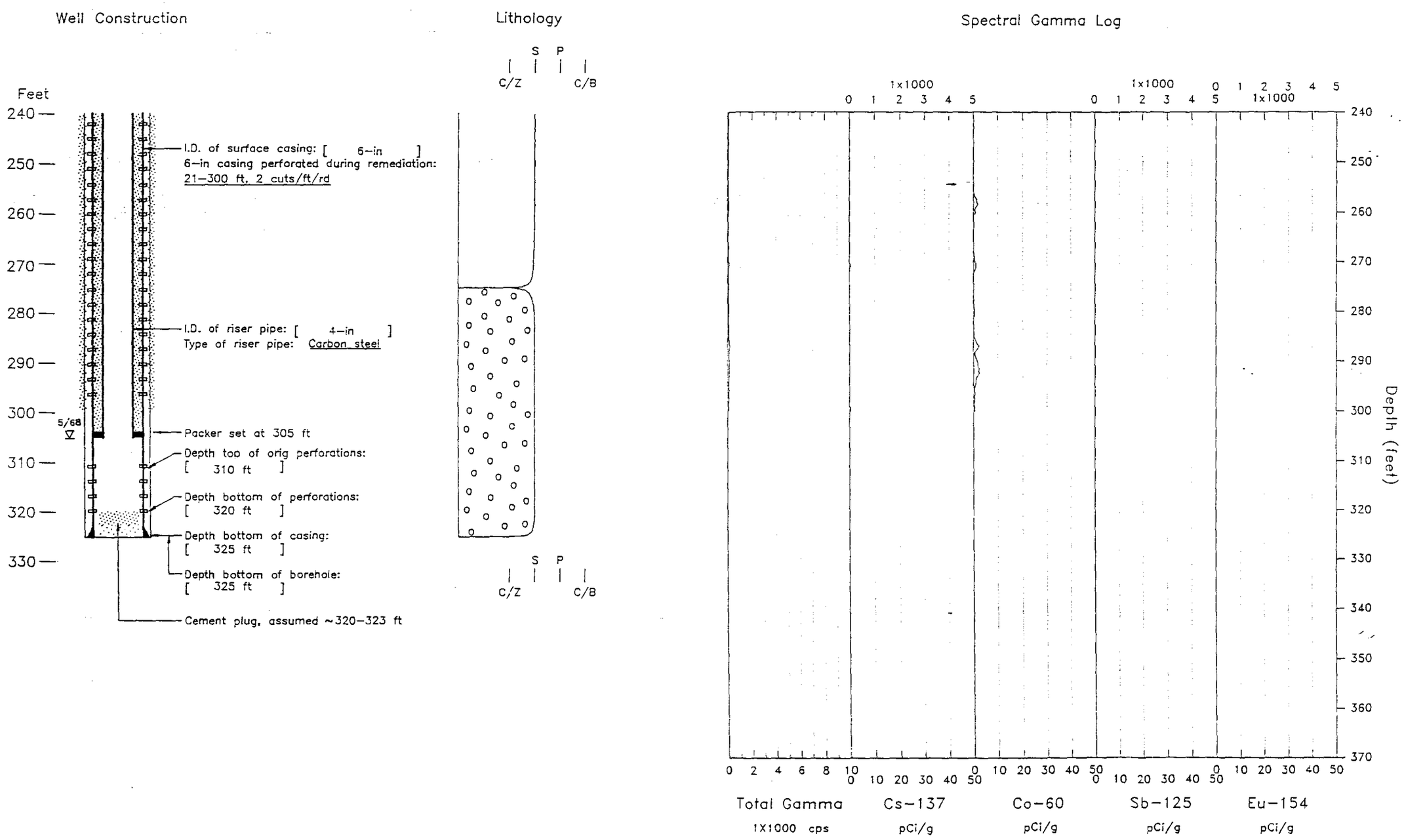
Well 299-E17-9 | Crib 216-A-36 | Log Date 8/26/92



WELLS\E17-9B

RLS Spectral Gamma Ray Borehole Survey (Page 3)

Well 299-E17-9 | Crib 216-A-36 | Log Date 8/26/92



WELLS\E17-9C

RLS Borehole Survey Report

299-E17-9 216-A-36 Crib

Casing	Depth: 320 ft	Size: 6 in	Thickness: 0.36 in
	Depth: 305 ft	Size: 4 in	Thickness: 0.24 in
Water	Depth: 315.75 ft		
Survey	Depth: 0 - 31 ft	Mode: MSA 35 sec	Date: 8/26/92
	31.5- 47 ft	Mode: MSA 75 sec	(GI no lead sheild)
	47.5- 169 ft	Mode: MSA 35 sec	(standard config.)
	167 - 299 ft	Mode: MSA 35 sec	Date: 8/27/92

General Notes:
Limited borehole access time and extended borehole depth required more than one day for screening survey.

High gamma activity potentially threatened saturation of the counting system standard configuration. The depth interval from 31.5 feet to 47 feet was surveyed in the Gated Integrator (GI) mode. The borehole size prevented use of the lead shield.

The maximum calibrated casing correction of 0.40 inches was applied to the survey data. The computed activity for data recorded through multiple casing strings will be underestimated.

Detector depth was checked and adjusted every 50 feet to 300 feet with at steel tape. The maximum depth error is 0.7% on 8/26/92 (ie. 0.37 ft from 100 feet to 150 feet).

Man-made Radionuclides:
Cesium (Cs-137) was encountered in the borehole survey from 29 feet to 61 feet. The cesium decay activity exceeded 200 pCi/g from 30 feet to 47 feet. The decay activity exceeded 5000 pCi/g from 31 feet to 39 feet.

Cobalt (Co-60) was encountered in the borehole survey from 46 feet to 92 feet and from 167 feet to the maximum survey depth of 300 feet. The cobalt decay activity detected was less than 3 pCi/g.

Antimony (Sb-125) was encountered in the borehole survey from 47 feet to 92 feet. The antimony decay activity detected was less than 7 pCi/g.

No Europium-154 (Eu-154) was encountered in the borehole survey. The plot track is present only for uniformity of the displayed data.

299-E17-4

Westinghouse Hanford Company | LOG HEADER | Page 1 of 2

Well No. 299-E17-4 Area 200 East Date 8/5/92
Log Run #1 Log Type Gross Gamma
Elevation Datum Top of Casing Elevation 217.05
Survey Coordinates N 73999 E 109950
Log Measured From Ground Surface
Location Description 2-36 Crib South of Pipe
Ground Surface Elevation
Surface Temperature N/A Weather Clear-Warm

BOREHOLE INFORMATION

Driller
Drill Rig Type | Bit Type/Diameter
Borehole Diameters/Depth 8"/398' 4"/393'
Depth Driller 398' | Depth Logger 380.1'
Liquid Level 312' (Grouted Well) | Liquid Density Clear
Temperature N/A

CASING RECORD

Type 8" Carbon Steel Sch 40 | Interval +18' -398'
Type 4" Carbon Steel Sch 40 | Interval +3.0' -393'
Type | Interval
Type | Interval
Well Screen Interval Perforated 298-398'
Comments: Casing Fingers +0.15' high
Centralizer used
Cement Grout between 8" & 4" Casings

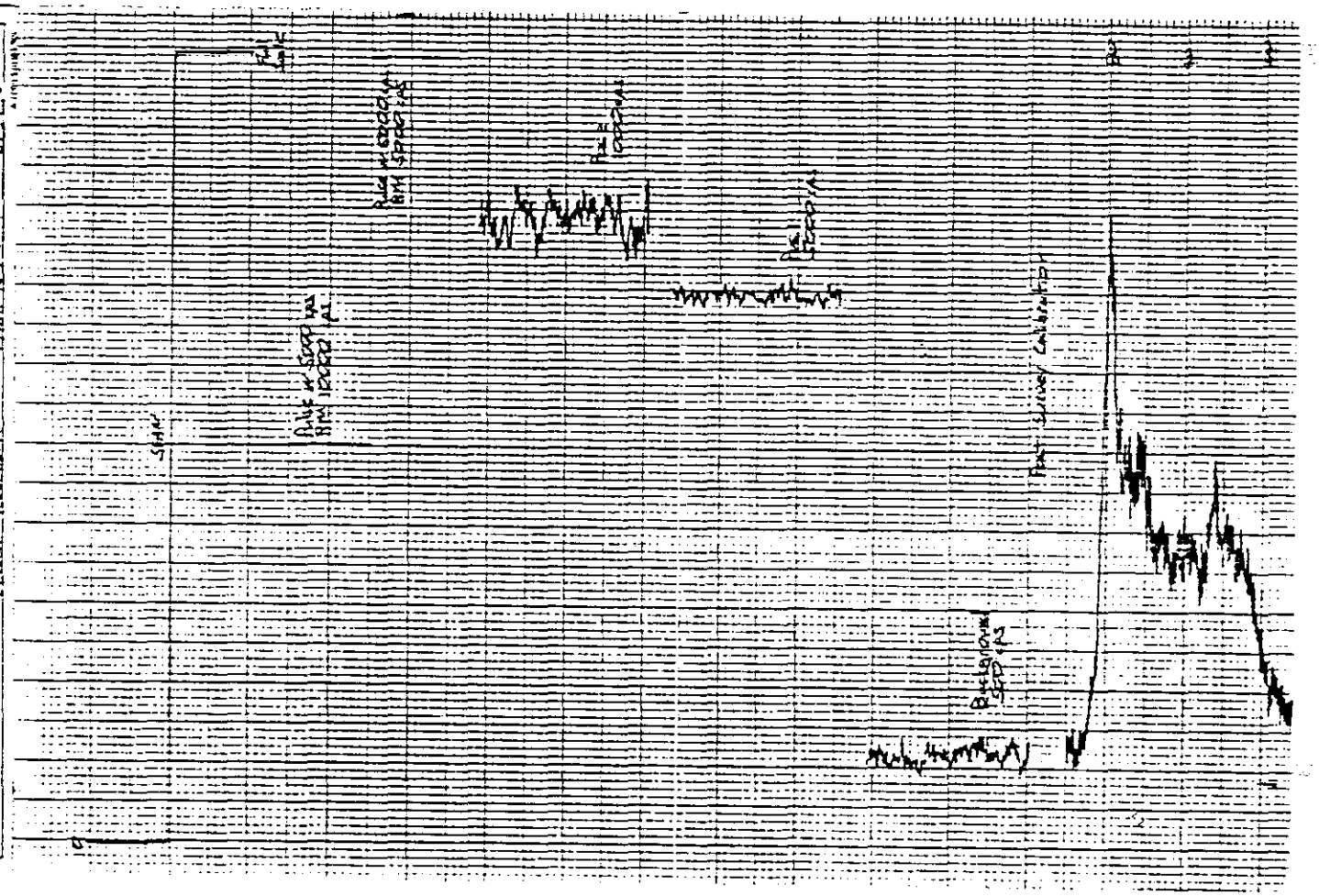
LOG HEADER

EQUIPMENT DATA

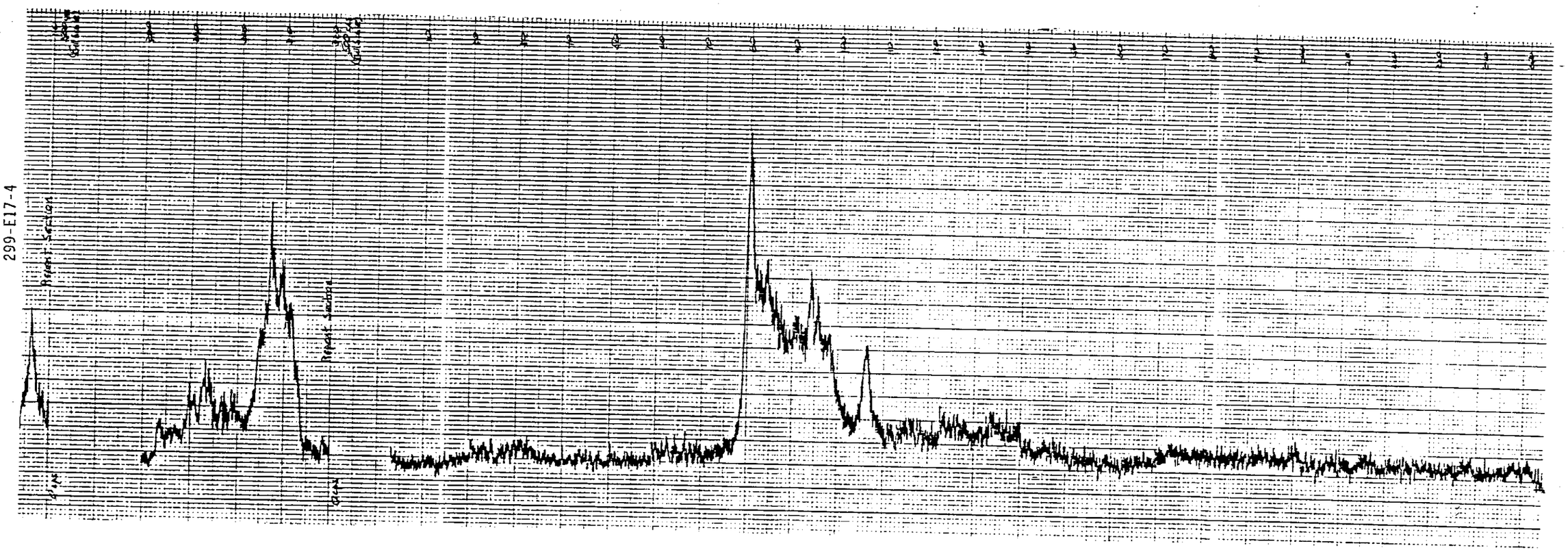
Logging Company PNL
Operator(s) Alan C. Pierson
Equipment Brand NIS
Tool Type Gamma Rat.
Base Calibration Date 5/92
Calibration Probe Factor 4.00 Mr/hr Calibration Datum (cf) 1.0
Used Time 12.3 hrs

LOGGING INFORMATION

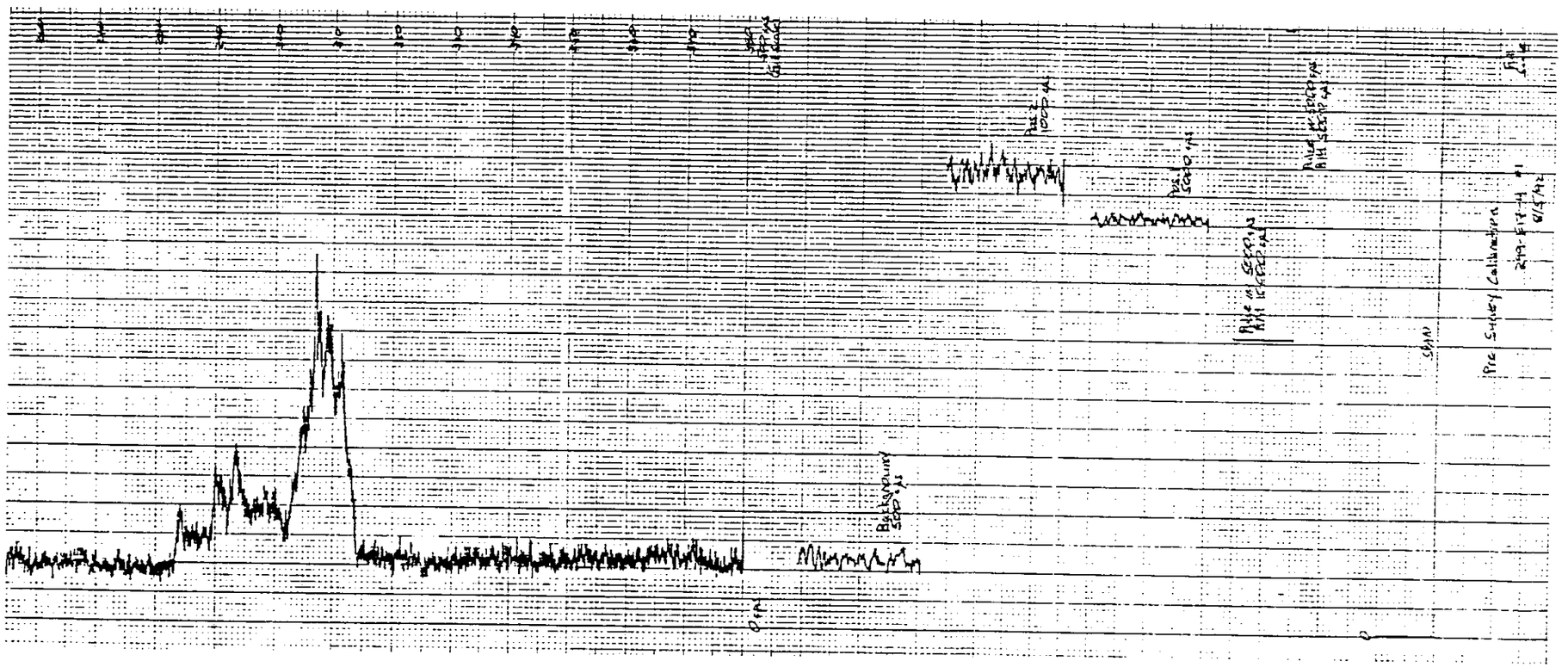
Log Interval from 3801 To 1'
Recorded 3800' to 2800' @ 50 ft/min ... 1100' to 750' @ 50 ft/min
Pre Survey Verification: Position 1 3169 cpm Position 2 65.8 cpm
Base Calibration Difference: Position 1 18 cpm Position 2 0.7 cpm
Logging Speed 5 ft/min
Start Time 0620
Chart Speed(s), Rate 10 ft/in
Chart Recorder Horizontal Scale, CPSec 50 cps/in
Post Survey Verification: Position 1 3023 cpm Position 2 66.5 cpm
Percent Change: Position 1 2.1% Position 2 1.1%
Comments Casing Fingers +0.15' high
Centralizer used
Witnessed and Verified by: (sign and print name) Alan Pierson Date 8/5/92



299-E17-4



299-E17-4



Crib Designation: 216-B-5

Type of Facility: Injection well

Location: N 43480, W 52855, North east of B-Plant, adjacent to Baltimore ave

Service Dates: 4/45 to 10/47

Description of Waste: Cell drainage from 224-B and other liquid waste via Tank 5-6 in 221-B building, low salt, neutral to basic

Radionuclide Release Summary:

As of 12/31/89	Radionuclide	Quantity
	Cs-137	29.2 Ci
	Ru-106	undetectable
	Sr-90	25.5 Ci
	Pu	4270 g

Summary of Past Logging:

Boreholes	Date	Reference
299-E28-7	1976	Fecht, et al., 1977
	1986	Geophysics files
	1989	"
299-E28-23	none	
299-E28-24	1986	Geophysics files
	1987	"
299-E28-25	none	
299-E28-73	1986	Geophysics files
	1987	"
299-E28-74	1986	"
	1987	"

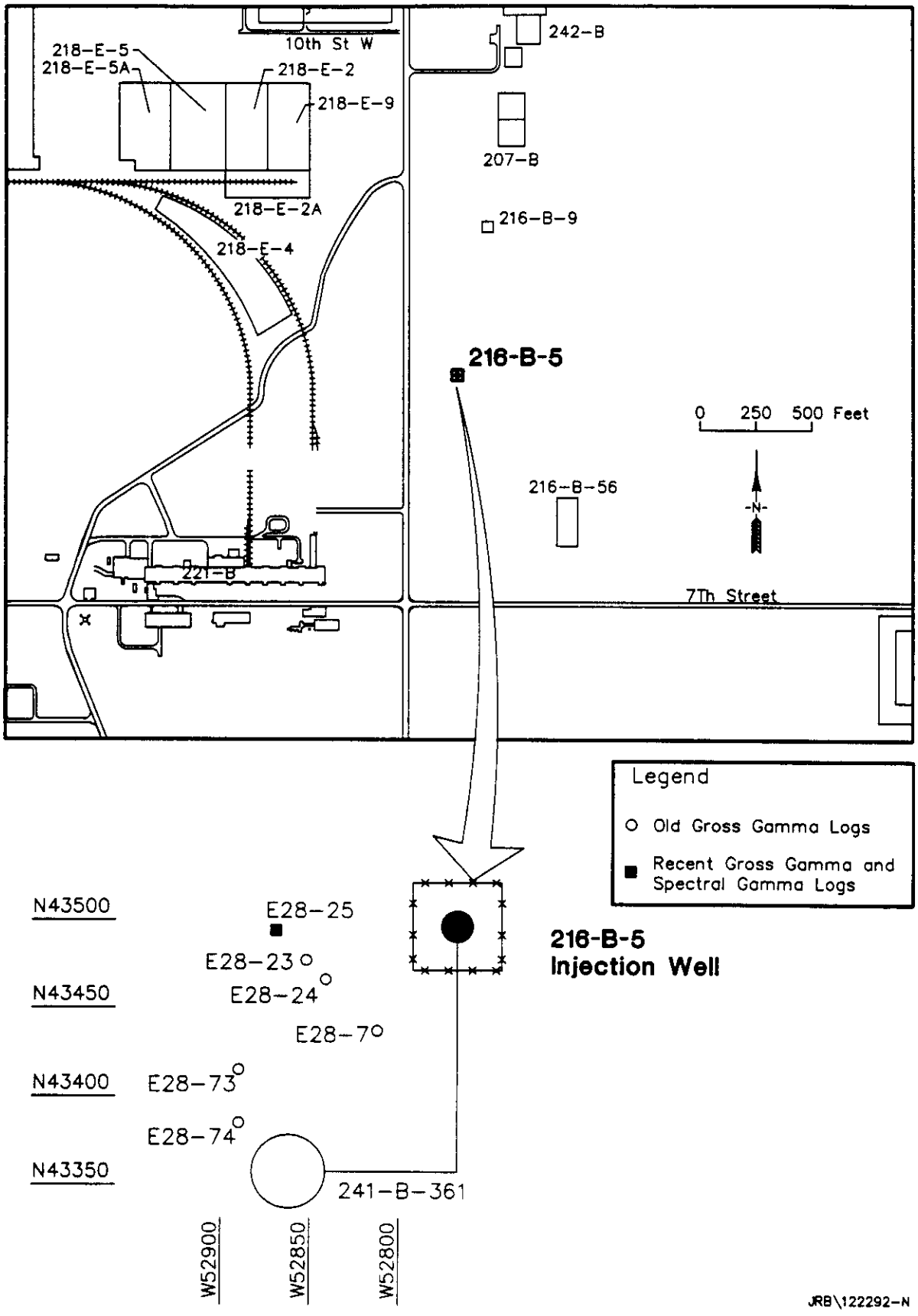
Review of Current Logging:

Borehole: 299-E28-25

This borehole was logged with the PNL gross gamma and the RLS spectral gamma-ray logging systems.

The spectral gamma log shows a small zone of surface Cs-137 surface contamination and it shows extensive contamination of the groundwater. This is consistent with the fact that this is the site of an injection well where the radioactive effluent was injected directly into the groundwater. Only Cs-137 was detected in the groundwater.

The old gross gamma logs all show elevated activity in the groundwater. The lateral extent of the migration is uncertain although studies are reported to have been done which would provide such information. An attempt will be made to locate these reports and include them in future assessments of this site.


10th St W
218-E-5
218-E-5A
218-E-2
218-E-9
218-E-2A
218-E-4
242-B
207-B
216-B-9
216-B-5
0 250 500 Feet
216-B-56
N
221-B
7Th Street
Legend
Old Gross Gamma Logs
Recent Gross Gamma and Spectral Gamma Logs
N43500
E28-25
E28-23
N43450
E28-24
E28-7
N43400
E28-73
E28-74
N43350
241-B-361
216-B-5
Injection Well
W52900
W52850
W52800
JRB\122292-N

Westinghouse Hanford Company
RLS Spectral Gamma-Ray Borehole Survey Log Header

Project: 200 East AAMS, 216-B-5 Crib

Borehole	299-E28-25			
Coordinates	43,494 N	52,869 W	Feet	(Plant 200 E)
Elevation	. feet		Top of Casing	(Plant 200 E)

Borehole Environment Information

Borehole Fluid Depth 282.2 (Feet) from Zero (0.0) Depth Reference of Log

Casing Size I.D. (inch)	Casing Thickness (inch)	Top Depth (feet)	Base Depth (feet)
8	0.34	0	263
4	0.24	0	327

RLS Passive Spectral Gamma Survey Information

Logging Engineers R. V. Cram S. E. Kos
Log Depth Reference at Zero (0.0) depth is Ground Level

Log Date	Archive File Names	Log Mode[1] Speed	Depth Interval (feet) Top	Base	Incr
Sept 11, 92	H2E2825\A242	MSA 35sec LT	0.0	168.5	0.5
Sept 12, 92	H2E2825\A243	MSA 35sec LT	166.5	285.0	0.5

[1] MSA: Move-Stop-Acquire Lt: Live Time

Calibration and Analysis Information

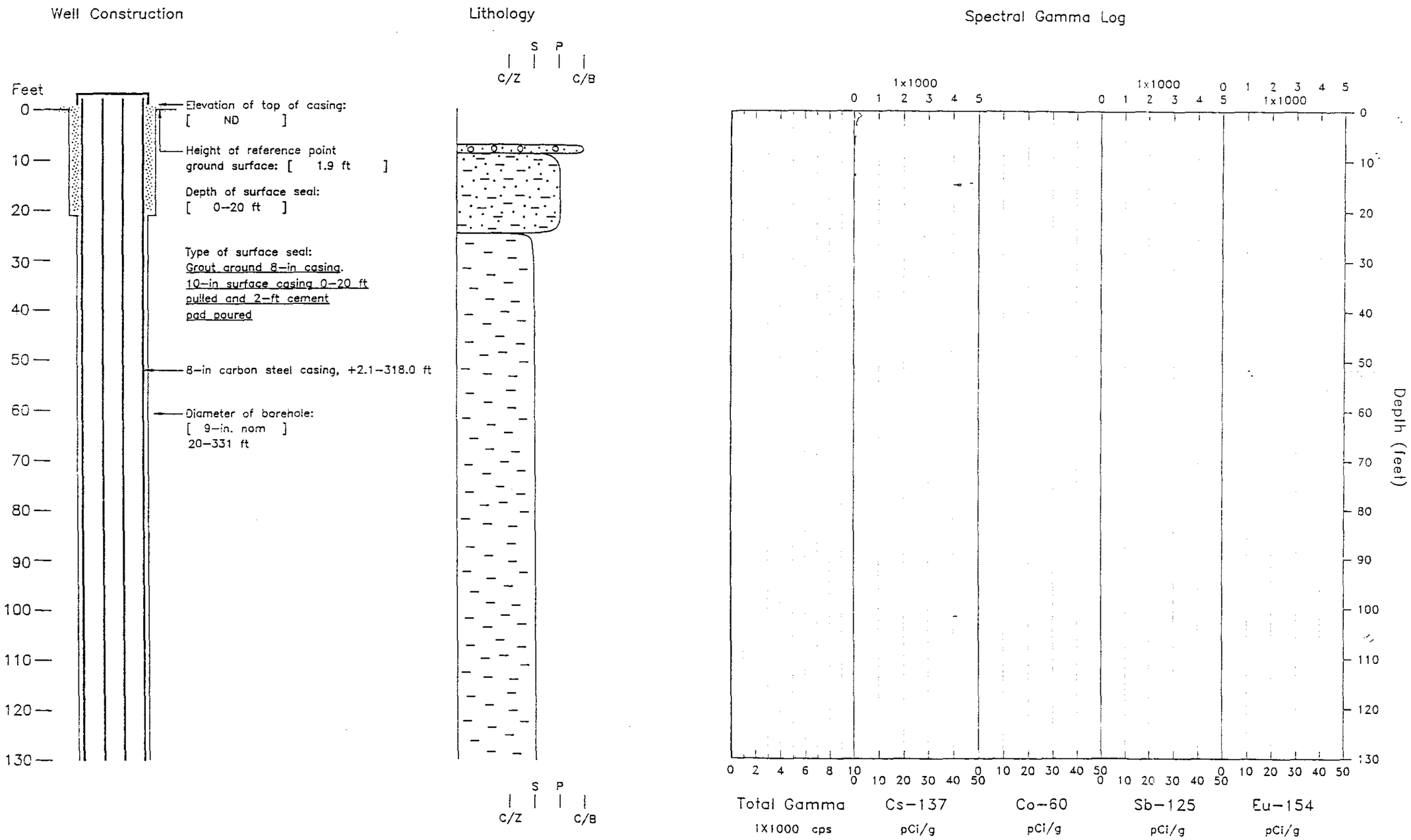
RLS Calibration Date: Nov 21, 1991
Calibration Report: WHC-SD-EN-TRP-001

Analyst Names: J. P. Kiesler
Analysis Date: Sept 21, 1992

Analysis Notes: Correction for 4" casing applied for 4" screen 279-329ft
Radionuclides identified: Cs-137

RLS Spectral Gamma Ray Borehole Survey

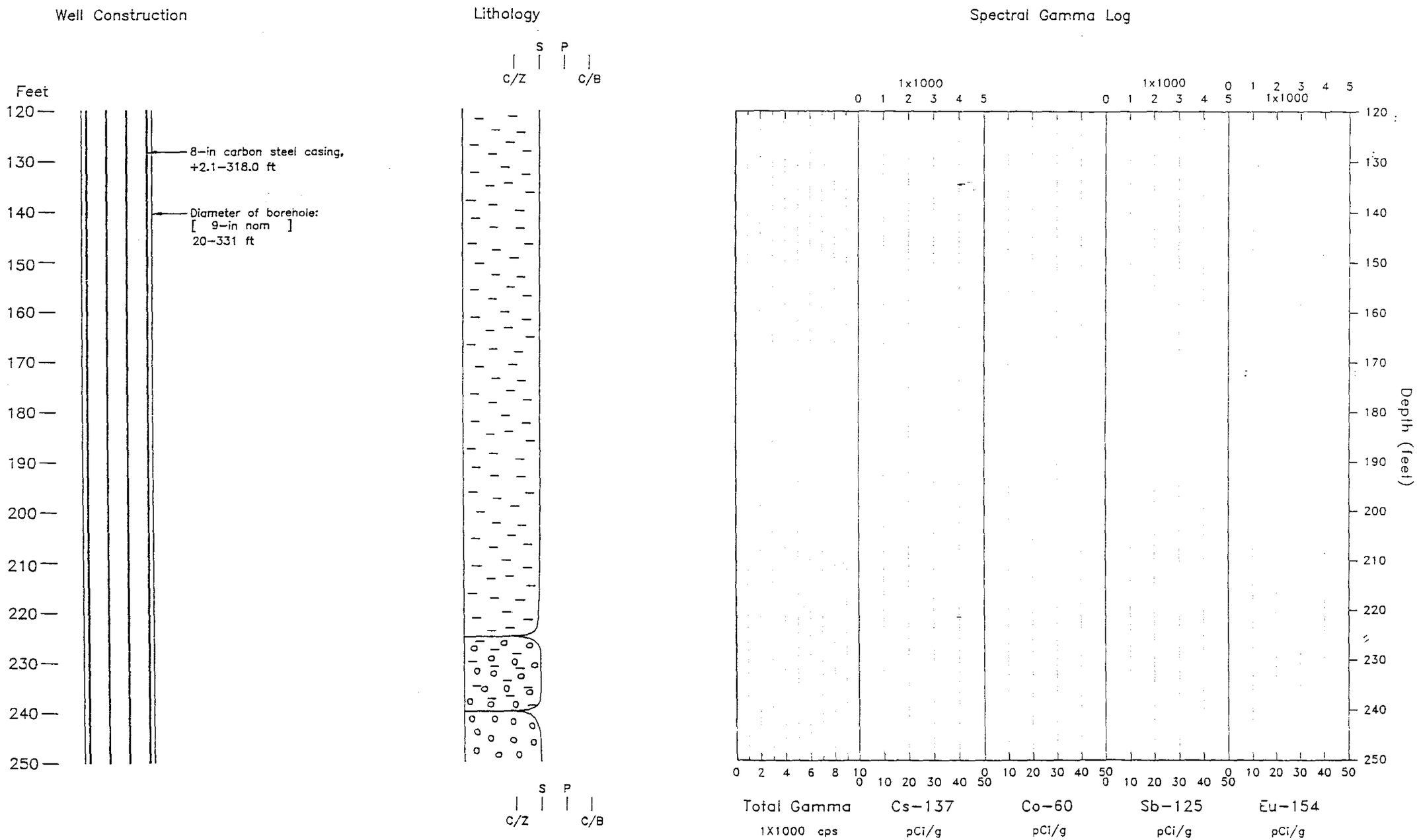
Well 299-E28-25 | Crib 216-B-5 | Log Date 9/12/92



WELLS\E28-25A

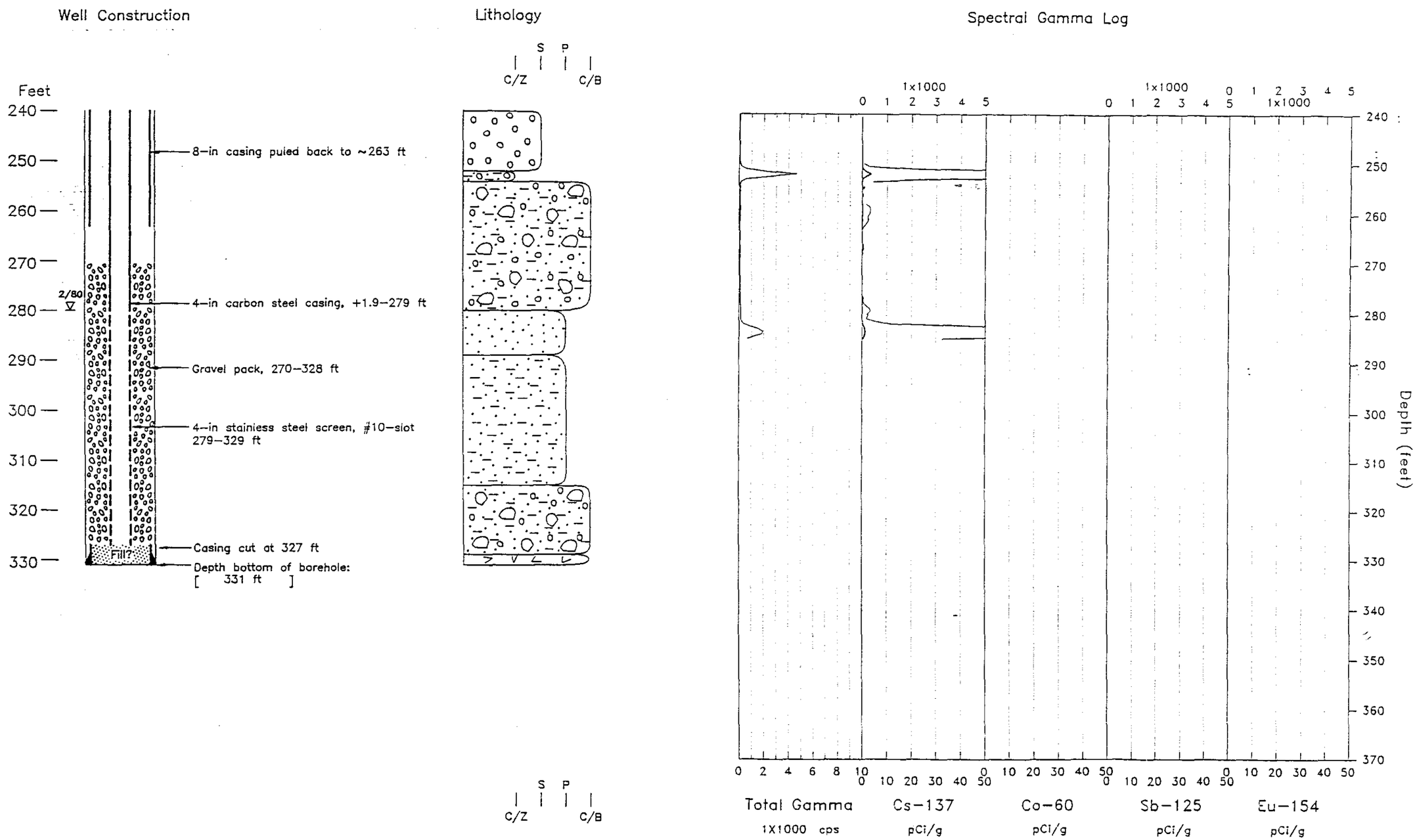
RLS Spectral Gamma Ray Borehole Survey

Well 299-E28-25 | Crib 216-B-5 | Log Date 9/12/92



RLS Spectral Gamma Ray Borehole Survey

Well 299-E28-25 | Crib 216-B-5 | Log Date 9/12/92



WELLS\E28-25C

RLS Borehole Survey Report

299-E28-25 216-B-5 Crib

Casing	Depth: 263 ft	Size: 8 in	Thickness: 0.34 in
	Depth: 327 ft	Size: 4 in	Thickness: 0.24 in
Water	Depth: 282.2 ft		
Survey	Depth: 0 - 168 ft	Mode: MSA 35 sec	Date: 9/11/92
	166 - 285 ft	Mode: MSA 35 sec	Date: 9/12/92

General Notes:
Detector depth was checked every 50 feet to 250 feet with at steel tape. The tool depth was not adjusted. The maximum depth error is 0.6% (ie. 0.32 ft at 50 ft).

The inner casing is screened from 279 feet to 329 feet. The gamma ray attenuation through the casing screen may be less than solid casing. The computed radionuclide activity may be greater than the true formation decay activity.

Man-made Radionuclides:
Cesium (Cs-137) was encountered in the borehole survey in two zones; from the surface to 13 feet and a second zone from 250 feet to the maximum survey depth of 285 feet. The maximum cesium decay activity detected was 360 pCi/g at 252 feet.

No Cobalt (Co-60) was encountered in the borehole survey. The plot track is present only for uniformity of the displayed data.

No Antimony (Sb-125) was encountered in the borehole survey. The plot track is present only for uniformity of the displayed data.

No Europium-154 (Eu-154) was encountered in the borehole survey. The plot track is present only for uniformity of the displayed data.

299-E28-25

Westinghouse Hanford Company | **LOG HEADER** | Page 1 of 2

Well No. 299-E28-25 Area 200East Date 9/20/92
Log Run #1 Log Type Gross Gamma
Elevation Datum Elevation
Survey Coordinates N 47494 X 152967 Y
Log Measures from Ground Surface
Location Description NZAC 216-B-5 Crib
Ground Surface Elevation
Surface Temperature N/A Weather Partly Cloudy - Warm

BOREHOLE INFORMATION

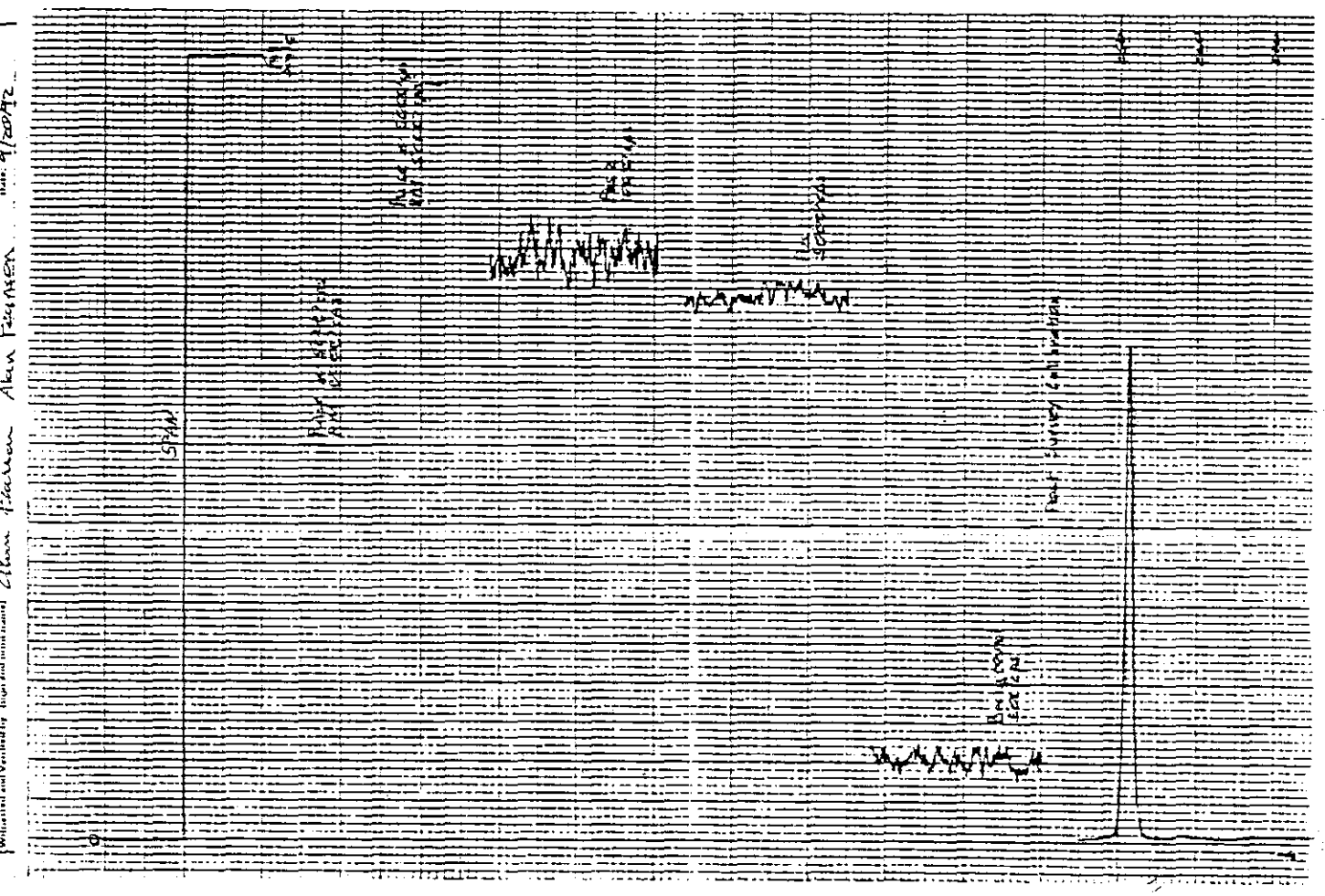
Driller ?
Unit Rig Type ? Bit Type/Diameter ?
Borehole Diameter(s)/Depth 8"/329' 4"/329'
Depth Driller 329' Depth Logger 325.8'
Liquid Level 260' Liquid Type/Temperature Clear
Temperature N/A

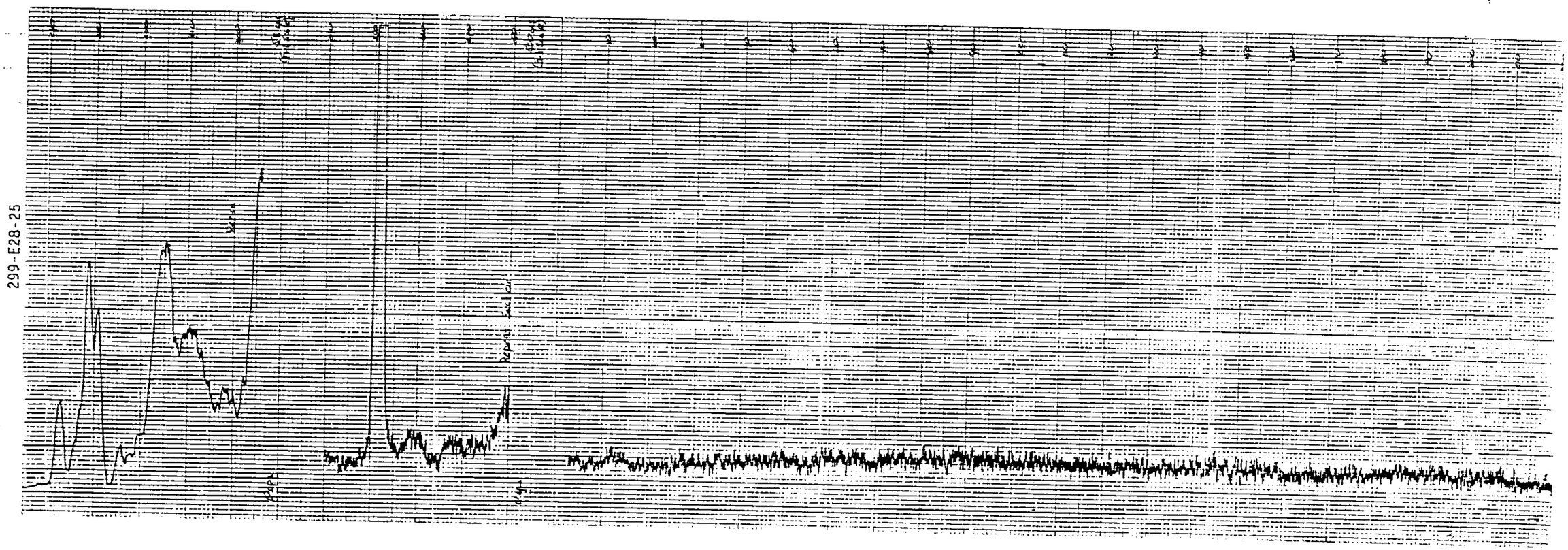
CASING RECORD

Type 8" Carbon Steel Sch 40 Interval +2.3' - 329' ?
Type 4" Carbon Steel Sch 40 Interval +2.2' - 329' ?
Type Interval
Type Interval
Well Screen Intervals 279' - 329'
Comments: Casing Stick +0.15' high
Centralizer used
Info from Hanford Wells

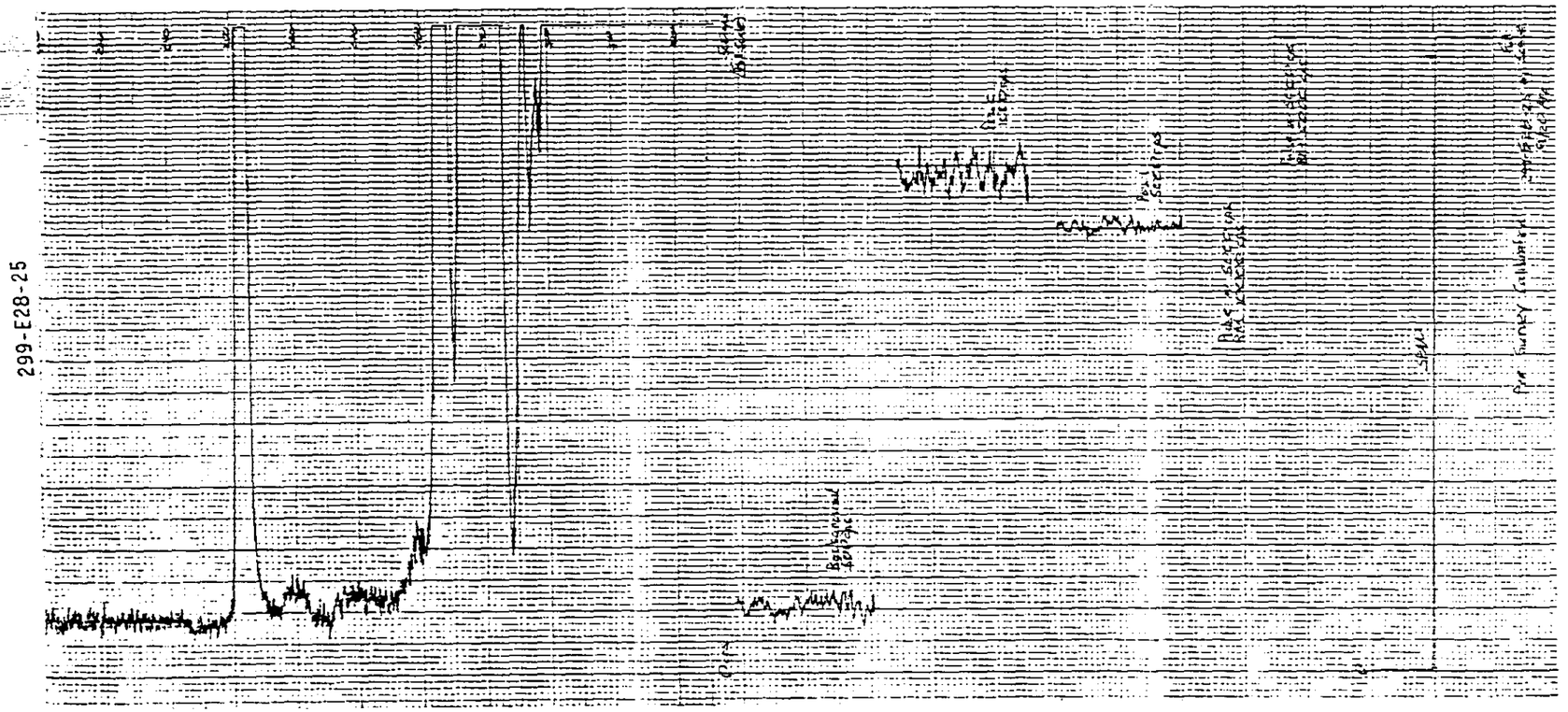
LOG HEADER Page 2 of 2

Logging Company PNL
Operator(s) Alan Warren
Equipment Brand AMS
Tool Type Gamma Ray
Base Calibration Date 5/92
Calibration Factor 1.00 at 1.0 MeV Calibration Datum [cal]
Tool Item 123 Serial
Logging Direction Down
Start Depth 325.9' Stop Depth 0.0' Log Speed 2100' @ 5000 cps
Detector(s) Position 1 2135 cell Position 2 2169 cell Background 55 cps
Post Survey Verification Position 1 Position 2 Position 3 Position 4
Base Calibration Reference Position 1 3151 cell Position 2 6511 cell
Logging Speed 5.5'/min
Start Time 0700 Stop Time 1000
Chart Speed(s) Unit 10'/hr
Chart Recorder Identification Type, GPM 50 GPM
Post Survey Verification Position 1 2085 cell Position 2 Position 3 Position 4
Depth Offset Change Position 1 1.5' Position 2
Comments Values Zero +0.15' high
Centralizer used
Witnessed and Verified by Signature Alan Warren Date 9/20/92





299-E28-25


299-E28-25

Crib Designation: 216-B-7 A & B

Type of Facility: Two 14 ft. by 14 ft. wooden crib structures

Location: N 45602, W 52764, north of 241-B Tanbk Farm, next to Baltimore Ave.

Service Dates: 10/46 to 5/67

Description of Waste: 43.6 x 10^6 liters of liquid waste from 224-B via overflow of 201-B, cell drainage and other liquid waste via tank 5-6, liquid waste from 224-B, decontamination construction waste from 221-B, all low salt, neutral to basic, contains TRU fission products.

Radionuclide Release Summary:

As of 12/31/89

Radionuclide	Quantity
Cs-137	43.2 Ci
Sr-90	2200 Ci
gross Pu	4300 g
gross U	0.0606 Ci

Summary of Past Logging:

Boreholes	Date	Reference
299-E33-18	1976	Fecht, et al., 1977
299-E33-58	1976	"
299-E33-59	1976	"
299-E33-75	1976	"

Review of Current Logging:

Borehole: 299-E33-18, 299-E33-58

Both of these boreholes were logged with the PNL gross gamma logging system and borehole E33-58 was logged with the spectral gamma system.

Only Cs-137 was identified in the spectral gamma-ray log of E33-58 near the surface and in a high concentration zone below crib depth. The near surface zone of cesium is most likely from a surface spill or a pipeline leak. Possible sources of this need to be investigated.

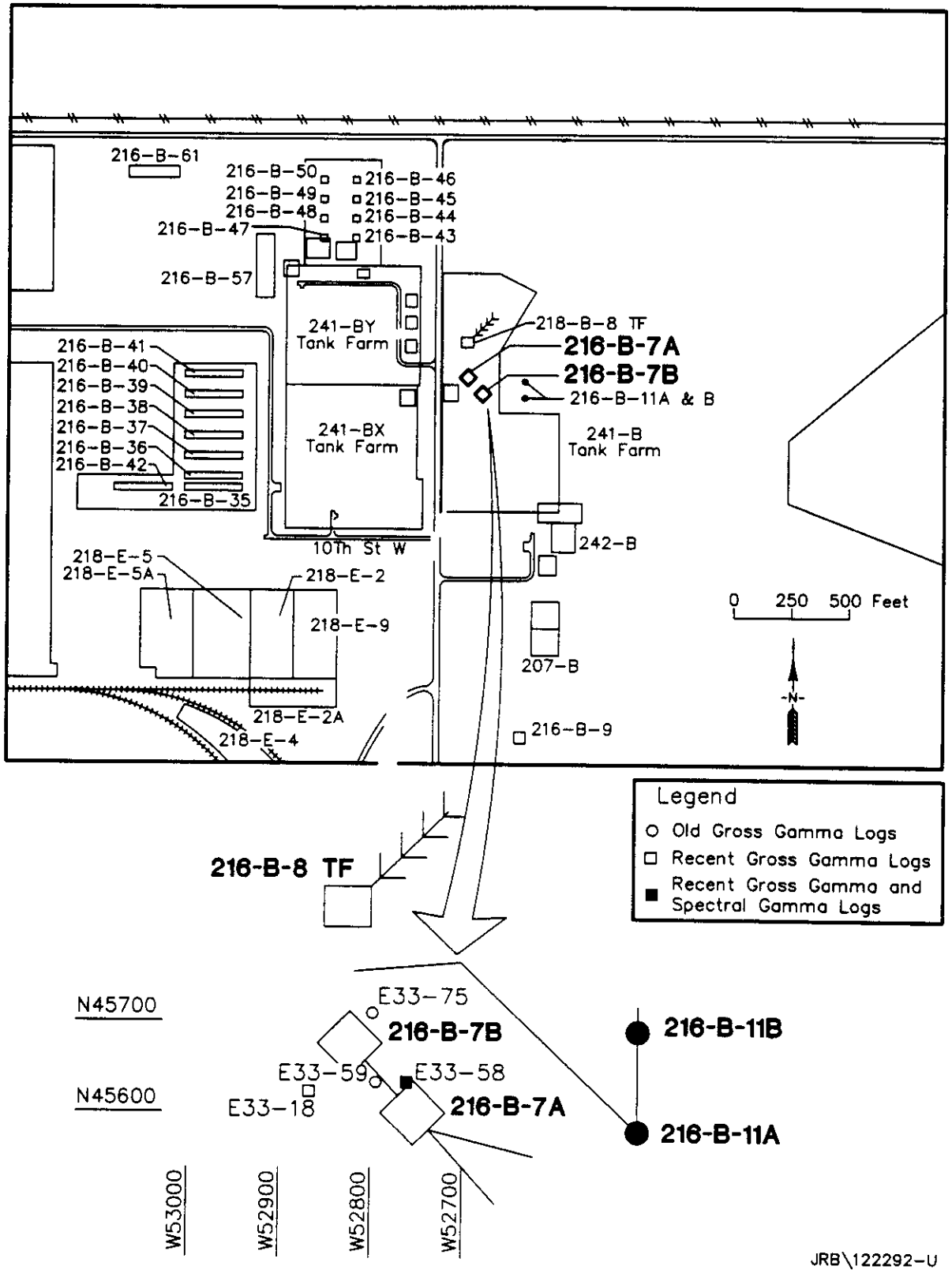
The major high concentration zone is found from 20 feet to about 100 feet. This is obviously due to the radionuclide releases at this crib. No man-made radionuclides were detected below 100 feet in this borehole although the borehole does not reach the groundwater.

The only borehole at this site that penetrates the groundwater is E33-18. This borehole is further away from the B-7 cribs than the others and it does not have any obvious contamination zones in the unsaturated sediments other than the near surface contamination as seen in E33-58. However, the groundwater beneath this site is contaminated. The groundwater contamination is probably from the nearby B-8 crib or the 241-B

Tank Farms immediately to the south. Additional spectral gamma-ray logging of the nearby boreholes will provide information as to the source of the groundwater contamination and it will shed some light on the current status of any nuclides deposited in the unsaturated zone.

From the information available, it appears that the radionuclides released at this site migrated downward and did not move horizontally very much. This is somewhat characteristic of the 200 East area which does not have much in the way of lithology interfaces that would cause horizontal migration.

It is not possible to compare the shapes of the new gross gamma activity profiles with those of the older logs due to drastic differences in the logging data acquisition procedures.


216-B-61
216-B-50
216-B-49
216-B-48
216-B-47
216-B-46
216-B-45
216-B-44
216-B-43
216-B-57
241-BY Tank Farm
218-B-8 TF
216-B-7A
216-B-7B
216-B-11A & B
216-B-41
216-B-40
216-B-39
216-B-38
216-B-37
216-B-36
216-B-42
216-B-35
241-BX Tank Farm
241-B Tank Farm
10th St W
242-B
218-E-5
218-E-5A
218-E-2
218-E-9
0 250 500 Feet
207-B
218-E-2A
218-E-4
216-B-9
N
Legend
Old Gross Gamma Logs
Recent Gross Gamma Logs
Recent Gross Gamma and Spectral Gamma Logs
216-B-8 TF
N45700
E33-75
216-B-7B
216-B-11B
E33-59
E33-58
N45600
E33-18
216-B-7A
216-B-11A
W53000
W52900
W52800
W52700
JRB\122292-U

Westinghouse Hanford Company
RLS Spectral Gamma-Ray Borehole Survey Log Header

Project: 200 East AAMS, 216-B-7 Crib

Borehole	299-E33-58		
Coordinates	45,633 N	52,761 W	Feet (Plant 200 E)
Elevation	642.82 feet		Top of Casing (Plant 200 E)

Borehole Environment Information

Borehole Fluid Depth none (Feet) from Zero (0.0) Depth Reference of Log

Casing Size I.D. (inch)	Casing Thickness (inch)	Top Depth (feet)	Base Depth (feet)
8	0.32	0.0	153.

RLS Passive Spectral Gamma Survey Information

Logging Engineers R. V. Cram S. E. Kos
Log Depth Reference at Zero (0.0) depth is Ground Level

Log Date	Archive File Names	Log Mode, Speed	Depth Interval (feet) Top	Base	Incr
Sept 25, 92	H2E3358\A252	FIXED 0.6 fpm	0	31	0.5
		FIXED 0.6 fpm	52	140	0.5
	(Lead shield)	FIXED 0.6 fpm	30	53	0.5
		Station 300 s	Depth: 95.5,111,141 ft		

[1] FIXED: Fixed velocity of Cable Speed: fpm: Feet per minute Station: Long count at specified depth

Calibration and Analysis Information

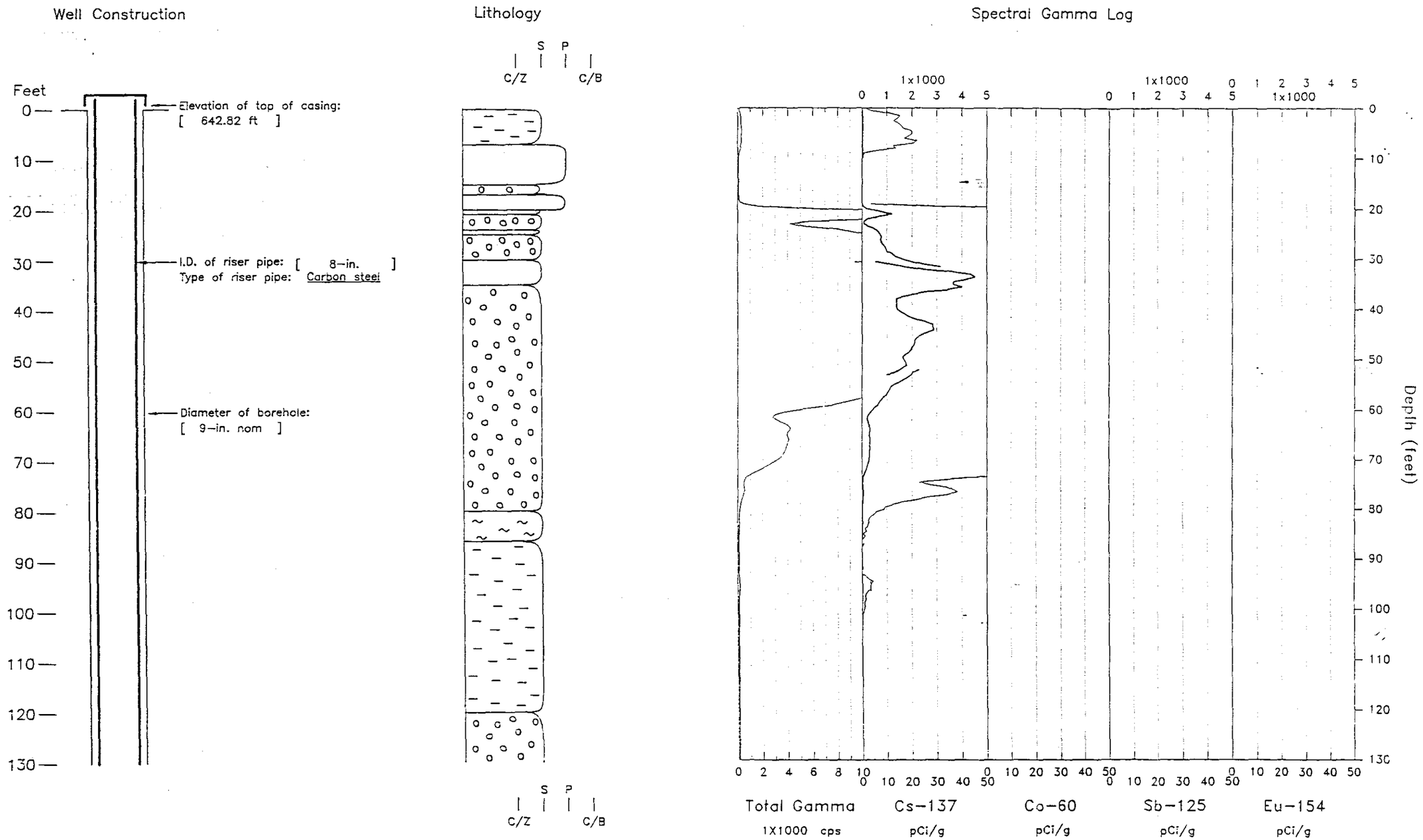
RLS Calibration Date: Nov 21, 1991
Calibration Report: WHC-SD-EN-TRP-001

Analyst Names: J. P. Kiesler
Analysis Date: Sept 29, 1992

Analysis Notes: Interval 30 to 53 feet logged with GI underestimated
Radionuclides identified: Cs-137

RLS Spectral Gamma Ray Borehole Survey

Well 299-E33-58 | Crib 216-B-7 | Log Date NA

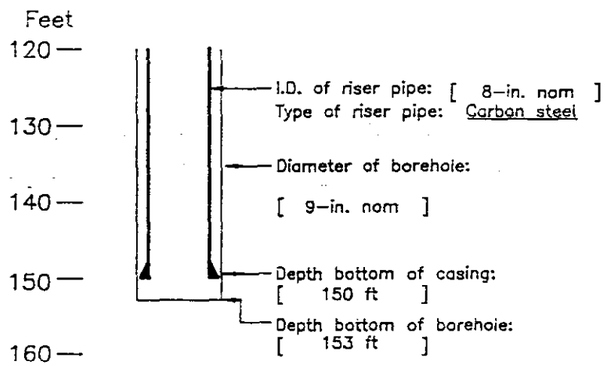


WELLS\E33-58A

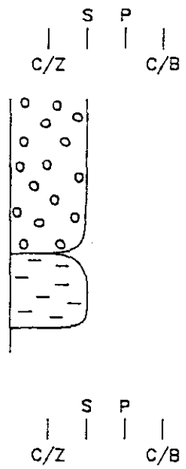
RLS Spectral Gamma Ray Borehole Survey (Page 2)

Well 299-E33-58 | Crib 216-B-7 | Log Date NA

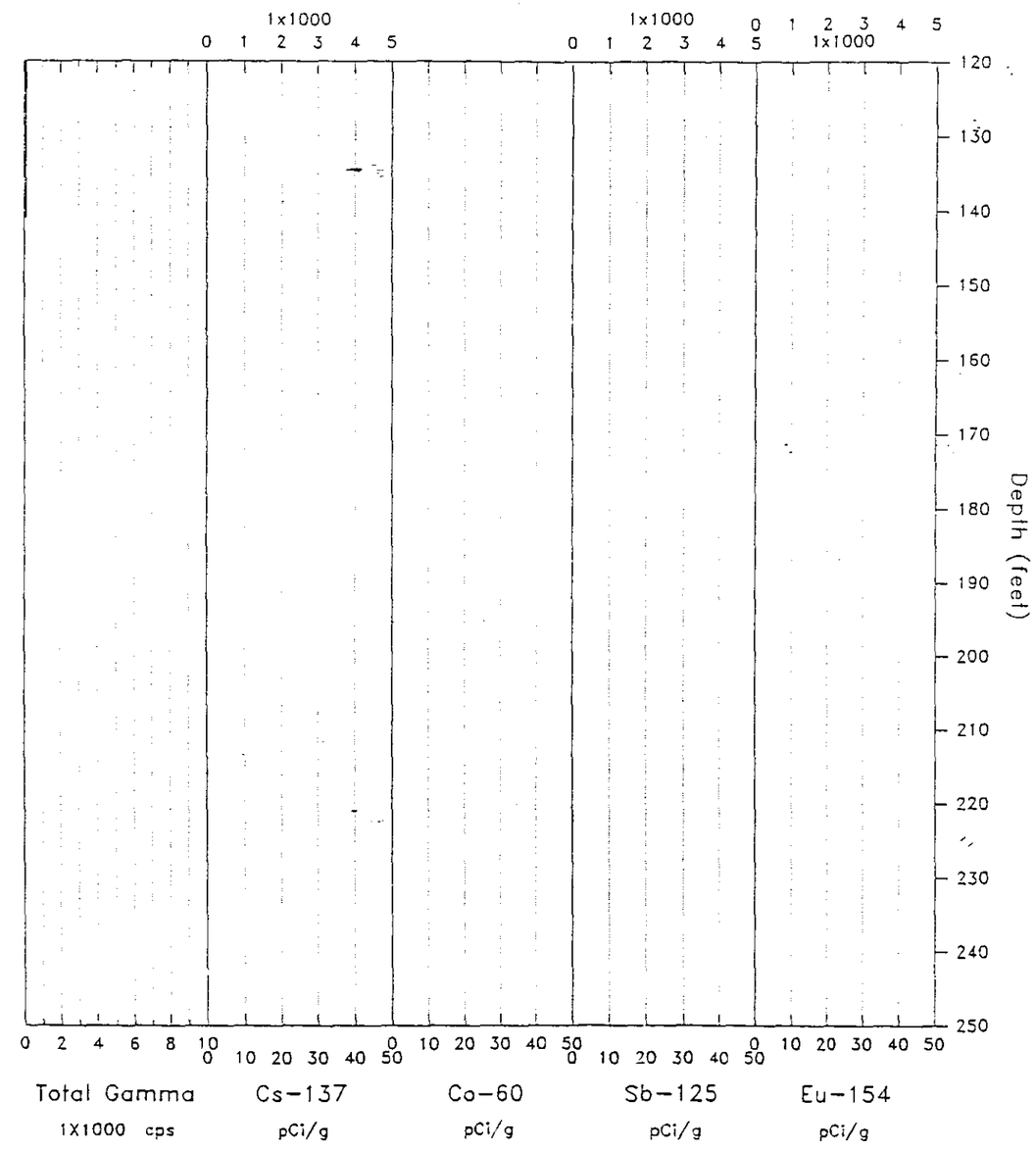
Well Construction



Lithology



Spectral Gamma Log



WELLS\E33-58B

RLS Borehole Survey Report

299-E33-58 216-B-7 Crib

Casing	Depth: 153 ft	Size: 8 in	Thickness: 0.32 in
Water	Depth: none		
Survey	Depth: 0 - 31 ft	Mode: Fixed 0.6 fpm	Date: 9/25/92
	52 - 140 ft	Mode: Fixed 0.6 fpm	(Interval 2)
	30 - 53 ft	Mode: Fixed 0.6 fpm	(Gated Integrator)

General Notes:
High gamma ray activity recorded by the gated integrator logging configuration may be represented by two photo peaks in the spectra. The net area under the larger peak is used for decay activity calculation. The plotted decay activity may be underestimated. The problem is being investigated.

Man-made Radionuclides:
Cesium (Cs-137) was encountered in the borehole survey from the surface to 101 feet. The cesium decay activity exceeded 200 pCi/g from 20 feet to 71 feet.

No Cobalt (Co-60) was encountered in the borehole survey. The plot track is present only for uniformity of the displayed data.

No Antimony (Sb-125) was encountered in the borehole survey. The plot track is present only for uniformity of the displayed data.

No Europium-154 (Eu-154) was encountered in the borehole survey. The plot track is present only for uniformity of the displayed data.

299-E33-18

Westinghouse Hanford Company | LOG HEADER | Page 1 of 2

Well No. 299-E33-18 Area 200 East Date 9/21/92
Log Run #1 Log Type Gross Gamma
Elevation Datum Top of Casing Elevation 643.84
Survey Coordinates N 45624 ? W 52325
Log Measured From Ground Surface
Location Description East of 8X-8Y Tank Farm
Ground Surface Elevation
Surface Temperature NA Weather Clear - Hot

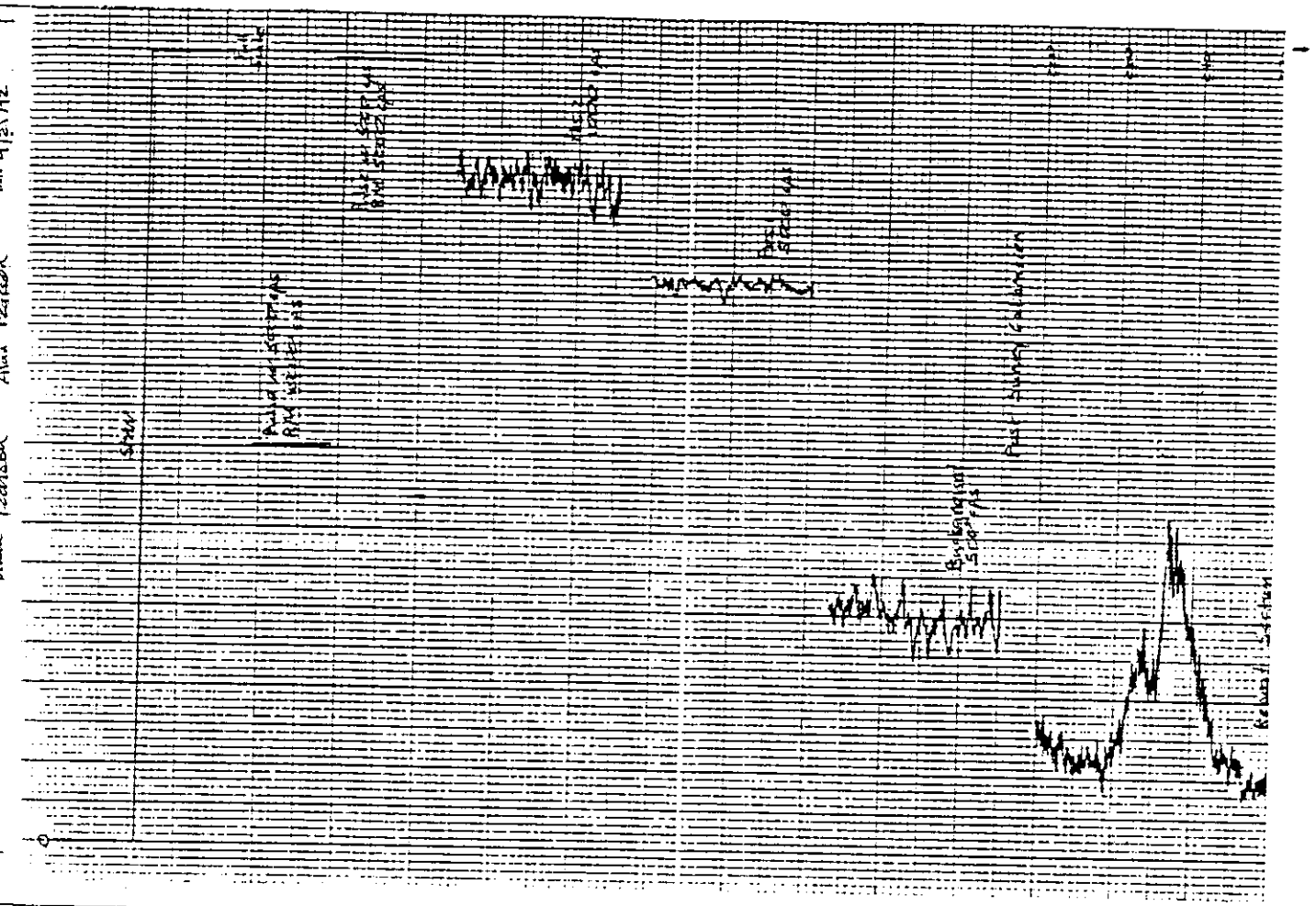
BOREHOLE INFORMATION
Driller ?
Drill Rig Type ? Bit Type/Diameter ?
Borehole Diameter(s)/Depth 8"/263'
Depth Driller 263' Depth Logger 267.1'
Liquid Level 239' Liquid Density approximate clear
Temperature NA

CASING RECORD
Type 8" Carbon Steel Sch.40 Interval 1.5 - 263' ?
Type Interval
Type Interval
Type Interval
Well Screen Interval 240'-260'
Comments: Datum Error = +0.2' high
Centralizer used
Info from Hanford Wells

LOG HEADER — Page 2 of 2

EQUIPMENT DATA
Logging Company PNL
Operator(s) Alan Pearson
Equipment Brand HLS
Equipment Type Flow-Log
Tool Type Gamma Ray
Serial No. CGZ7HY1
Base Calibration Date 5/92
Calibration Reference PNL-STD20 HC-4020
Calibration Factor 9.201 x 10^-4 Calibration Datum (ft) Position 1 3151 ft Position 2 651 ft
Tread Line 123 cts/sec Warm Up Time 715 min

LOGGING INFORMATION
Log Interval from 267.1' to 3.6'
Actual 2500' to 2800'
Pre Survey Verification: Position 1 323.7 cts Position 2 61.5 cts Background 155 cpm
Base Calibration Difference Position 1 11.4 cts Position 2 0.6 cts
Logging Speed 5 ft/min Recorder Scale (CPM) 50 CPM/in
Start Time 1500 Completion Time 1530
Chart Speed (in/min) 10 in/hr Time Constant(s) 16-1
Chart Recorder Horizontal Scale (CPM) 50 CPM/in
Post Survey Verification: Position 1 308.3 cts Position 2 63.1 cts Background 150 cpm
Percent Change: Position 1 -4.6% Position 2 2.6%
Comments: Datum Error: +0.2' high
Centralizer used
Witnessed and Verified by (Sign and print name) Alan Pearson Alan Pearson Date 9/21/92



299-E33-58

Westinghouse Hanford Company | LOG HEADER | Page 1 of 2

Well No. 299-E33-58 Area 200 East Date 9/22/92
Log Run #1 Log Type Gross Gamma
Elevation Datum Top of Casing Elevation 642.92
Survey Coordinates N 45673 ? W 52761
Log Measured From Ground Surface
Location Description East of 8X-8Y Tank Farm
Ground Surface Elevation
Surface Temperature NA Weather Overcast - Warm

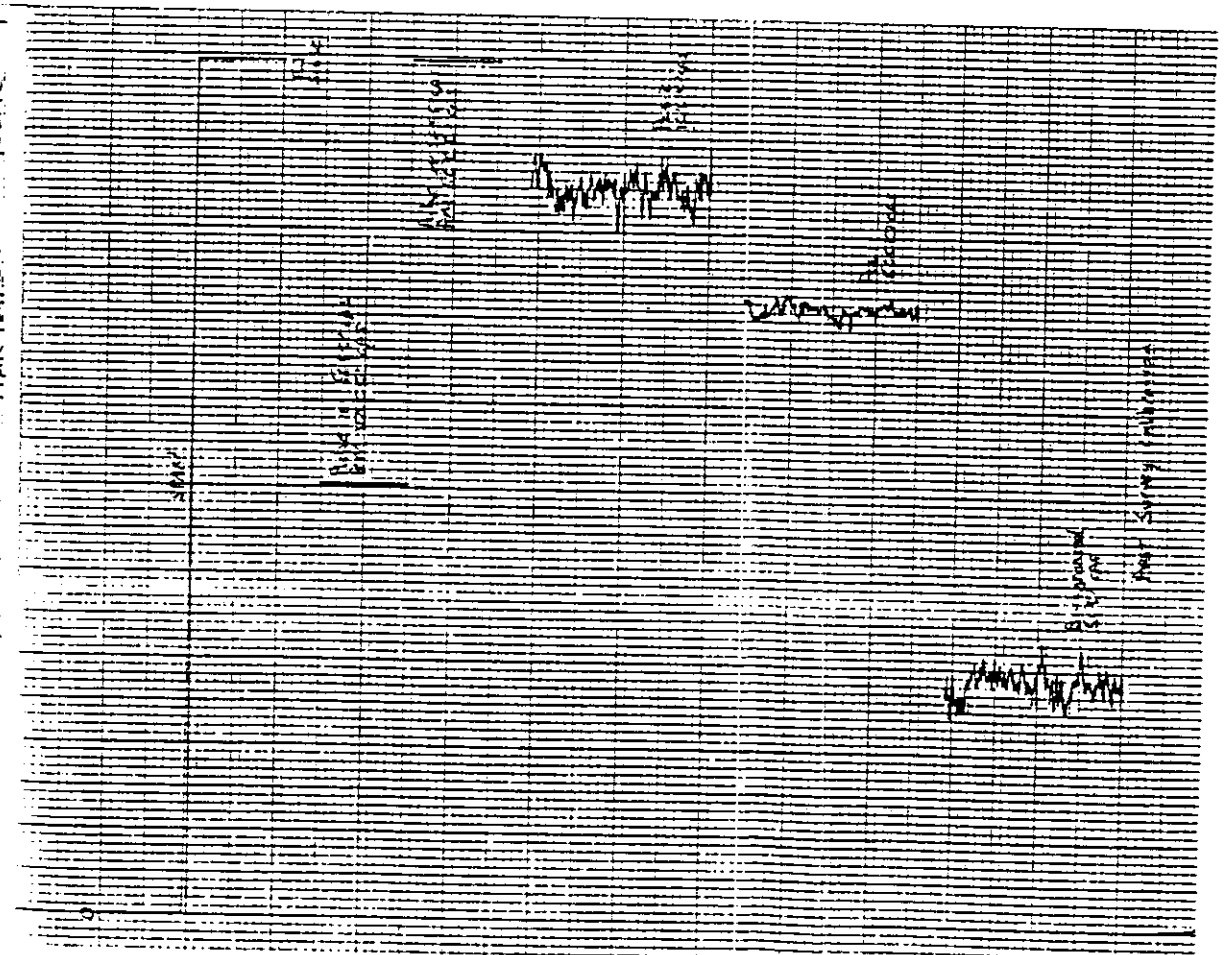
BOREHOLE INFORMATION
Driller ?
Drill Rig Type ? Bit Type/Diameter ?
Borehole Diameter(s)/Depth 8"/153'
Depth Driller 153' Depth Logger 144.3'
Liquid Level NA (capped) Liquid Density NA
Temperature NA

CASING RECORD
Type 8" Carbon Steel Sch.40 Interval +14' - 153'
Type Interval
Type Interval
Type Interval
Well Screen Interval NA
Comments: Datum Error = +0.1' high
Centralizer used
Info from Hanford Wells

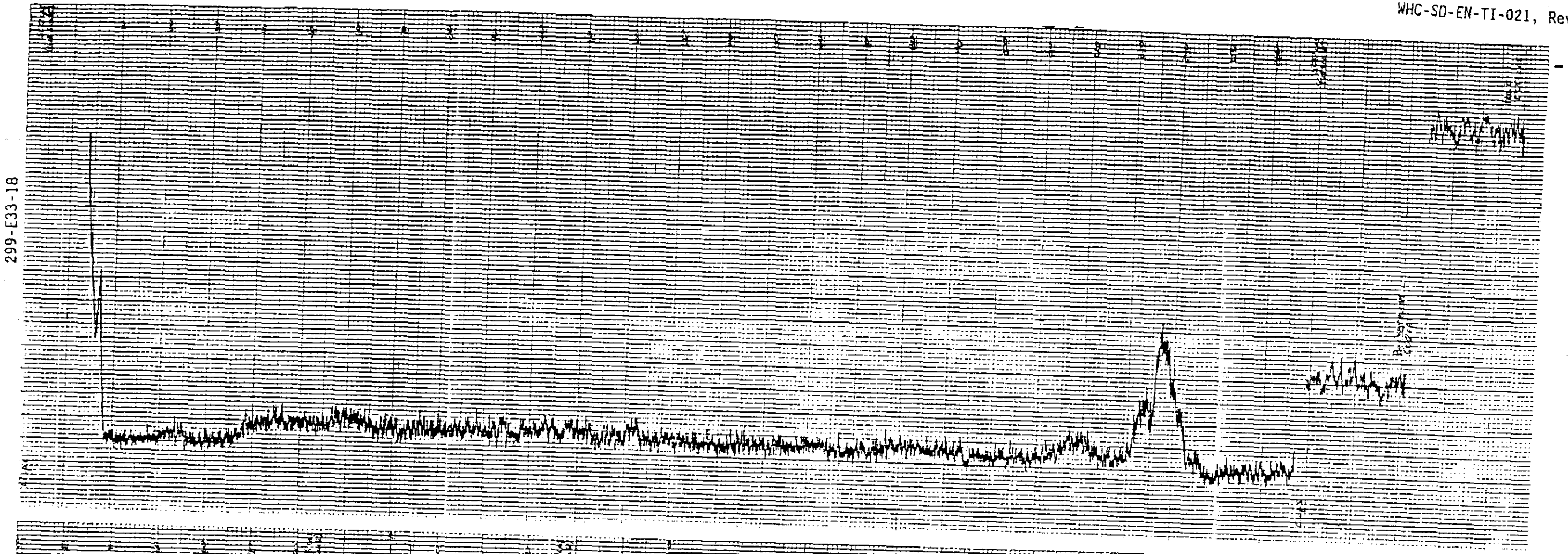
LOG HEADER — Page 2 of 2

EQUIPMENT DATA
Logging Company PNL
Operator(s) Alan Pearson
Equipment Brand HLS
Equipment Type Flow-Log
Tool Type Gamma Ray
Serial No. CGZ7HY1
Base Calibration Date 5/92
Calibration Reference PNL-STD20 HC-4020
Calibration Factor 9.201 x 10^-4 Calibration Datum (ft) Position 1 315.1 ft Position 2 65.1 ft
Tread Line 123 cts/sec Warm Up Time 715 min

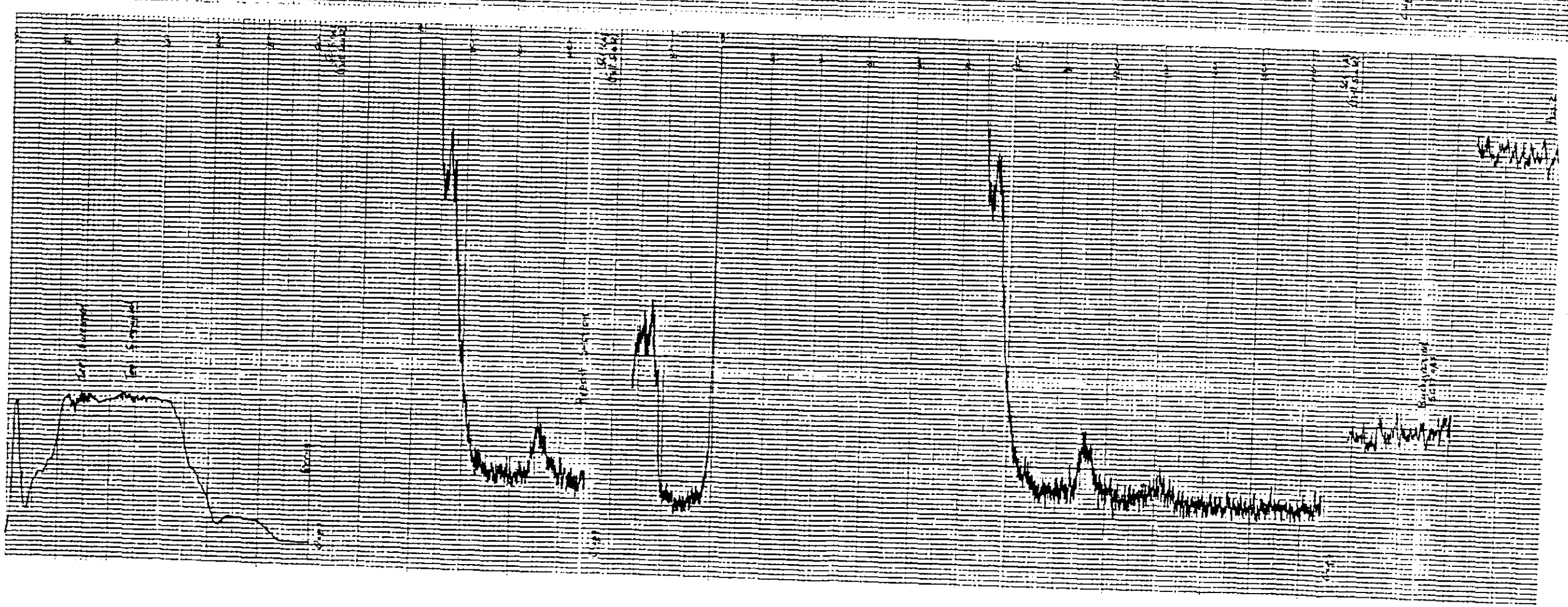
LOGGING INFORMATION
Log Interval from 144.3' to 3.7'
Actual 150' to 450'
Pre Survey Verification: Position 1 312.7 cts Position 2 61.7 cts Background 145 cpm
Base Calibration Difference Position 1 1.4 cts Position 2 0.2 cts
Logging Speed 5 ft/min Recorder Scale (CPM) 50 CPM/in
Start Time 0830 Completion Time 0930
Chart Speed (in/min) 10 in/hr Time Constant(s) 16-1
Chart Recorder Horizontal Scale (CPM) 50 CPM/in
Post Survey Verification: Position 1 311.3 cts Position 2 61.0 cts Background 145 cpm
Percent Change: Position 1 -0.4% Position 2 1.1%
Comments: Datum Error: +0.1' high
Centralizer used
Witnessed and Verified by (Sign and print name) Alan Pearson Alan Pearson Date 9/22/92



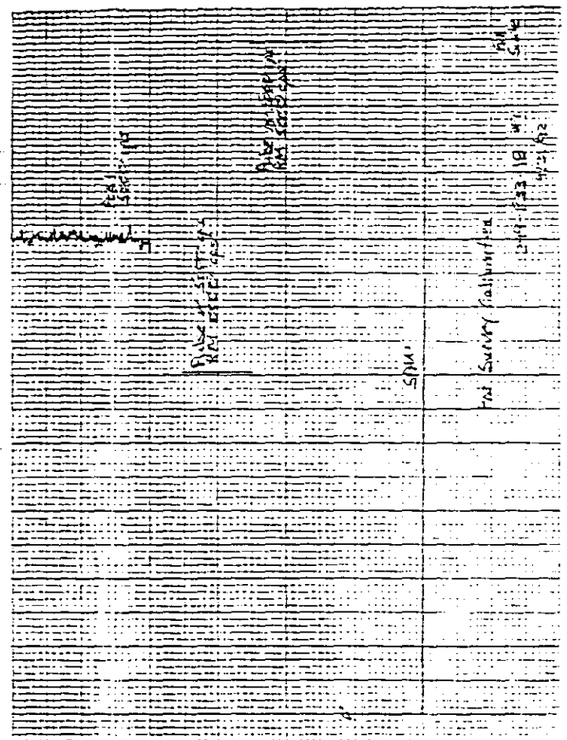
299-E33-18



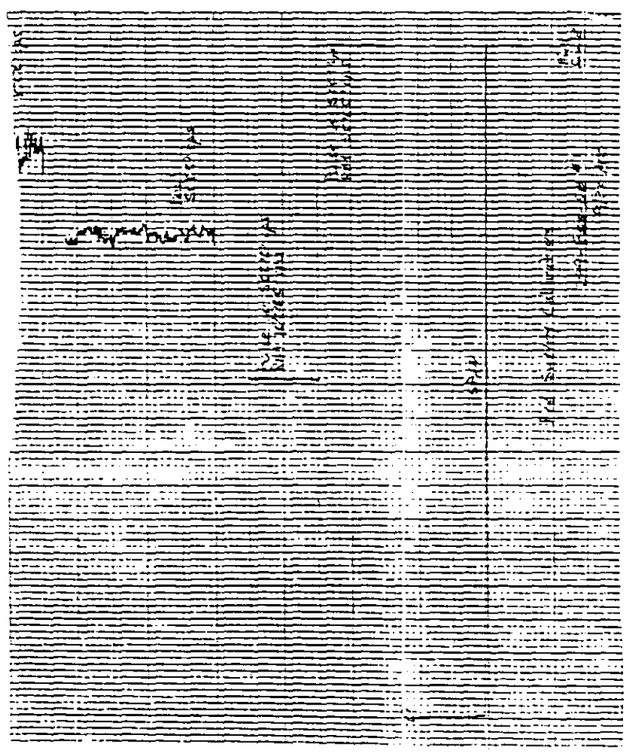
299-E33-58



299-E33-18



299-E33-58



Crib Designation: 216-B-9

Type of Facility: 14 ft by 14 ft wooden crib and tile field

Location: N43757 to N 43944, W 52617 Just east of Baltimore Ave., 1250 feet south of 241-B Tank Farm

Service Dates: 8/48 to 7/51

Description of Waste: 36 x 10^6 liters of celldrainage from Tank 5-6 in 221-B building, low salt, neutral to basic, contains TRU and fission products

Radionuclide Release Summary:
As of 12/31/92

Radionuclide	Quantity
Cs-137	3.92 Ci
Sr-90	5.52 Ci
gross Pu	174 g
gross U	0.015 Ci

Summary of Past Logging:

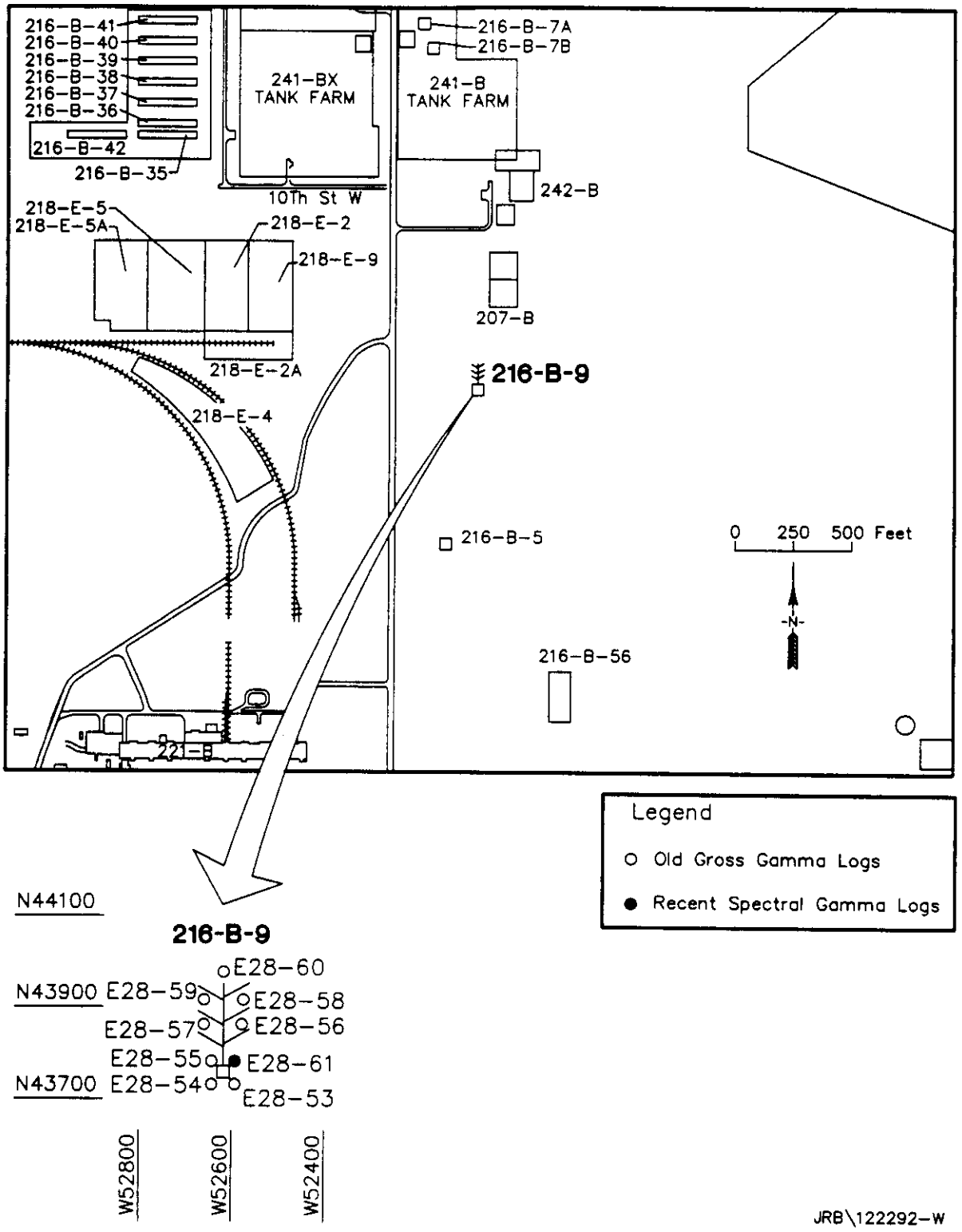
Boreholes	Date	Reference
299-E28-53	1976	Fecht, et al., 1977
299-E28-54	1976	"
299-E28-55	1976	"
299-E28-56	1976	"
299-E28-57	None	
299-E28-58	1976	"
299-E28-59	1976	"
299-E28-60	1976	"
299-E28-61	1976	"

Review of Current Logging:

Borehole: 299-E28-61

This borehole was only logged with the RLS spectral gamma system. No recent gross gamma-ray logs exist for this site. This log shows a zone of high Cs-137 concentration just below the crib between 15 and 25 feet. No other man-made nuclides are detected in this borehole.

No other data exists for this crib site and it is not possible to determine if the radionuclides released at this site have traveled to the groundwater. Additional data are needed to assess this site.


216-B-41
216-B-40
216-B-39
216-B-38
216-B-37
216-B-36
216-B-42
216-B-35
241-BX
TANK FARM
10Th St W
216-B-7A
216-B-7B
241-B
TANK FARM
242-B
218-E-5
218-E-5A
218-E-2
218-E-9
207-B
218-E-2A
216-B-9
218-E-4
216-B-5
0 250 500 Feet
-N-
216-B-56
221-B
Legend
Old Gross Gamma Logs
Recent Spectral Gamma Logs
N44100
216-B-9
E28-60
N43900 E28-59
E28-58
E28-57
E28-56
E28-55
E28-61
N43700 E28-54
E28-53
W52800
W52600
W52400
JRB\122292-W

Westinghouse Hanford Company
RLS Spectral Gamma-Ray Borehole Survey Log Header

Project: 200 East AAMS 216-B-9 Crib

Borehole	299-E28-61		
Coordinates	43,782 N	52,593 W	Feet (Plant 200 E)
Elevation	680.51 feet		Top of Casing (Plant 200 E)

Borehole Environment Information

Borehole Fluid Depth none (Feet) from Zero (0.0) Depth Reference of Log

Casing Size I.D. (inch)	Casing Thickness (inch)	Top Depth (feet)	Base Depth (feet)
8	0.37	0.0	150.0

RLS Passive Spectral Gamma Survey Information

Logging Engineers R. V. Cram S. E. Kos
Log Depth Reference at Zero (0.0) depth is Ground Level

Log Date	Archive File Names	Log Mode[1], Speed	Depth Interval (feet) Top	Base	Incr
Sept 09, 92	H2E2861\A239	MSA 35sec LT	0.0	147.0	0.5

[1] MSA: Move-Stop-Acquire Lt: Live Time

Calibration and Analysis Information

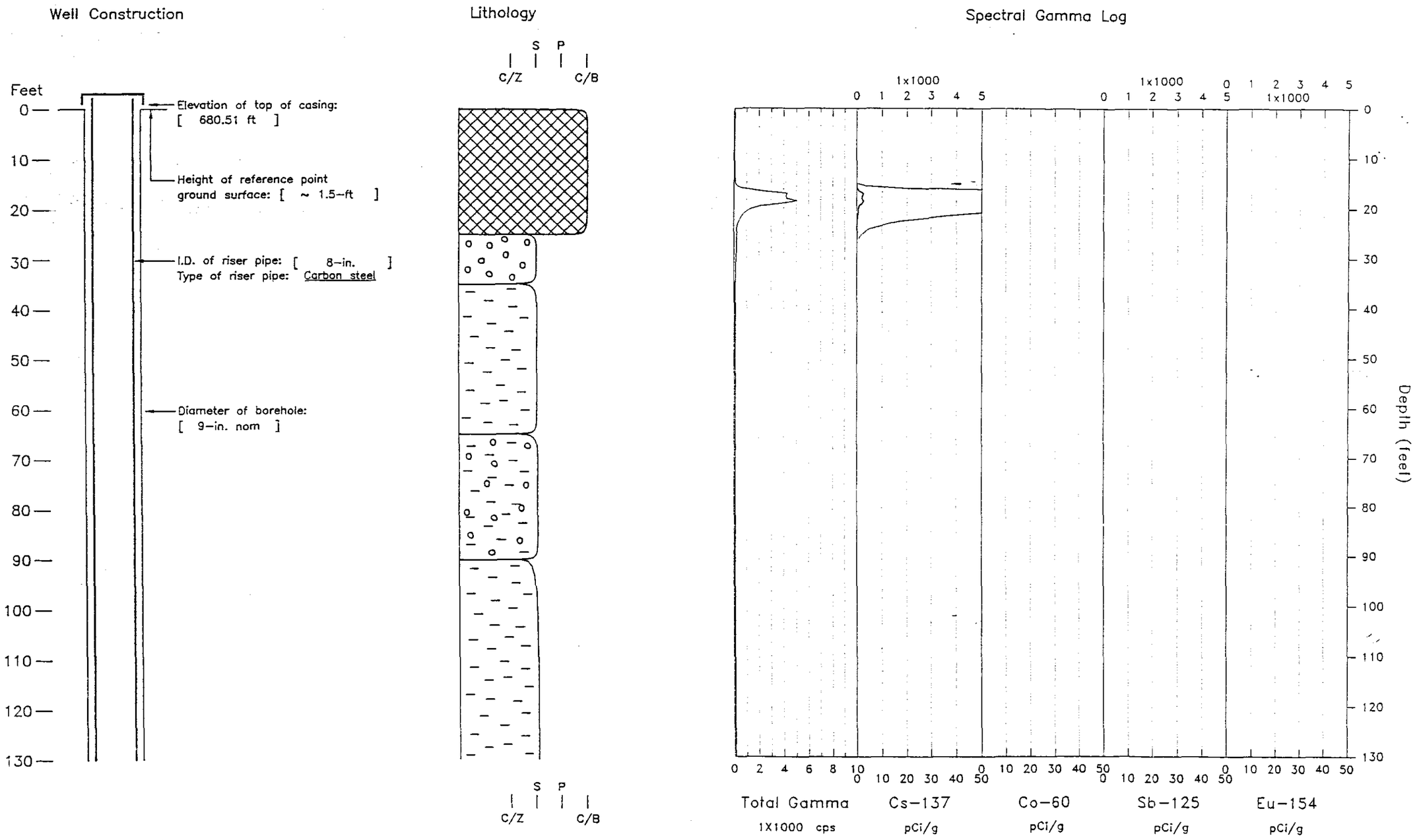
RLS Calibration Date: Nov 21, 1991
Calibration Report: WHC-SD-EN-TRP-001

Analyst Names: J. P. Kiesler
Analysis Date: Sept 23, 1992

Analysis Notes: No manmade radionuclides identified below 26 feet
Radionuclides identified: Cs-137

RLS Spectral Gamma Ray Borehole Survey

Well 299-E28-61 | Crib 216-B-9 | Log Date 9/9/92

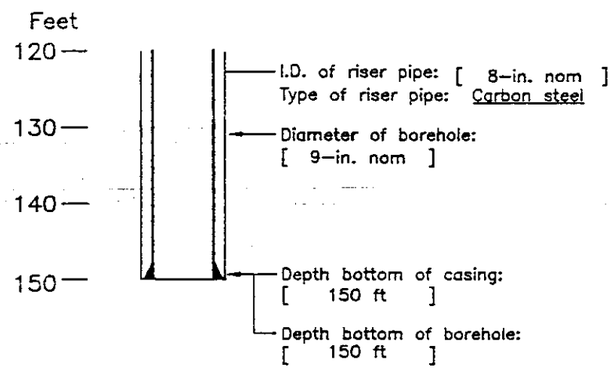


WELLS\E28-61A

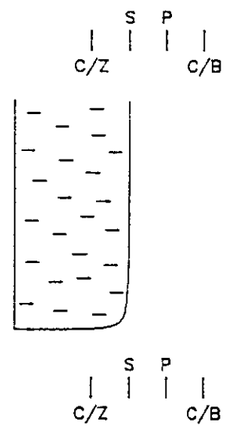
RLS Spectral Gamma Ray Borehole Survey (Page 2)

Well 299-E28-61 | Crib 216-B-9 | Log Date 9/9/92

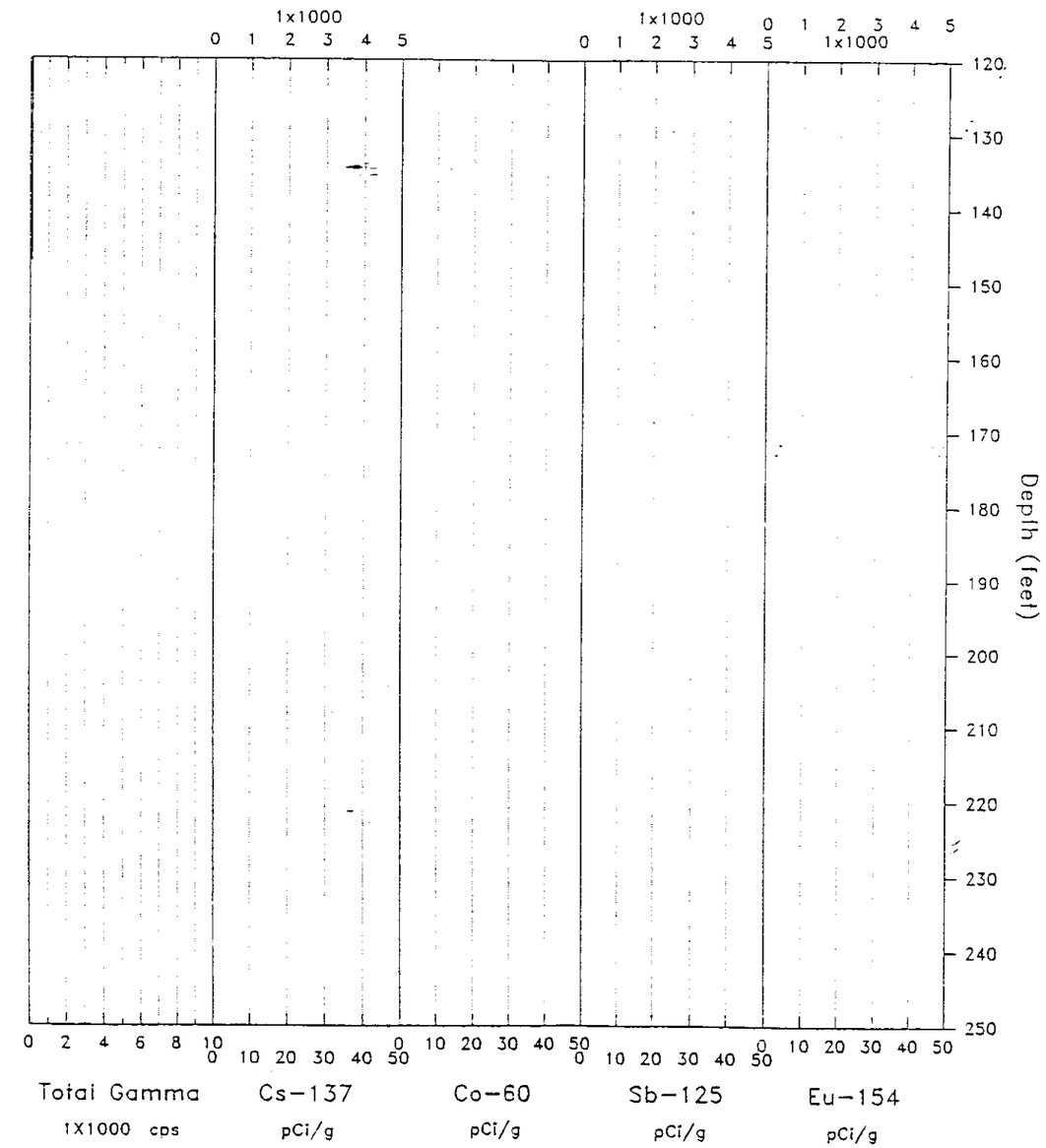
Well Construction



Lithology



Spectral Gamma Log



GEOSCI\E28-61B

RLS Borehole Survey Report

299-E28-61 216-B-9 Crib

Casing	Depth: 150 ft	Size: 8 in	Thickness: 0.37 in
Water	Depth: none		
Survey	Depth: 0 - 147 ft	Mode: MSA 35 sec	Date: 9/09/92

General Notes:
A long count (300 second) spectra was acquired at the maximum survey depth of 147.2 feet. No manmade radionuclides were identified in the spectra.

Man-made Radionuclides:
Cesium (Cs-137) was encountered in the borehole survey from the 15 feet to 26 feet. The cesium decay activity exceeded 200 pCi/g from 17 feet to 19 feet.

No Cobalt (Co-60) was encountered in the borehole survey. The plot track is present only for uniformity of the displayed data.

No Antimony (Sb-125) was encountered in the borehole survey. The plot track is present only for uniformity of the displayed data.

No Europium-154 (Eu-154) was encountered in the borehole survey. The plot track is present only for uniformity of the displayed data.

Crib Designation: 216-B-11 A & B

Type of Facility: Two injection wells

Location: 216-B-11 A N 45674, W 52619
216-B-11 B N 45734, W 52619

Service Dates: 12/51 to 12/54

Description of Waste: 29.6 x 10^6 liters of process condensate from 242-B waste evaporator, low salt, neutral to basic

Radionuclide Release Summary:

Radionuclide	Quantity
Pu	4 g
Sr-90	5 Ci
Cs-137	50 Ci
Co-60	0.1 Ci
U	14 kg

Summary of Past Logging:

Boreholes	Date	Reference
299-E33-19	1976	Fecht, et al., 1977
299-E33-20	1976	Fecht, et al., 1977

Review of Current Logging:

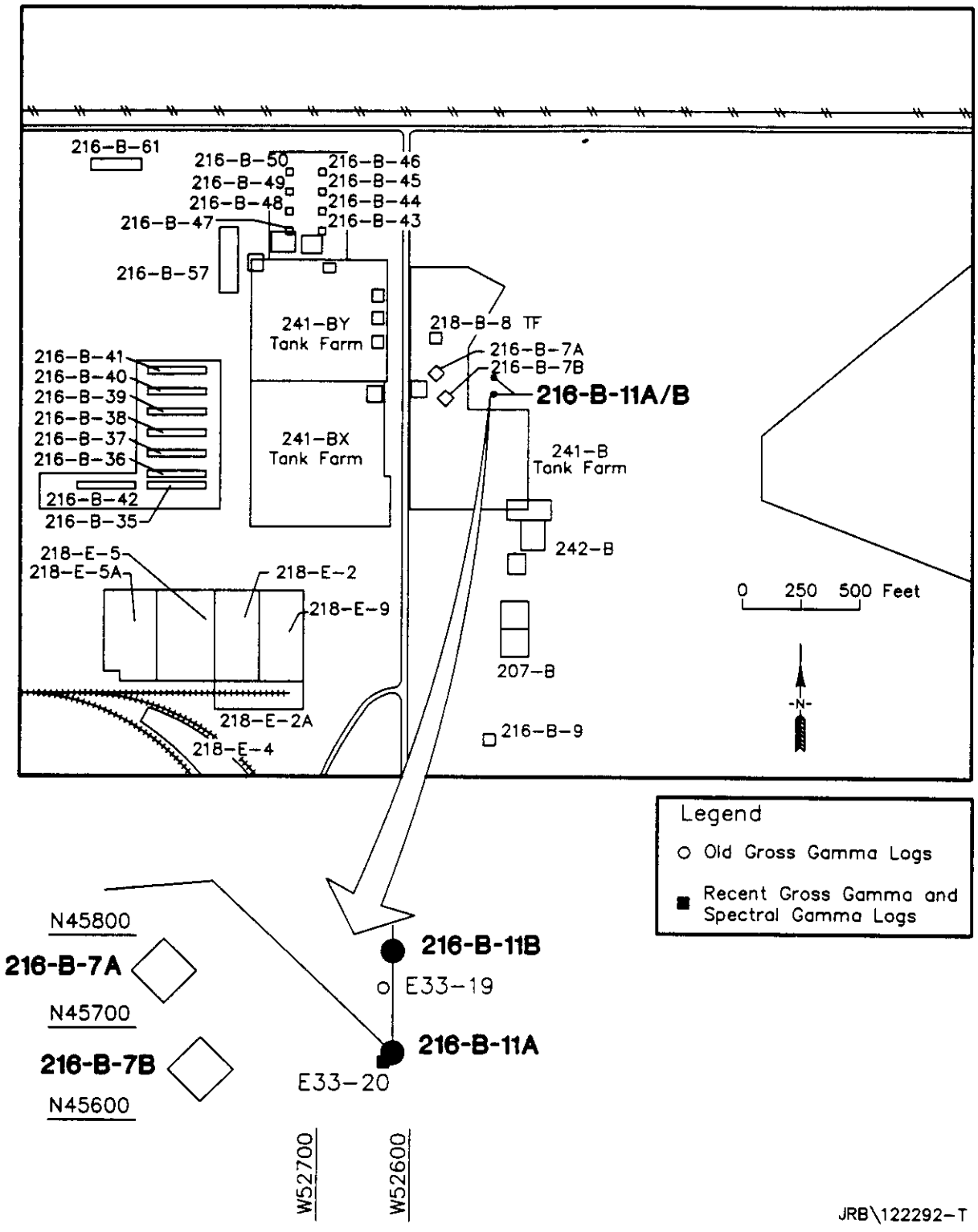
Borehole: 299-E33-20

This borehole was logged with both the PNL gross gamma logging system and the RLS spectral gamma system. The spectral gamma log shwo three zones of Cs-137 contamination. The uppermost zone is found from the surface down to 10 feet. This has to be the result of a surface spill or pipeline leak, probably the same one that is seen in the logs from the B-7 cribs.

The second zone of cesium contamination is found as a thin zone at 90 feet in the borehole. It is likely that there is some sort of a lithology change at this depth which would cause such a thin, high concentration zone such as this.

The lower zone of cesium is at 190 feet which is about 40 feet above the groundwater table. This is a thicker, lower concentration zone than the one at 90 feet.

Older gross gamma-ray logs show elevated gross gamma activity all the way down and into the groundwater. It is safe to assume that the groundwater at this site has been contaminated with Cs-137 released from these injection wells.


216-B-61
216-B-50
216-B-49
216-B-48
216-B-47
216-B-46
216-B-45
216-B-44
216-B-43
216-B-57
241-BY Tank Farm
241-BX Tank Farm
218-B-8 TF
216-B-7A
216-B-7B
216-B-11A/B
241-B Tank Farm
242-B
207-B
216-B-9
216-B-41
216-B-40
216-B-39
216-B-38
216-B-37
216-B-36
216-B-42
216-B-35
218-E-5
218-E-5A
218-E-2
218-E-9
218-E-2A
218-E-4
0 250 500 Feet
N
Legend
Old Gross Gamma Logs
Recent Gross Gamma and Spectral Gamma Logs
N45800
216-B-7A
N45700
216-B-7B
N45600
216-B-11B
E33-19
216-B-11A
E33-20
W52700
W52600
JRB\122292-T

Westinghouse Hanford Company
RLS Spectral Gamma-Ray Borehole Survey Log Header

Project: 200 AAMS 216-B-11 Crib

Borehole	299-E33-20			
Coordinates	41,664 N	52,629 W	Feet	(Plant 200 E)
Elevation	639.6 feet		Top of Casing	(Plant 200 E)

Borehole Environment Information

Borehole Fluid Depth none (Feet) from Zero (0.0) Depth Reference of Log

Casing Size I.D. (inch)	Casing Thickness (inch)	Top Depth (feet)	Base Depth (feet)
8	0.33	0	254
6	0.25	0	254

RLS Passive Spectral Gamma Survey Information

Logging Engineers R. V. Cram S. E. Kos
Log Depth Reference at Zero (0.0) depth is Ground Level

Log Date	Archive File Names	Log Mode[1], Speed	Depth Interval (feet) Top	Base	Incr
Sept 28, 92	H2E3320\A253	FIXED 0.6 fpm	0	10	0.5
			85	117	0.5
			188	198	0.5
		Station 300sec	50,89,150,190,200,234,240 & 255 feet		

[1]FIXED: Fixed velocity of Cable Speed; fpm: Feet per minute

Calibration and Analysis Information

RLS Calibration Date: Nov 21, 1991
Calibration Report: WHC-SD-EN-TRP-001

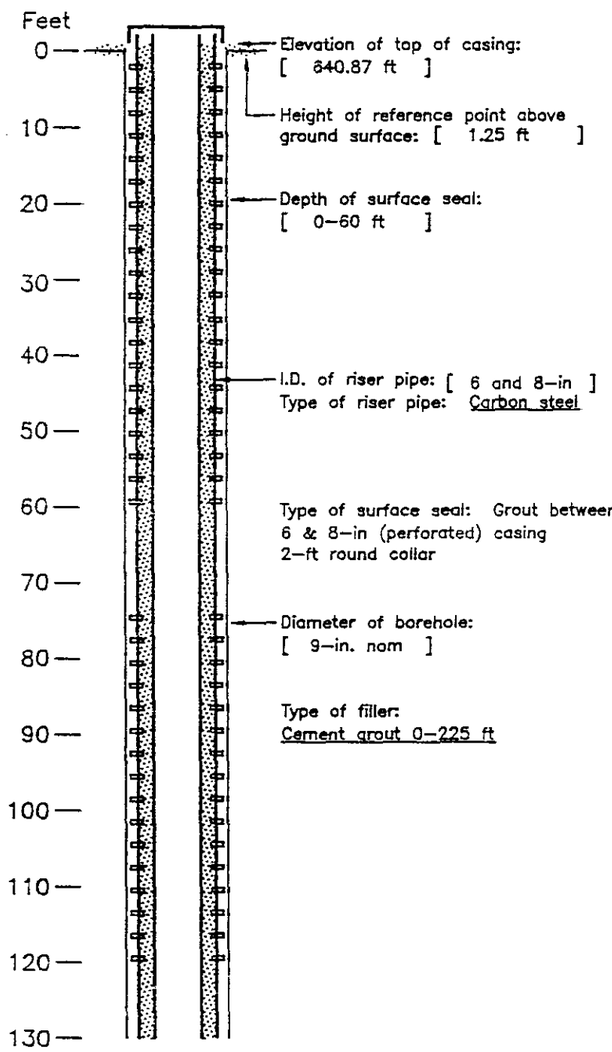
Analyst Names: J. P. Kiesler
Analysis Date: Oct 13, 1992

Analysis Notes: Depth intervals selected from older gross gamma survey.
Radionuclides identified: Cs-137, Co-60

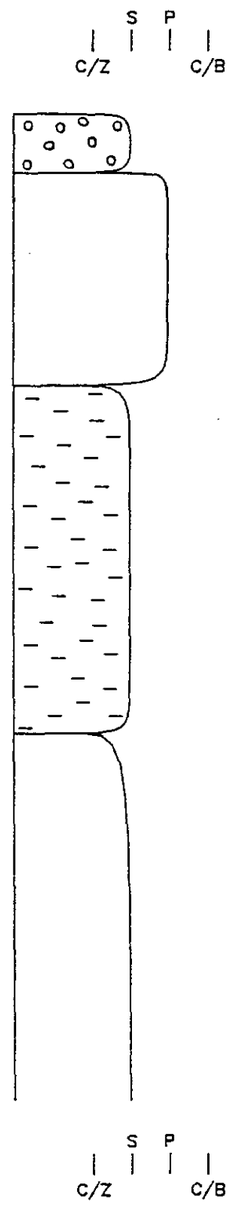
RLS Spectral Gamma Ray Borehole Survey

Well 299-E33-20 | Cribs 216-B-11 | Log Date NA

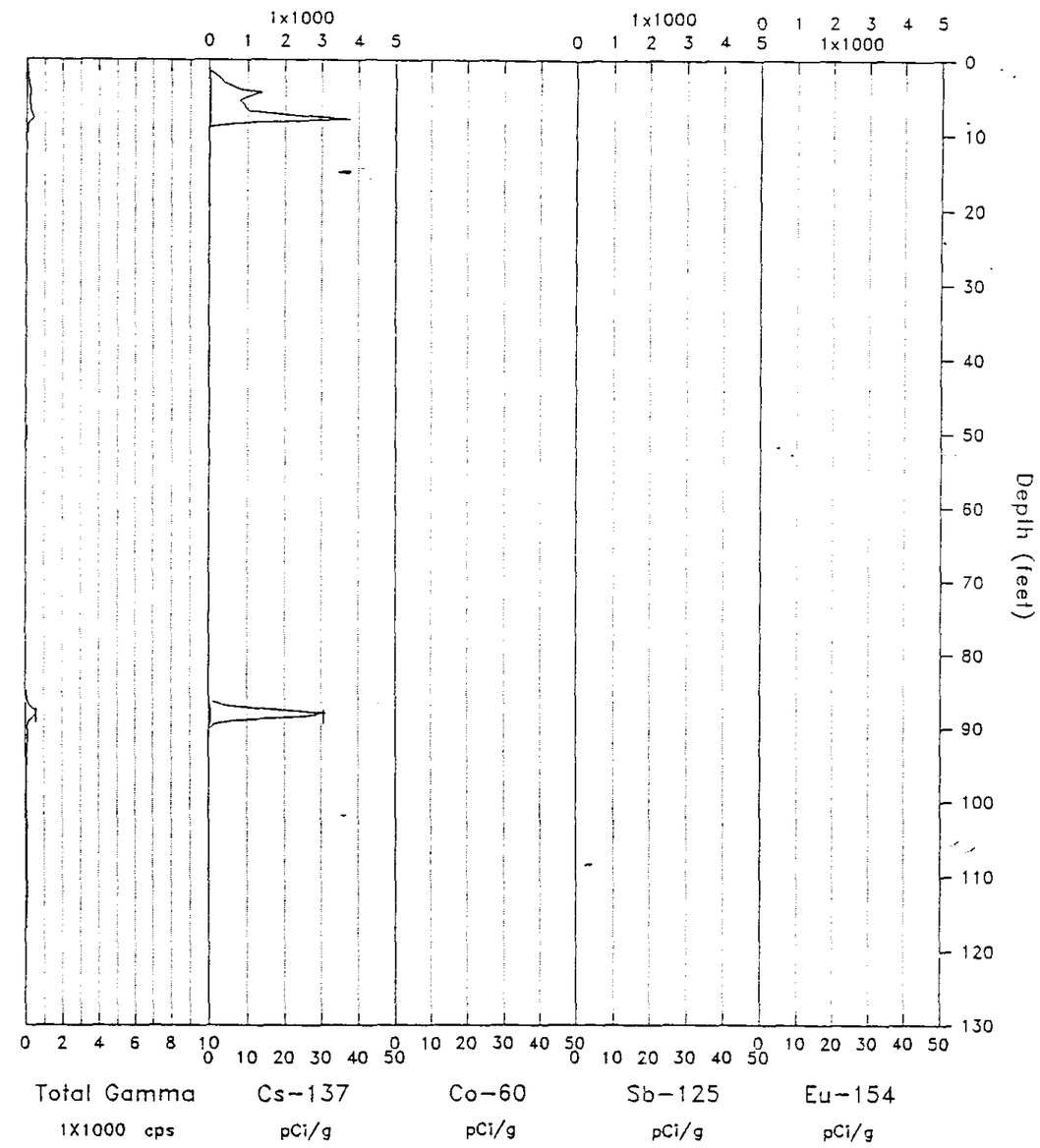
Well Construction



Lithology



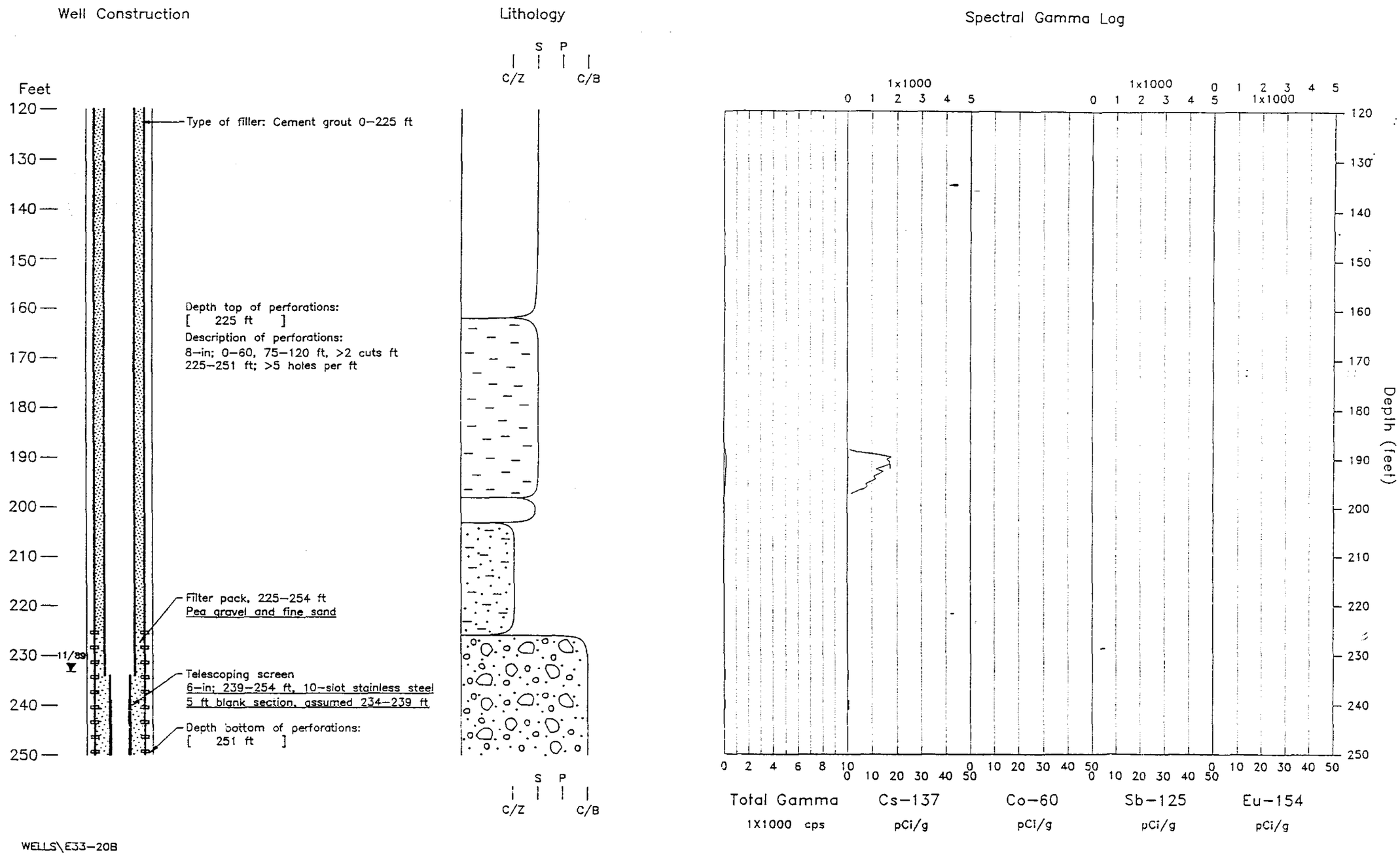
Spectral Gamma Log



WELLS\E33-20A

RLS Spectral Gamma Ray Borehole Survey (Page 2)

Well 299-E33-20 | Crib 216-B-11 | Log Date NA

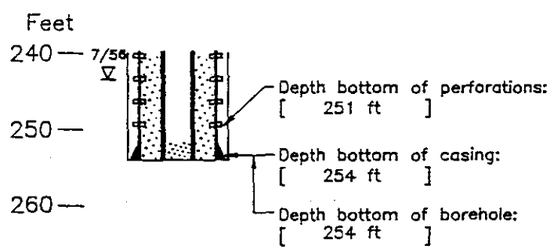


WELLS\E33-20B

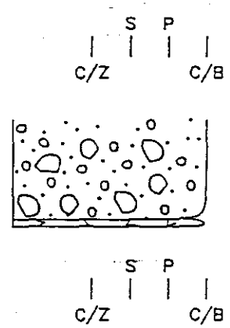
RLS Spectral Gamma Ray Borehole Survey (Page 3)

Well 299-E33-20 | Crib 216-B-11 | Log Date NA

Well Construction



Lithology



Spectral Gamma Log

WELLS\E33-20C

RLS Borehole Survey Report

299-E33-20 216-B-11 Crib

Casing	Depth: 254 ft	Size: 8 in	Thickness: 0.33 in
	Depth: 254 ft	Size: 6 in	Thickness: 0.25 in
Water	Depth: 234		
Survey	Depth: 0 - 10 ft	Mode: Fixed 0.6 fpm	Date: 9/28/92
	85 - 117 ft	Mode: Fixed 0.6 fpm	
	188 - 198 ft	Mode: Fixed 0.6 fpm	
	50,88,150,190 ft	Stations: 300sec	
	200,234,240,255 ft		

General Notes:
The screening survey depth intervals were determined from a review of the PNL gross gamma survey acquired earlier.

Detector depth was checked at 50,150 and 200 feet with a steel tape. The tool depth was not adjusted . The maximum depth error is 0.54% (ie. 0.27 ft at 50 ft.)

The maximum calibrated casing correction of 0.40 inches was applied to the survey data. The computed activity for data recorded through multiple casing strings will be underestimated.

Man-made Radionuclides:
Cesium (Cs-137) was encountered in all three zones logged and the stations at 234 and 240 feet. The maximum cesium decay activity detected was about 40 pCi/g at 8 feet.

Cobalt (Co-60) was only identified at the 255 foot station with a detected activity of 2 pCi/g.

No antimony (Sb-125) was encountered in the borehole survey. The plot track is present only for uniformity of the displayed data.

No europium-154 (Eu-154) was encountered in the borehole survey. The plot track is present only for uniformity of the displayed data.

299-E33-20

Westinghouse Hanford Company | **LOG HEADER** | Page 1 of 2

Well No. 299-E33-20 Area 200 East Date 9/25/92
Log Run #1 Log Type Gross Gamma
Elevation Datum Top of casing Elevation 640.87
Survey Coordinates N 45664 W 52627
Log Measured From Ground Surface
Location Description R-11 Crib
Ground Surface Elevation
Surface Temperature NA Weather Clear-Warm

BOREHOLE INFORMATION

Driller ?
Drill Rig Type ? Bit Type/Diameter ?
Borehole Diameter(s)/Depth 8"/244' 6"/244'
Depth Driller 244' Depth Logger 261.0'
Liquid Level None ? Liquid Density NA
Temperature NA

CASING RECORD

Type 8" Carbon Steel Sch.40 Interval +2.5 - 254'
Type 6" Carbon Steel Sch.40 Interval +2.7 - 254'
Type Interval
Type Interval
Well Screen Interval 225' - 251'
Comments: Return Error = +0.2' high
Centralizer used
Backfill added over previous ground surface & change in total depth of well.

Page 2 of 2

LOG HEADER

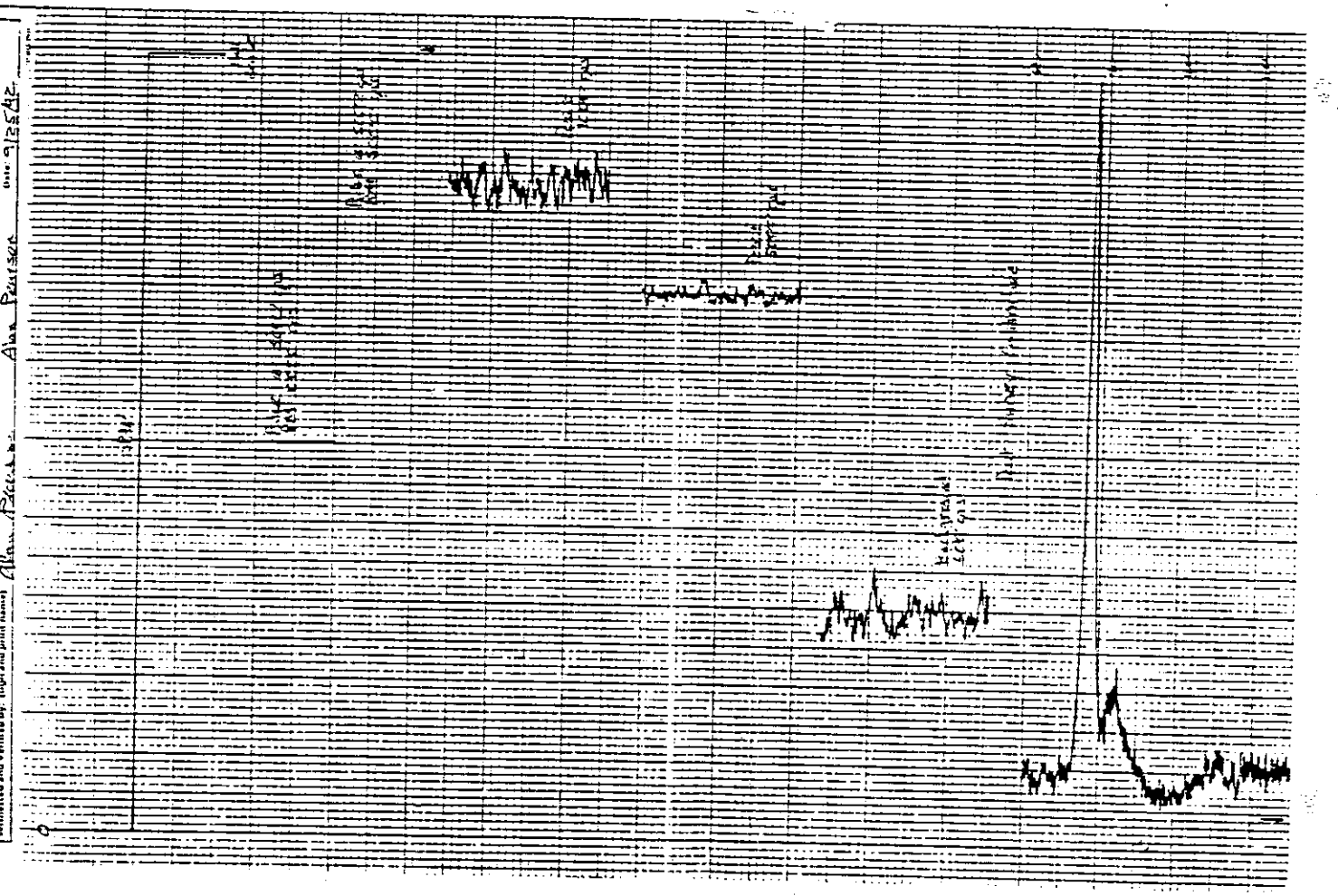
EQUIPMENT DATA

Logging Company PNL
Operator(s) Alan Pearson
Equipment Brand MLS
Equipment Type Analog
Tool Type Gamma Bar
Serial No. C627M11
Base Calibration Date 5/92
Calibration Reference PNL-8220 HC-606
Calibration/Probe Factor 9.00 x 10^-2 Calibration Datum (cfl): Position 1 315.1 cfl Position 2 65.1 cfl
Head Time 12.3 cusec Warm Up Time >15 min

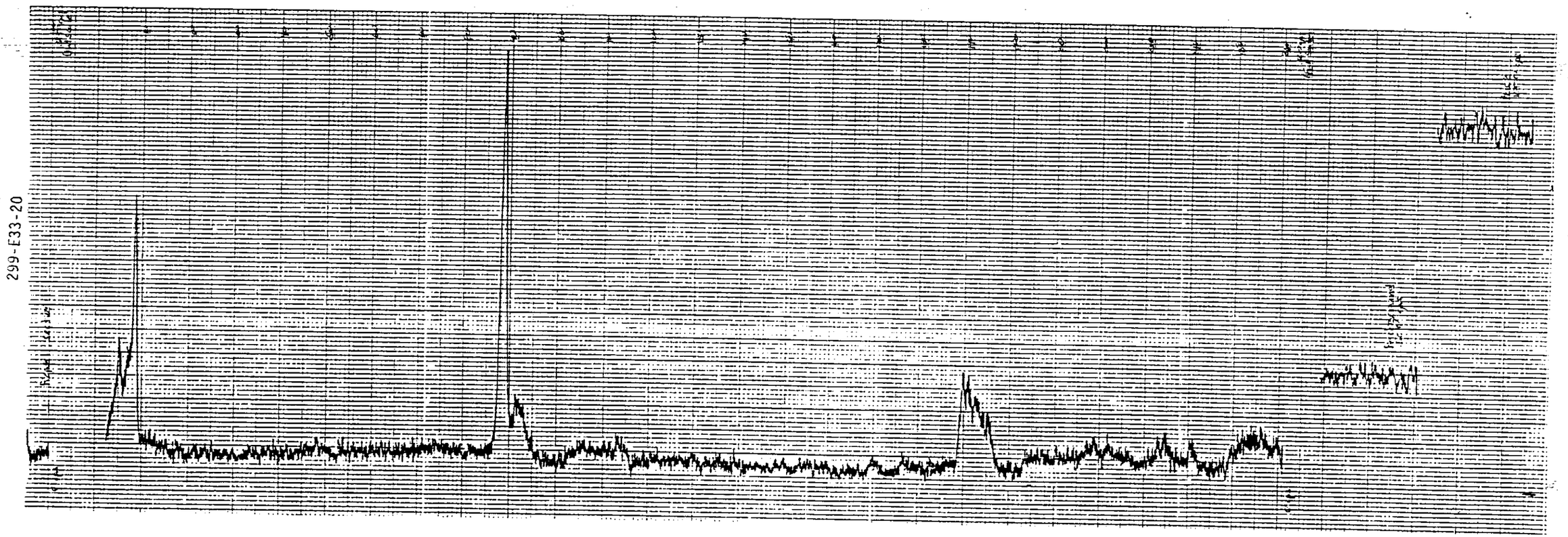
LOGGING INFORMATION

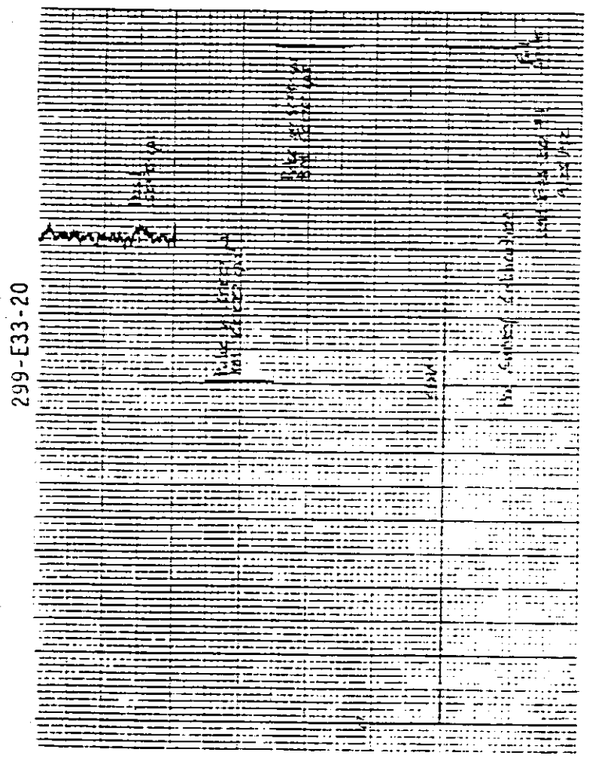
Log Interval From 261.0' To 2.4'
Reno(s) 1200' to 800'
Pre Survey Verification: Position 1 309.2 cfl Position 2 62.7 cfl Background 1115 cps
Base Calibration Difference: Position 1 5.9 cfl Position 2 2.4 cfl
Logging Speed 5 ft/min Reno Scales, CPS/in 50 cps/in
Start Time 1400 Completion Time 1610
Chart Speed(s), Min 10 ft/in
Chart Recorder Horizontal Scale, CPS/in 50 cps/in Time Constant(s) 12.1
Post Survey Verification: Position 1 304.6 cfl Position 2 62.7 cfl Background 1115 cps
Percent Change: Position 1 1.5% Position 2 0.0%
Comments: Return Error = +0.2' high
Centralizer used

Witnessed and Verified by: (sign and print name) Alan Pearson Date: 9/25/92



299-E33-20




299-E33-20

Crib Designation: 216-B-12

Type of Facility: Three 16 ft x 16 ft wooden cribs on a 160 ft x 50 ft gravel base

Location: N 42972 to N 43133, W 55000

Service Dates: 11/52 to 12/57, 11/67 to 11/73

Description of Waste: 520 x 10^6 liters of: process condensate from the waste evaporators in 221-U and 224-U buildings, later received construction waste from 221-B building and process condensate from the 221-B building, All waste was low salt, neutral to basic

Radionuclide Release Summary:

Radionuclide	Quantity
gross Pu	370 g
Sr-90	<150 Ci
Ru-106	310 Ci
Cs-137	1200 Ci
Co-60	<1.7 Ci
gross U	21 x 10^3 kg

Summary of Past Logging:

Boreholes	Date	Reference
299-E28-9	1976	Fecht, et al., 1977
	1987	Geophysics files
299-E28-16	1976	Fecht, et al., 1977
299-E28-64	1976	"
299-E28-65	1976	"
299-E28-66	1976	"

Review of Current Logging:

Borehole: 299-E28-16

This borehole was logged with the PNL gross gamma and the RLS spectral gamma-ray logging systems.

The spectral gamma log for this borehole is rather interesting and complex. First, there is a zone of near surface Cs-137 from the surface to about 10 feet.

Next there is a small zone of high Th-232 at about 45 feet which is probably naturally occurring and not the result of the releases at this site. The origin and significance of this high thorium as it relates to the Hanford formation stratigraphy is not known at this point due to a lack of data on the natural potassium, uranium and thorium variations in the Hanford formation.

A zone of high Cs-137 concentration is found at about 100 feet. This no doubt has been released at this site and has migrated to this depth.

Finally, U-235 and U-238 have been detected in this borehole in relatively low concentrations at 80 feet, 105 feet, 150 feet

and 305 feet. The thickness of these zones of uranium vary. Considering the amount of uranium released at this site, it is not suprising to find it in the unsaturated zone. Because it is quite mobile in the unsaturated zone and because it is found at multiple depths all the way to and into the groundwater, it is obvious that the uranium released at this site has traveled to the groundwater and contributed to the groundwater contamination.

The various zones of uranium, cesium and thorium all show up in the recent gross gamma-ray log although some of the zones would not be identified as gross gamma activity anomalies if they were not identified by the spectral gamma logging.

There is very good separation of the uranium and cesium in this borehole indicating that they behave differently in the unsaturated zone due to different chemical interactions.

It is not possible to compare the recent gross gamma log with the older logs due to drastic differences in the data acquisition procedures.

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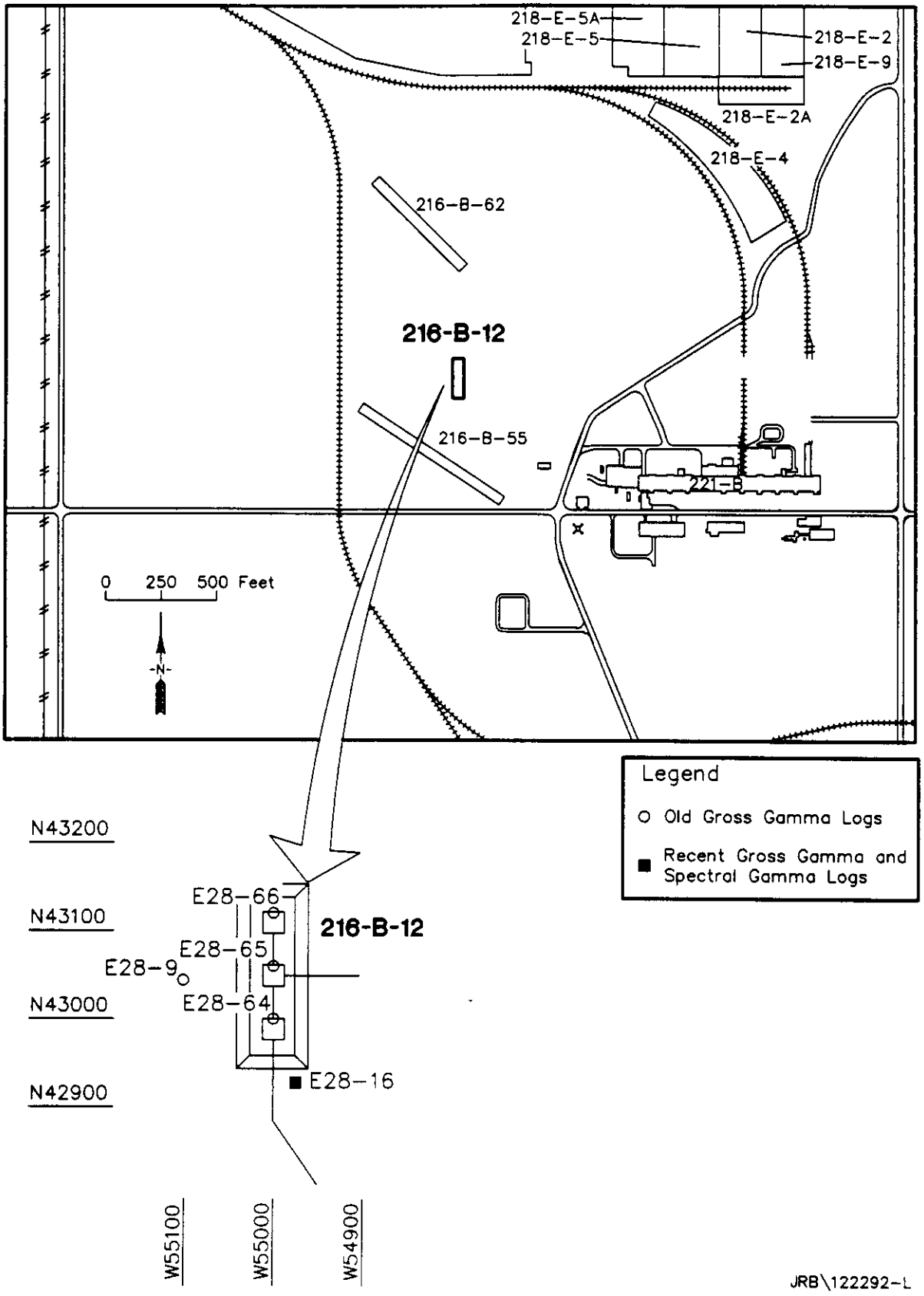

218-E-5A
218-E-5
218-E-2
218-E-9
218-E-2A
218-E-4
216-B-62
216-B-12
216-B-55
221-B
0 250 500 Feet
N
Legend
Old Gross Gamma Logs
Recent Gross Gamma and Spectral Gamma Logs
N43200
N43100
N43000
N42900
E28-66
E28-65
E28-9
E28-64
E28-16
216-B-12
W55100
W55000
W54900
JRB\122292-L

Westinghouse Hanford Company
RLS Spectral Gamma-Ray Borehole Survey Log Header

Project: 200 East AAMS 216-B-12 Crib

Borehole	299-E28-16			
Coordinates	42,927 N	54,975 W	Feet	(Plant 200 E)
Elevation	700.4 feet		Top of Casing	(Plant 200 E)

Borehole Environment Information

Borehole Fluid Depth 299 (Feet) from Zero (0.0) Depth Reference of Log

Casing Size I.D. (inch)	Casing Thickness (inch)	Top Depth (feet)	Base Depth (feet)
6	0.25	0.0	325.0

RLS Passive Spectral Gamma Survey Information

Logging Engineers R. V. Cram S. E. Kos
Log Depth Reference at Zero (0.0) depth is Ground Level

Log Date	Archive File Names	Log Mode[1], Speed	Depth Intervals (feet)
Sept 24, 92	H2E2816\A251	FIXED 0.6 fpm	0-10,43-50,77-112, 143-158 & 170-180
	(Lead Shield)	FIXED 0.6 fpm	Lead Shield 93-103
		Stations 300 s	46,80,151,176,200,250,307

[1]FIXED: Fixed velocity of Cable Speed: fpm: Feet per minute Stations: Stationary measurement at specified depth

Calibration and Analysis Information

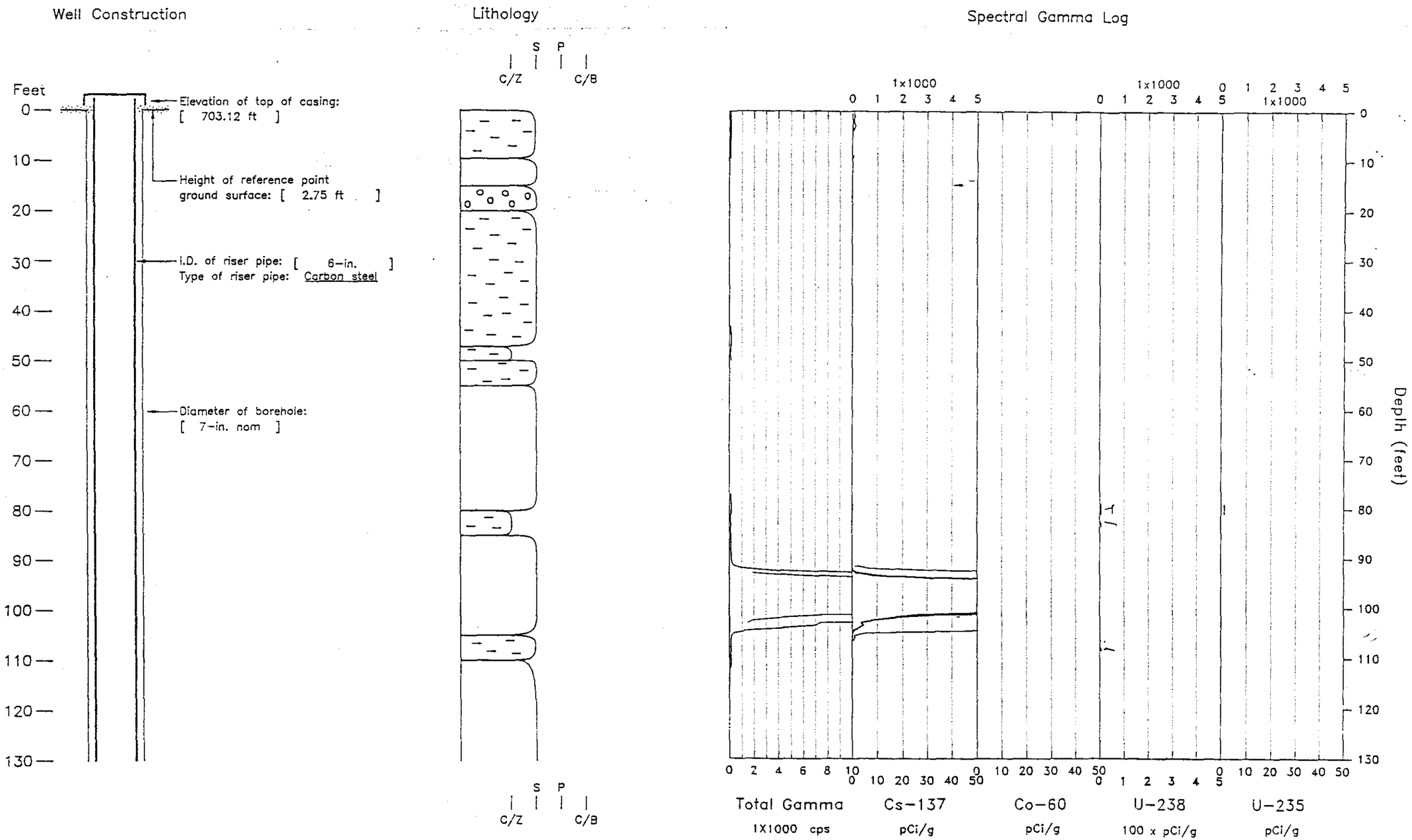
RLS Calibration Date: Nov 21, 1991
Calibration Report: WHC-SD-EN-TRP-001

Analyst Names: J. P. Kiesler
Analysis Date: Sept 30, 1992

Analysis Notes: Interval 93-103ft relogged with Pb shield
Radionuclides identified: Cs-137, U-235, U-238,

RLS Spectral Gamma Ray Borehole Survey

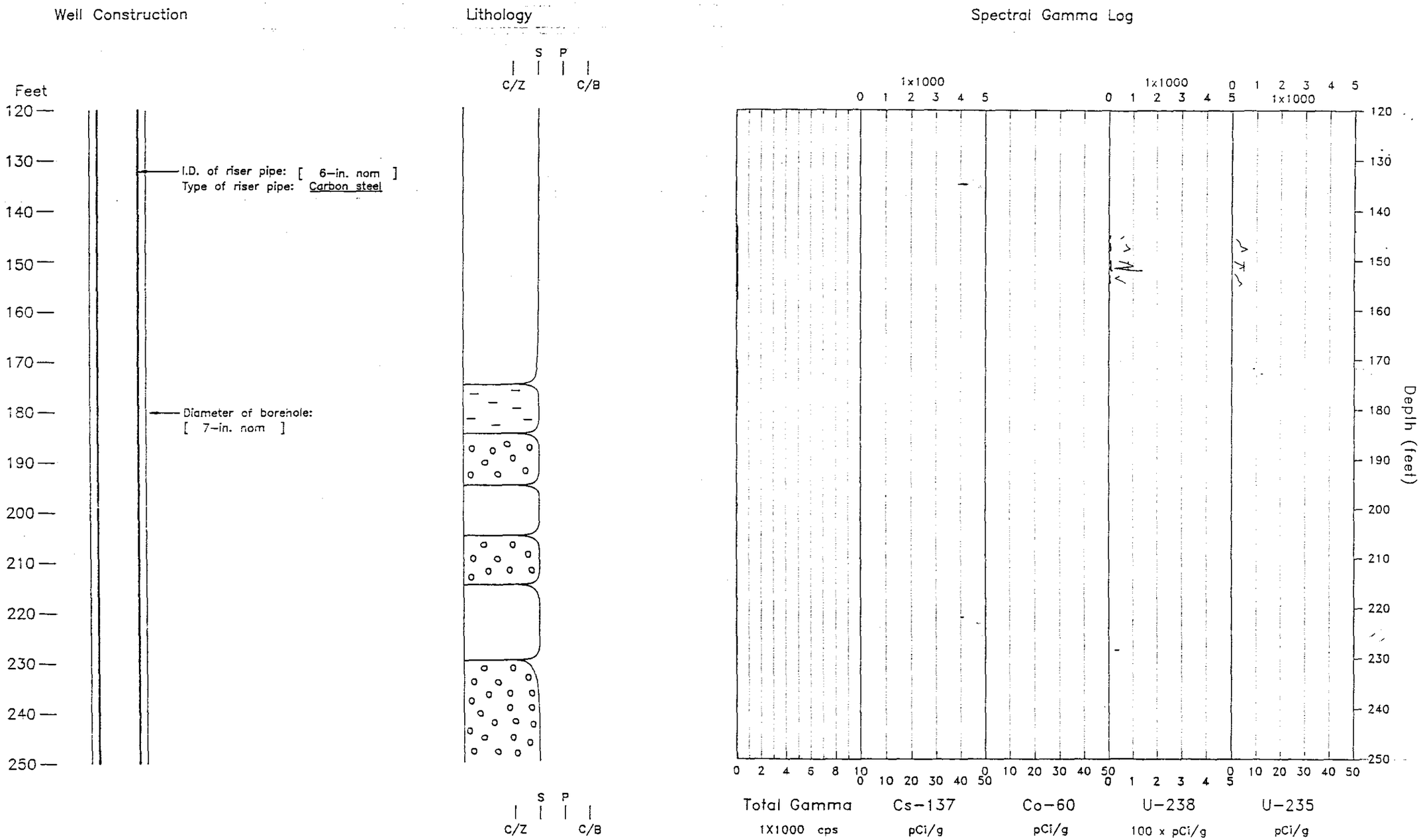
Well 299-E28-16 | Crib 216-B-8 | Log Date 9/24/92



WELLS\E28-16A

RLS Spectral Gamma Ray Borehole Survey (Page 2)

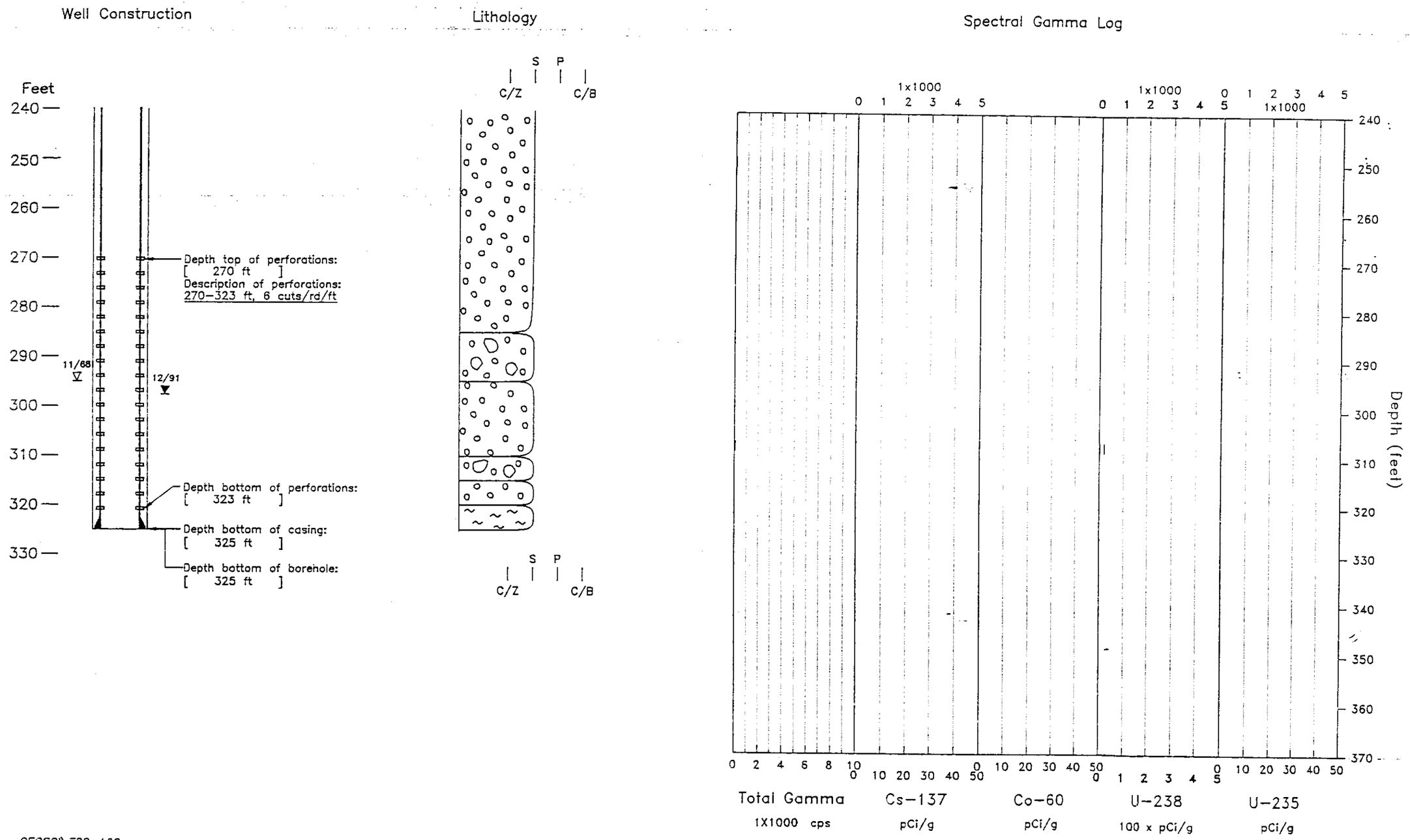
Well 299-E28-16 | Crib 216-B-8 | Log Date 9/24/92



GEOSCI\E28-16B

RLS Spectral Gamma Ray Borehole Survey (Page 3)

Well 299-E28-16 | Crib 216-B-8 | Log Date 9/24/92



GEOSC:\E28-16C

RLS Borehole Survey Report

299-E28-16 216-B-12 Crib

Casing	Depth: 325 ft	Size: 6 in	Thickness: 0.25 in
Water	Depth: 299 ft		
Survey	Depth: 0 - 10 ft	Mode: Fixed 0.6 fpm	Date: 9/24/92
	43 - 50 ft	Mode: Fixed 0.6 fpm	
	77 - 112 ft	Mode: Fixed 0.6 fpm	
	143 - 158 ft	Mode: Fixed 0.6 fpm	
	170 - 180 ft	Mode: Fixed 0.6 fpm	
	93 - 103 ft	Mode: Fixed 0.6 fpm	(Lead Shield)
	46,80,151,176 ft	Stations: 300sec	
	200,250,307 ft		

General Notes:
The screening survey intervals were determined from a gross gamma survey. Stationary measurements were acquired at seven depth locations.

The depth interval from 43 to 50 feet was selected by the high count on the gross gamma survey. The interval contained natural thorium at 1.5 pCi/g, about twice the expected activity.

The counting system saturated from 94 to 101 feet. The lead shield was installed and depth interval was relogged. The uncorrected total gamma curve from the lead shield is plotted with the standard total gamma curve.

Detector depth was checked but not adjusted every 50 feet to 300 feet. The maximum depth error is 0.26% (ie. 0.13 ft at 50 ft.)

Man-made Radionuclides:
Cesium (Cs-137) was encountered in the borehole from the surface to 10 feet and from 91 feet to 107 feet. Cesium decay activity exceeded 200 pCi/g from 93 to 104 feet. The activity exceeded 5000 pCi/g from 94 to 101 feet.

No Cobalt (Co-60) was encountered in the borehole survey. The plot track is present only for uniformity of the displayed data.

Uranium-238 (U-238) was encountered in the borehole from 79 to 84 feet, from 91 to 177 feet and at the 307 ft station. U-238 is assumed to be present at low concentrations even in the unlogged intervals. The maximum uranium-238 activity detected was 80 pCi/g at 115 ft. The U-238 identified in this borehole must not be confused with naturally occuring uranium. Natural uranium will be in secular equilibrium with all of its daughters. The U-238 radionuclide identified in 299-E28-16 was not in secular equilibrium because the daughters below radium (Ra-226) were present only at natural levels.

Uranium-235 (U-235) was encountered in the borehole from 144 feet to 155 feet. The decay uranium-235 decay activity detected was less than 7 pCi/g. The computed activity is not considered accurate. The identifying gamma-ray at 185.7 keV is at the lower energy range of the valid calibration data.

299-E28-16

Westinghouse Hanford Company | LOG HEADER | Page 1 of 2

Well No. 299-E28-16 Area 200 East Date 9/19/92

Log Run #1 Log Type Gross Gamma

Elevation Datum Top of casing Elevation 727.12

Survey Coordinates N 142922.5 W 54975

Log Measured From Ground Surface

Location Description SW Corner of 216-B-12 Crib

Ground Surface Elevation

Surface Temperature NA Weather Overcast - Cool

BOREHOLE INFORMATION

Driller ?

Drill Rig Type ? Bit Type/Diameter ?

Borehole Diameter(s)/Depth 6"/315'

Depth Driller 315' Depth Logger 313.6'

Liquid Level 300' Liquid Density Appearance Clean

Temperature NA

CASING RECORD

Type 6" Carbon Steel Sch 40 Interval +3.3' - 323'

Type Interval

Type Interval

Type Interval

Well Screen Interval 270' - 323'

Comments: Casing Stick +0.2' high

Centralizer used

Borehole info taken from Hanford Wells

Page 2 of 2

LOG HEADER

EQUIPMENT DATA

Logging Company PNL

Operator(s) Alan Peschen

Equipment Brand NLS

Tool Type Gamma Ray

Base Calibration Date 5/92

Calibration Factor 1.00 Calibration Position(s)

Tool Diameter 12.3 inches

Log Interval from 313.6' to 1100' @ 500 ft/hr

Remarks 1800' to 1100' @ 500 ft/hr

Pre Survey Verification: Position 1 313.7 ft

Base Calibration Differences: Position 1 1.1 ft

Logging Speed 5 ft/min

Start Time 0820

Client Specified Data 100 ft/in.

Client Recorder Horizontal Scale (cm/in) 50 cm/in.

Post Survey Verification: Position 1 310.1 ft

Percent Change Position 1 1.1%

Comments: Return time = 702' high

Centralizer used

Equipment Type NaI Scintillation

Serial No. CG23M11

Calibration Reference NVL-8320 NVL-4030

Position 1 65.1 cpm

Warm Up Time >15 min

LOGGING INFORMATION

Log 1 9'

Position 1 1182' to 1050' @ 500 ft/hr

Background 60 cps

Position 1 667 cpm

Position 1 1.6 cpm

Noise Spikes (Yes) 50 cps/div

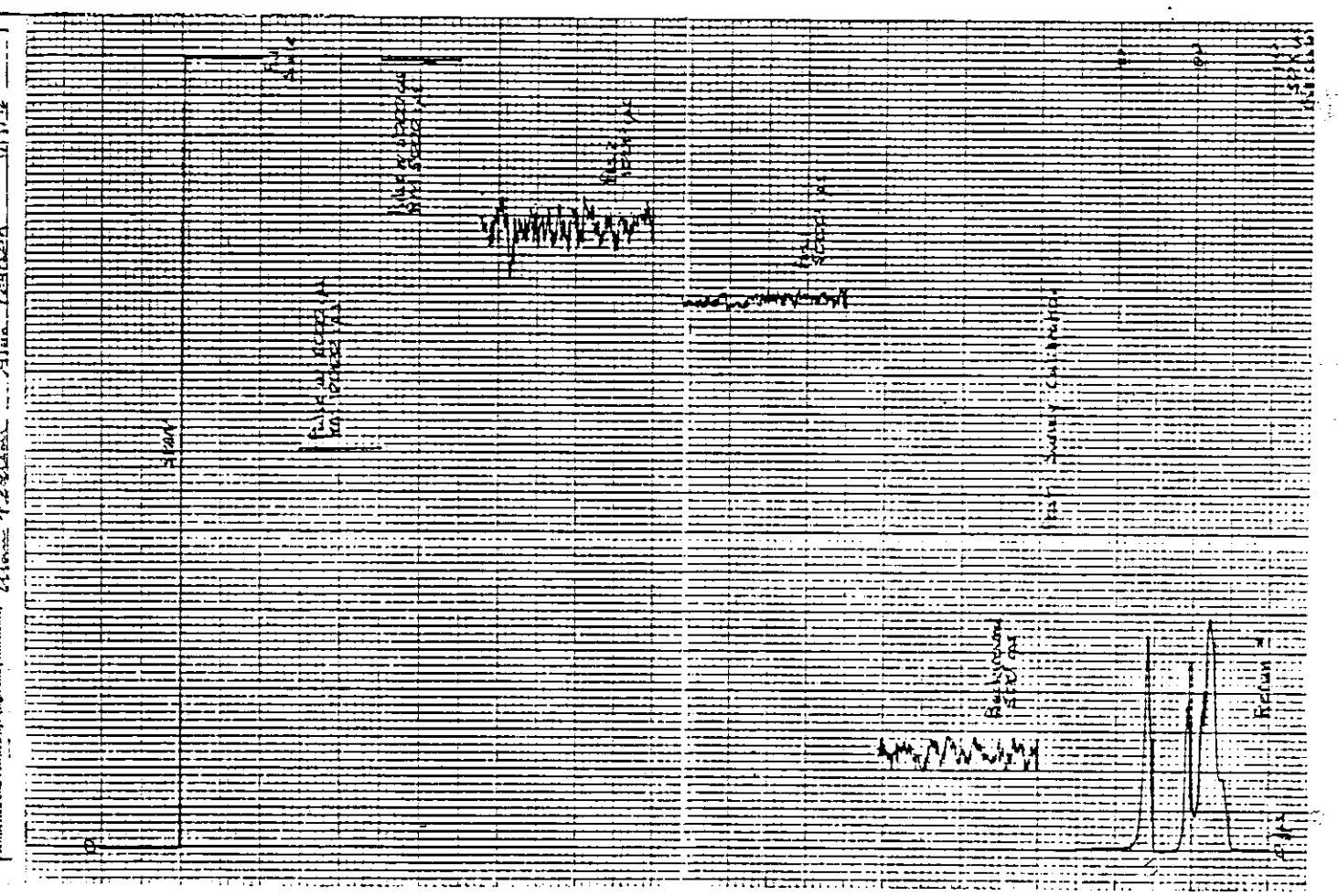
Compensation Time 0.1 sec

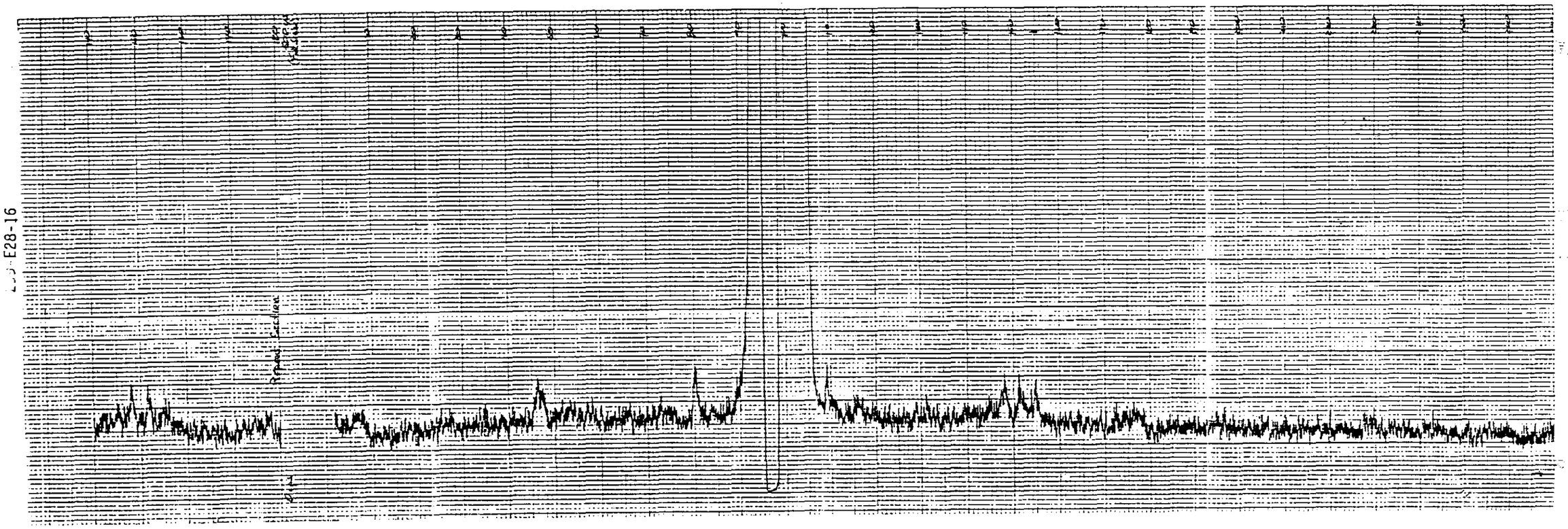
Time Constant(s) TC-1

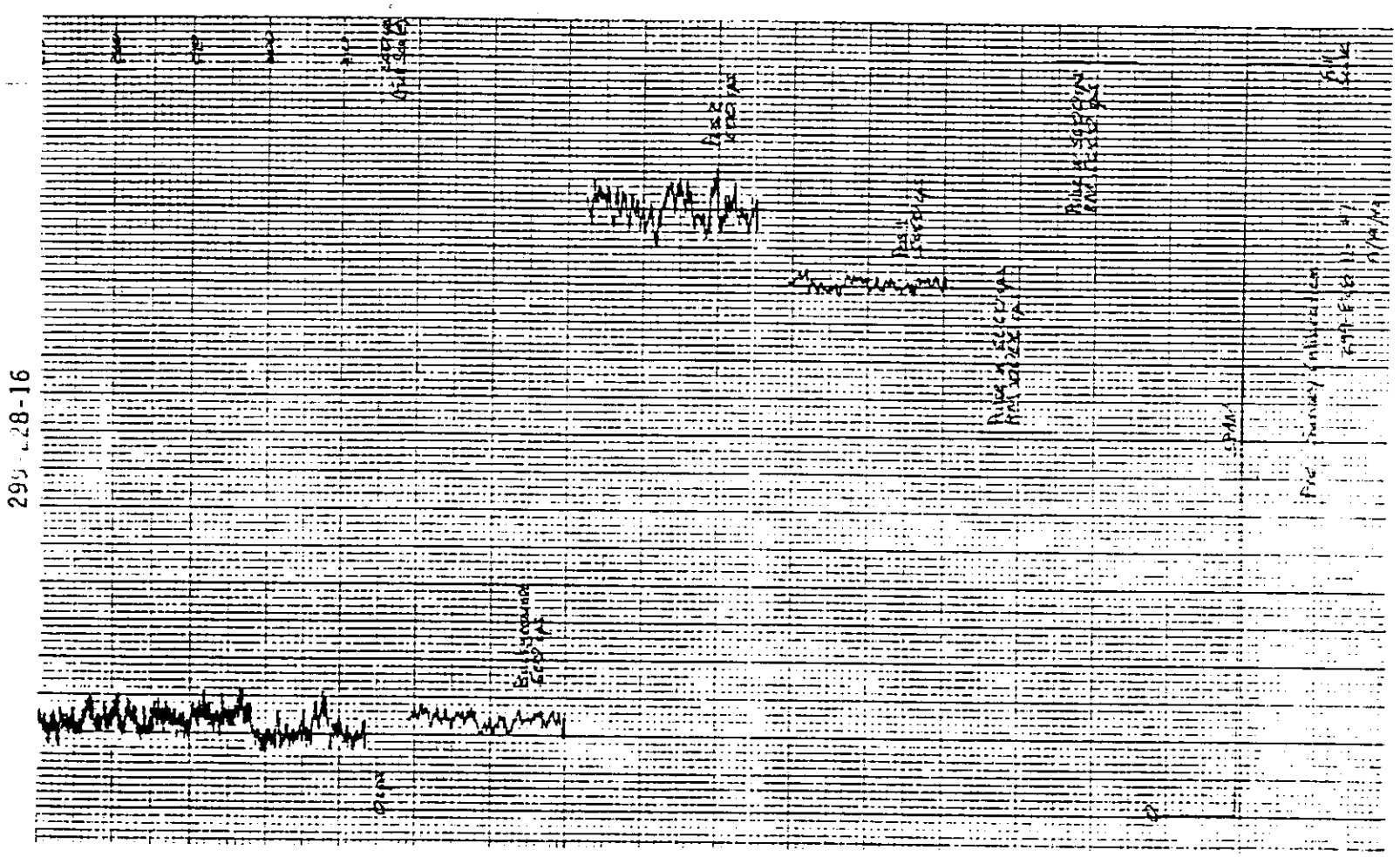
Position 1 65.8 cpm Background 60 cps

Position 1 1.3%

Witnessed and Verified by (sign and print name) Alan Peschen Date 9/19/92




E28-16



Crib Designation: 216-B-14 through 216-B-19

Location: N 35577 to N35955, W 53309 to W 53607

Service Dates: 1956 to 1957

Description of Waste: Scavenged waste from the uranium recovery process (TBP solvent extraction) in 221-U; High-salt, neutral to basic
216-B-14: 8.71 x 10^6 liters
216-B-15: 6.32 x 10^6 liters
216-B-16: 5.6 x 10^6 liters
216-B-17: 3.41 x 10^6 liters
216-B-18: 8.52 x 10^6 liters
216-B-19: 6.4 x 10^6 liters

Radionuclide Release Summary:

216-B-14

Radionuclide	Quantity
Pu	25 g
Sr-90	400 Ci
Ru-106	59 x 10^3 Ci
Cs-137	250 Ci
Co-60	5 Ci
U	220 kg

216-B-15

Radionuclide	Quantity
Pu	5 g
Sr-90	200 Ci
Ru-106	22 x 10^3 Ci
Cs-137	200 Ci
Co-60	5 Ci
U	100 kg

216-B-16

Radionuclide	Quantity
Pu	10 g
Sr-90	700 Ci
Ru-106	13 x 10^3 Ci
Cs-137	650 Ci
Co-60	5 Ci
U	320 kg

216-B-17

Radionuclide	Quantity
Pu	10 g
Sr-90	160 Ci
Ru-106	250 Ci
Cs-137	220 Ci
Co-60	1 Ci
U	350 kg

216-B-18

Radionuclide	Quantity
Pu	10 g
Sr-90	190 Ci
Ru-106	19 x 10^3 Ci
Cs-137	250 Ci
Co-60	5 Ci
U	240 kg

216-B-19

Radionuclide	Quantity
Pu	10 g
Sr-90	200 Ci
Ru-106	5100 Ci
Cs-137	270 Ci
Co-60	5 Ci
U	180 kg

Summary of Past Logging:

Boreholes	Date	Reference
299-E13-1	1976	Fecht, et al., 1977
	1985	Geophysics files
	1987	"
299-E13-2	1976	Fecht, et al., 1977
	1985	Geophysics files
	1987	"
299-E13-3	1976	Fecht, et al., 1977
	1985	Geophysics files
	1987	"
299-E13-4	1976	Fecht, et al., 1977
	1985	Geophysics files
	1987	"
299-E13-5	1976	Fecht, et al., 1977
	1985	Geophysics files
299-E13-6	1976	Fecht, et al., 1977
	1985	Geophysics files
	1987	"
299-E13-20	1985	Geophysics files
	1987	Geophysics files
299-E13-21	1976	Fecht, et al., 1977
	1985	Geophysics files
	1987	"

Review of Current Logging:

Boreholes: 299-E13-1, 299-E13-3, 299-E13-5

All of three of these boreholes were logged with the RLS spectral gamma-ray logging system and borehole 299-E13-5 was also logged with the PNL gross gamma-ray system. Specific nuclides identified by the spectral gamma-ray logging include Cs-137, Co-60, Sb-125 and Eu-154.

Borehole E13-1 has Co-60 down to about 280 feet which is about 40 feet above the groundwater table. High concentrations of Cs-137 are found down to about 100 feet with trace amounts to about 180 feet. Sb-125 is only found concentrated up near the

bulk of the high concentration nuclides.

Boreholes E13-3 has the same nuclides as E13-1 with the additiona of Eu-154 which is found with the bulk of the higher concentrations of the other nuclides.

Borehole E13-5 shows varying concentrations of cesium, cobalt and antimony down to a maximum depth of 100 feet. This shows up in the gross gamma-ray log as multiple spatial peaks down to the 100 foot level. Below the contamination zone there is little or no variation in the natural background activity indicating little lithology variation.

This borehole contrasts considerably with the other borehole at this site, E13-21 which is very close to E13-5, but on the other side of the crib. The gross gamma log of E13-21 shows gamma-emitting nuclides down to at least 310 feet.

From analysis of all of the data, some general statements can be made about this site. First, from the little background variation seen in the recent and old gross gamma-ray logs, it is evident that there is little lithology variation. This contrasts with the 200 west area lithology considerably and it results in less horizontal spreading of the contamination plumes from the cribs. This is seen in as significant differences in the contaminant distributions between boreholes E13-5 and E13-21 even though they are very to each other.

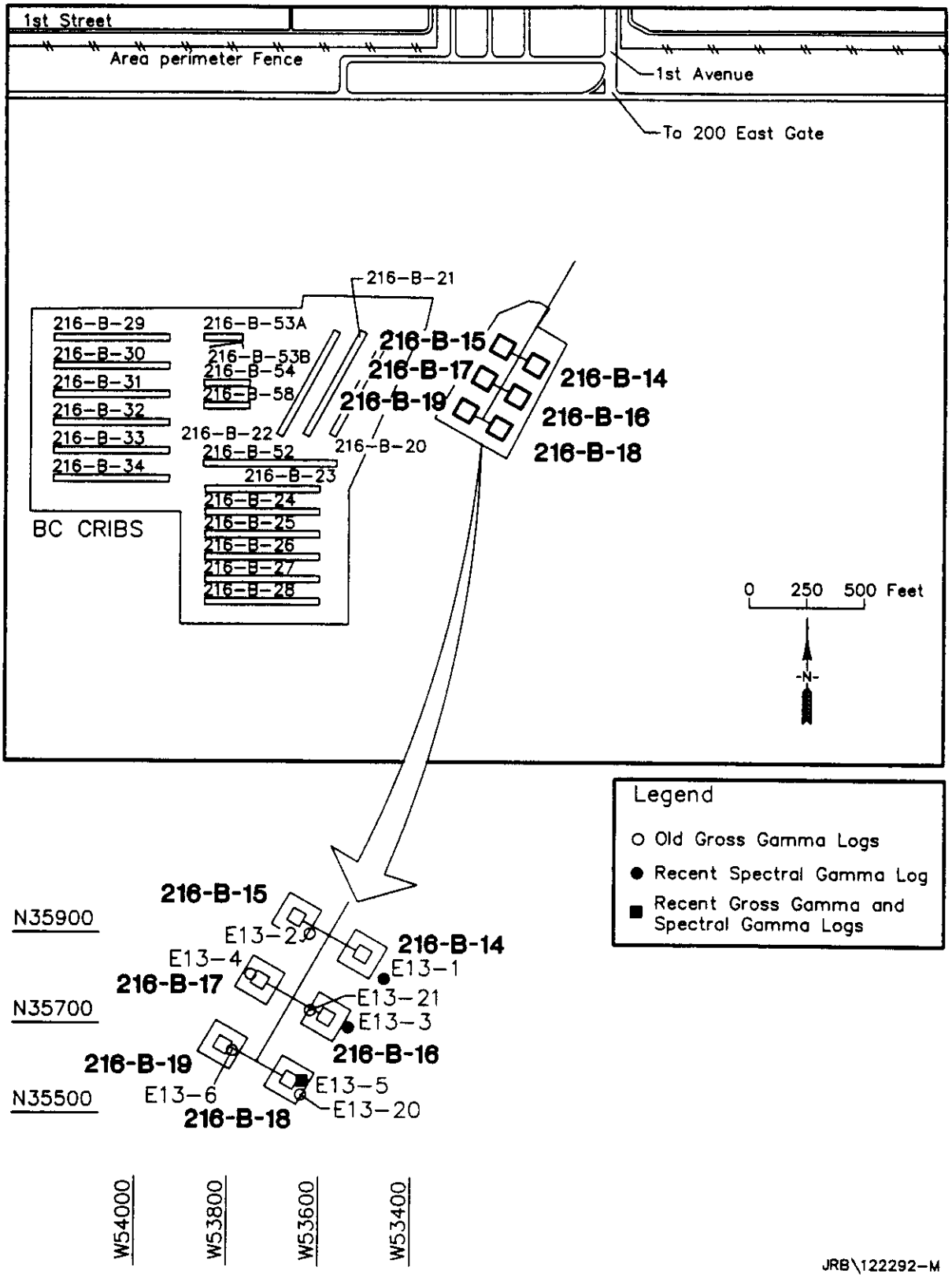
With this in mind, and considering the closeness of the contamination to the groundwater as shown in the spectral log of borehole E13-1 and as seen in the old gross gamma logs of E13-21, we can conclude that at least the contamination from these two adjacent cribs (B-14 and B-16) most certainly has reached the groundwater. Although we do not have any direct evidence from the boreholes adjacent to the other cribs, it is possible that they also have caused some groundwater contamination.

It is also evident that it will be extremely difficult to provide any type of areal correlation of the contaminant distribution due to the highly vertical nuclide migration tendency.

Some horizontal migration due to stratigraphic changes is evident as seen by the lobe of contamination shown in borehole E13-20. Even though we do not have good definition of the stratigraphy, we can assume that this contamination is most certainly caused by horizontal migration of liquids at depth along a hydrologic potential barrier of sorts.

Much of the old data as provided in Fecht, et al., 1977 are inconclusive about both the contamination at depth and any natural background variation due to lithology changes. It is clear that we need a better understanding of the lithology at this site.

Finally, because there is little horizontal migration of the nuclides, it would be helpful to obtain gamma-ray logs through boreholes drilled through the center or just adjacent to each crib. This would penetrate the most highly contaminated zone at each crib and provide data which would show which of the cribs did have nuclide migration to the groundwater.


1st Street
Area perimeter Fence
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To 200 East Gate
216-B-21
216-B-29
216-B-30
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216-B-34
216-B-53A
216-B-53B
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216-B-58
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216-B-14
216-B-16
216-B-18
BC CRIBS
0 250 500 Feet
N
Legend
Old Gross Gamma Logs
Recent Spectral Gamma Log
Recent Gross Gamma and Spectral Gamma Logs
N35900
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N35500
216-B-15
E13-2
216-B-14
E13-1
E13-4
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216-B-19
E13-6
E13-5
E13-20
216-B-18
W54000
W53800
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JRB\122292-M

Westinghouse Hanford Company
RLS Spectral Gamma-Ray Borehole Survey Log Header

Project: 200 East AAMS, B-Plant 216-B-14 thru 216-B-19 Cribs

Borehole	299-E13-1		
Coordinates	35,800 N	53,260 W	Feet (Plant 200 E)
Elevation	741.9 feet		Top of Casing (Plant 200 E)

Borehole Environment Information

Borehole Fluid Depth 338.0 (Feet) from Zero (0.0) Depth Reference of Log

Casing Size I.D. (inch)	Casing Thickness (inch)	Top Depth (feet)	Base Depth (feet)
6	0.257	0.0	346.6

RLS Passive Spectral Gamma Survey Information

Logging Engineers R. V. Cram S. E. Kos
Log Depth Reference at Zero (0.0) depth is Ground Level

Log Date	Archive File Names	Log Mode[1]	Speed	Depth Interval (feet) Top	Base	Incr
Aug 31, 92	H2E1301\A232	MSA	35sec RT	0	97	0.5
Sept 01, 92	H2E1301\A233	MSA	35sec LT	95	273	0.5
Sept 02, 92	H2E1301\A234	MSA	75sec RT	10	60	0.5

[1] MSA: Move-Stop-Acquire Lt: Live Time Rt: Real Time

Calibration and Analysis Information

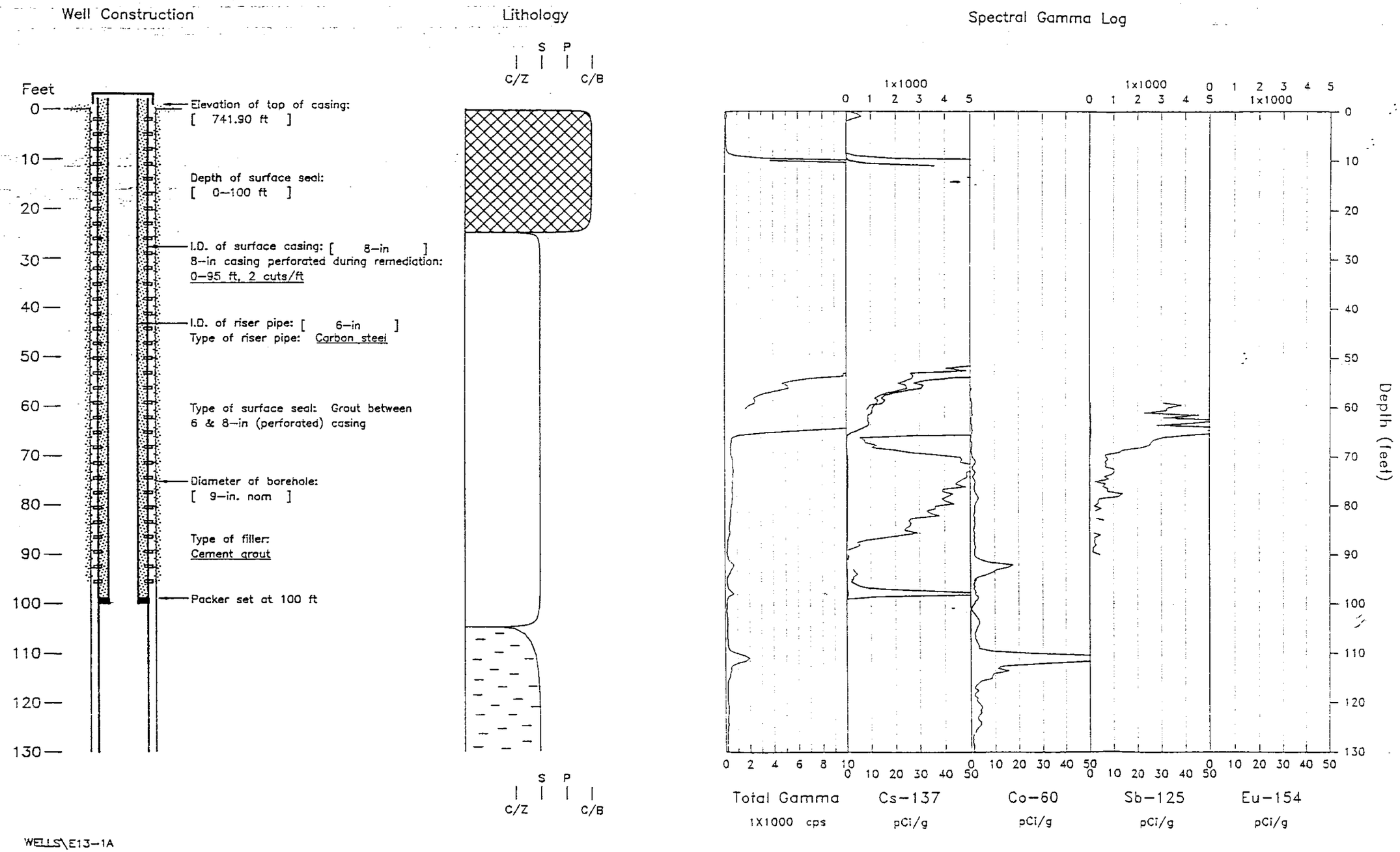
RLS Calibration Date: Nov 21, 1991
Calibration Report: WHC-SD-EN-TRP-001

Analyst Names: J. P. Kiesler
Analysis Date: Sept 17, 1992

Analysis Notes: Lead shield used 9/24/92 (A234) Depths 10 - 60 ft
Radionuclides identified: Cs-137, Co-60, Sb-125

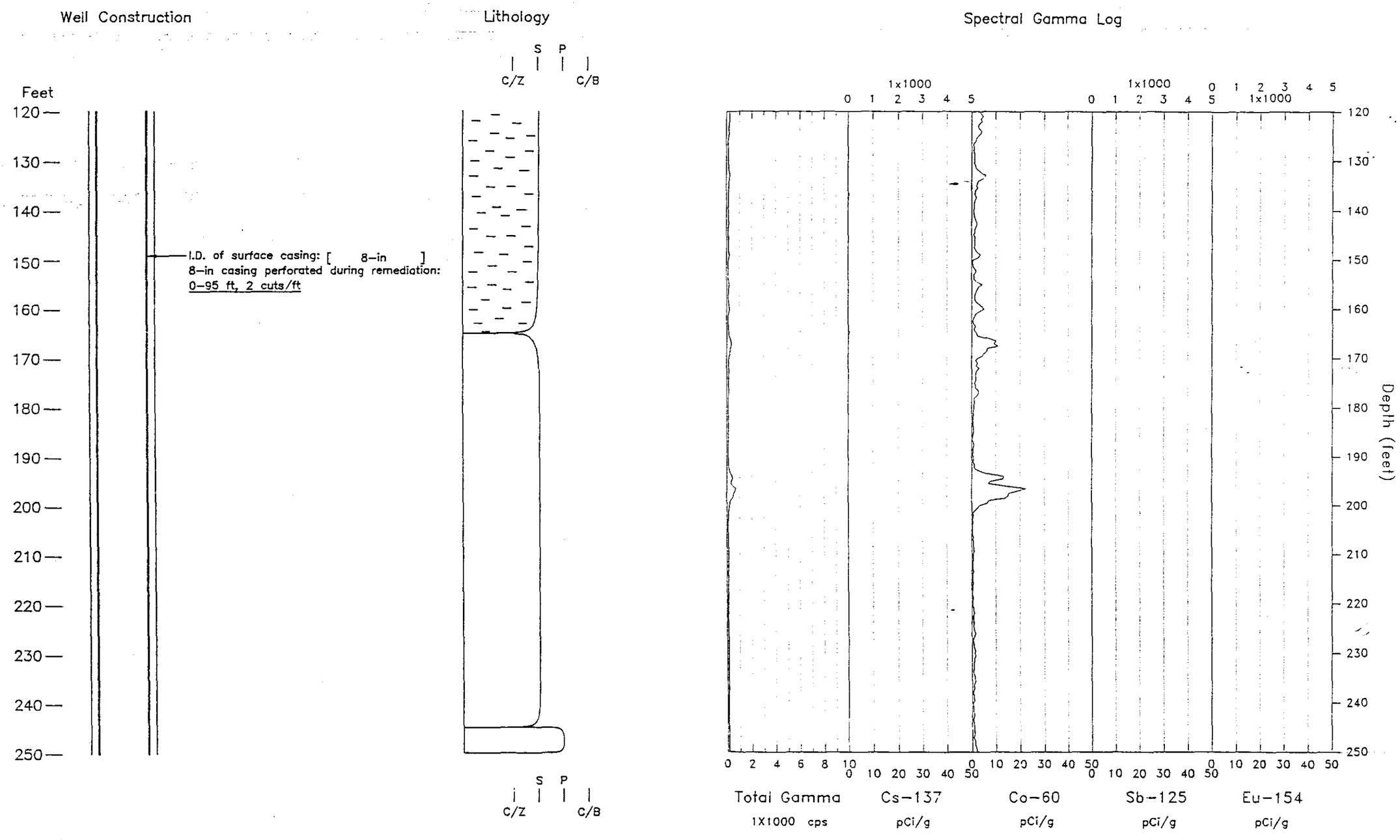
RLS Spectral Gamma Ray Borehole Survey

Well 299-E13-1 | Cribs B-C | Log Date 8/31/92



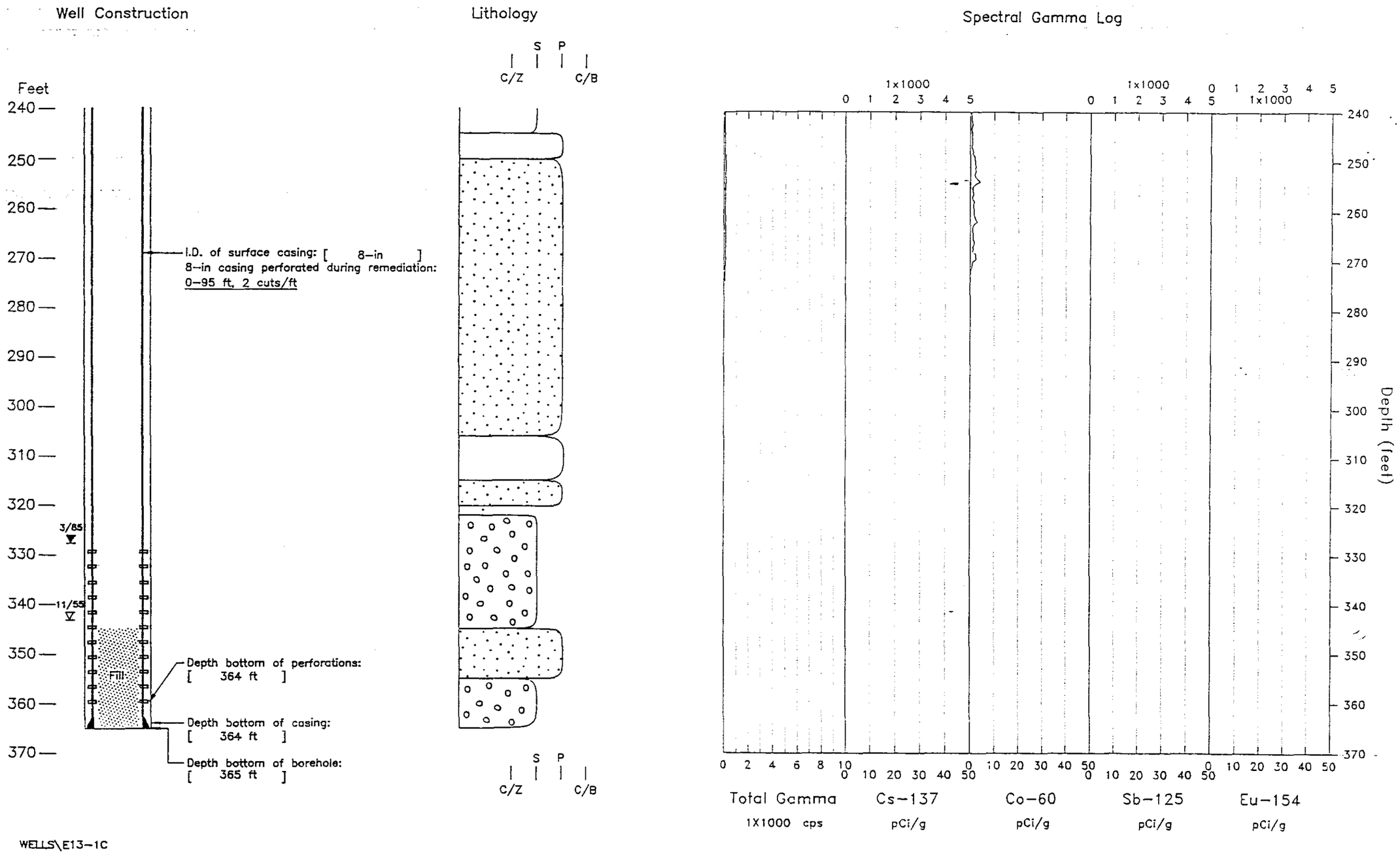
RLS Spectral Gamma Ray Borehole Survey (Page 2)

Well 299-E13-1 | Cribs B-C | Log Date 8/31/92



RLS Spectral Gamma Ray Borehole Survey (Page 3)

Well 299-E13-1 | Cribs B-C | Log Date 8/31/92



WELLS\E13-1C

RLS Borehole Survey Report

299-E13-1 216-B-14 thru 216-B-19 Cribs

Casing	Depth: 346 ft	Size: 6 in	Thickness: 0.26 in
Water	Depth: 338 ft		
Survey	Depth: 0 - 97 ft	Mode: MSA 35 sec	Date: 8/31/92
	95 - 273 ft	Mode: MSA 35 sec	Date: 9/01/92
	10 - 60 ft	Mode: MSA 75 sec	Date: 9/02/92 (Shielded)

General Notes:
HPT detected 250 cpm (beta/gamma) on pre survey swab of borehole on 8/31/92. Determined it to be radon by decrease in count rate after several minutes of monitoring.

Delay in accessing borehole, limited borehole access time, and extended depth required more than one day for screening survey of borehole.

The maximum screening survey depth of 273 feet was determined from review of the PNL gross gamma survey acquired earlier. Stationary spectral gamma ray measurements were taken at 274, 300, and 341 feet. No manmade radionuclides were identified in the spectra acquired at 300 and 341 feet.

High counting activity saturated the standard logging system configuraiton from 11 feet to 49 feet. The lead shield was installed and the counting system configuration changed to maximize count rate capabilities. The counting system continued to saturate from 11-14 ft, 17-22 ft, and 28-46 ft.

Both standard configuration and lead shield logging configuration data surveys are plotted together. The numeric data values of the Total Gamma plot for the two configurations will not produce identical values. No Total Gamma correction for the gamma-ray attenuation from the lead shield has been established.

Detector depth was checked every 50 feet with at steel tape. The tool depth was not adjusted. The maximum depth error is 0.2% (ie. 0.6 ft at 300 ft).

Man-made Radionuclides:
Cesium (Cs-137) was encountered in the borehole from the surface to 99 ft. Cesiuim decay activity exceeded 200 pCi/g from 10 feet to 64.5 feet and exceeded 5000 pCi/g from 11 feet to 50 feet.

Cobalt (Co-60) was encountered in the borehole survey from 56 feet to the maximum survey depth of 274 feet. The maximum cobalt decay activity detected was 70 pCi/g at 111 feet. The presence of cobalt could not be identified when cesium activity exceeded 2000 pCi/g.

Antimony (Sb-125) was encountered in the borehole survey from 59 feet to 90 feet. The maximum antimony decay activity detected was 60 pCi/g at 64 feet.

No europium-154 (Eu-154) was detected in the borehole survey. The plot track is present only for uniformity of the displayed data.

Westinghouse Hanford Company
RLS Spectral Gamma-Ray Borehole Survey Log Header

Project: 200 East AAMS BC Cribs

Borehole	299-E13-3		
Coordinates	35,734 N 53,408 W	Feet	(Plant 200 E)
Elevation	741.48 feet	Top of Casing	(Plant 200 E)

Borehole Environment Information

Borehole Fluid Depth 336 (Feet) from Zero (0.0) Depth Reference of Log

Casing Size I.D. (inch)	Casing Thickness (inch)	Top Depth (feet)	Base Depth (feet)
8	0.33	0.0	350.
6	0.25	0.0	350.

Casing depths are an assumption

RLS Passive Spectral Gamma Survey Information

Logging Engineers R. V. Cram S. E. Kos
Log Depth Reference at Zero (0.0) depth is Ground Level

Log Date	Archive File Names	Log Mode[1] Speed	Depth Interval (feet) Top	Base	Incr
Sept 03, 92	H2E1303\A235	MSA 35sec LT	0.	11.5	0.5
			22.0	150.0	0.5
		MSA 300sec LT	150,177,221,282,330,345		
Sept 04, 92	H2E1303\A236	MSA 75sec RT	10.0	24.5	0.5

[1] MSA: Move-Stop-Acquire Lt: Live Time RT: Real Time

Calibration and Analysis Information

RLS Calibration Date: Nov 21, 1991
Calibration Report: WHC-SD-EN-TRP-001

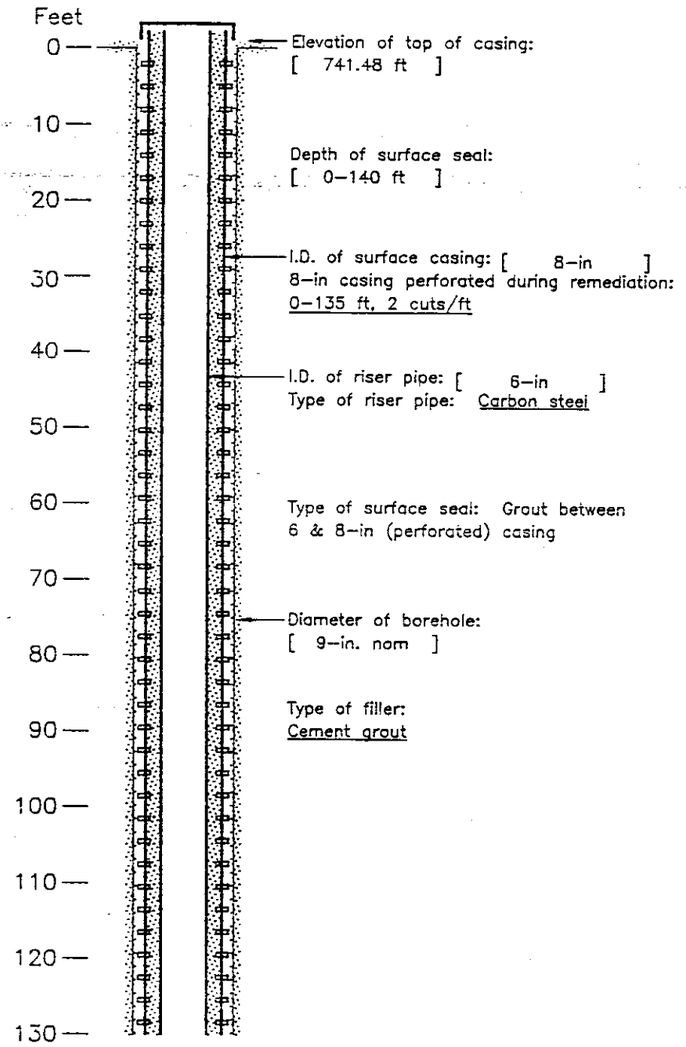
Analyst Names: J. P. Kiesler
Analysis Date: Sept 28, 1992

Analysis Notes: A236 logged with Pb shield
Radionuclides identified: Cs-137, Co-60, Eu-154, Sb-125

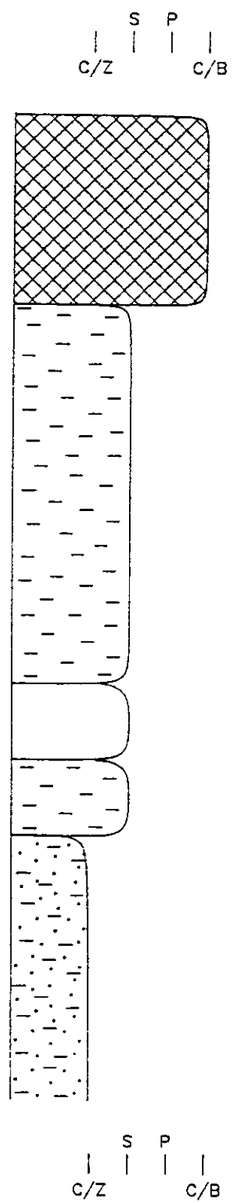
RLS Spectral Gamma Ray Borehole Survey

Well 299-E13-3 | Cribs B-C | Log Date 9/3/92

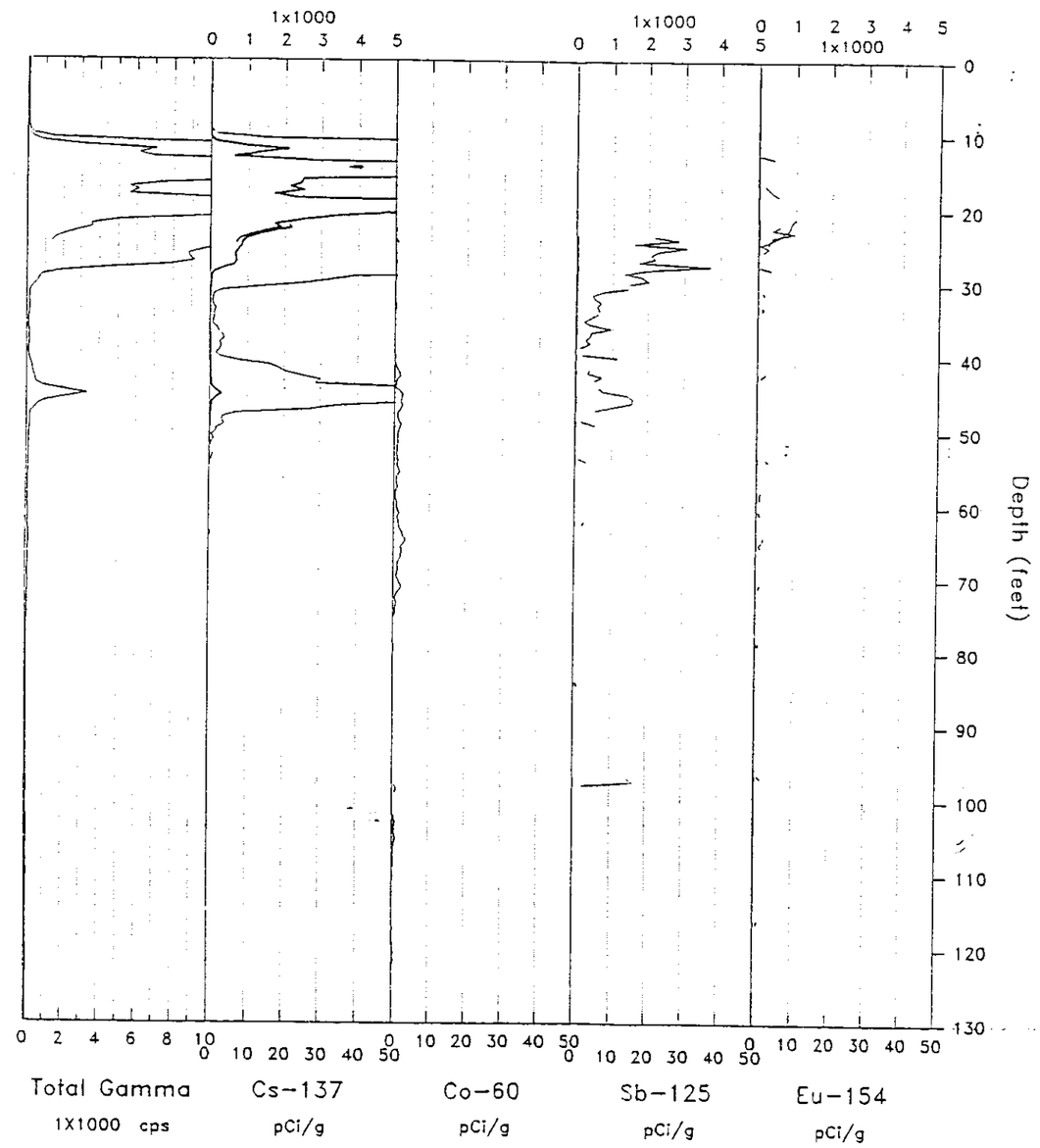
Well Construction



Lithology



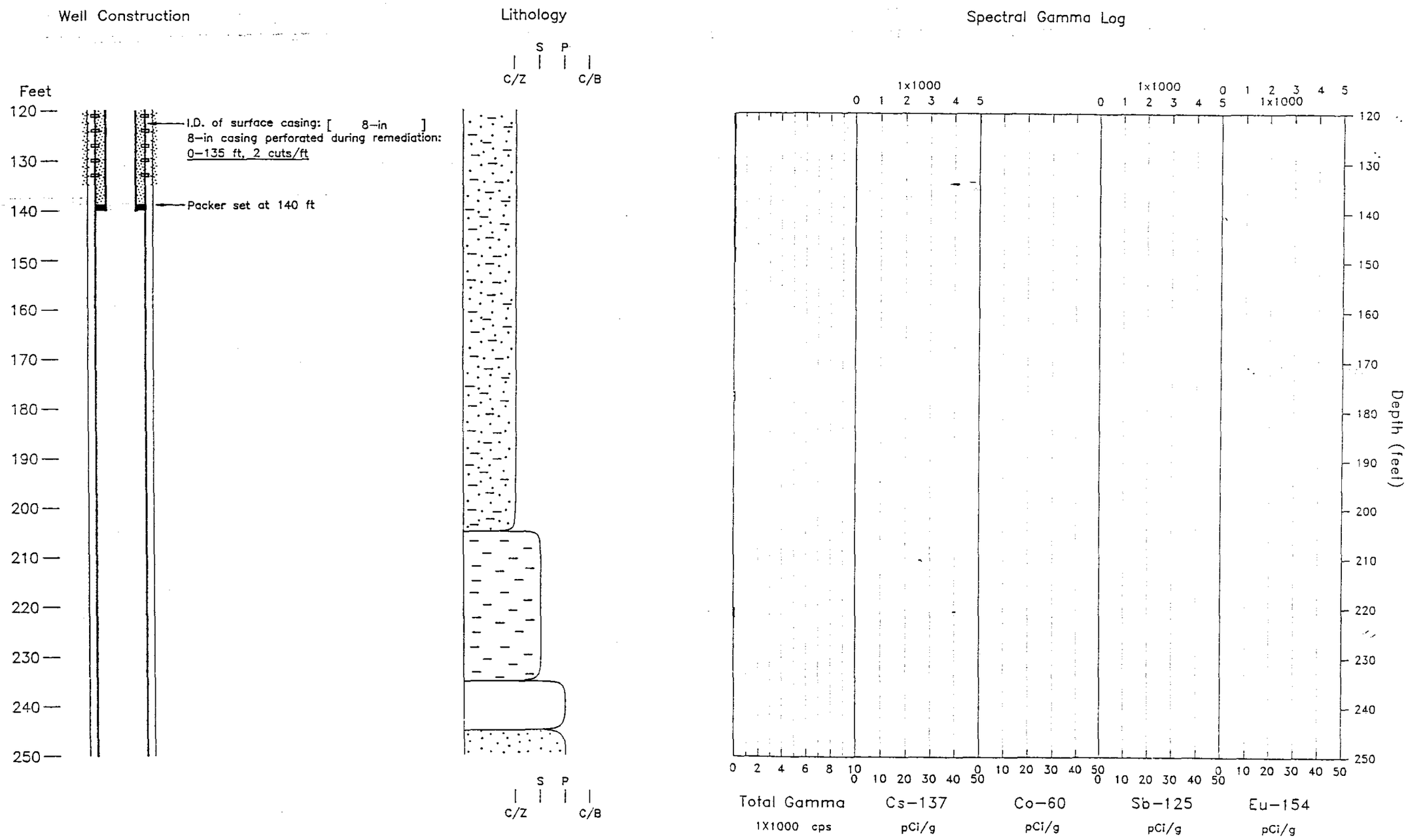
Spectral Gamma Log



WELLS\E13-3A

RLS Spectral Gamma Ray Borehole Survey (Page 2)

Well 299-E13-3 | Cribs B-C | Log Date 9/3/92

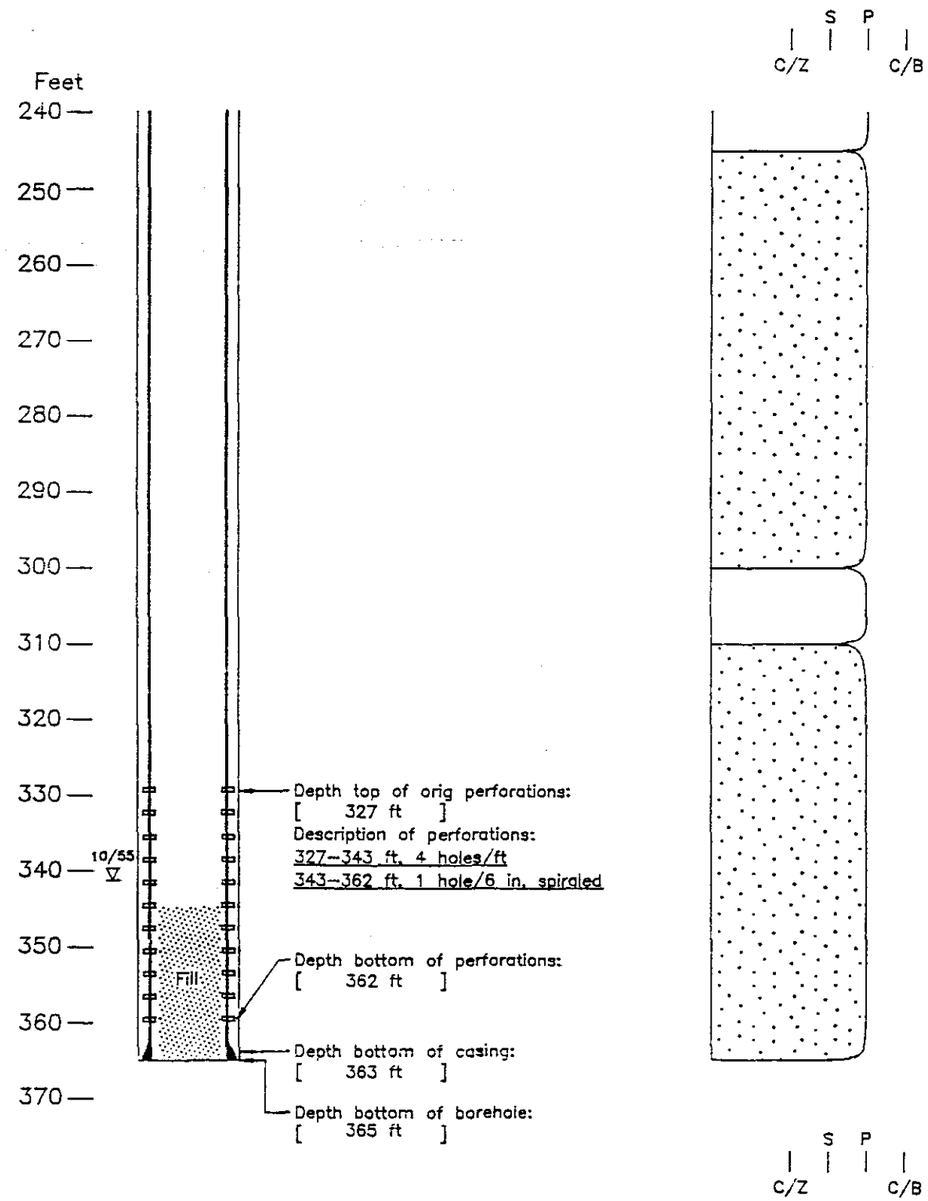


WELLS\E13-3B

RLS Spectral Gamma Ray Borehole Survey (Page 3)

Well 299-E13-3 | Cribs B-C | Log Date 9/3/92

Well Construction | Lithology | Spectral Gamma Log



WELLS\E13-3C

RLS Borehole Survey Report

299-E13-3 216-B-14 thru 216-B-19 Cribs

Casing	Depth: 350 ft	Size: 8 in	Thickness: 0.33 in
	Depth: 350 ft	Size: 6 in	Thickness: 0.25 in
Water	Depth: 336 ft		
Survey	Depth: 0 - 11.5 ft	Mode: MSA 35 sec	Date: 9/03/92
	22 - 150 ft	Mode: MSA 35 sec	Date: 9/03/92
	10 - 24 ft	Mode: MSA 75 sec	Date: 9/04/92 (Shielded)

General Notes:
The maximum screening survey depth of 150 feet was determined from review of the PNL gross gamma survey acquired earlier. Stationary spectral gamma ray measurements were taken at 150, 177, 221, 282, 330, and 345 feet. No manmade radionuclides were identified in the spectra acquired below 150 feet.

High counting activity may have saturated the standard logging system configuraiton from 11 feet to 20 feet. The lead shield was installed and the counting system configuration changed to maximize count rate capabilities. The interval from 11 to 24 feet was surveyed with the lead shield. No counting system saturation occured in the high count rate configuration.

Both standard configuration and lead shield logging configuration data surveys are plotted together. The numeric data values of the Total Gamma plot for the two configurations will not produce identical values. No Total Gamma correction for the gamma-ray attenuation from the lead shield has been established.

Detector depth was checked every 50 feet to 300 feet with at steel tape. The tool depth was not adjusted. The maximum depth error is 0.2% (ie. 0.66 ft at 300 ft).

Man-made Radionuclides:
Cesium (Cs-137) was encountered in the borehole from the 6 feet to 55 ft. Cesiuim decay activity exceeded 200 pCi/g from 11 feet to 28 feet and from 44 feet to 46 feet. The cesium activity exceeded 5000 pCi/g from 14 feet to 15 feet and from 19 feet to 20 feet.

Cobalt (Co-60) was encountered in the borehole survey from 22 feet to 122 feet. The cobalt decay activity detected was less than 4 pCi/g.

Antimony (Sb-125) was encountered in the borehole survey from 23 feet to 47 feet. The maximum antimony decay activity detected was 40 pCi/g at 28 feet.

Europium-154 (Eu-154) was encountered in the borehole survey from 16 feet to 26 feet. The europium decay activity detected was less than 10 pCi/g.

Westinghouse Hanford Company
RLS Spectral Gamma-Ray Borehole Survey Log Header

Project: 200 East AAMS B-C Cribs

Borehole	299-E13-5			
Coordinates	35,565 N	53,447 W	Feet	(Plant 200 E)
Elevation	743.06 feet		Top of Casing	(Plant 200 E)

Borehole Environment Information

Borehole Fluid Depth none (Feet) from Zero (0.0) Depth Reference of Log

Casing Size I.D. (inch)	Casing Thickness (inch)	Top Depth (feet)	Base Depth (feet)
8	0.38	0.	100.[a]
6	0.26	0.	365.

[a]Casing depth based on interpretation of Gross Gamma log.

RLS Passive Spectral Gamma Survey Information

Logging Engineers R. V. Cram S. E. Kos
Log Depth Reference at Zero (0.0) depth is Ground Level

Log Date	Archive File Names	Log Mode,[1] Speed	Depth Interval (feet) Top	Base	Incr
Sept 22, 92	H2E1305\A250	FIXED 0.6 fpm	0.	100.	0.5
	(Lead Sheild)	MSA 60sec LT	10.	20.	0.5
		Station: 300 s	35,58,83,92,150,200,250, 300 & 362 ft		

[1]FIXED: Fixed cable speed velocity fpm: Feet per minute
MSA: Move-Stop-Acquire LT: Live Time

Calibration and Analysis Information

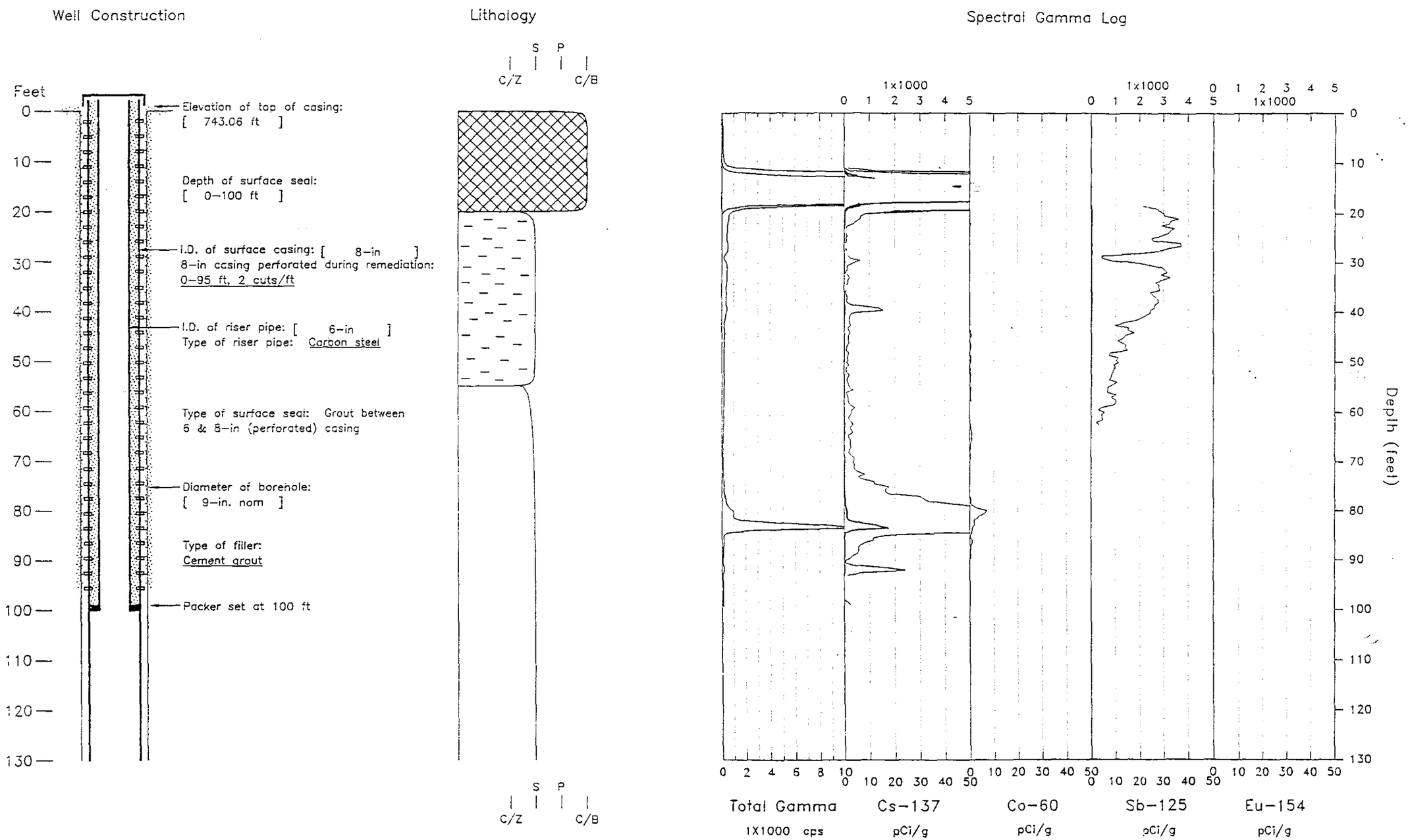
RLS Calibration Date: Nov 21, 1991
Calibration Report: WHC-SD-EN-TRP-001

Analyst Names: J. P. Kiesler R. K. Price
Analysis Date: Sept 25, 1992

Analysis Notes: Interval 10 to 20 feet logged with Pb shield
Radionuclides identified: Cs-137, Co-60, Sb-125

RLS Spectral Gamma Ray Borehole Survey

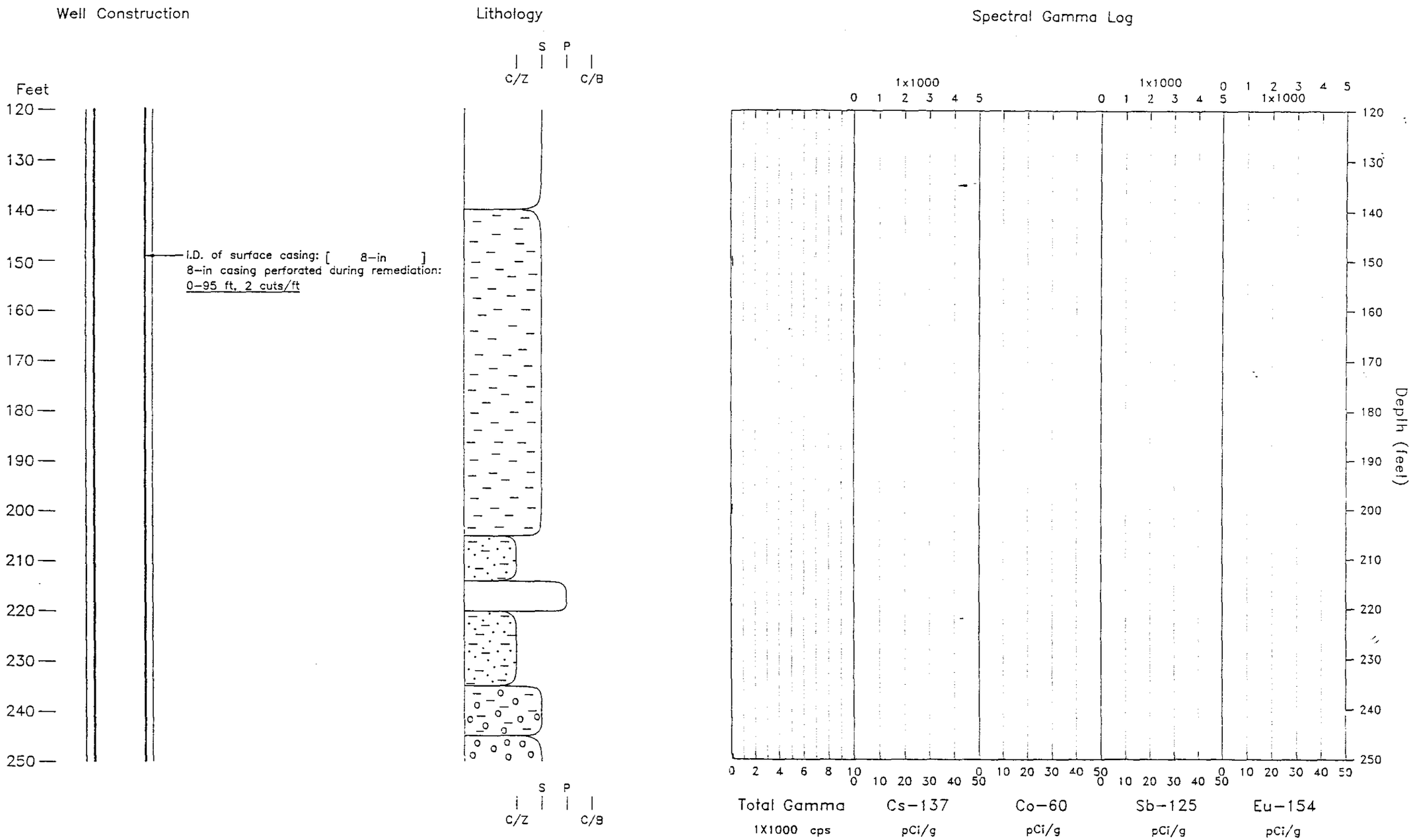
Well 299-E13-5 | B-C Cribs | Log Date 9/22/92



WELLS\E13-5A

RLS Spectral Gamma Ray Borehole Survey (Page 2)

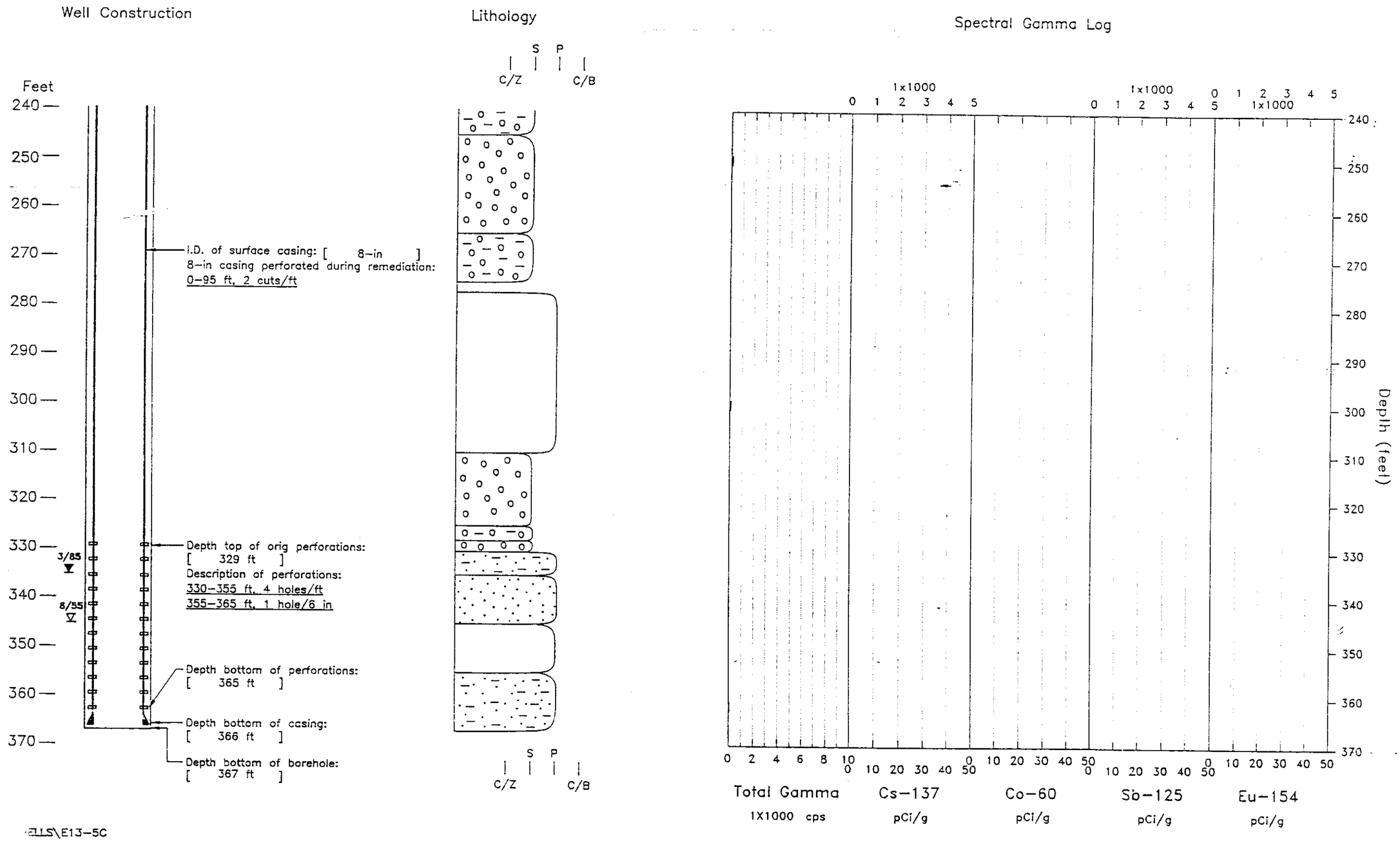
Well 299-E13-5 | Cribs B-C | Log Date 9/22/92



WELLS\E13-5B

RLS Spectral Gamma Ray Borehole Survey (Page 3)

Well 299-E13-5 | Cribs B-C | Log Date 9/22/92



STLS\E13-5C

RLS Borehole Survey Report

299-E13-5 B-C Cribs

Casing	Depth: 100 ft	Size: 8 in	Thickness: 0.38 in
	Depth: 365 ft	Size: 6 in	Thickness: 0.26 in
Water	Depth: 335 ft		
Survey	Depth: 0 - 100 ft	Mode: Fixed 0.6 fpm	Date: 9/22/92
	10 - 20 ft	Mode: MSA 60 sec	(Lead Shield)

General Notes:
The maximum screening survey depth of 100 feet was determined from review of the PNL gross gamma survey acquired earlier. Stationary spectral gamma ray measurements were taken at 35, 58, 83, 92.5, 150, 200, 250, 300, and 362 feet. No manmade radionuclides were identified in the spectra acquired below 100 feet.

The maximum calibrated casing correction of 0.40 inches was applied to the survey data. The computed activity for data recorded through multiple casing strings will be underestimated.

High counting activity saturated the standard logging system configuraiton from 13 feet to 17 feet. The lead shield was installed and the counting system configuration changed to maximize count rate capabilities. The interval from 10 to 20 feet was surveyed with the lead shield. The counting system saturation occured from 14 feet to 17 feet in the high count rate configuration.

Both standard configuration and lead shield logging configuration data surveys are plotted together. The numeric data values of the Total Gamma plot for the two configurations will not produce identical values. No Total Gamma correction for the gamma-ray attenuation from the lead shield has been established.

Detector depth was checked every 50 feet to 300 feet with at steel tape. The tool depth was not adjusted. The maximum depth error is 0.45% (ie. 1.33 ft at 300 ft).

Man-made Radionuclides:
Cesium (Cs-137) was encountered in the borehole from the 17 feet to 99 ft. Cesiuim decay activity exceeded 200 pCi/g from 12 feet to 19 feet and from 82 feet to 84 feet. The cesium activity exceeded 5000 pCi/g from 13 to 18 feet.

Cobalt (Co-60) was encountered in the borehole survey from 41 feet to 90 feet. The cobalt decay activity detected was less than 7 pCi/g.

Antimony (Sb-125) was encountered in the borehole survey from 18 feet to 63 feet. The maximum antimony decay activity detected was about 40 pCi/g at 26 feet.

No europium-154 (Eu-154) was encountered in the borehole survey. The plot track is present only for uniformity of the displayed data.

Crib Designation: 216-S-13

Type of Facility: 40ft. X 40 ft. Wooden crib

Location: N 34610, W 74620

Service Dates: 1/52 to 7/72

Description of Waste: 5 x 10^6 liters of "liquid waste" from 203-S and 204-S storage facilities and occasional neutral to basic "sump waste" from 204-S. Also received waste from the 276-S organic solvent make-up facility which was low salt, neutral/basic.

Radionuclide Release Summary:

Radionuclide	Quantity
Pu	8.0 g
Sr-90	0.04 Ci
Ru-106	100 Ci
Cs-137	5. Ci
Co-60	<0.1 Ci
U	<91.0 kg

Summary of Past Logging:

Boreholes	Date	Reference
299-W22-21	1976	Fecht, et al., 1977 Geophysics Files

Review of Current Logging:

Borehole 299-W22-21 was logged with the PNL gross gamma system and with the RLS spectral system. Old gross gamma logs show high gamma activity up close to the top of the borehole from about 30 feet to 90 feet. There is no gamma activity anomaly near the top of the groundwater at about 210 feet in the oldest gamma ray logs.

In the more recent logs, the anomaly closer to the top of the borehole has decreased down to background levels indicating short lived gamma-emitting nuclides in that zone. These logs also show increased activity near the water table. The spectral gamma log data show that this increased activity is coming from U-238 and U-235.

The question then arises as to the source of this deep uranium anomaly. Process records show discharges of very little uranium and high pH effluent which is not chemically conducive for the transport of uranium. If these process records are correct, the uranium near the groundwater interface could not have come from this crib facility.

Records of the nearby 216-S-7 crib show a discharge of over 9000 kg of uranium from that crib. Additionally, the discharge effluent was acidic (as low as pH=2), there was a very large volume of effluent and the current Cs-137 profile from the borehole at this crib indicates contamination has migrated to the groundwater. The S-7 crib is also the closest point of effluent

299-E13-5

Westinghouse Hanford Company — LOG HEADER — Page 1 of 2

Well No. 299-E13-5	Area 200 East — Date 9/21/92
Log Run #1	Log Type Gross Gamma
Elevation Datum Top of casing	Elevation 447.06
Survey Coordinates N 75516	E 57447
Log Measured From Ground Surface	
Location Description South end of 216-B-2-ditch	
Ground Surface Elevation	
Surface Temperature N/A	Weather Clear-Warm

BOREHOLE INFORMATION

Driller ?	
Drill Rig Type ?	Bit Type/Diameter ?
Borehole Diameter/Depth 8"/365	6"/?
Depth Driller 365'	Depth Logger 365.3'
Liquid Level 335'	Liquid Quality Clear
Temperature N/A	

CASING RECORD

Type 8" Carbon Steel Sch 40	Interval 0'-365'
Type 6" Carbon Steel Sch 40	Interval ?'-?
Type	Interval
Type	Interval
Well Screen Interval 330'-365'	

Comments: Datum Error +0.2' high
Centralizer used
Info from Hanford Wells.

LOG HEADER — Page 2 of 2

EQUIPMENT DATA

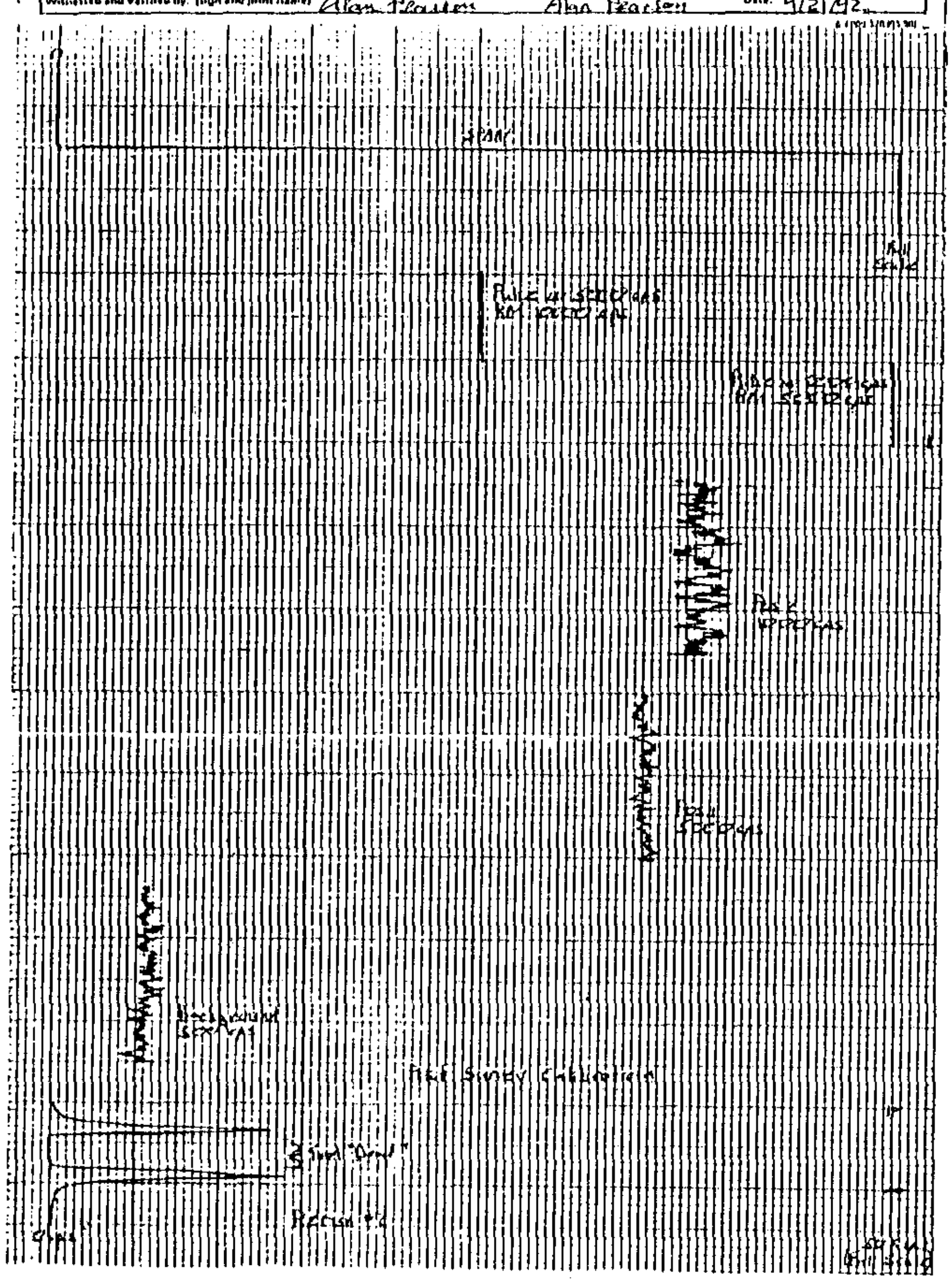
Logging Company PNL	
Operator(s) Alan Pearson	
Equipment Brand MIS	Equipment Type Analog
Tool Type Gamma Ray	Serial No. CG27A97
Base Calibration Date 5/92	Calibration Reference PNL-8220 HC-606
Calibration/Probe Factor 4.00×10⁻⁴ ... Base Calibration Datum (eU) Position 1 315.1 eU	Position 2 65.1 eU
Dead Time 12.3 μsec	Warm Up Time >15 min

LOGGING INFORMATION

Log Interval From 365.3'	To 4.0'	
Range(s) 60.0' to 250' @ 500 cps, 950' to 750' @ 10K cps, 250' to 10.0' cps		
Pre Survey Verification: Position 1 315.1 eU	Position 2 65.1 eU	Background 55 cps
Base Calibration Difference: Position 1 0.0 eU	Position 2 0.3 eU	
Logging Speed 5 ft/min	Range Scales, CPS/in 50 CPS/in	
Start Time 0850	Completion Time 1145	
Chart Speed(s), ft/in 10 ft/in		
Chart Recorder Horizontal Scale, CPS/in 50 CPS/in	Time Constant(s) 1.2-1	
Post Survey Verification: Position 1 315.1 eU	Position 2 64.9 eU	Background 55 cps
Percent Change: Position 1 0.0%	Position 2 0.8%	

Comments: Datum Error +0.2' high
Centralizer used

Witnessed and Verified by: (sign and print name) Alan Pearson Alan Pearson Date: 9/21/92



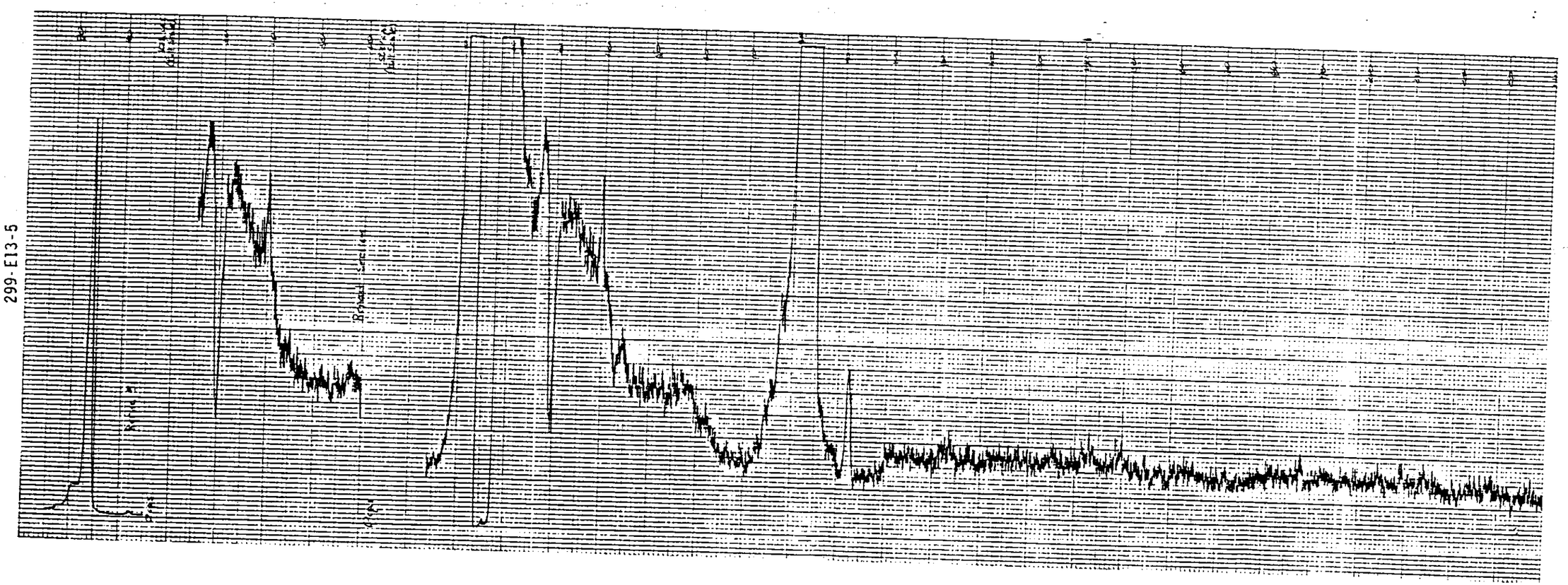
discharge to the S-13 crib.

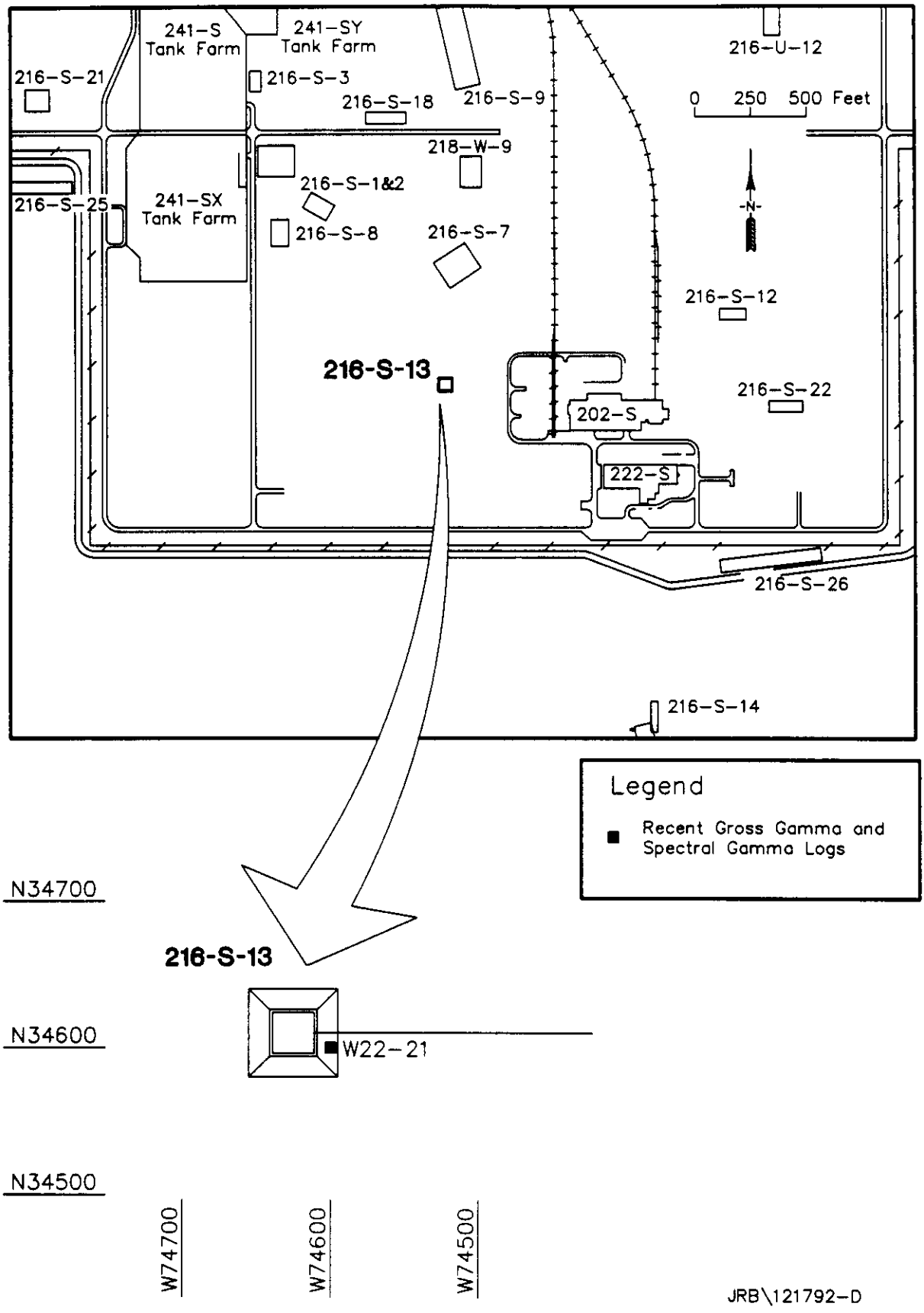
It is likely that the uranium at the groundwater interface in borehole 299-W22-21 at the S-13 crib had it's origin from the S-7 crib and was flushed thru the unsaturated zone to the groundwater and is now being detected below the S-13 crib.

Gamma-ray activity from nuclides previously deposited in the upper portion of the unsaturated zone at this crib was primarily due to Ru-106 which is short lived. Low concentrations of Cs-137 were detected with the spectral gamma logging system near the 10 foot level. This small amount of Cs is consistent with the above nuclide discharge information.

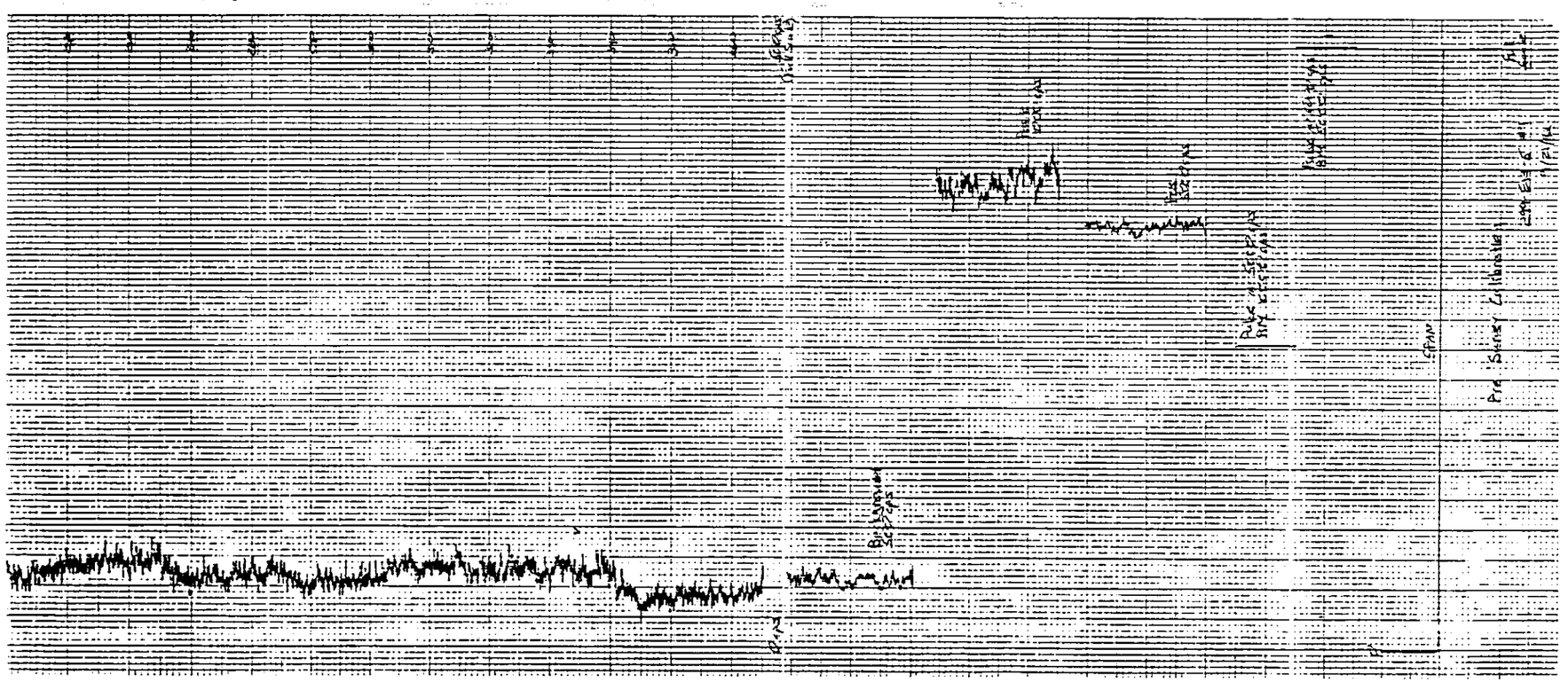
Because the borehole was grouted, the reported radionuclide concentration data from the spectral log are not accurate and the uncertainty of the reported values is very high.

299-E13-5




241-S
Tank Farm
241-SY
Tank Farm
216-U-12
216-S-21
216-S-3
216-S-18
216-S-9
0 250 500 Feet
218-W-9
216-S-1&2
216-S-25
241-SX
Tank Farm
216-S-8
216-S-7
-N-
216-S-12
216-S-13
216-S-22
202-S
222-S
216-S-26
216-S-14
Legend
Recent Gross Gamma and Spectral Gamma Logs
N34700
216-S-13
N34600
W22-21
N34500
W74700
W74600
W74500
JRB\121792-D

299-E13-5



Crib Designation: 216-B-35 through 216-B-41 Trenches

Type of Facility: seven parallel trenches, each 252 ft x 10 ft bottom dimensions

Location: N 45273 to N 45800, W 53800 to W 54125, Just west of 241-BX tank farms

Service Dates: All trenches were used from early 1953 to late 1954

Description of Waste:
216-B-35: 1.06 x 10^6 liters
216-B-36: 1.94 x 10^6 liters
216-B-37: 4.32 x 10^6 liters
216-B-38: 1.43 x 10^6 liters
216-B-39: 1.54 x 10^6 liters
216-B-40: 1.64 x 10^6 liters
216-B-41: 1.44 x 10^6 liters

All trenches except B-37 received first cycle supernatant waste from 221-B building. B-37 received first cycle bottom supernatant waste from the 242-B waste evaporator.

Radionuclide Release Summary:

216-B-35

Radionuclide	Quantity
gross Pu	1.2 g
Sr-90	240 Ci
Ru-106	230 Ci
Cs-137	430 Ci
Co-60	0.03 Ci
gross U	17 kg

216-B-36

Radionuclide	Quantity
gross Pu	0.8 g
Sr-90	490 Ci
Ru-106	470 Ci
Cs-137	770 Ci
Co-60	0.07 Ci
gross U	16 kg

216-B-37

Radionuclide	Quantity
gross Pu	2.0 g
Sr-90	16 Ci
Ru-106	500 Ci
Cs-137	3100 Ci
Co-60	1.0 Ci
gross U	3.6 kg

216-B-38

Radionuclide	Quantity
gross Pu	1.2 g

Westinghouse Hanford Company
RLS Spectral Gamma-Ray Borehole Survey Log Header

Project: 200 AAMS, S-13 Crib

Borehole	299-W22-21			
Coordinates	34,600 N	74,600 W	Feet	(Plant 200 W)
Elevation	670.0 feet		Top of Casing	(Plant 200 W)

Borehole Environment Information

Borehole Fluid Depth none (Feet) from Zero (0.0) Depth Reference of Log

Casing Size I.D. (inch)	Casing Thickness (inch)	Top Depth (feet)	Base Depth (feet)
8.0	0.312	0.0	222.0
4.0	0.250	0.0	195.0

RLS Passive Spectral Gamma Survey Information

Logging Engineers R. V. Cram S. E. Kos
Log Depth Reference at Zero (0.0) depth is Ground Level

Log Date	Archive File Names	Log Mode,[1] Speed	Depth Interval (feet) Top	Base	Incr
Feb 15, 92	H2W2221\A136	FIXED 0.6 fps	0.	214.	0.5

[1] FIXED: Fixed velocity of Cable Speed: fps: Feet per second

Calibration and Analysis Information

RLS Calibration Date: Nov 21, 1991
Calibration Report: WHC-SD-EN-TRP-001

Analyst Names: R. K. Price _____
Analysis Date: _____

Analysis Notes: Low total gamma activity at 200 feet
Radionuclides identified: Cs-137, U-238(not natural), U235

Sr-90	1900 Ci
Ru-106	560 Ci
Cs-137	510 Ci
Co-60	<0.06 Ci
gross U	42 kg

216-B-39

Radionuclide	Quantity
gross Pu	1.5 g
Sr-90	23 Ci
Ru-106	65 Ci
Cs-137	450 Ci
Co-60	<0.01 Ci
gross U	5.8 kg

216-B-40

Radionuclide	Quantity
gross Pu	1.0 g
Sr-90	280 Ci
Ru-106	240 Ci
Cs-137	350 Ci
Co-60	<0.02 Ci
gross U	35 kg

216-B-41

Radionuclide	Quantity
gross Pu	0.30 g
Sr-90	47 Ci
Ru-106	130 Ci
Cs-137	890 Ci
Co-60	0.01 Ci
gross U	7.5 kg

Summary of Past Logging:

Boreholes	Date	Reference
299-E33-8	1976	Fecht, et al., 1977
299-E33-21	1976	"
299-E33-290	1976	"
	1984	Geophysics files
	1987	"

Review of Current Logging:

Borehole: 299-E33-21, 299-E33-290

Both of these boreholes were logged with both the PNL gross gamma and the RLS spectral gammaa logging systems.

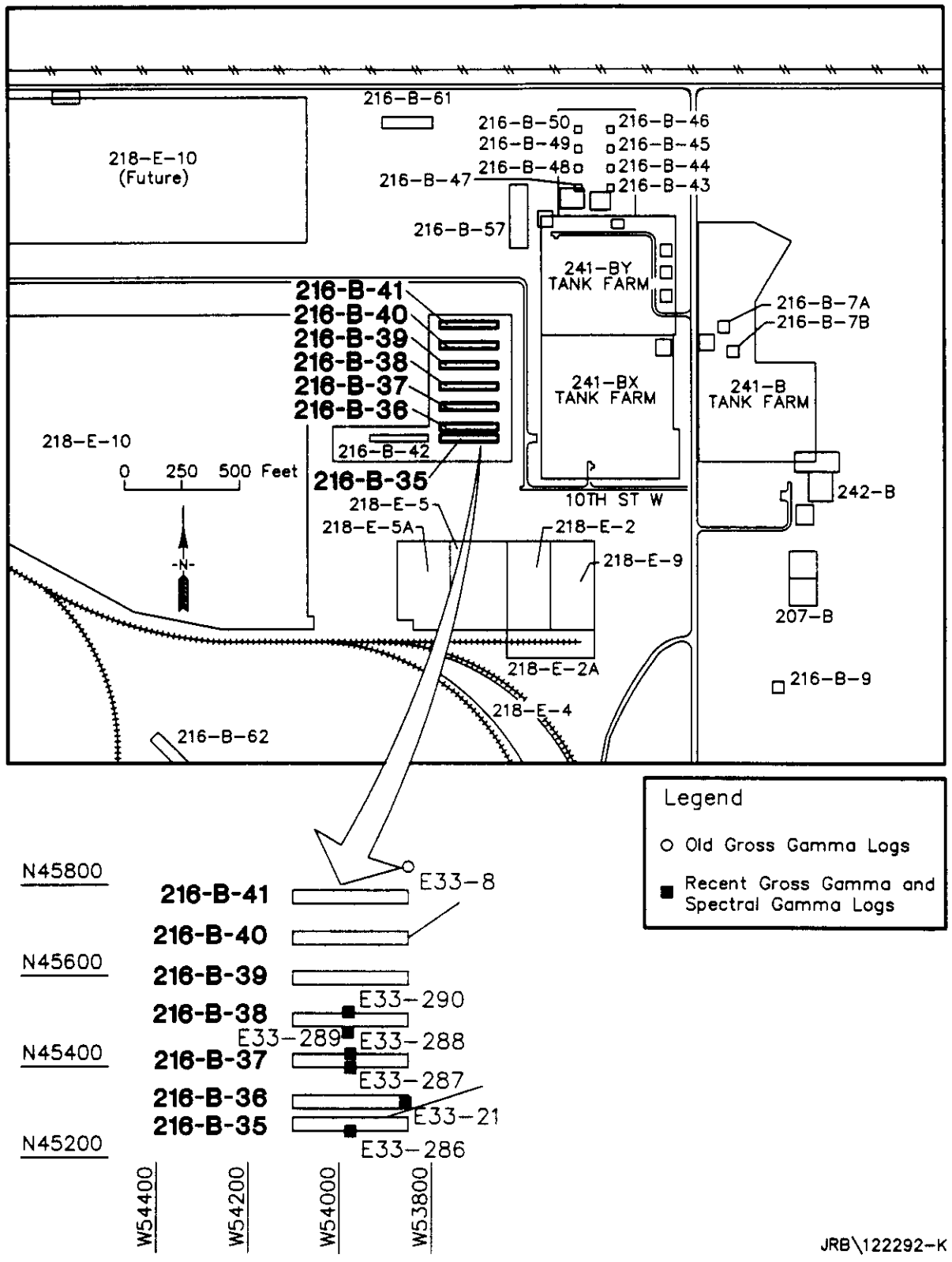
Borehole E33-290 shows a zone of surface Cs-137 contamination from a surface leak or spill and a thick zone of cesium contamination from the bottom of the trench down to the total depth of the borehole.

Borehole E33-21 shows Cs-137 contamination from the surface all the way down and into the groundwater. It is obvious that the cesium released at this site reached the groundwater. This also shows up in the new gross gamma log as well as the older

log.

No other man-made nuclides were detected in this borehole. Considering that the cesium has moved extensively through the unsaturated zone, it is likely that the uranium and strontium released at this site have also reached the groundwater. Uranium is difficult to detect in the presence of other gamma emitters and Sr-90 can only be detected when it is found in very high concentrations and creates significant bremstrahlung radiation. Therefore it is difficult to detect either of these nuclides with the spectral gamma logging system.

Sediment samples from down deep in the unsaturated zone would be required to determine the fate of the other radionuclides released at this site.


216-B-61
216-B-50
216-B-49
216-B-48
216-B-46
216-B-45
216-B-44
216-B-43
216-B-47
218-E-10
(Future)
216-B-57
241-BY
TANK FARM
216-B-41
216-B-40
216-B-39
216-B-38
216-B-37
216-B-36
216-B-7A
216-B-7B
241-BX
TANK FARM
241-B
TANK FARM
218-E-10
0 250 500 Feet
216-B-42
216-B-35
218-E-5
218-E-5A
10TH ST W
218-E-2
218-E-9
242-B
207-B
218-E-2A
216-B-9
218-E-4
216-B-62
N
Legend
Old Gross Gamma Logs
Recent Gross Gamma and Spectral Gamma Logs
N45800
N45600
N45400
N45200
216-B-41
216-B-40
216-B-39
216-B-38
216-B-37
216-B-36
216-B-35
E33-8
E33-290
E33-289
E33-288
E33-287
E33-21
E33-286
W54400
W54200
W54000
W53800
JRB\122292-K

Westinghouse Hanford Company
RLS Spectral Gamma-Ray Borehole Survey Log Header

Project: 200 East AAMS, B-Plant 216-B-35 thru 216-B-41 Cribs

Borehole	299-E33-21		
Coordinates	45,324 N	53,855 W	Feet (Plant 200 E)
Elevation	663.5 feet		Top of Casing (Plant 200 E)

Borehole Environment Information

Borehole Fluid Depth 260.9 (Feet) from Zero (0.0) Depth Reference of Log

Casing Size I.D. (inch)	Casing Thickness (inch)	Top Depth (feet)	Base Depth (feet)
8	0.319	0.0	278.0

RLS Passive Spectral Gamma Survey Information

Logging Engineers R. V. Cram S. E. Kos
Log Depth Reference at Zero (0.0) depth is Ground Level

Log Date	Archive File Names	Log Mode[1], Speed	Depth Interval (feet) Top	Base	Incr
Aug 4, 92	H2E3321\A221 (Std config.)	MSA 35sec LT	0	50	0.5
		MSA 35sec LT	50	162	0.5
Aug 5, 92	H2E3321\A222	MSA 35sec LT	162.0	279.0	0.5

[1]MSA: Move-Stop-Acquire Lt: Live Time

Calibration and Analysis Information

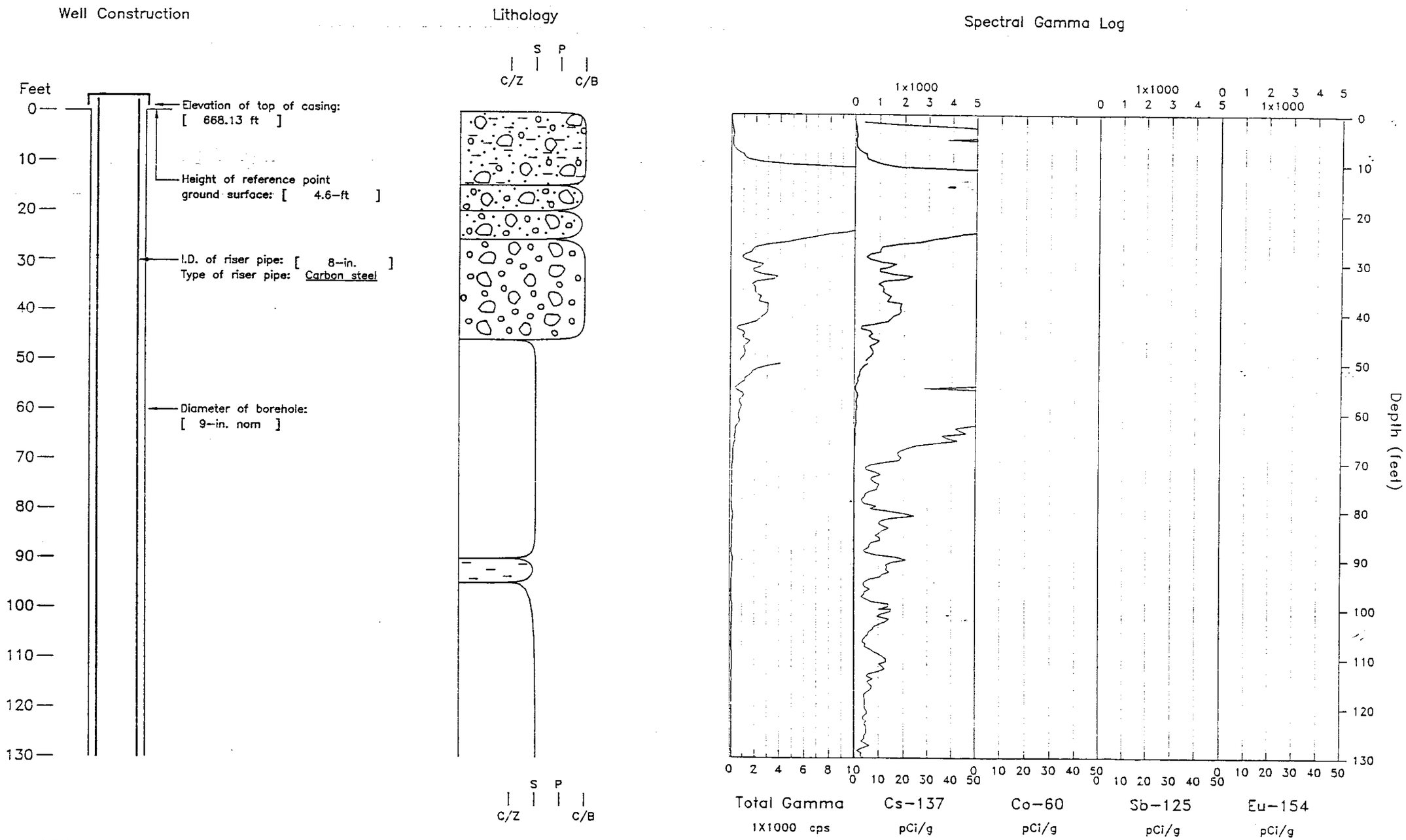
RLS Calibration Date: Nov 21, 1991
Calibration Report: WHC-SD-EN-TRP-001

Analyst Names: J. P. Kiesler
Analysis Date: Sept 18, 1992

Analysis Notes: Lead shield used 0 to 50 feet
Radionuclides identified: Cs-137, Co-60

RLS Spectral Gamma Ray Borehole Survey

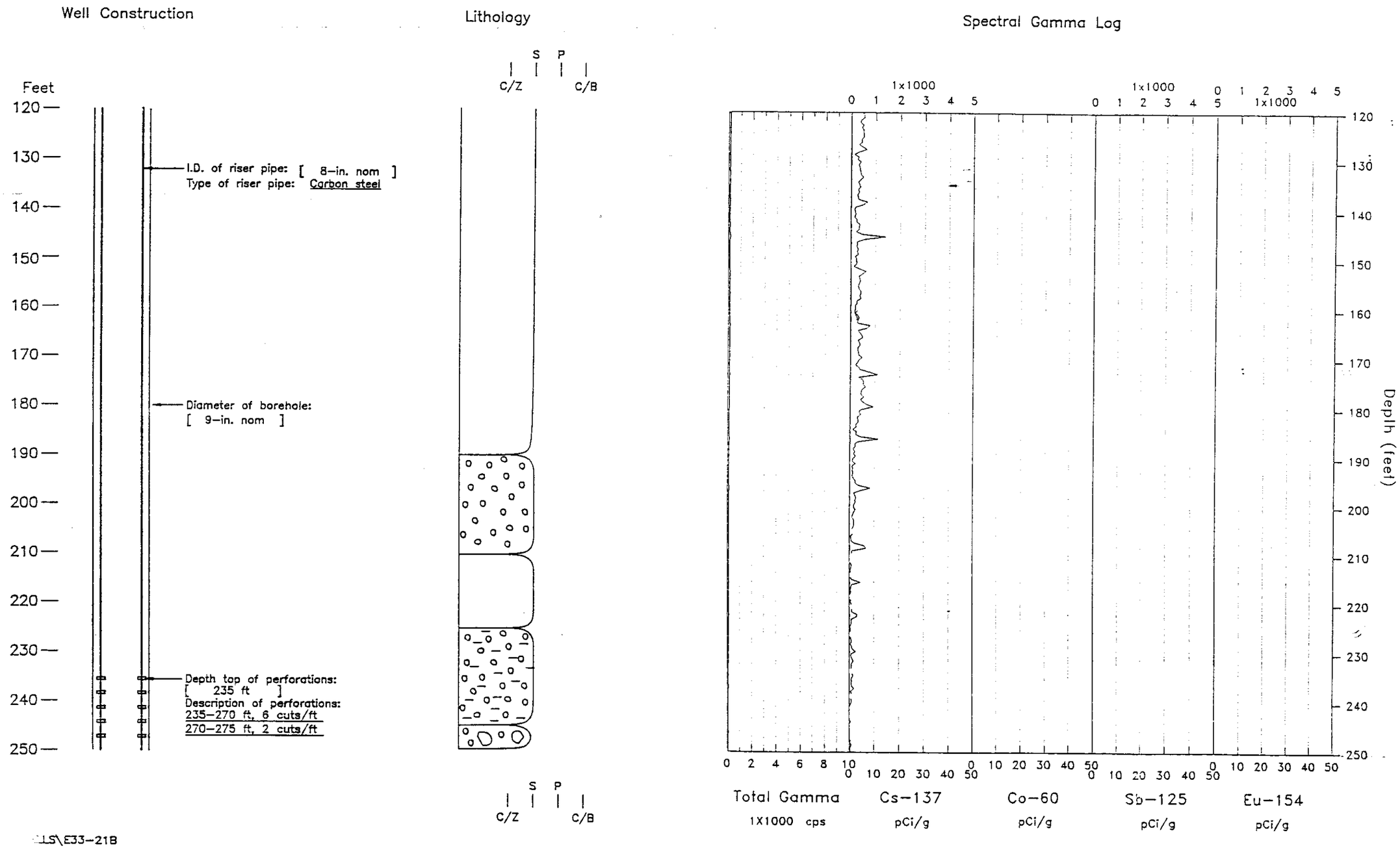
Well 299-E33-21 | Cribs B35-B41 | Log Date 8/4/92



/eils\E33-21A

RLS Spectral Gamma Ray Borehole Survey (Page 2)

Well 299-E33-21 | Cribs B35 - B41 | Log Date 8/4/92

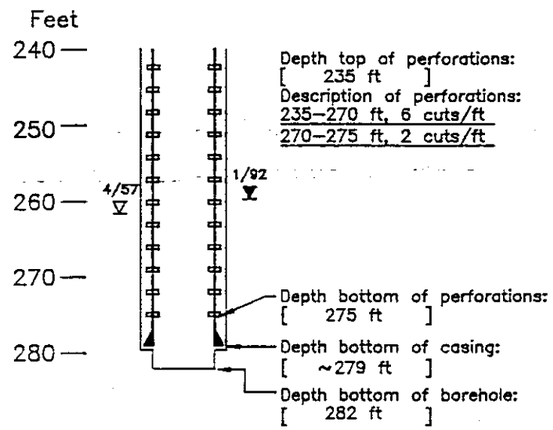


LS\E33-21B

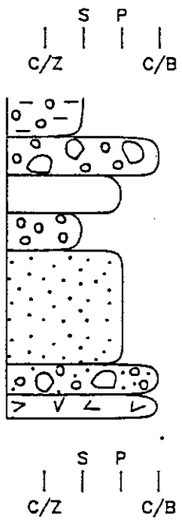
RLS Spectral Gamma Ray Borehole Survey (Page 3)

Well 299-E33-21 | Cribs B35 - B41 | Log Date 8/4/92

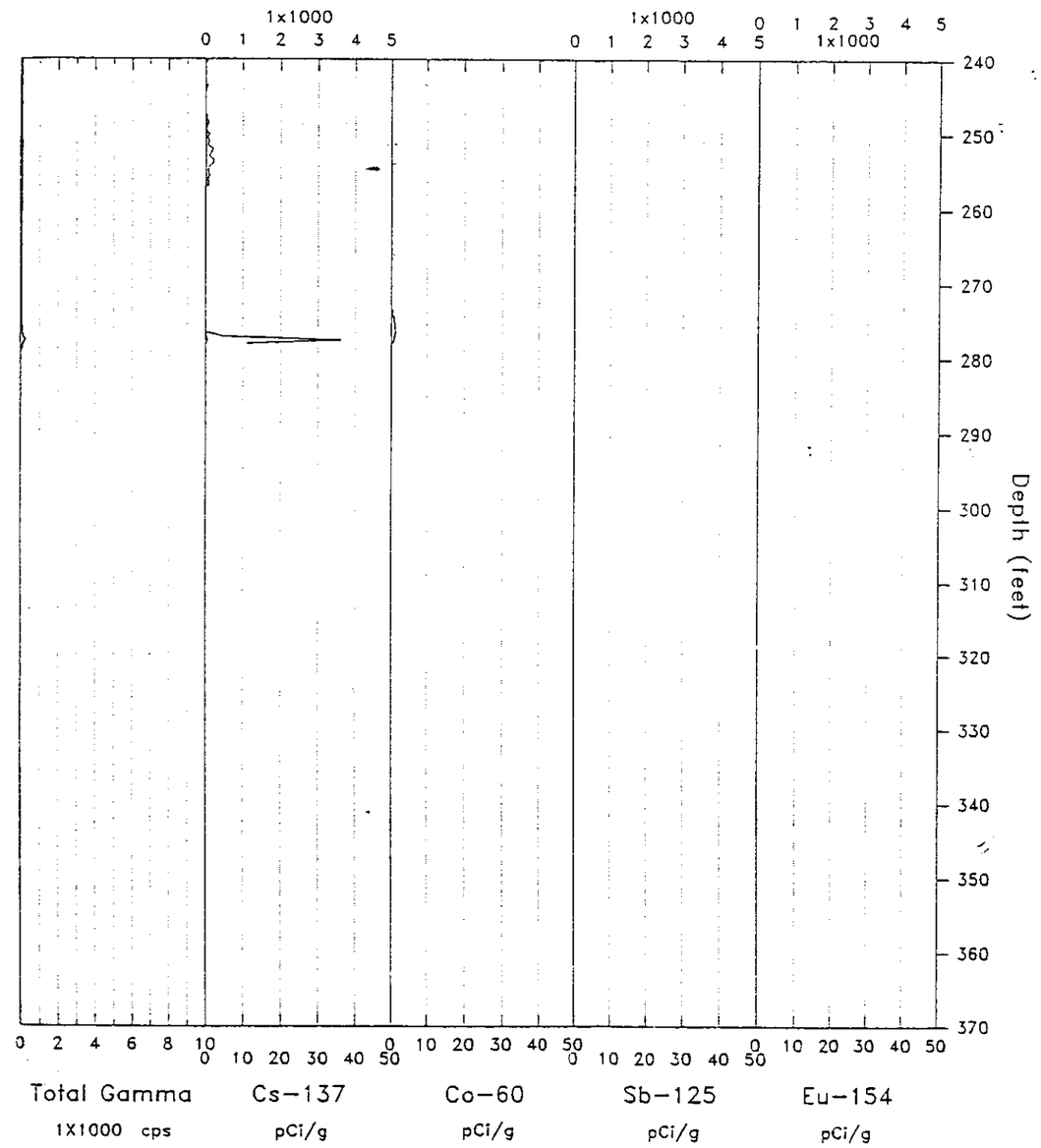
Well Construction



Lithology



Spectral Gamma Log



...ils\E33-21C

RLS Borehole Survey Report

299-E33-21 216-B-35 thru 216-B-41 Cribs

Casing	Depth: 278 ft	Size: 8 in	Thickness: 0.32 in
Water	Depth: 261 ft		
Survey	Depth: 0 - 50 ft	Mode: MSA 35 sec	Date: 8/04/92
	50 - 162 ft	Mode: MSA 35 sec	(non sheilded)
	162 - 279 ft	Mode: MSA 35 sec	Date: 8/05/92

General Notes:
Cesium activity does not commonly extend to the maximum borehole depth. The borehole may have acted as a condiut for the downward movement of radionuclides.

Detector depth was checked and adjusted every 50 feet to 250 feet with a steel tape. The logging cable was failing. The maximum depth error is 2.8% on 8/05/92 (ie. 1.4 ft from 150 ft to 200 ft).

The lead shield and gated integrator logging configuration was used from 0 to 50 feet. The total gamma activity recorded is different for the two logging configurations. No overlap of the data is available for the two configurations.

Man-made Radionuclides:
Cesium (Cs-137) was encountered in the borehole survey from the surface to the maximum survey depth of 279 feet. The cesium decay activity exceeded 200 pCi/g from 7 feet to 52 feet. The decay activity exceeded 5000 pCi/g from 11 feet to 24 feet.

Cobalt (Co-60) was encountered in the borehole survey from 188 feet to 278 feet. The cobalt decay activity detected was less than 2 pCi/g.

No Antimony (Sb-125) was encountered in the borehole survey. The plot track is present only for uniformity of the displayed data.

No Europium-154 (Eu-154) was encountered in the borehole survey. The plot track is present only for uniformity of the displayed data.

Westinghouse Hanford Company
RLS Spectral Gamma-Ray Borehole Survey Log Header

Project: 200 East AAMS, B-Plant, 216-B-41 Crib

Borehole	299-E33-290		
Coordinates	45,520 N	53,980 W	Feet (Plant 200 E)
Elevation	. feet		Top of Casing (Plant 200 E)

Borehole Environment Information

Borehole Fluid Depth none (Feet) from Zero (0.0) Depth Reference of Log

Casing Size I.D. (inch)	Casing Thickness (inch)	Top Depth (feet)	Base Depth (feet)
8	0.32	0	50

RLS Passive Spectral Gamma Survey Information

Logging Engineers R. V. Cram A. Pearson
Log Depth Reference at Zero (0.0) depth is Ground Level

Log Date	Archive File Names	Log Mode[1]	Speed	Depth Interval (feet) Top	Base	Incr
Aug 01, 92	H2E33290\A219	MSA	50sec LT	0.0	45.5	0.5
	(Lead sheild)	MSA	50sec RT	19.0	31.0	0.5
	(Lead sheild)	MSA	50sec RT	44.0	45.5	0.5

[1] MSA: Move-Stop-Acquire Lt: Live Time Rt: Real Time

Calibration and Analysis Information

RLS Calibration Date: Nov 21, 1991
Calibration Report: WHC-SD-EN-TRP-001

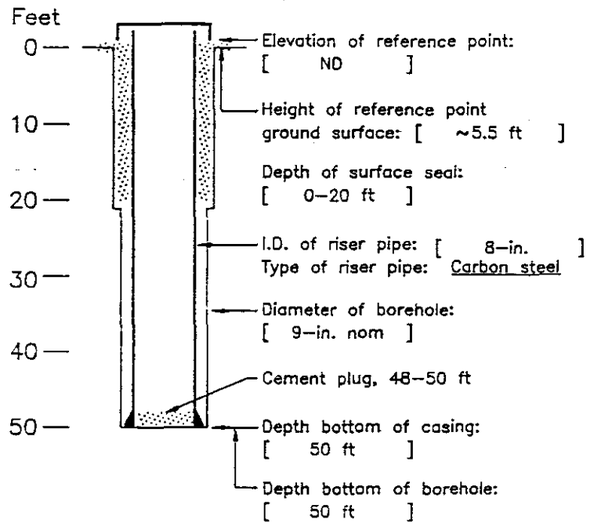
Analyst Names: J. P. Kiesler
Analysis Date: Sept 18, 1992

Analysis Notes: Lead shield used 19-31 ft and 44-45.5 ft
Radionuclides identified: Cs-137, Co-60

RLS Spectral Gamma Ray Borehole Survey

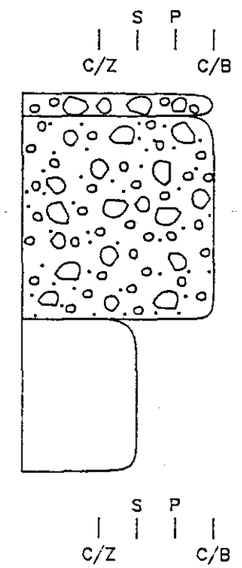
Well 299-E33-290 | 218-E-18 Burial | Log Date 8/1/92

Well Construction

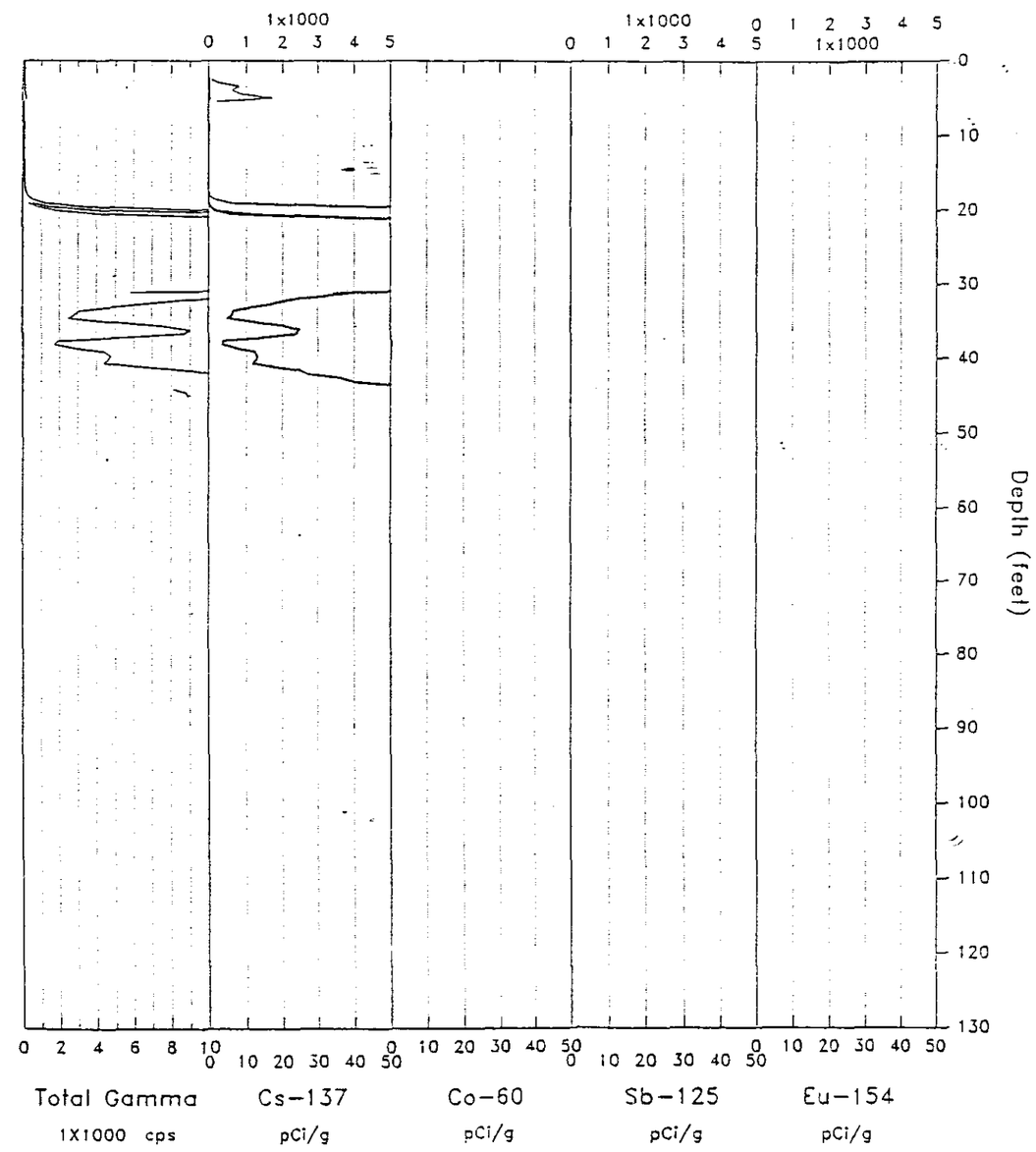


Type of surface seal:
Cement grout between 8-in casing and 11-in nominal hole as 10-in surface casing to 20-ft was pulled back. Collar was also poured

Lithology



Spectral Gamma Log



/ELLS\E33-290A

RLS Borehole Survey Report

299-E33-290 216-B-35 thru 216-B-41 Cribs

Casing	Depth: 50 ft	Size: 8 in	Thickness: 0.32 in
Water	Depth: none		
Survey	Depth: 0 - 45 ft	Mode: MSA 50 sec	Date: 8/01/92
	19 - 31 ft	Mode: MSA 50 sec	(Lead shield)
	44 - 45 ft	Mode: MSA 50 sec	(Lead sheild)

General Notes:
The borehole assignment has been changed from 218-E-10 Burial site to the 216-B-35 thru 216-B-41 Crib complex. The reassignment is based on the actual borehole location.

The counting system saturated from 22 feet to 29 feet with the normal equipment configuration. The lead shield was installed to reduce the number of log energy gamma rays being counted by the detector.

Man-made Radionuclides:
Cesium (Cs-137) was encountered in the borehole survey in two intervals, the first interval is from 2 feet to 7 feet and from 16 feet to the maximum survey depth of 45.5 feet. The cesium decay activity exceeded 200 pCi/g from 20 feet to the maximum survey depth of 45.5 feet. The decay activity exceeded 5000 pCi/g from 21 feet to 31 feet.

Cobalt (Co-60) was encountered in the borehole survey from 31 feet to 41 feet. The cobalt decay activity detected was less than 1 pCi/g.

No Antimony (Sb-125) was encountered in the borehole survey. The plot track is present only for uniformity of the displayed data.

No Europium-154 (Eu-154) was encountered in the borehole survey. The plot track is present only for uniformity of the displayed data.

299-E33-21

Westinghouse Hanford Company | LOG HEADER | Page 1 of 2

Well No. 299-E33-21 Area 200 East Date 8/1/92
Log Run #1 Log Type Gross Gamma
Elevation Datum Top of casing Elevation 663.43
Survey Coordinates N 49321 X W 53956
Log Measures From Ground Surface
Location Description West of RX-RY Tank Farm (835-41 (rd))
Ground Surface Elevation
Surface Temperature NA Weather Clear - Hot

BOREHOLE INFORMATION

Driller
Drill Rig Type | Bit Type/Diameter
Borehole Diameter(s)/Depth 8"/282'
Depth Driller 282' | Depth Logger 2832'
Liquid Level 262' | Liquid Density Appearance Clear
Temperature NA

CASING RECORD

Type 8" Carbon Steel Sch 40 | Interval +46' - 282'
Type | Interval
Type | Interval
Type | Interval
Well Screen Interval Perforated 235-275'
Comments: Casing Stick +0.2' high
Centralizer used

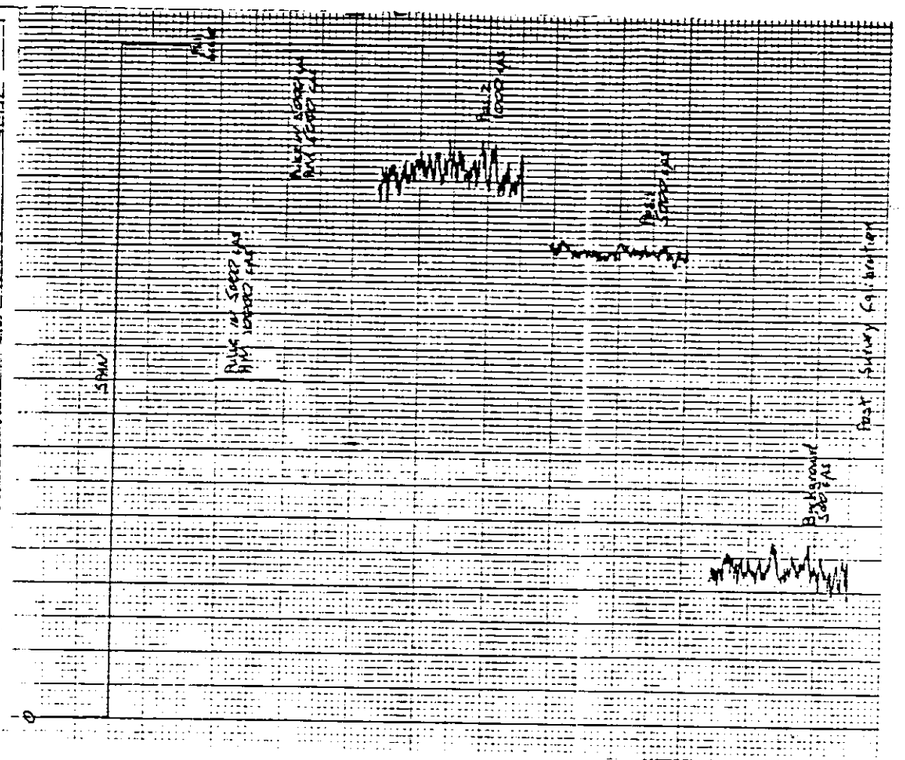
LOG HEADER | Page 2 of 2

EQUIPMENT DATA

Logging Company PNL
Operator(s) Alan Pearson
Equipment Brand AMS | Equipment Type Analog
Tool Type Gamma Ray | Serial No. CA27AM11
Base Calibration Date 5/92 | Calibration Reference PNL-PR320 HC-6016
Calibration Probe Factor 0.2 | Calibration Datum (kV) 1.0 | Position 1 3151 cll | Position 2 651 cll
Used Time 12.3 cl/s | Warm Up Time >15 min

LOGGING INFORMATION

Log Interval From 2832' To 0.5'
Record 2800' to 1300' @ 50 fpm, 1300' to 450' @ 25 fpm, 450' to 0.5' @ 12 fpm
Pre Survey Verification: Position 1 2800 cll | Position 2 64.2 cll | Background 118 cps
Base Calibration Difference: Position 1 386 cll | Position 2 .05 cll
Logging Speed 5 ft/min | Raw Scale, CPSm 50 cps/div
Start Time 0730 | Completion Time 1100
Chart Recorder Illuminated Scale, CPSm 50 cps/div
Chart Speed(s) Min 10 cm/m | Time Constant(s) 1 & 2 : 1
Post Survey Verification: Position 1 3027.4 cll | Background 115 cps
Percent Change: Position 1 1.3% | Position 2 0.9%
Comments: Drum Stuck 0.2' high
Centralizer used
Witnessed and Verified by (logs and print name) Alan Pearson Date 8/1/92



299-E33-290

Westinghouse Hanford Company | LOG HEADER | Page 1 of 2

Well No. 299-E33-290 Area 200 East Date 8/3/92
Log Run #1 Log Type Gross Gamma
Elevation Datum Elevation
Survey Coordinates N 49520 X W 53950
Log Measures From Ground Surface
Location Description E-10 Burial
Ground Surface Elevation
Surface Temperature NA Weather Clear Hot

BOREHOLE INFORMATION

Driller
Drill Rig Type | Bit Type/Diameter
Borehole Diameter(s)/Depth 8"/50'
Depth Driller 50' | Depth Logger 48.4'
Liquid Level NA (none) | Liquid Density NA
Temperature NA

CASING RECORD

Type 8" Carbon Steel Sch 40 | Interval +36' - 50'
Type | Interval
Type | Interval
Type | Interval
Well Screen Interval NA
Comments: Casing Stick +0.2' high
Centralizer used

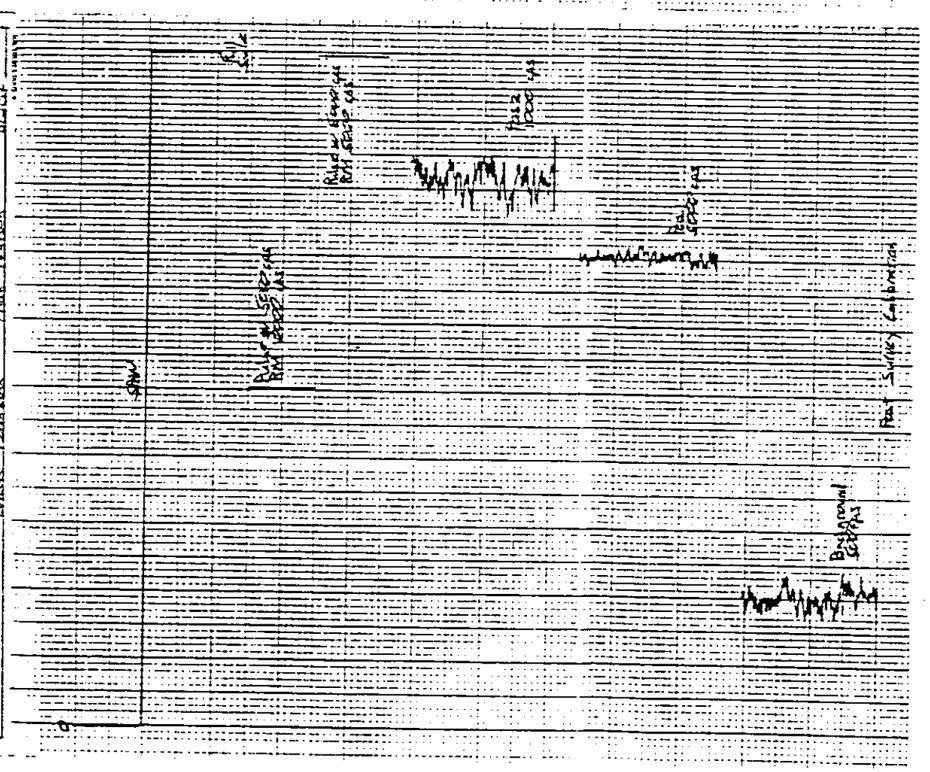
LOG HEADER | Page 2 of 2

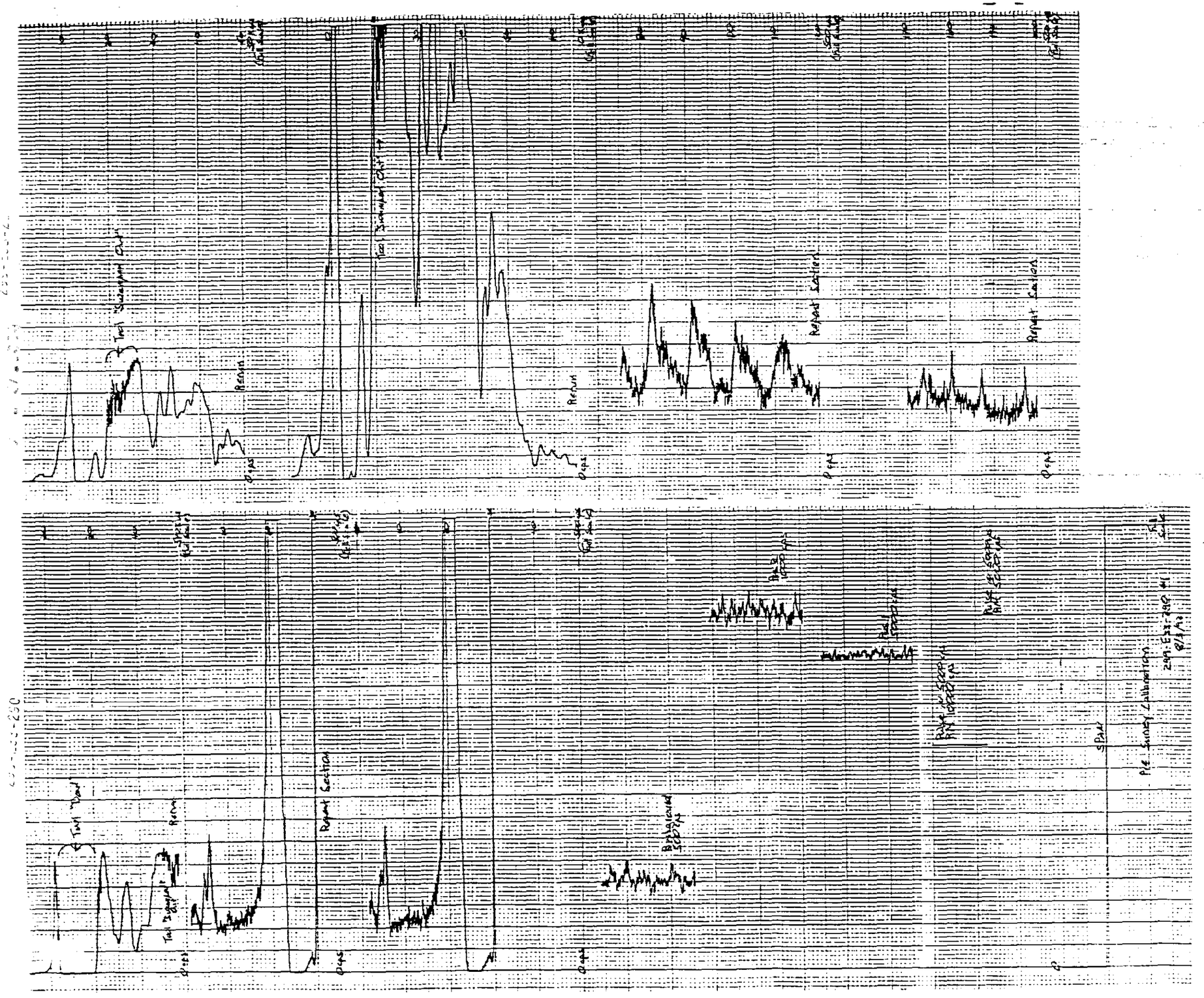
EQUIPMENT DATA

Logging Company PNL
Operator(s) Alan Pearson
Equipment Brand AMS | Equipment Type Analog
Tool Type Gamma Ray | Serial No. CA27AM11
Base Calibration Date 5/92 | Calibration Reference PNL-PR320 HC-6016
Calibration Probe Factor 0.2 | Calibration Datum (kV) 1.0 | Position 1 3151 cll | Position 2 651 cll
Used Time 12.3 cl/s | Warm Up Time >15 min

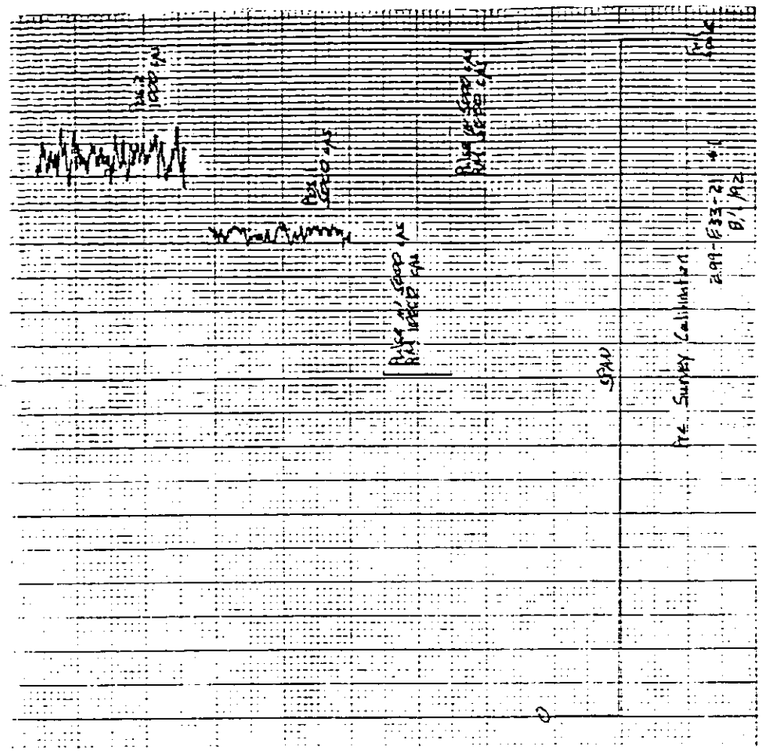
LOGGING INFORMATION

Log Interval From 48.4' To 0.5'
Record 350' to 15' @ 50 fpm, 48.4' to 15' @ 25 fpm
Pre Survey Verification: Position 1 312.2 cll | Position 2 64.9 cll | Background 100 cps
Base Calibration Difference: Position 1 1.8 cll | Position 2 .02 cll
Logging Speed 5 ft/min | Raw Scale, CPSm 50 cps/div
Start Time 0945 | Completion Time 1120
Chart Recorder Illuminated Scale, CPSm 50 cps/div
Chart Speed(s) Min 10 cm/m | Time Constant(s) 1 & 2 : 1
Post Survey Verification: Position 1 311.0 cll | Background 100 cps
Percent Change: Position 1 0.4% | Position 2 0.0%
Comments: Drum Stuck +0.2' high
Centralizer used
Witnessed and Verified by (logs and print name) Alan Pearson Date 8/3/92




Tool "Swamped Out"
Rerun
Repeat Section
Tool "Dow"
Tool "Swamped Out"
Repeat Section
Pre Survey Calibration

299-E33-21


SPAN
Pre Survey Calibration

Crib Designation: 216-B-51

Type of Facility: French drain (Injection well)

Location: N 46366, W 52567 Northeast corner of 241-B tank Farm

Service Dates: 1/56 to 1/58

Description of Waste: 1000 liters of flush drainage from the BC crib pipeline

Radionuclide Release Summary:

less than 10 Ci total beta

Summary of Past Logging:

Boreholes	Date	Reference
299-E33-11	1976	Geophysics files
299-E33-14	none	

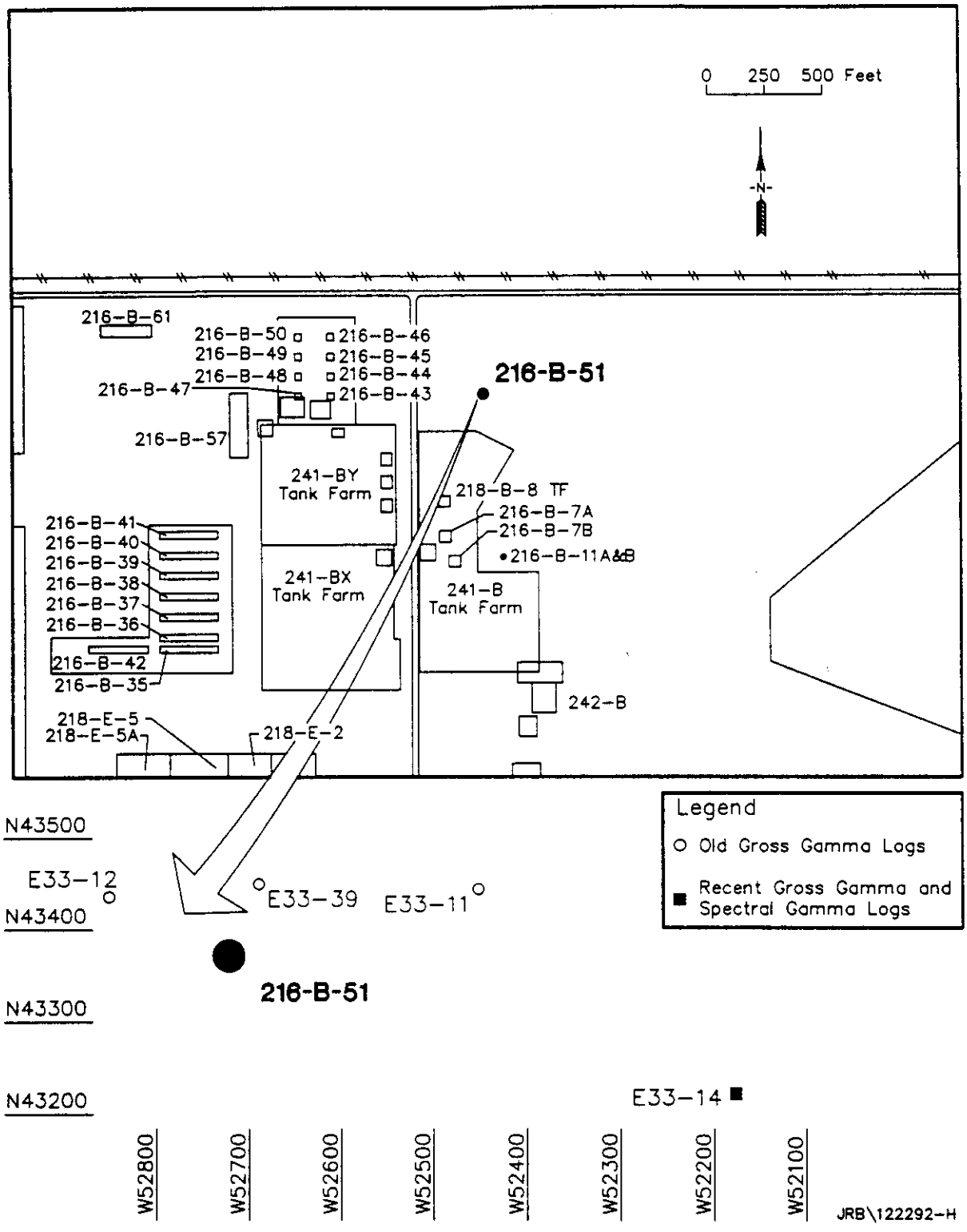
Review of Current Logging:

Borehole: 299-E33-14

This borehole was logged with both the PNL gross gamma system and the RLS spectral gamma system. Co-60 was encountered in this borehole toward the bottom of the borehole from about 210 feet to the bottom at 228 feet. This shows up in the gross gamma log of this borehole and it shows up in the old gross gamma log of E33-11. This contamination is at the top of the groundwater table and it may not be from this site. It could have been released from the B-8 crib or the 241-B tank farms. It is further unlikely that this contamination is from the french drain because records indicate that very little effluent was released at this site.

At 166 feet, the gross gamma log show a slightly elevated activity. The spectral gamma log shows this to be due to the presence of naturally occurring thorium and uranium. This elevated thorium and uranium may correlate with a zone of coarser sediment although it is extremely difficult to be certain due to a lack of lithology information.

Clearly there is little man-made contamination in the unsaturated zone at this site.


0 250 500 Feet
N
216-B-61
216-B-50
216-B-49
216-B-48
216-B-47
216-B-46
216-B-45
216-B-44
216-B-43
216-B-51
216-B-57
241-BY Tank Farm
218-B-8 TF
216-B-7A
216-B-7B
216-B-11A&B
216-B-41
216-B-40
216-B-39
216-B-38
216-B-37
216-B-36
216-B-42
216-B-35
241-BX Tank Farm
241-B Tank Farm
242-B
218-E-5
218-E-5A
218-E-2
Legend
Old Gross Gamma Logs
Recent Gross Gamma and Spectral Gamma Logs
N43500
E33-12
N43400
E33-39
E33-11
216-B-51
N43300
N43200
E33-14
W52800
W52700
W52600
W52500
W52400
W52300
W52200
W52100
JRB\122292-H

Westinghouse Hanford Company
RLS Spectral Gamma-Ray Borehole Survey Log Header

Project: 200-BP-1 and 200 East AAMS, ~~216-B-56 Crib~~

Borehole	200-E33-14		
Coordinates	46,233 N 52,177 W	Feet	(Plant 200 E)
Elevation	622.12 feet	Top of Casing	(Plant 200 E)

Borehole Environment Information

Borehole Fluid Depth 216.35 (Feet) from Zero (0.0) Depth Reference of Log

Casing Size I.D. (inch)	Casing Thickness (inch)	Top Depth (feet)	Base Depth (feet)
8	0.307	0.0	230.0

RLS Passive Spectral Gamma Survey Information

Logging Engineers R. V. Cram S. E. Kos
Log Depth Reference at Zero (0.0) depth is Ground Level

Log Date	Archive File Names	Log Mode[1] Speed	Depth Interval (feet) Top	Base	Incr
July 30, 92	H2E3314\A217	MSA 35sec LT	0	50	0.5
		MSA 35sec LT	86	117	0.5
		MSA 35sec LT	160	179	0.5
		MSA 35sec LT	200	225	0.5

[1]MSA: Move-Stop-Acquire Lt: Live Time

Calibration and Analysis Information

RLS Calibration Date: Nov 21, 1991
Calibration Report: WHC-SD-EN-TRP-001

Analyst Names: J. P. Kiesler R. K. Price
Analysis Date: Sept 2, 1992

Analysis Notes: Survey depth selected from PNL gross gamma survey
Radionuclides identified: Co-60

RLS Spectral Gamma Ray Borehole Survey

Well 299-E33-14 | Crib 216-B-56 | Log Date 7/30/92

Well Construction

Feet

0, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120, 130

Elevation of top of casing:
[622.05 ft]

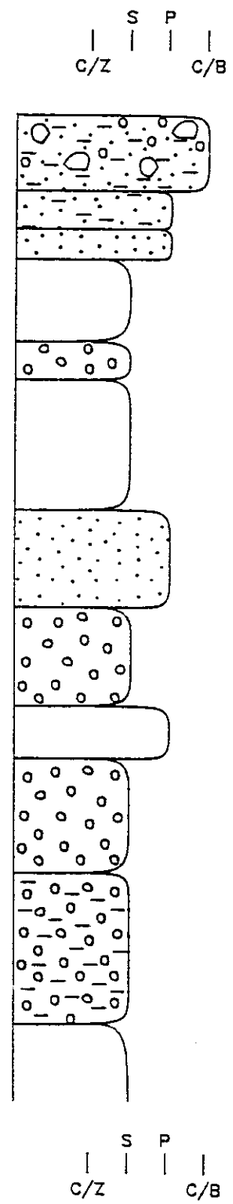
Type of surface seal above ground surface
[0-20 ft]

Type of surface seal:
4 ft by 4 ft concrete surface pad
Cement grout between 8-in casing and 15-in hollow-stem auger hole

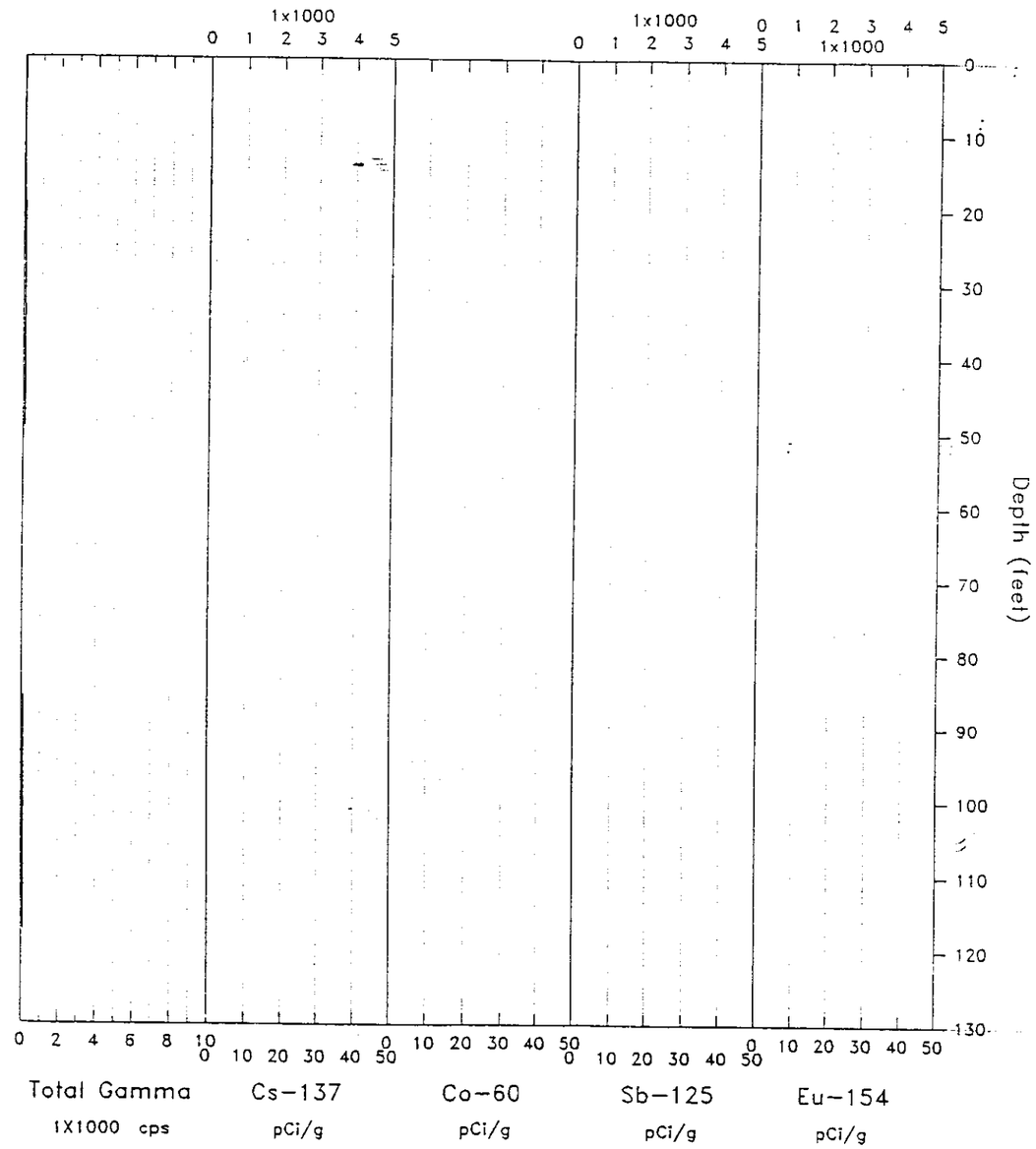
I.D. of riser pipe: [8-in.]
Type of riser pipe: Carbon steel

Diameter of borehole:
[9-in. nom]

Lithology



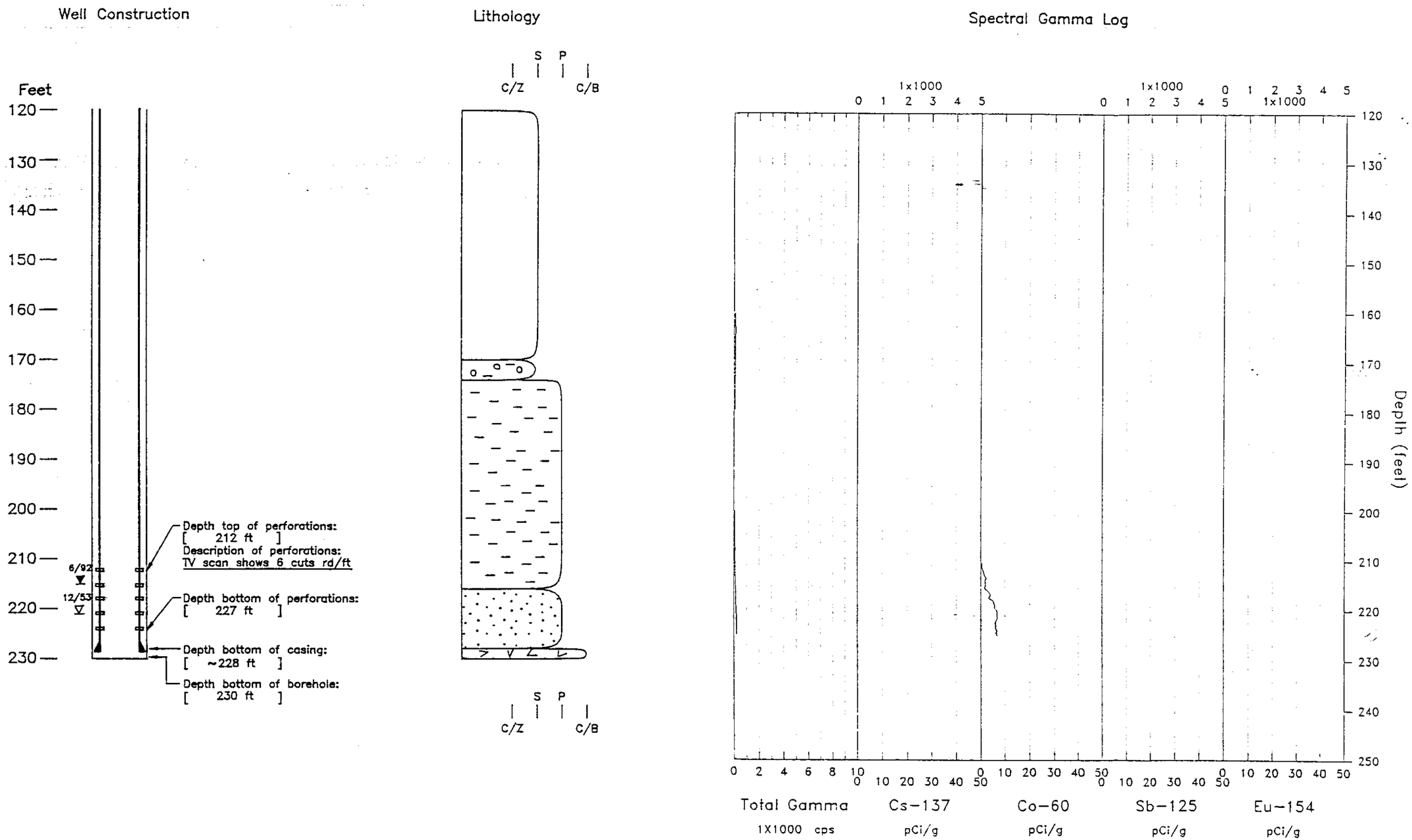
Spectral Gamma Log



WELLS\E33-14A

RLS Spectral Gamma Ray Borehole Survey (Page 2)

Well 299-E33-14 | Crib 216-B-56 | Log Date 7/30/92



ELLS\E33-14B

RLS Borehole Survey Report

299-E33-14 216-B-56 Crib

Casing	Depth: 230 ft	Size: 8 in	Thickness: 0.31 in
Water	Depth: 216 ft		
Survey	Depth: 0 - 50 ft	Mode: MSA 35 sec	Date: 7/30/92
	86 - 117 ft	Mode: MSA 35 sec	
	160 - 179 ft	Mode: MSA 35 sec	
	200 - 225 ft	Mode: MSA 35 sec	

General Notes:
The screening survey depth intervals were determined from review of the PNL gross gamma survey acquired earlier. Stationary spectral gamma ray measurements were also taken at 37.7, 98, 168.9 and 222.5 feet. Manmade radionuclides were identified in the long count spectra only at 222.5 feet.

Detector depth was checked every 50 feet to 220 feet with at steel tape. The tool depth was not adjusted. The logging cable was failing. The maximum depth error is 1.3% (ie. 2.62 ft at 200 ft).

Man-made Radionuclides:
No Cesium (Cs-137) was encountered in the borehole survey. The plot track is present only for uniformity of the displayed data.

Cobalt (Co-60) was encountered in the borehole survey from 208 feet to the maximum survey depth of 225 feet. The cobalt decay activity detected was less than 7 pCi/g.

No Antimony (Sb-125) was encountered in the borehole survey. The plot track is present only for uniformity of the displayed data.

No Europium-154 (Eu-154) was encountered in the borehole survey. The plot track is present only for uniformity of the displayed data.

299-E33-14

Westinghouse Hanford Company | LOG HEADER | Page 1 of 2

Well No. 299-E33-14 Area 200 East Date 7/31/92
Log Run #1 Log Type Gross Gamma
Elevation Datum T.O. of Casing Elevation 622.12 ±
Survey Coordinates N 46223 ± X W 52172
Log Measures From Ground Surface
Location Description ~1000 ft East of BX-34 Tank Farm
Ground Surface Elevation
Surface Temperature N/A Weather Clear-Hot

BOREHOLE INFORMATION

Driver
Drill Rig Type Bit Type/Diameter
Borehole Diameters/Depth 8"/227.0 227.0
Depth Driller 227.0 227.0' Depth Logger 227.9'
Liquid Level 221.0' Liquid Temp Clear
Temperature N/A

CASING RECORD

Type 8" Carbon Steel Sch. 40 Interval +2.5 - 214' 220.0'
Type Interval
Type Interval
Type Interval
Well Screen Interval Perforated 212'-217'
Comments: Casing Error ~~221.0'~~ +0.2' Hwt
Centralizer used

LOG HEADER

Logging Company PNL
Operator(s) Alan Hoersen
Equipment Board 415
Load Type Gamma Bat
Base Calibration Date 5/92
Calibration Pads Error 0.0 ± 0.2 Calibration Pattern Full
Head Time 1:23 AM

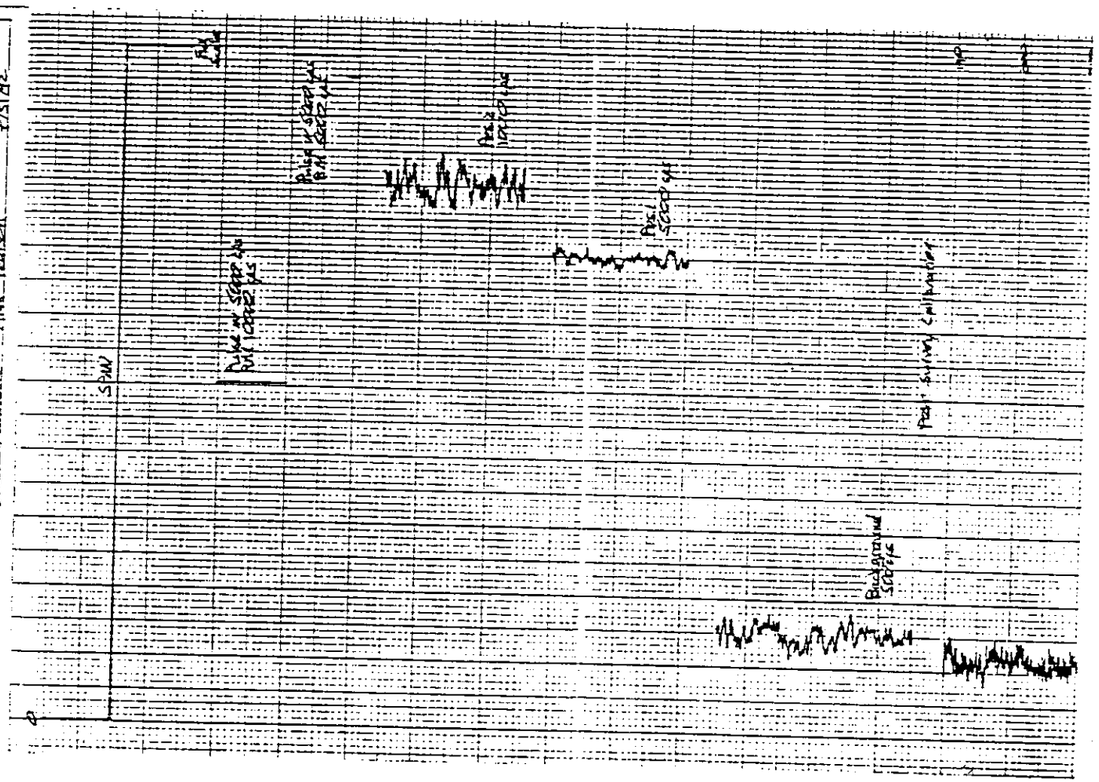
Log Interval From 227.9 To 0
Recorded 227.9 Mfr Number 1920
Pre Survey Verification: Position 1 3087 cll Position 2 611 cll
Base Calibration Difference: Position 1 Position 2
Logging Speed 5 ft/min
Start Time 1030
Chart Speed(s) Time 10 ft/in
Chart Recorder Horizontal Scale Option 50 cps/in
Post Survey Verification: Position 1 3082 cll Position 2 07 cll
Percent Change: Position 1 0.7% Position 2
Comments: Values Since 1902 High
Centralizer used

Witnessed and Verified by: (sign and print name) Alan Hoersen Date 7/31/92

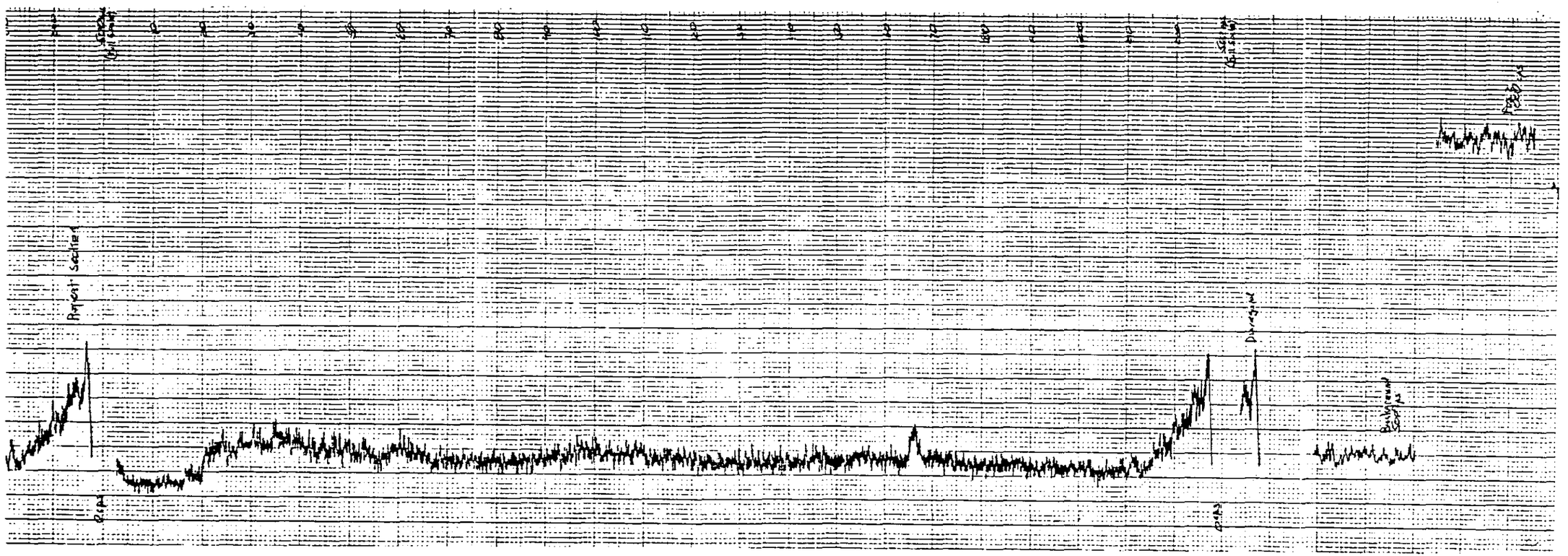
Page 1 of 2

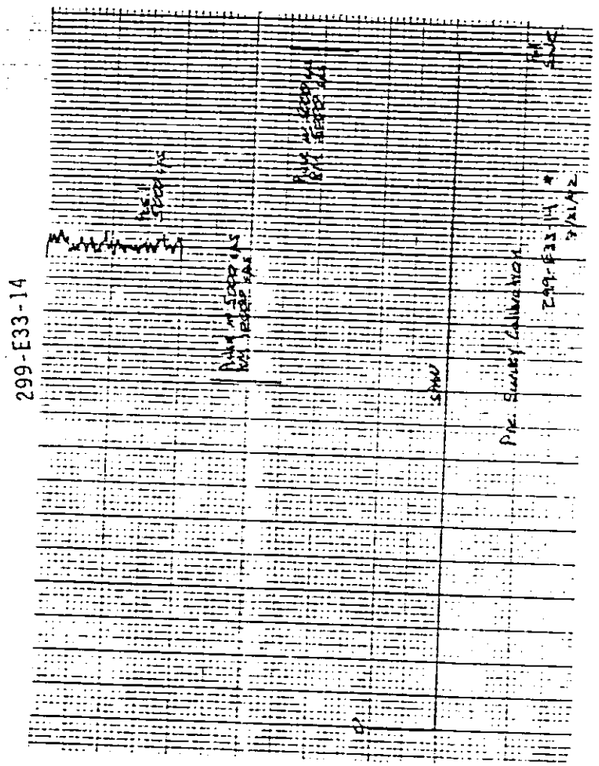
Equipment Type Analog
Serial No. 022 7 AVI
Calibration Reference: Position 1 3151 cll Position 2 651 cll
Warm Up Time 7:15 min
LOGGING INFORMATION
In 2.6'
Mfr Number 1920
Position 1 658 cll Background 75 cps
Position 2 07 cll
Recorder Scale (CPS/in) 50 cps/in
Completion Time 12:30
Final Continuity 76-1
Position 1 658 cll Background 75 cps
Position 2 00 cll

Alan Hoersen Date 7/31/92



299-E33-14




299-E33-14

Crib Designation: 216-B-57

Type of Facility: 200 ft. x 15 ft. gravel crib

Location: N 46160 to N 46360, W 53775 Just west of the B cribs (216-B-43 through 216-B-50), off the north-west corner of the BY tank farm

Service Dates: 2/68 to 6/73

Description of Waste: 84 x 10^6 liters of waste storage tank condensate from the ITS #2 unit in the 241-BY tank farm

Radionuclide Release Summary:

Radionuclide	Quantity
gross Pu	0.19 g
gross U	0.89 kg
Sr-90	3.2 Ci
Ru-106	8.7 Ci
Cs-137	370 Ci
Co-60	0.14 Ci

Summary of Past Logging:

Boreholes	Date	Reference
299-E33-24	1976	Fecht, et al., 1977

Review of Current Logging:

Borehole: 299-E33-24, 299-E33-304, 299-E33-305, 299-E33-306

Borehole was logged as a part of the AAMS study with the PNL gross gamma and the RLS spectral gamma logging systems. The other three boreholes were drilled and logged with the RLS spectral gamma system as a part of the 200-BP-1 operable unit remedial investigation. The spectral gamma log data presentations for these boreholes are somewhat different from the AAMS study data.

Borehole E33-24 is an older monitoring borehole which was installed all the way to groundwater. The spectral gamma log of this borehole shows a zone of very high Cs-137 contamination from 30 feet to about 60 feet. Cs-137 was also detected in the groundwater and some surface cesium was detected. Cobalt-60 was found in the groundwater along with the cesium.

Borehole E33-304 was drilled through the crib at the effluent release point. It was drilled with multiple, telescoping casings all the way to groundwater and it was logged after placement of each casing. The logs presented represent each log run after placement of each casing. Note the casing designation below the borehole number on the log presentation.

This spectral gamma log is very similar to that of E33-24 because they are very close together. It too shows a zone of high cesium contamination below crib depth and it show some near surface contamination. However, no man-made nuclides were detected in the groundwater in this borehole.

Borehole E33-305 is a shallow borehole drilled in the middle of the crib to provide sediment samples of the contamination. The cesium plume is less intense and less extensive in theis area compared to the area immediately adjacent to the release point. Some surface Cs-137 contamination is also seen in the log.

Borehole E33-306 was drilled at the north end of the crib, opposite from the effluent release point. It too is a shallow sampling borehole. In the 50 foot total depth of the borehole, no man-made radionuclides were detected with the spectral gamma logging system. This does not mean that there is no contamination at depth. But it does mean that the effluent released at this site traveled straight downward from the release point. This is typical of the cribs in the 200 East area where we find little horizontal migration of the nuclides and little horizontal movement of the driving effluent.

There appears to be three different deposition mechanisms at this site. First, the surface Cs-137 contamination is from airborne deposition. Because the concentration has been measured as high as 10 pCi/g through two layers of casing and two layers of grout, it is evidently quite a significant airborne release or series of releases.

The very high cesium concentration zone is definitely due to the effluent released at this crib. This is seen in the older gross gamma logs and there has been very little migration since the site was closed.

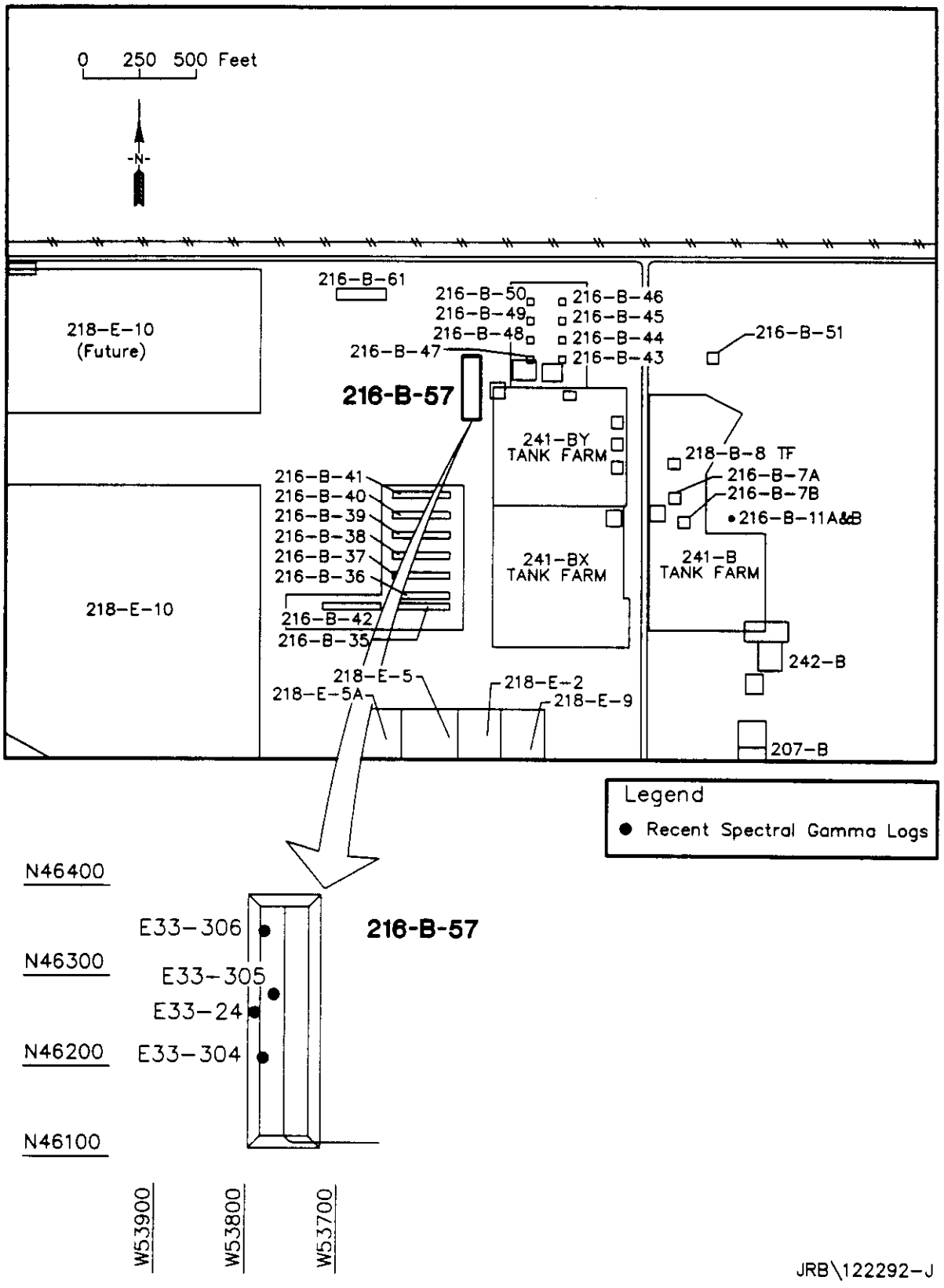
The groundwater contamination of cesium and cobalt is the result of migration into the area from another site or from the BY or BX tank farms. There is no history of migration of radionuclides released from this crib into and through the lower unsaturated zone as seen in the older gross gamma-ray logs, thus it is unlikely that the groundwater contamination is from this site.

The new gross gamma log shows the high cesium concentration zone and the lower groundwater contamination zone but it does not show the surface contamination zone. The background activity signature is typical of the lithology in the east area, boring and uninteresting with almost no compositional variation.

It is apparent that the radionuclides released at this site have been retained and concentrated high up in the unsaturated zone and that this site has not contributed to the contamination of the groundwater beneath this site.

It is recommended that more unsaturated zone logging be performed in this area to help identify the source of groundwater contamination beneath the area. This would include logging at the BX and BY tank farms, the B cribs, the BX trenches and all of the other nearby cribs.

It is also recommended to perform an investigation of the surface contamination to identify the source of these airborne releases if it makes economic sense in terms of the overall remedial investigation strategy. Regardless, it must be recognized that there has been significant airborne releases near this site.


0 250 500 Feet
N
218-E-10
(Future)
216-B-61
216-B-50
216-B-49
216-B-48
216-B-47
216-B-46
216-B-45
216-B-44
216-B-43
216-B-51
216-B-57
241-BY
TANK FARM
218-B-8 TF
216-B-7A
216-B-7B
216-B-11A&B
216-B-41
216-B-40
216-B-39
216-B-38
216-B-37
216-B-36
216-B-42
216-B-35
241-BX
TANK FARM
241-B
TANK FARM
218-E-10
242-B
218-E-5
218-E-5A
218-E-2
218-E-9
207-B
Legend
Recent Spectral Gamma Logs
N46400
N46300
N46200
N46100
E33-306
E33-305
E33-24
E33-304
216-B-57
W53900
W53800
W53700
JRB\122292-J

Westinghouse Hanford Company
RLS Spectral Gamma-Ray Borehole Survey Log Header

Project: 200 AAMS, 216-B-57 Crib

Borehole	299-E33-24			
Coordinates	42,260 N	53,790 W	Feet	(Plant 200 W)
Elevation	638.03 feet		Top of Casing	(Plant 200 W)

Borehole Environment Information

Borehole Fluid Depth 232.5 (Feet) from Zero (0.0) Depth Reference of Log

Casing Size I.D. (inch)	Casing Thickness (inch)	Top Depth (feet)	Base Depth (feet)
8.0	0.327	0.0	249.7

RLS Passive Spectral Gamma Survey Information

Logging Engineers R. V. Cram S. E. Kos
Log Depth Reference at Zero (0.0) depth is Ground Level

Log Date	Archive File Names	Log Mode[1] Speed	Depth Interval (feet) Top	Base	Incr
July 13, 92	H2E3324\A204	MSA 80sec LT	0.0	75.0	0.5
July 14, 92	H2E3324\A205	MSA 80sec LT	73.0	191.5	0.5
July 15, 92	H2E3324\A206 A206"A"	MSA 80sec LT	190.0 28.0	246.7 53.0	0.5 0.5

[1]MSA: Move-Stop-Acquire LT: Live Time

Calibration and Analysis Information

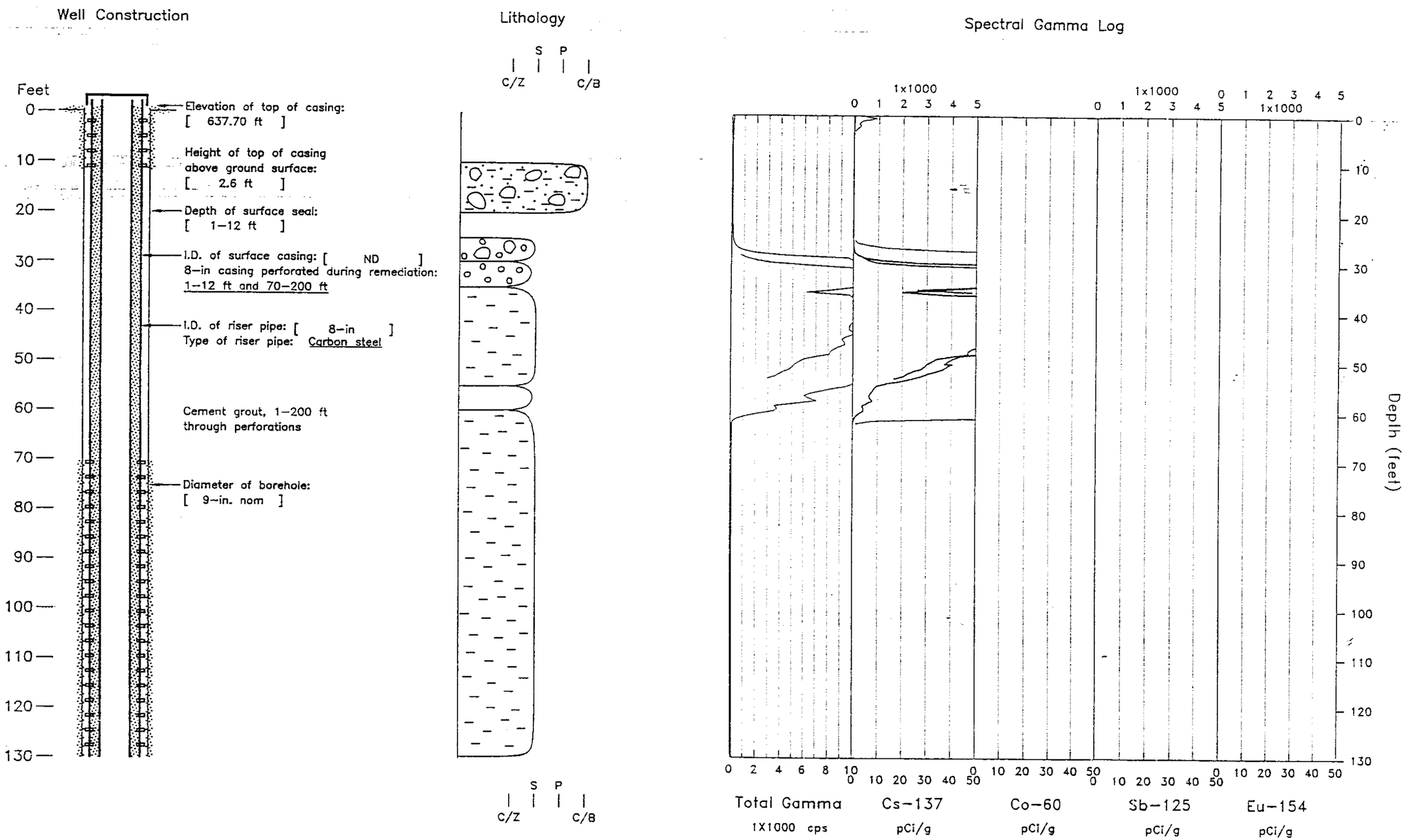
RLS Calibration Date: Nov 21, 1991
Calibration Report: WHC-SD-EN-TRP-001

Analyst Names: J. P. Kiesler R. K. Price
Analysis Date: August 3, 1992

Analysis Notes: A206"A" is rerun of 28.0 to 53.0 feet with Pb shield
Radionuclides identified: Cs-137, Co-60

RLS Spectral Gamma Ray Borehole Survey

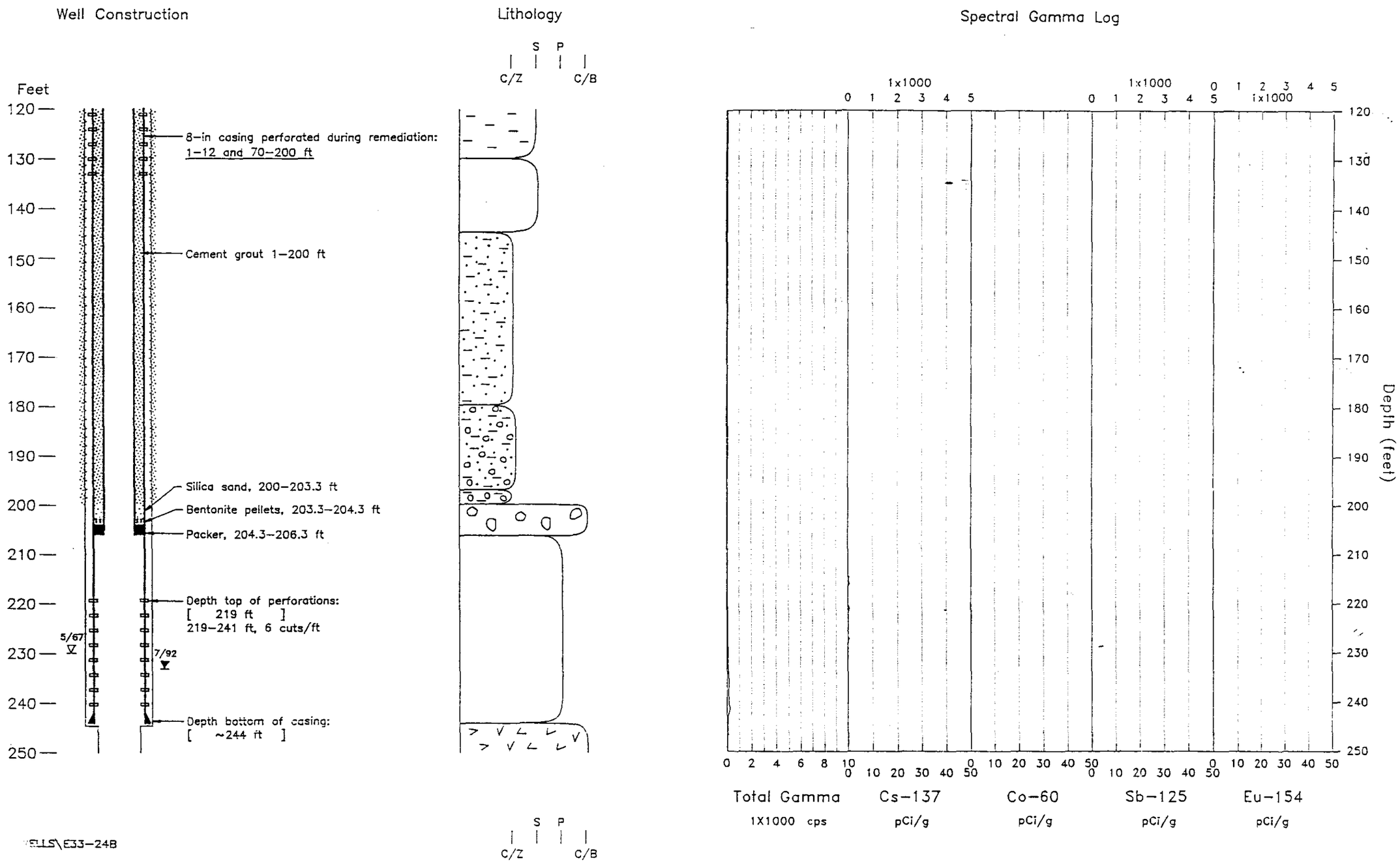
Well 299-E33-24 | Crib 216-B-57 | Log Date 7/14/92



WELLS\E33-24A

RLS Spectral Gamma Ray Borehole Survey (Page 2)

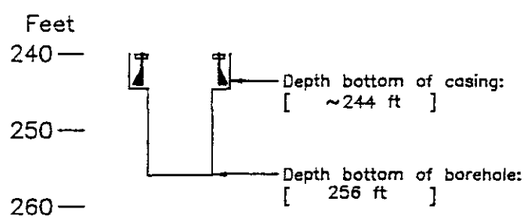
Well 299-E33-24 | Crib 216-B-57 | Log Date 7/14/92



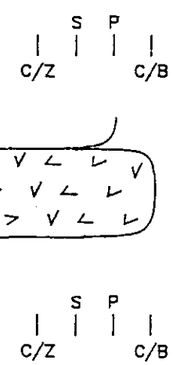
RLS Spectral Gamma Ray Borehole Survey (Page 3)

Well 299-E33-24 | Crib 216-B-57 | Log Date 7/14/92

Well Construction



Lithology



Spectral Gamma Log

RLS Borehole Survey Report

299-E33-24 216-B-57 Crib

Casing	Depth: 249.7'	Size: 8"	Thickness: 0.327
Water	Depth: 232.5'		
Survey	Depth: 0 - 75'	Mode: MSA 80 sec	Date: 7/13/92
	Depth: 73 - 191'	Mode: MSA 80 sec	Date: 7/14/92
	Depth: 190 - 246'	Mode: MSA 80 sec	Date: 7/15/92
	28 - 53'	Mode: MSA 80 sec	(Lead Shield)

General Notes:
The maximum total gamma count rate reported by the data reduction program "LGCALC" prior to Aug 20, 1992 was 10,000 cps. Total gamma activity from 30 feet to 55 feet exceeded the plotted maximum of 10,000 cps.

Both standard configuration and lead shield logging configuration data surveys are plotted together. The numeric data values of the Total Gamma plot for the two configurations will not produce identical values. No Total Gamma correction for the gamma-ray attenuation from the lead shield has been established.

Computed activity for the man-made radionuclides for both logging configurations agree within the 2 sigma uncertainitites.

Man-made radionuclides:
Cesium (Cs-137) was encountered in three zones in the borehole. The depth intervals are: surface to 3 feet, 25 to 63 feet, and 204 to 245 feet. The cesium decay activities exceeded 200 pCi/g from 28 feet to 60 feet. The decay activity exceeded 5000 pCi/g from 30 to 35 feet and from 36 to 47 feet.

Cobalt (Co-60) was observed from 228 feet to 243 feet. The maximum decay activity detected was 5 pCi/g at 241 feet.

No Antimony (Sb-125) was encountered in the borehole. The plot track is present only for the uniformity of the displayed data.

No Europium-154 (Eu-154) was encountered in the borehole. The plot track is present only for the uniformity of the displayed data.

299-E33-24

Washington Nuclear Chemistry

LOG HEADER

Page 1 of 2

Well No. 299-E33-24

Log Run #1

Direction Outside

Survey Commencing N 416 291

Log Measured From Ground Surface

Location Description South of 200 West 3-55 Fence

Ground Surface Elevation

Surface Temperature

Area 200 West Date 6/22/92

Log Type Gamma Gamma

Elevation N 5 [illegible]

WELLHEAD INFORMATION

Drilled By [illegible]

Drill Rig Type [illegible]

Borehole Diameter/Depth 5"/55'

Casing Driver 35'

Casing Length 35'

Casing Diameter 5"

CASING RECORD

Type 5" Carbon Steel Casing Interval 0-35'

Type Interval

Type Interval

Type Interval

Pad Screw Interval Bentonite 5' [illegible]

Comments: Drain Spigot 7.22' [illegible]

Centralizer used

Page 2 of 2

LOG HEADER

EQUIPMENT DATA

Logging Company PNL

Operator(s) Alan Pearson

Equipment Brand AMS

Equipment Type Analog

Tool Type Gamma Ray

Serial No. CL27M1

Date Calibration Date 5/92

Calibration Reference PNL

Calibration/Probe Factor(s) [illegible]

Line Calibration Datum (cll) Position 1 315.1 cll

Position 2 65.1 cll

Dead Time 12.3 [illegible]

Warm-up Time 7.15 min

LOGGING INFORMATION

Log Interval From 211.7 To 5.5'

Remarks 211.7 to 2000 @ 500 cfs 1.5' to 3.5' @ 50% CPS

Pre Survey Verification Position 1 207.4 cll Position 2 62.6 cll Background 100%

Date Calibration Difference Position 1 7.7 cll Position 2 1.5 cll

Logging Speed 5'/min

Human Scales, CPS/in 50%/in

Start Time 0845

Completion Time 1112

Chart Speed(s), in/m 10'/m

Chart Recorder Horizontal Scale, CPS/in 50%/in

Time Constant(s) TC=1

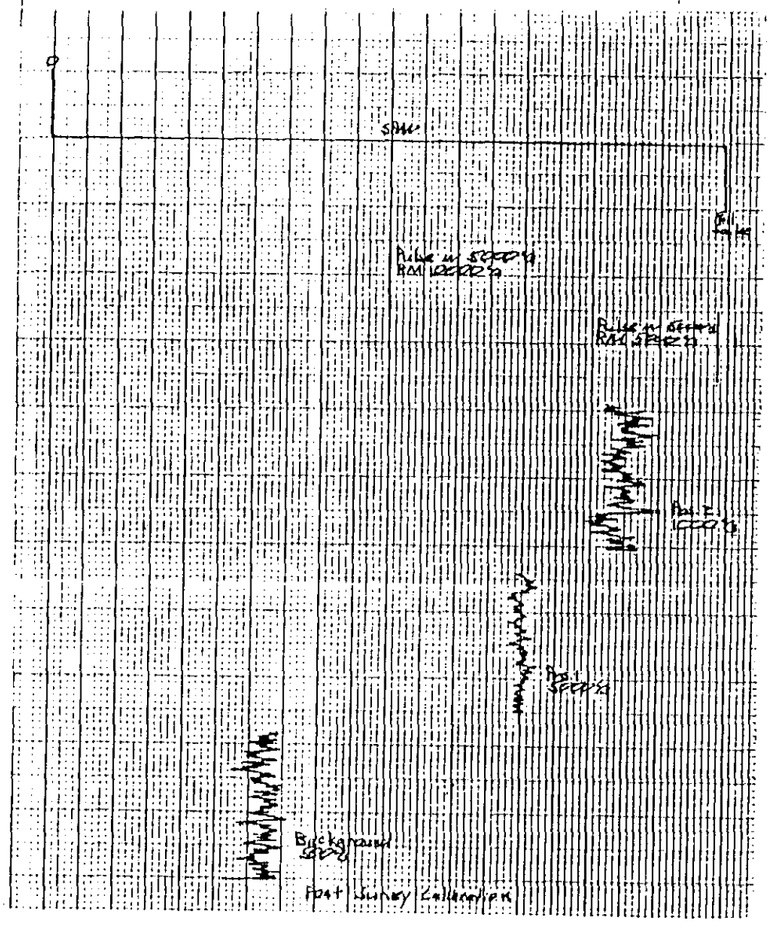
Post Survey Verification Position 1 505.1 Position 2 62.5 cll Background 100%

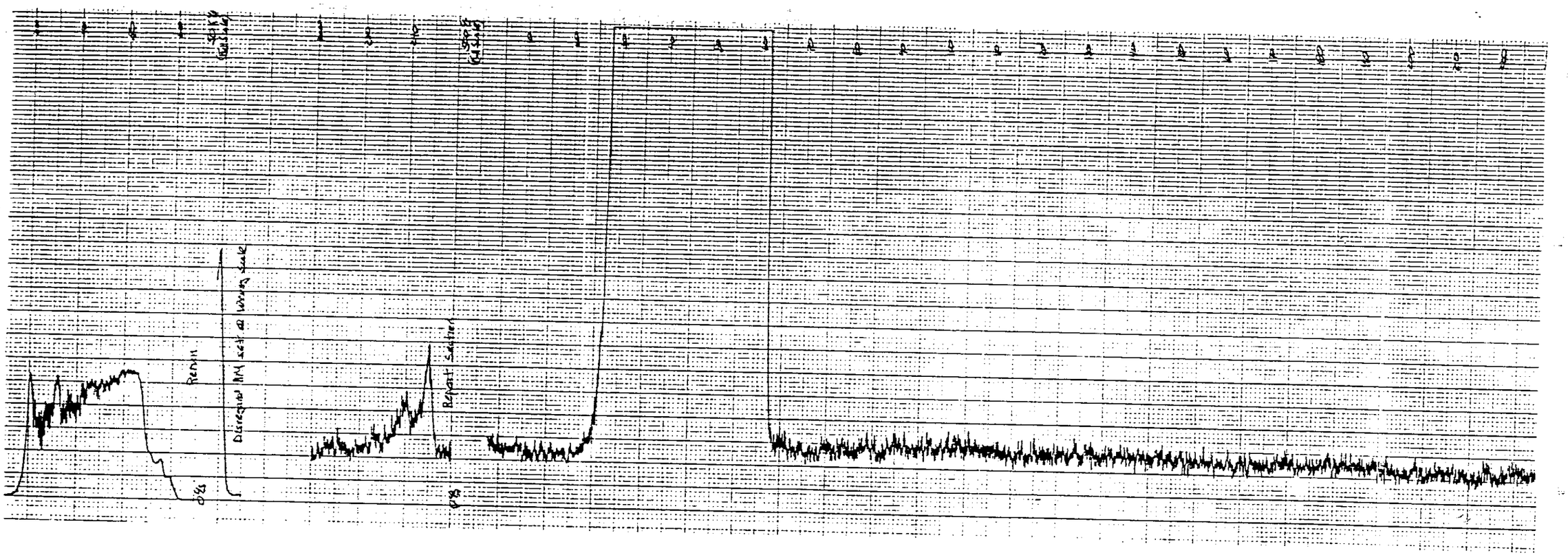
Percent Change Position 1 1.4% Position 2 1.7%

Comments: Below Zero = 7.22' [illegible]

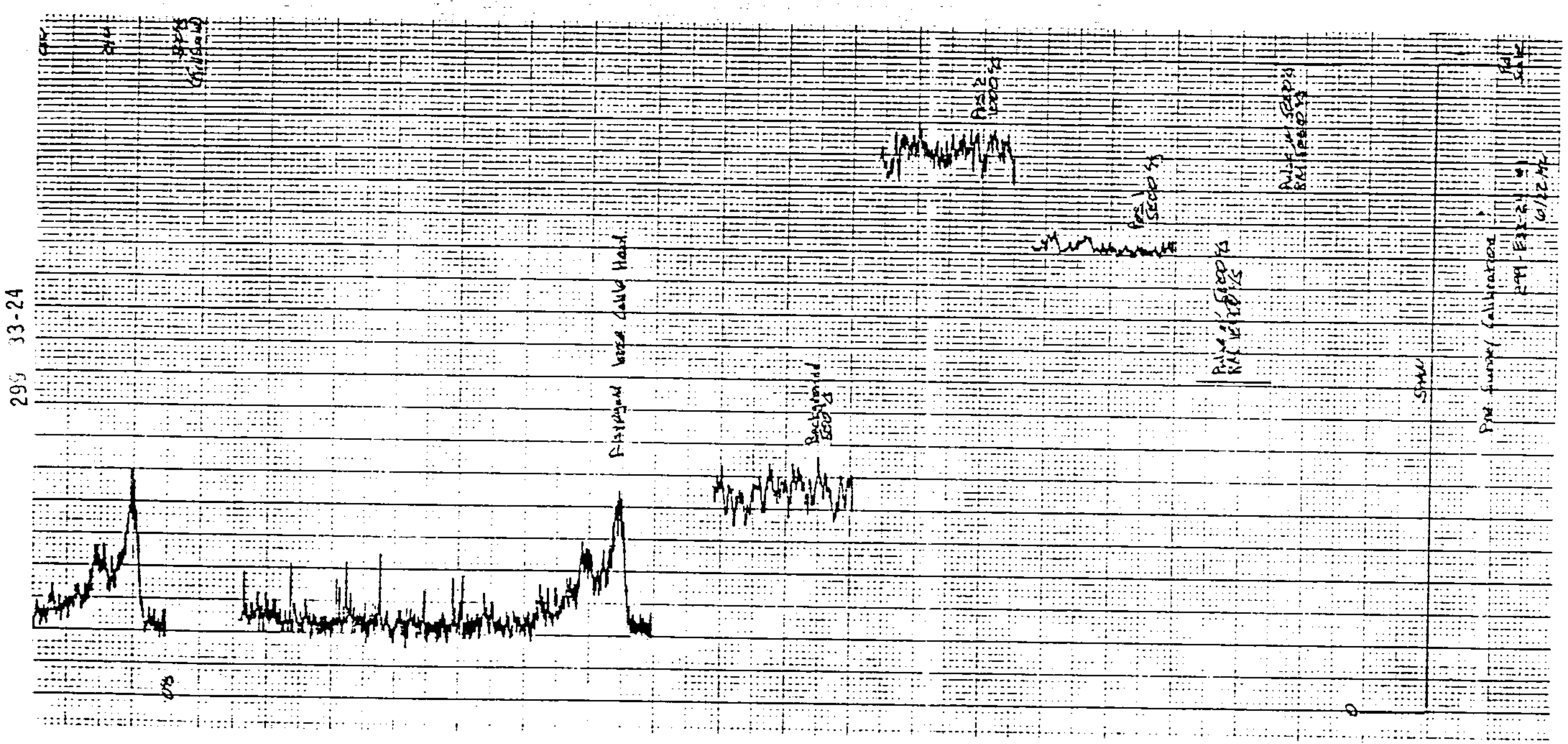
Centralizer used

Witnessed and Verified by: (sign and print name) Alan Pearson Alan Pearson Date: 6/22/92





299-133-24



Crib Designation: 216-B-61

Type of Facility: 1750 sq. ft. Gravel filled crib

Location: N 46650, W 54175 to W 54350

Service Dates: Never used

Description of Waste: Never used

Radionuclide Release Summary:
Never used

Summary of Past Logging:

Boreholes	Date	Reference
299-E33-25	1976	Fecht, et al., 1977
299-E33-26	1976	"

Review of Current Logging:

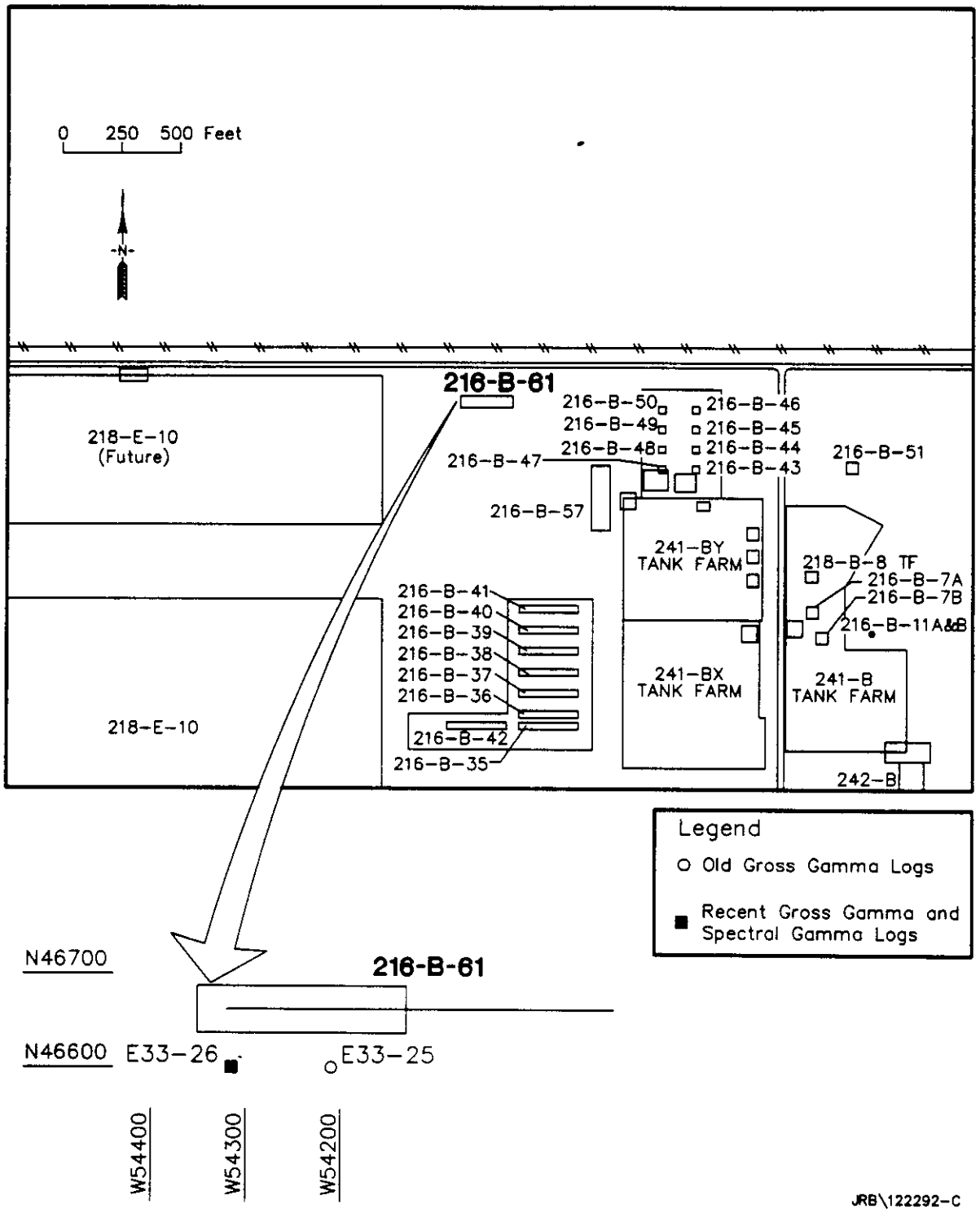
Borehole: 299-E33-26

This borehole was logged with the PNL gross gamma system and the RLS spectral gamma system.

Two zones of man-made contamination were encountered in the borehole. First a surface contamination zone of Cs-137 is found at the top of the borehole. This is due to either airborne deposition or a surface spill.

The other contamination zone is in the groundwater and is the result of Co-60 carried in through the groundwater. Because this site was never used and because there is no unsaturated zone contamination, it is certain that this groundwater contamination is from another site.

As recommended with the B-57 crib, it is recommended that this entire area be subjected to extensive vadose zone logging with the spectral gamma system to positively identify the sources of groundwater contamination. In addition, it appears that the surface contamination is more extensive than previously thought. Surface contamination is found at many of the nearby sites and the cesium concentrations are rather high in some of the areas. Therefore it is recommended that an extensive surface survey be performed with intrinsic germanium gamma-ray detectors to identify and outline the surface contamination.


0 250 500 Feet
N
216-B-61
218-E-10
(Future)
218-E-10
216-B-50
216-B-49
216-B-48
216-B-47
216-B-46
216-B-45
216-B-44
216-B-43
216-B-51
216-B-57
241-BY
TANK FARM
218-B-8 TF
216-B-7A
216-B-7B
216-B-11A&B
216-B-41
216-B-40
216-B-39
216-B-38
216-B-37
216-B-36
216-B-42
216-B-35
241-BX
TANK FARM
241-B
TANK FARM
242-B
Legend
Old Gross Gamma Logs
Recent Gross Gamma and Spectral Gamma Logs
N46700
216-B-61
N46600
E33-26
E33-25
W54400
W54300
W54200
JRB\122292-C

Westinghouse Hanford Company
RLS Spectral Gamma-Ray Borehole Survey Log Header

Project: 200 East AAMS B-Plant 216-B-61 Crib

Borehole	299-E33-26			
Coordinates	46,600 N	54,513 W	Feet	(Plant 200 E)
Elevation	630.0 feet		Top of Casing	(Plant 200 E)

Borehole Environment Information

Borehole Fluid Depth 229.0 (Feet) from Zero (0.0) Depth Reference of Log

Casing Size I.D. (inch)	Casing Thickness (inch)	Top Depth (feet)	Base Depth (feet)
6	0.25	0	240

RLS Passive Spectral Gamma Survey Information

Logging Engineers R. V. Cram J. P. Kiesler
Log Depth Reference at Zero (0.0) depth is Ground Level

Log Date	Archive File Names	Log Mode[1], Speed	Depth Interval (feet) Top	Base	Incr
Aug 11, 92	H2E3326\A224	MSA 35sec LT	0	50	0.5
		MSA 35sec LT	185	200	0.5
		MSA 35sec LT	220	236	0.5

[1] MSA: Move-Stop-Acquire Lt: Live Time

Calibration and Analysis Information

RLS Calibration Date: Nov 21, 1991
Calibration Report: WHC-SD-EN-TRP-001

Analyst Names: J. P. Kiesler
Analysis Date: Sept 18, 1992

Analysis Notes: Primary radionuclide, Co-60, encountered only below water
Radionuclides identified: Cs-137, Co-60

RLS Spectral Gamma Ray Borehole Survey

Well 299-E33-26 | Crib 216-B-61 | Log Date 8/11/92

Well Construction

Feet

0, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120, 130

Elevation of reference point:
[632.77 ft]

Height of top of casing above ground surface:
[2.45 ft]

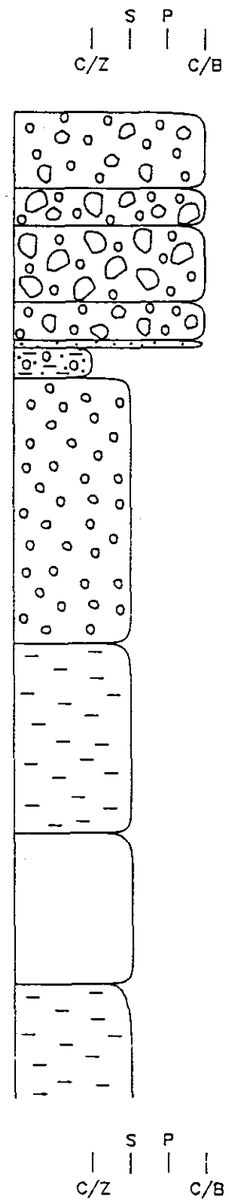
Type of surface seal above ground surface
[0-19 ft]

Type of surface seal:
4 ft by 4 ft concrete surface pad
Cement grout between 6-in casing and 15-in hollow-stem auger overdrilled hole to 19-ft

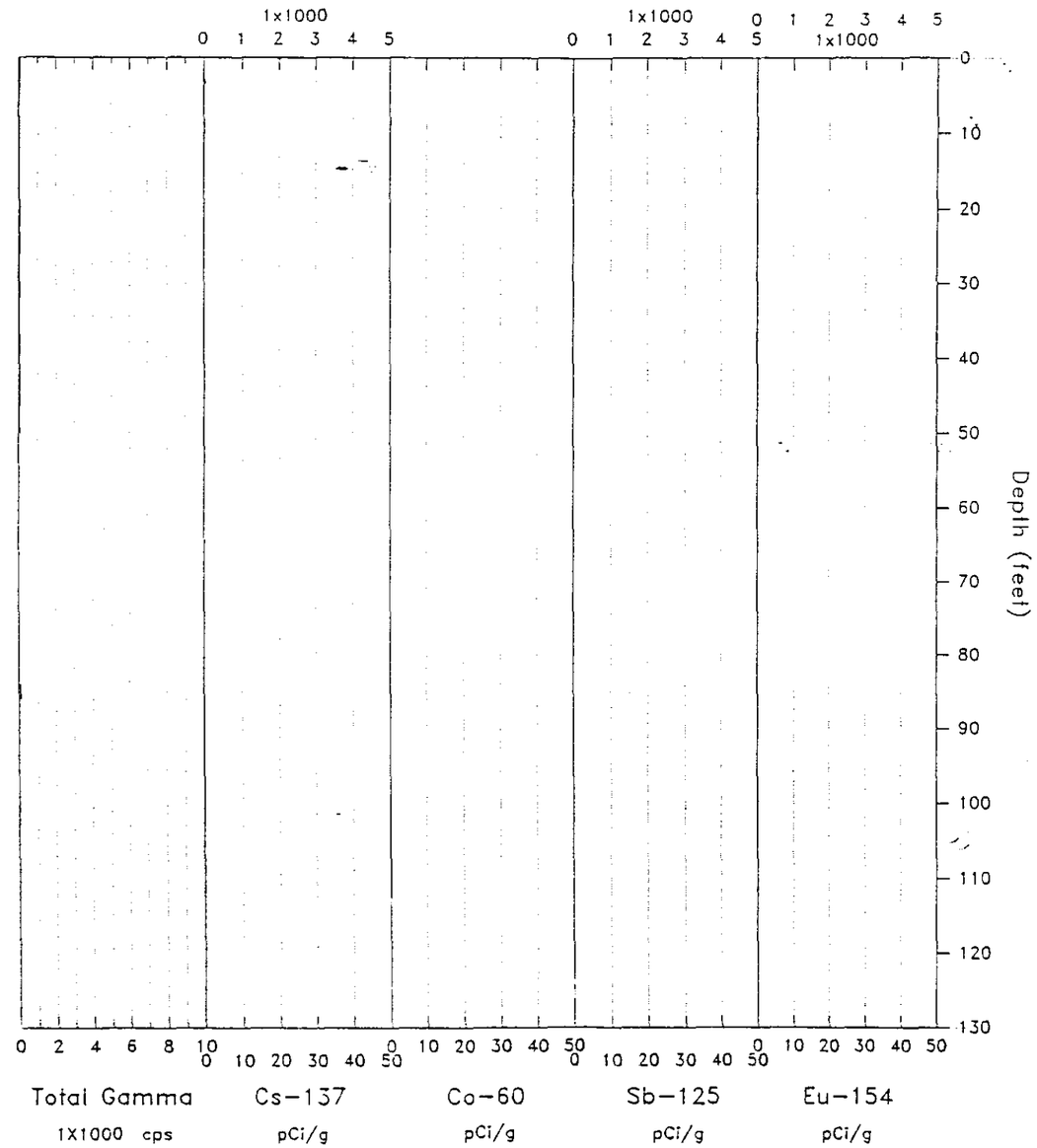
I.D. of riser pipe: [6-in.]
Type of riser pipe: Carbon steel

Diameter of borehole:
[7-in. nom]

Lithology



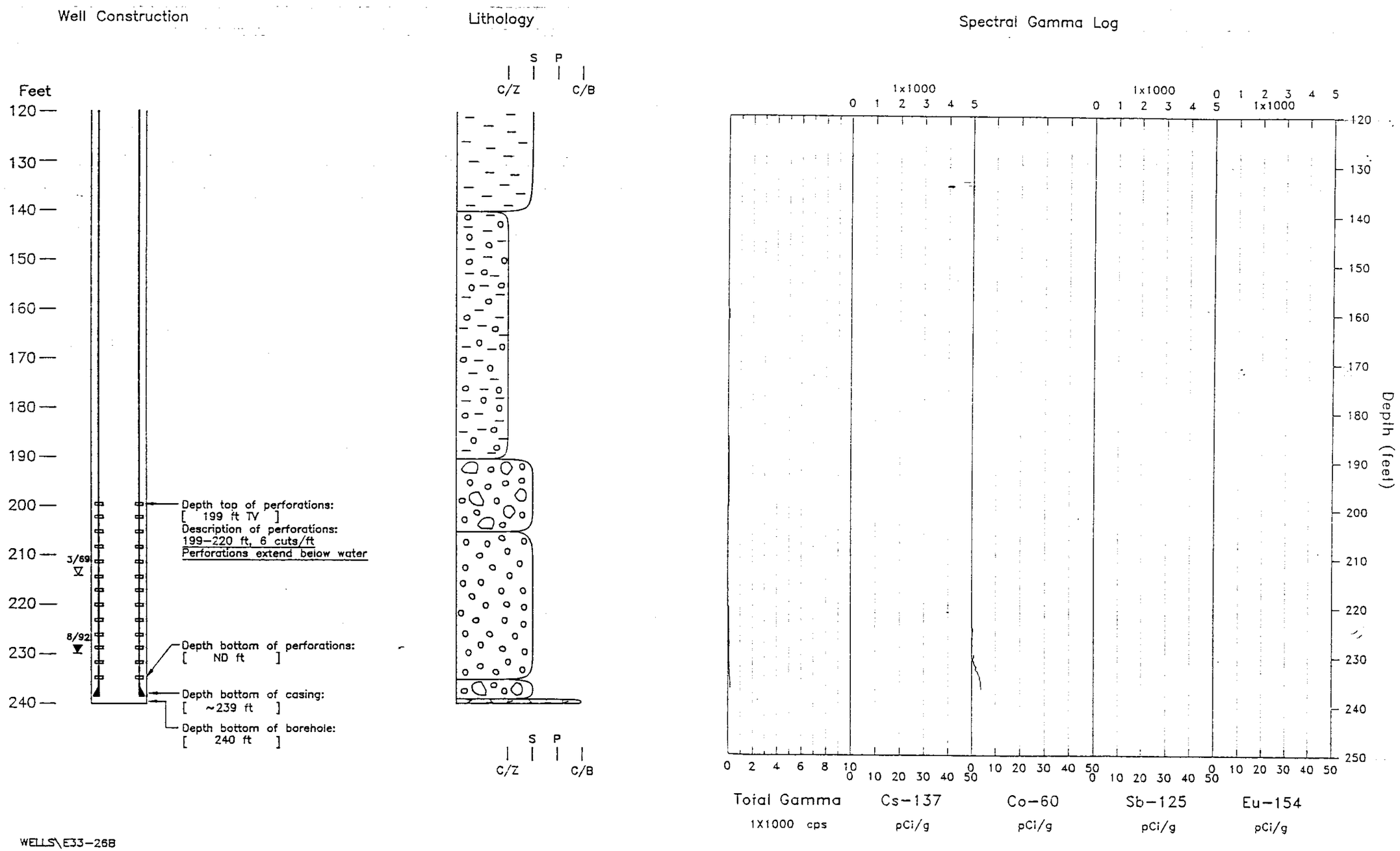
Spectral Gamma Log



WELLS\33-26A

RLS Spectral Gamma Ray Borehole Survey (Page 2)

Well 299-E33-26 | Crib 216-B-61 | Log Date 8/11/92



RLS Borehole Survey Report

299-E33-26 216-B-61 Crib

Casing	Depth: 240 ft	Size: 6 in	Thickness: 0.25 in
Water	Depth: 229 ft		
Survey	Depth: 0 - 50 ft	Mode: MSA 35 sec	Date: 8/11/92
	185 - 200 ft	Mode: MSA 35 sec	(Interval 2)
	220 - 236 ft	Mode: MSA 35 sec	(Interval 3)

General Notes:
The screening survey depth intervals were determined from review of the PNL gross gamma survey acquired earlier. Stationary spectral gamma ray measurements were also taken at 85 ft and 160 ft. No manmade radionuclides were identified in the long count spectra.

Detector depth was checked and reset at 85 feet and 160 feet with a steel tape. The logging cable was failing. The maximum depth error is 2.0% (ie. 1.5 ft between 85 ft and 160 ft).

Man-made Radionuclides:
Cesium (Cs-137) was encountered in the borehole survey from 3 feet to 4 feet. The maximum cesium decay activity was less than 1 pCi/g.

Cobalt (Co-60) was encountered in the borehole survey from 224 feet to the maximum survey depth of 236.5 feet. The cobalt decay activity detected was less than 4 pCi/g.

No Antimony (Sb-125) was encountered in the borehole survey. The plot track is present only for uniformity of the displayed data.

No Europium-154 (Eu-154) was encountered in the borehole survey. The plot track is present only for uniformity of the displayed data.

299-E33-26

Westinghouse Hanford Company | LOG HEADER | Page 1 of 2

Well No. 299-E33-26 Area 200 East Date 8/5/92
Log Run #1 Log Type Gross Gamma
Elevation Datum Top of casing Elevation 637.51
Survey Coordinates N 46600 W 50715
Log Measured From Ground Surface
Location Description B-61 C-43
Ground Surface Elevation
Surface Temperature NA Weather Overcast - Hot

BOREHOLE INFORMATION

Driller
Drill Rig Type | Bit Type/Diameter
Borehole Diameter(s)/Depth 6"/240
Depth Driller 240 | Depth Logger 237.5
Liquid Level 229' (Perched Water) | Liquid Density Clear
Temperature NA

CASING RECORD

Type 6" Carbon Steel Sch.40 | Interval +3.6' - 240
Type | Interval
Type | Interval
Type | Interval
Well Screen Interval NA ?
Comments: Depth Errors +3.2' high
Centralizer used

LOG HEADER

EQUIPMENT DATA

Page 2 of 2

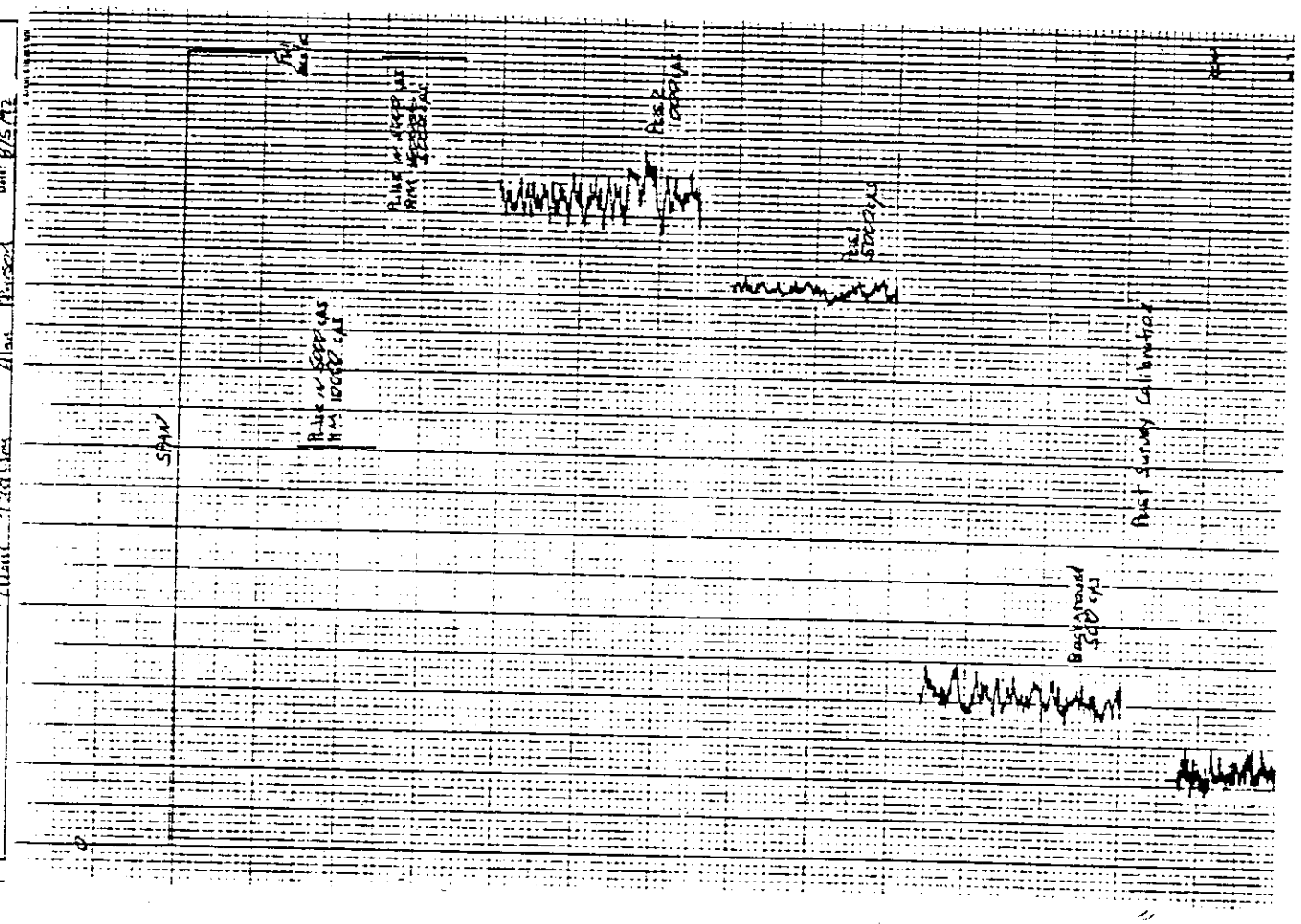
Logging Company PNL
Operator(s) Alan Dotson
Equipment Brand NIS
Tool Type Gamma Rat
Base Calibration Date 5/92
Calibration Probe Factors, cps/pCi/g: K=[illegible] Calibration Date [illegible]
Head Time 1.3 min

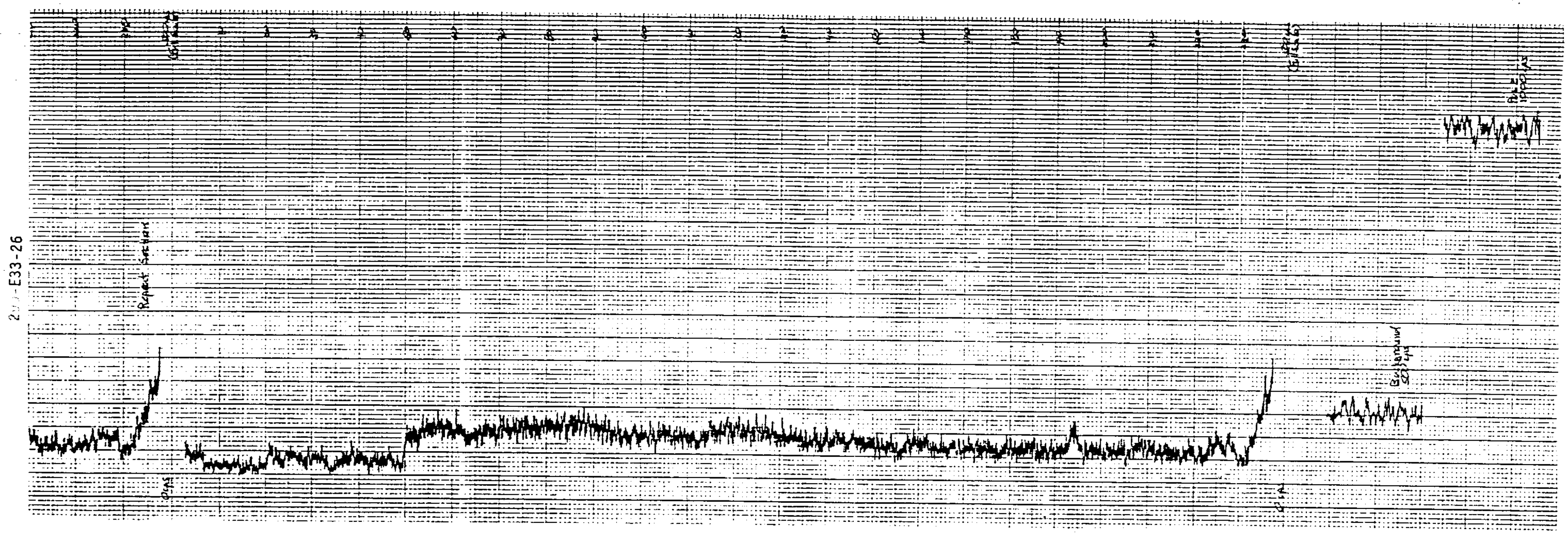
Equipment Type Analog
Serial No. GA27A91
Calibration Reference PNL-8280 NC-4016
Position 1 315.1 cell Position 2 651.1 cell
Wave Up Time 7.15 min

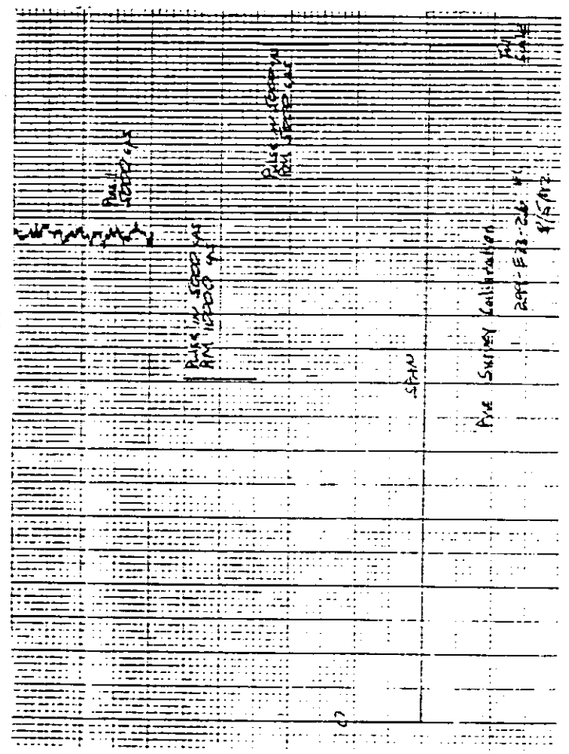
LOGGING INFORMATION

Log Interval From 237.5' To 3.5'
Actual 237.5' Bot. 1.4' Position 1 312.1 cell Position 2 65.1 cell Background 102 cpm
Pre Survey Verification Position 1 312.1 cell Position 2 2.0 cell
Base Calibration Difference Position 1 0.0 cell Position 2 0.5 cell
Logging Speed 5 ft/min Return Battery (Plan 50 ch/s) Completion Time 12:00
Start Time 10:15 Initial Calibration Position 1 1.6 cell Position 2 65.1 cell Background 105 cpm
Chart Recorder Zero Offset 10% Chart Recorder Horizontal Scale (Plan 50 ch/in.) 0.34"
Post Survey Verification Position 1 312.8 cell Position 2 0.1 cell
Percent Change 0.1%
Comments Return Time +3.2' high
Centralizer used

Witnessed and Verified by: Sign and print name Alan Dotson Date 8/5/92




E33-26


299-E33-26
Pulse 5000 gas
Pulse in 5000 gas AM 10000 gas
Pulse in 5000 gas PM 5000 gas
Full Scale
Span
Pre Survey Calibration
299-E33-26 #1
8/5/92

Crib Designation: 216-B-62

Type of Facility: 10 ft. by 500 ft gravel filled crib

Location: N 43580 to N 43934, W 54995 to W 55349 about 1500 ft northwest of the 221-B building

Service Dates: Currently active, started 11/73

Description of Waste: 282 x 10^6 liters of process condensate from the 221-B building separations facilities

Radionuclide Release Summary:

as of 12/31/89

Radionuclide	Quantity
Am-241	0.103 Ci
Cs-137	135 Ci
H-3	14.7 Ci
Pu-239	2.29 x 10^-3 Ci
Ru-106	4.92 x 10^-3 Ci
Sr-90	74.6 Ci
gross Pu	0.755 g
gross U	0.01 Ci

Summary of Past Logging:

Boreholes	Date	Reference
299-E28-18	1976	Fecht, et al., 1977
299-E28-20	1976	Fecht, et al., 1977
	quarterly	Tank Farms files
	1980	Geophysis files
	1982	"
	1984	"
299-E28-21	1976	Fecht, et al., 1977
	quarterly	Tank Farms files
	1980	Geophysics files
	1982	"
299-E28-75	quarterly	Tank Farms files
299-E28-84		
299-E28-85		
299-E28-86		
299-E28-87		
299-E28-89		
299-E28-90		
299-E28-91		

Review of Current Logging:

Borehole: 299-E28-18

This borehole was logged with the PNL gross gamma logging system and the RLS spectral gamma system.

The spectral gamma log shows a thick zone of high Cs-137 concentration from 30 feet to 110 feet. No other man-made nuclides are found in this borehole.

This is consistent with what was released at this site. Only Cs-137 and Sr-90 were released in any significant quantity and Sr-90 does not emitt gamma photons during decay.

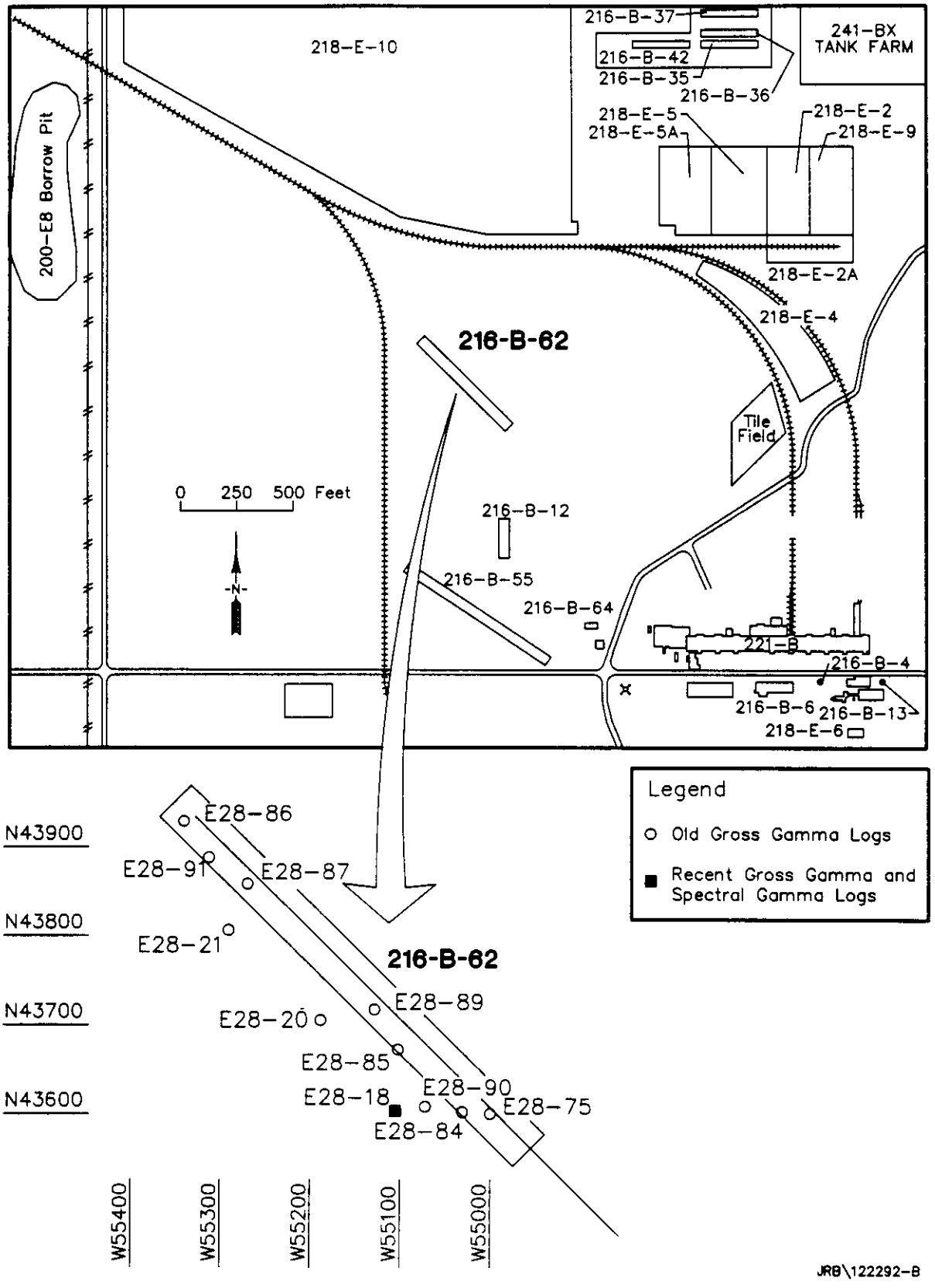
The gross gamma log becomes saturated throughout the entire zone of contamination. No other zones of elevated activity are seen in the gross gamma log.

This site has been subjected to groundwater monitoring (see Rockwell Hanford Operations, 1987). This monitoring effort showed that there was elevated quantities of uranium in the groundwater. Because there was little uranium released at this site, because there was an extensive amount of uranium released at the 216-B-12 site and because this crib is down gradient from the B-12 crib, it is reasonable to assume that the uranium in the groundwater at this site is from the B-12 crib.

Of the older gross gamma logs, only E28-75 shows a zone of high activity similar to that of E28-18. Both of these boreholes are near the effluent release pipe. This shows that all of the cesium released at the site are found near the release point of the crib and that the cesium does not migrate very far.

It is apparent that the man-made nuclides released at this site have not contaminated the groundwater beneath this site.

9413137.1618


218-E-10
216-B-37
216-B-42
216-B-35
216-B-36
241-BX
TANK FARM
218-E-5
218-E-5A
218-E-2
218-E-9
218-E-2A
218-E-4
200-E8 Borrow Pit
216-B-62
Tile
Field
0 250 500 Feet
N
216-B-12
216-B-55
216-B-64
221-B
216-B-4
216-B-6
216-B-13
218-E-6
Legend
Old Gross Gamma Logs
Recent Gross Gamma and
Spectral Gamma Logs
N43900
N43800
N43700
N43600
E28-86
E28-91
E28-87
E28-21
216-B-62
E28-89
E28-20
E28-85
E28-90
E28-18
E28-75
E28-84
W55400
W55300
W55200
W55100
W55000
JRB\122292-B

Westinghouse Hanford Company
RLS Spectral Gamma-Ray Borehole Survey Log Header

Project: 200 East AAMS, B-62 Crib

Borehole	299-E28-18		
Coordinates	43,603 N	55,705 W	Feet (Plant 200 E)
Elevation	692.58 feet		Top of Casing (Plant 200 E)

Borehole Environment Information

Borehole Fluid Depth 288 (Feet) from Zero (0.0) Depth Reference of Log

Casing Size I.D. (inch)	Casing Thickness (inch)	Top Depth (feet)	Base Depth (feet)
6	0.253	0.	309.
5	0.262	0.	237.

RLS Passive Spectral Gamma Survey Information

Logging Engineers R. V. Cram S. E. Kos
Log Depth Reference at Zero (0.0) depth is Ground Level

Log Date	Archive File Names	Log Mode[1], Speed	Depth Interval (feet) Top	Base	Incr
Aug 6, 1992	H2E2818\A223	MSA 35sec LT	0.	115.	0.5
		Station 300 s	Depth: 150,200,250,300 ft		
		Station 500 s	Depth: 306 ft		

[1]MSA: Move-Stop-Acquire Lt: Live Time Station: Long count at specified depths

Calibration and Analysis Information

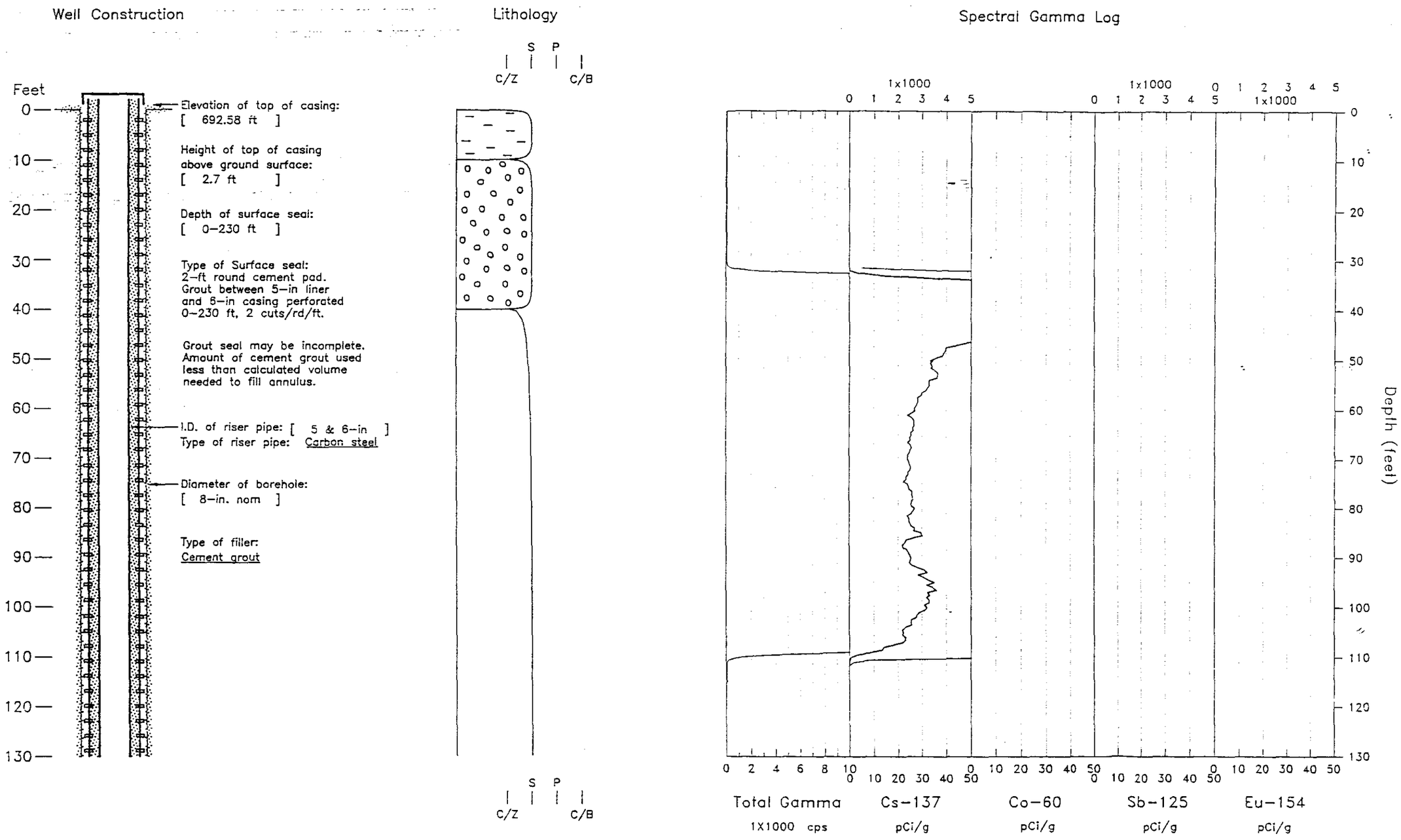
RLS Calibration Date: Nov 21, 1991
Calibration Report: WHC-SD-EN-TRP-001

Analyst Names: J. P. Kiesler
Analysis Date: Sept 23, 1992

Analysis Notes: Extensive interval of elevated Cesium-137 contamination
Radionuclides identified: Cs-137

RLS Spectral Gamma Ray Borehole Survey

Well 299-E28-18 | Crib 216-B-62 | Log Date 8/6/92

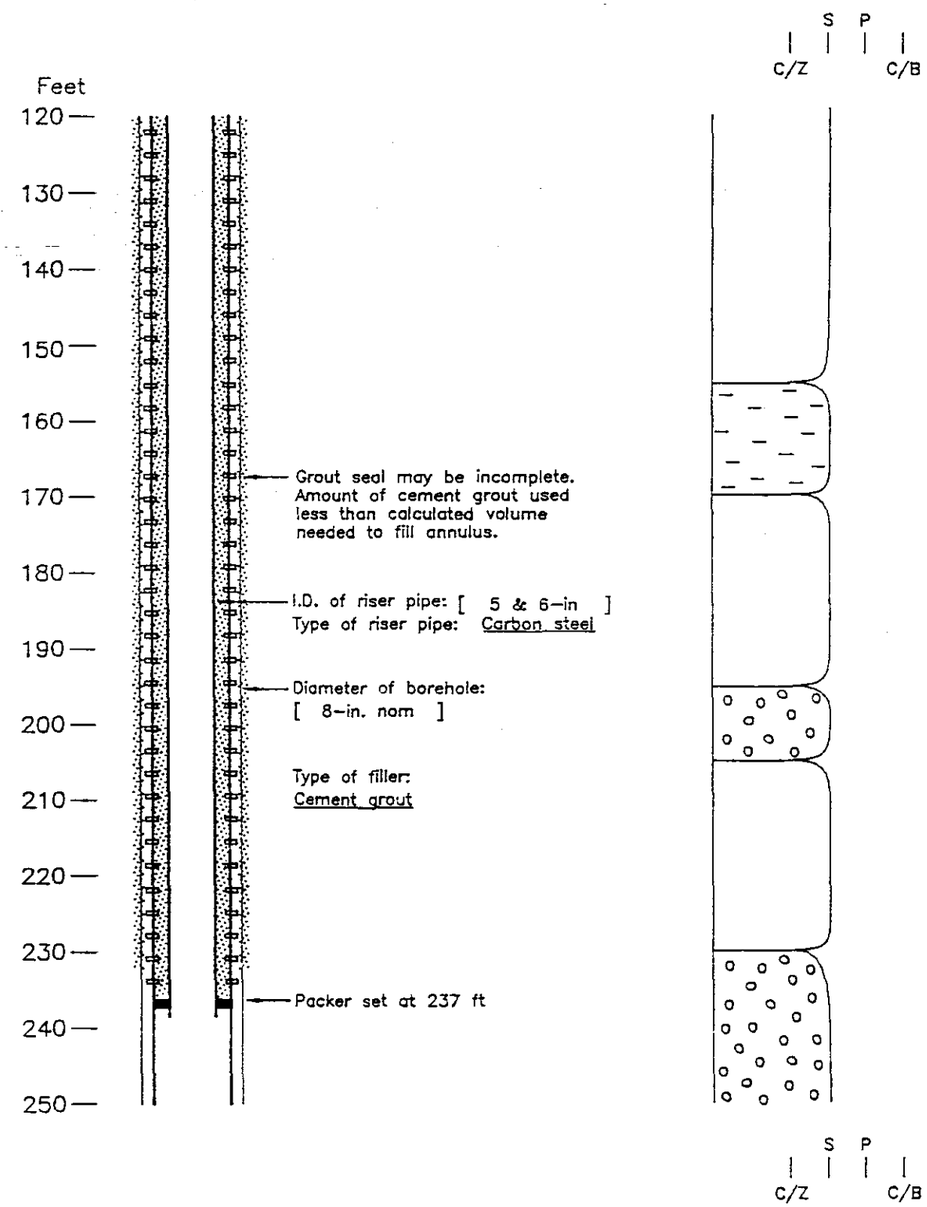


WELLS\E28-18A

RLS Spectral Gamma Ray Borehole Survey (Page 2)

Well 299-E28-18 | Crib 216-B-62 | Log Date 8/6/92

Well Construction | Lithology | Spectral Gamma Log

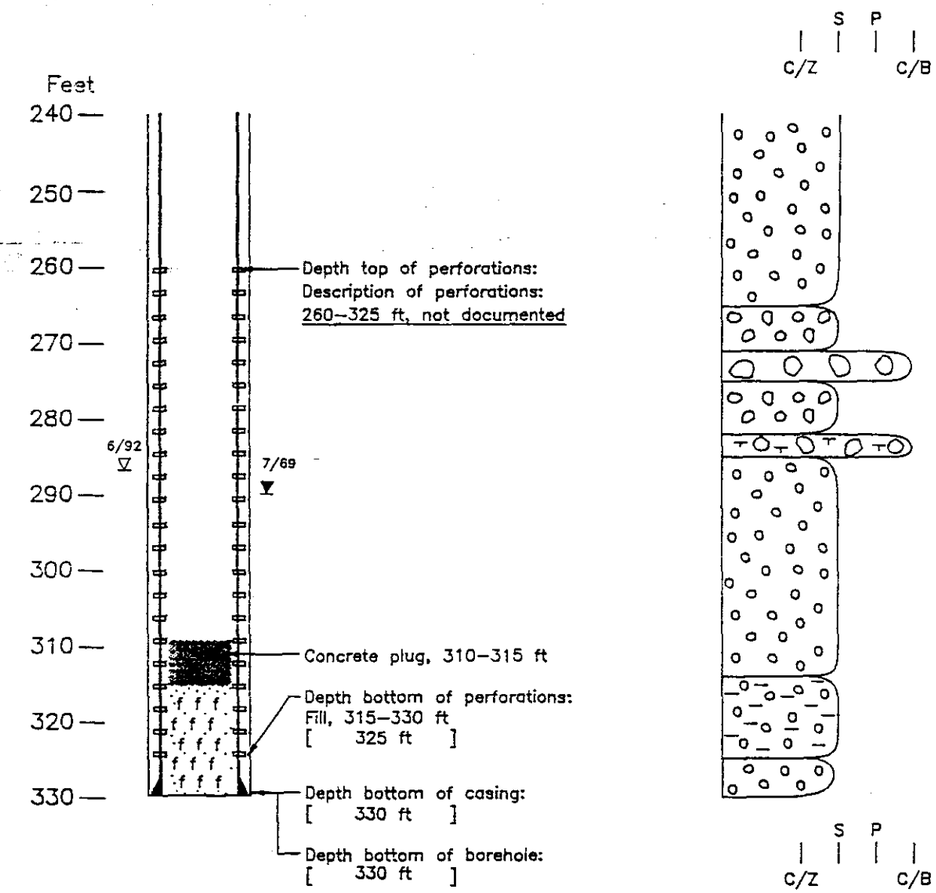


WELLS\E28-18B

RLS Spectral Gamma Ray Borehole Survey (Page 3)

Well 299-E28-18 | Crib 216-B-67 | Log Date 8/6/92

Well Construction | Lithology | Spectral Gamma Log



WELLS\E28-18C

RLS Borehole Survey Report

299-E28-18 216-B-62 Crib

Casing	Depth: 309 ft	Size: 6 in	Thickness: 0.25 in
	Depth: 237 ft	Size: 5 in	Thickness: 0.26 in
Water	Depth: 288 ft		
Survey	Depth: 0 - 115 ft	Mode: MSA 35 sec	Date: 8/06/92

General Notes:
An extensive interval (33 feet to 107 feet) of Cesium-137 contamination was encountered in the borehole survey.

The maximum screening survey depth of 115 feet was determined from review of the PNL gross gamma survey acquired earlier. Stationary spectral gamma ray measurements were taken at 150, 200, 250, 300 and 306 feet. No manmade radionuclides were identified in the spectra acquired below 115 feet.

Detector depth was checked and adjusted every 50 feet to 300 feet with at steel tape. The logging cable was failing. The maximum depth error is 2.5% (ie. 1.25 ft from 200 to 250 ft).

Man-made Radionuclides:
Cesium (Cs-137) was encountered in the borehole survey from 31 feet to 112 feet. The cesium decay activity exceeded 200 pCi/g from 32 feet to 110 feet. The decay activity exceeded 5000 pCi/g from 34 feet to 47 feet.

No Cobalt (Co-60) was encountered in the borehole survey. The plot track is present only for uniformity of the displayed data.

No Antimony (Sb-125) was encountered in the borehole survey. The plot track is present only for uniformity of the displayed data.

No Europium-154 (Eu-154) was encountered in the borehole survey. The plot track is present only for uniformity of the displayed data.

299-E28-18

Westinghouse Hanford Company | LOG HEADER | Page 1 of 2

Well No. 299-E28-18 Area 200 East Date 8/3/92
Log Run #1 Log Type Gross Gamma
Elevation Datum Top of casing Elevation 692.55
Survey Coordinates N: 43607 E: 55705
Log Measured From Ground Surface
Location Description B-62 Crib
Ground Surface Elevation
Surface Temperature N/A Weather Clear-Hot

SOREHOLE INFORMATION

Driller
Drill Rig Type | Bit Type/Diameter
Borehole Diameter(s)/Depth 6"/309' 5"/237'
Depth Driller 309' | Depth Logger 309.2'
Liquid Level 285' 298' | Liquid Density Apparent Clear
Temperature N/A

CASING RECORD

Type 6" Carbon Steel Sch.40 | Interval +0.5'-309'
Type 5" Carbon Steel Sch.40 | Interval 27'-237'
Type | Interval
Type | Interval
Well Screen Intervals Perforated 210'-235
Comments: Casing Error = -0.2' high
Centralizer used
Generator Quit Several Times During Logging Run

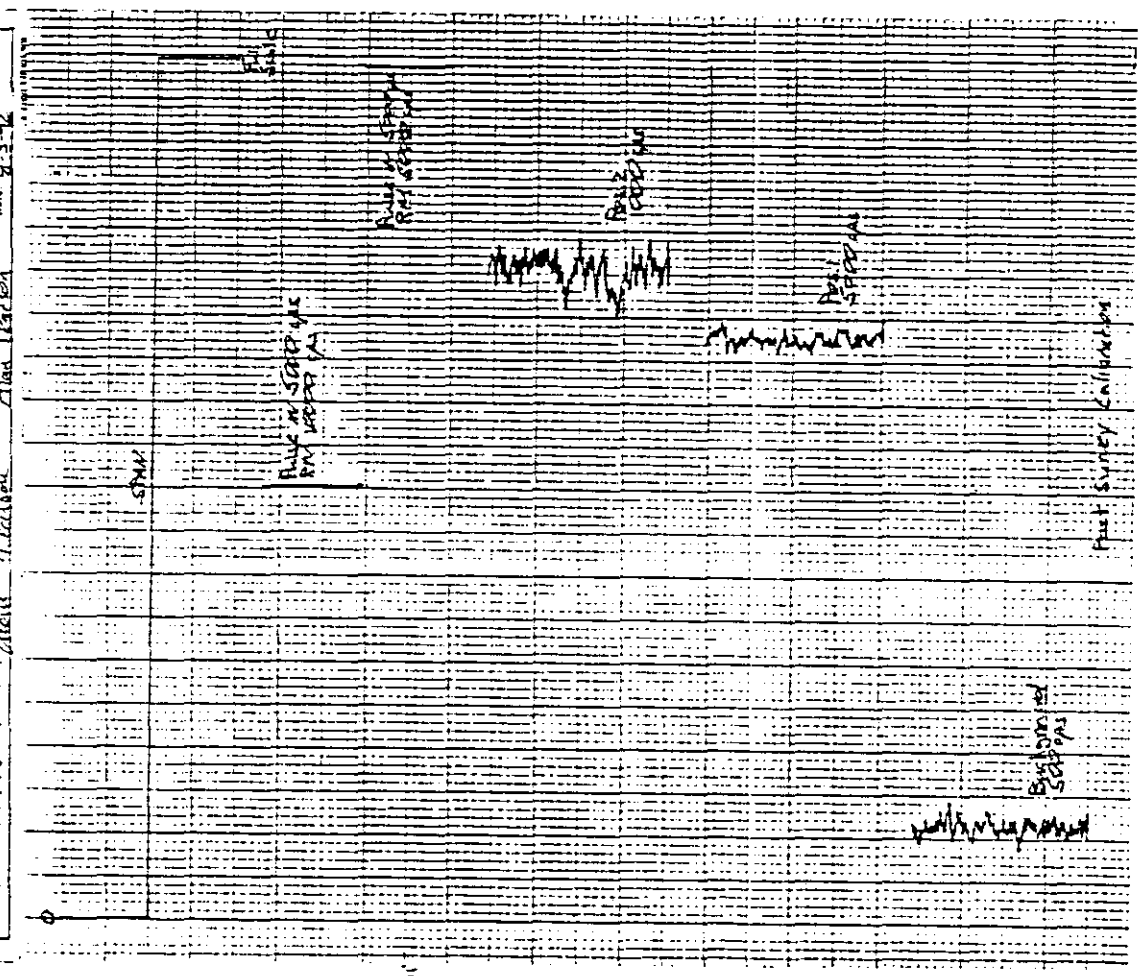
LOG HEADER | Page 2 of 2

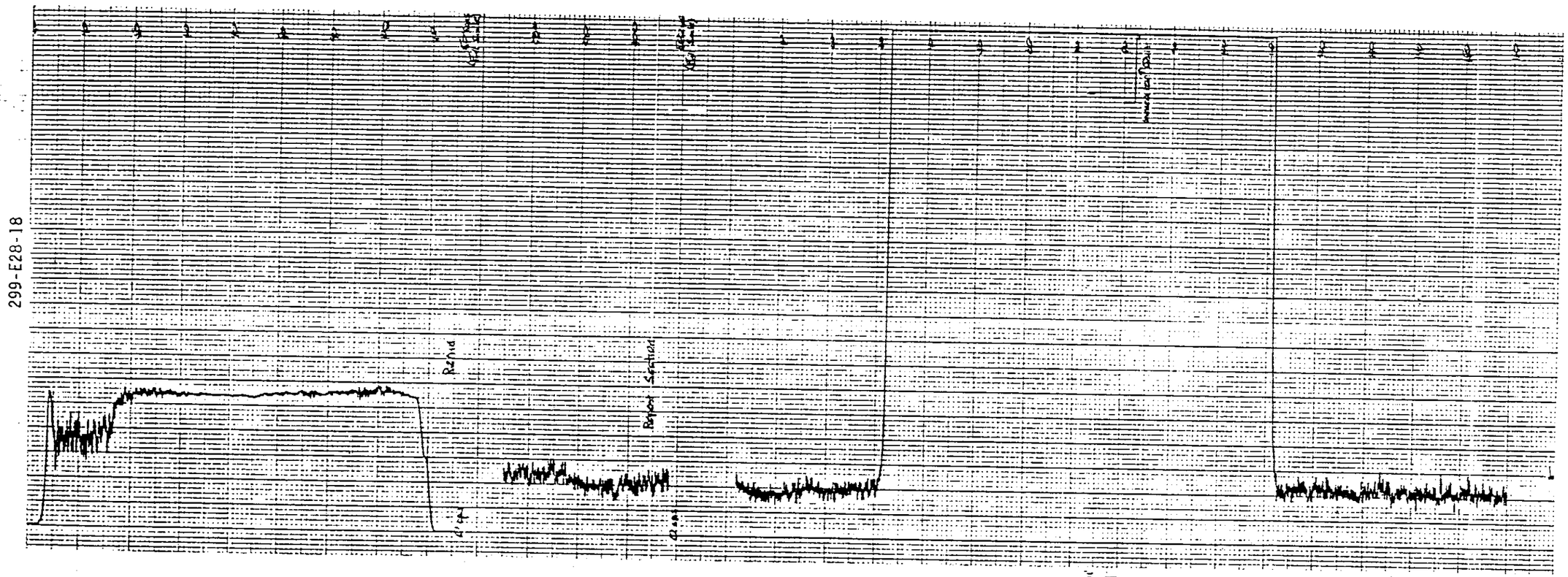
EQUIPMENT DATA

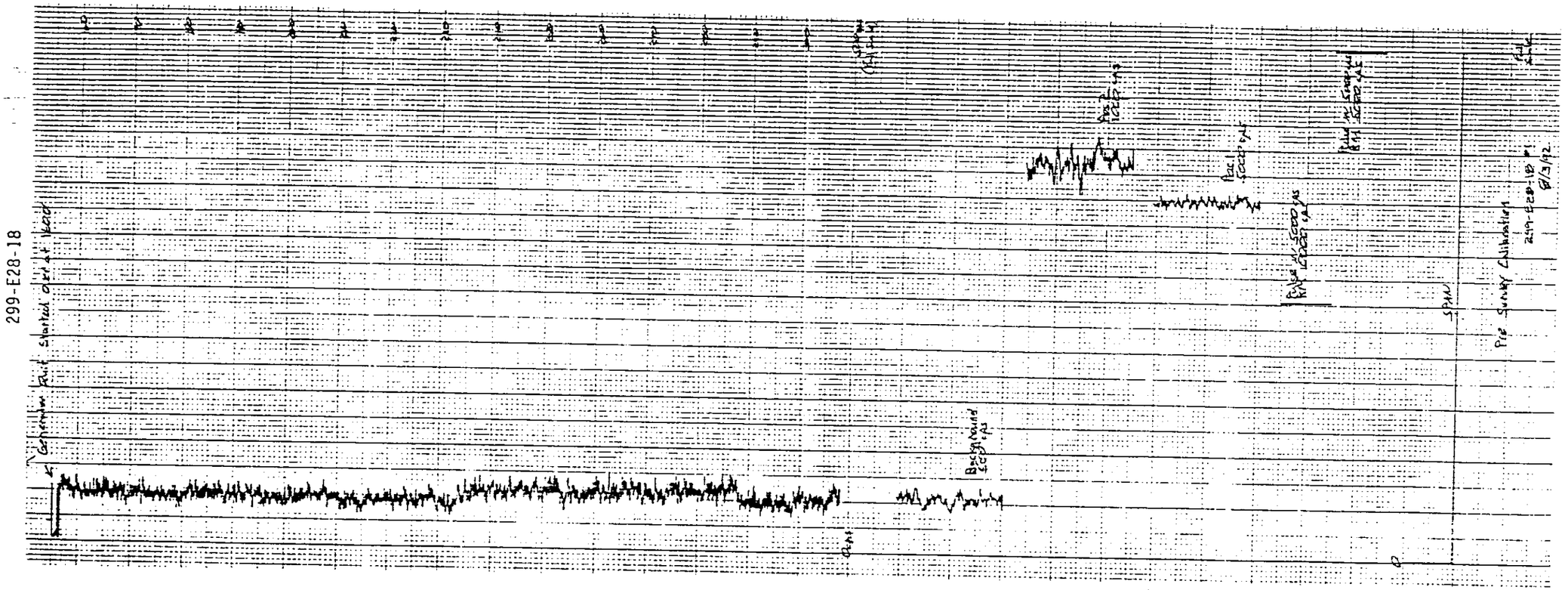
Logging Company PNL
Operator(s) Alan Pearson
Equipment Brand NIS
Tool Type Gamma Ray
Base Calibration Date 5/92
Calibration Factor 4.20 MeV Calibration Datum (cm)
Total Time 1.23 sec

Equipment Type Analog
Serial No. CG2781 Calibration Reference DOE-EH320 HC-4012
Position 1 315.1 cm Position 2 651 cm
Wavelength Line > 15 cm
CHECKING INFORMATION
In 20'
Log Interval From 309.2' To 225'
Around 309.2' Position 1 1150' Position 2 322' @ SR 8 cpm Background 55 cpm
Pre Survey Verification: Position 1 311.0 cm Position 2 651.1 cm
Base Calibration Difference: Position 1 111 cm Position 2 0.3 cm
Logging Speed 5 ft/min Return Speed (Plan) 50 cm/s
Start Time 1115 Completion Time 1140
Chart Speed(s) (Sec/in) 10 ft/in
Chart Recorder Horizontal Scale (Plan) 50 cm/s
Time Constant(s) 16-1
Post Survey Verification: Position 1 303.5 cm Position 2 642 cm Background 85 cpm
Percent Change 2.1% Position 1 Position 2 18%
Comments: Drum Since +0.2' high
Centralizer used

Witnessed and Verified by (Sign and print name) Alan Pearson Date 8-3-92




299-E28-18
Rend
Report Section


299-E28-18
Pre Sunky Calibration
SPAN

Crib Designation: 216-C-9

Type of Facility: 80,000 square foot pond

Location: N 42581, W 49870 to W 50694 , just north of 7th street opposite from C plant

Service Dates: 6/53 to 12/85

Description of Waste: 1.03 x 10^9 liters of the following:
process cooling water from 201-C building;
floor drains from 201-C, 215-C, 271-C, 276-C;
Miscellaneous water from 209-E;
Miscellaneous wastewater from the Hot Semiworks facilities

Radionuclide Release Summary:

Radionuclide	Quantity
Cs-137	0.703 Ci
Ru-106	8.7 x 10^-8 Ci
Sr-90	2.43 Ci
Pu	0.338 g
U	0.305 x 10^-3 Ci

Summary of Past Logging:

Boreholes	Date	Reference
299-E27-1	1987	Geophysics files

Review of Current Logging:

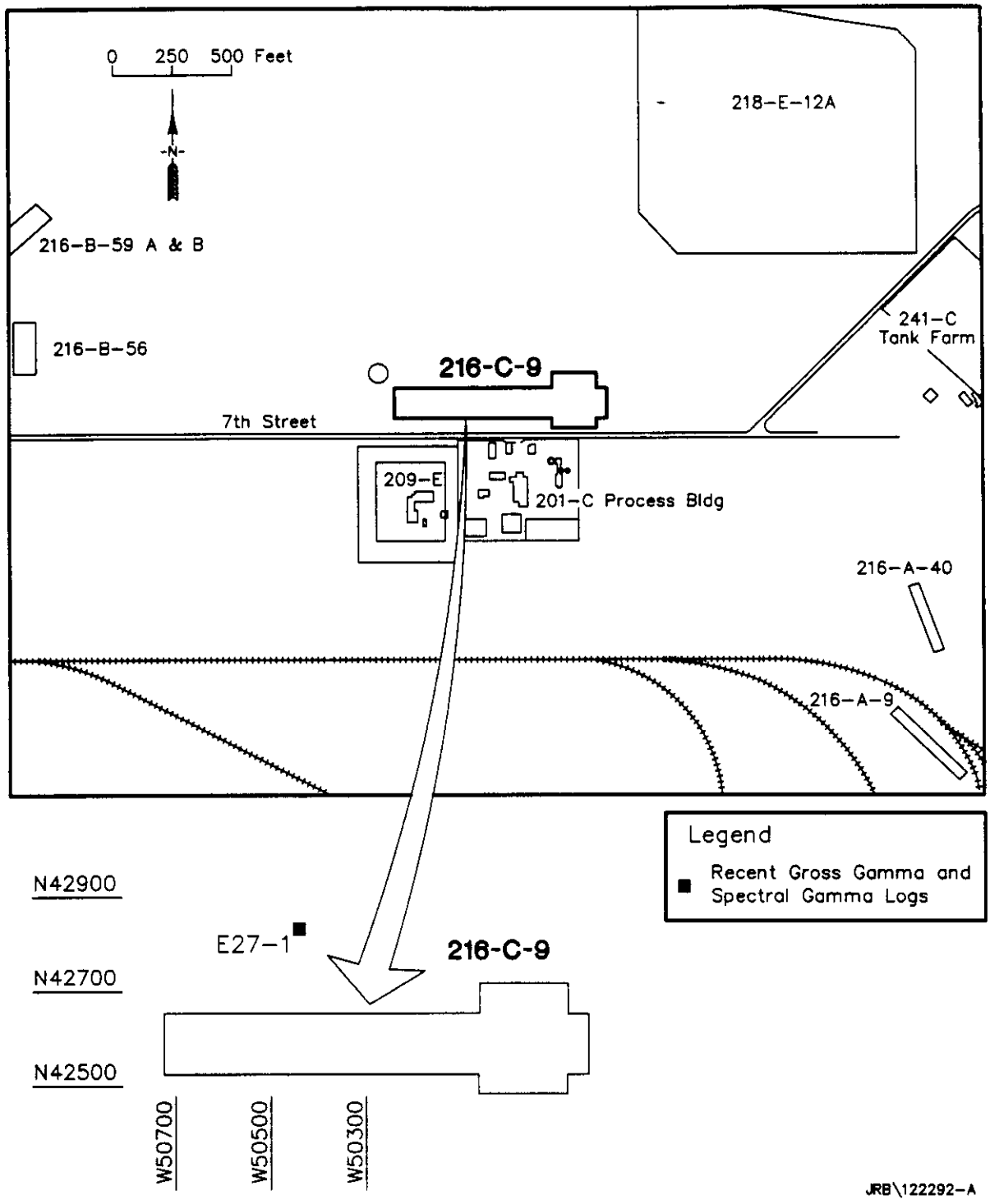
Borehole: 299-E27-1

This borehole was logged with the PNL gross gamma logging system and the RLS spectral gamma system. No man-made radionuclides were detected in the spectral gamma log.

The gross gamma log shows almost no variation in gamma activity throughout the entire length of the borehole. This is confirmed by the lithology log obtained during drilling of this borehole and it reflects the Hanford formation throughout much of the 200 East area. Lithology variations are textural variations, not compositional variations and thus there is no change in the natural background potassium, uranium and thorium, the significant natural gamma emitters.

There was a small rise in gamma activity at the bottom of the borehole in the older gross gamma log. This was not present in the new log and it is not certain if this was in fact a result of increased activity or if it was an instrumentation problem.

It is apparent from the discharge records and from the logging at this site, that little of no man-made contamination has been deposited at this site and it is very unlikely that there has been any groundwater contamination at this site.


0 250 500 Feet
N
218-E-12A
216-B-59 A & B
216-B-56
241-C
Tank Farm
216-C-9
7th Street
209-E
201-C Process Bldg
216-A-40
216-A-9
Legend
Recent Gross Gamma and Spectral Gamma Logs
N42900
E27-1
216-C-9
N42700
N42500
W50700
W50500
W50300
JRB\122292-A

Westinghouse Hanford Company
RLS Spectral Gamma-Ray Borehole Survey Log Header

Project: 200 East AAMS 216-C-9 Crib

Borehole	299-E27-1			
Coordinates	42,833 N	50,440 W	Feet	(Plant 200 E)
Elevation	681.05 feet		Top of Casing	(Plant 200 E)

Borehole Environment Information

Borehole Fluid Depth none (Feet) from Zero (0.0) Depth Reference of Log

Casing Size I.D. (inch)	Casing Thickness (inch)	Top Depth (feet)	Base Depth (feet)
10	0.37	0.0	4
8	0.31	0.0	332

RLS Passive Spectral Gamma Survey Information

Logging Engineers R. V. Cram S. E. Kos
Log Depth Reference at Zero (0.0) depth is Ground Level

Log Date	Archive File Names	Log Mode[1], Speed	Depth Interval (feet) Top	Base	Incr
Aug 13, 92	H2E2701\A226	MSA 35 sec LT	0.	50.	0.5
		Stations: 500s	Depth:100,150,200,250,261		

[1]MSA: Move-Stop-Acquire LT: Live time Stations: Long count at specified depths

Calibration and Analysis Information

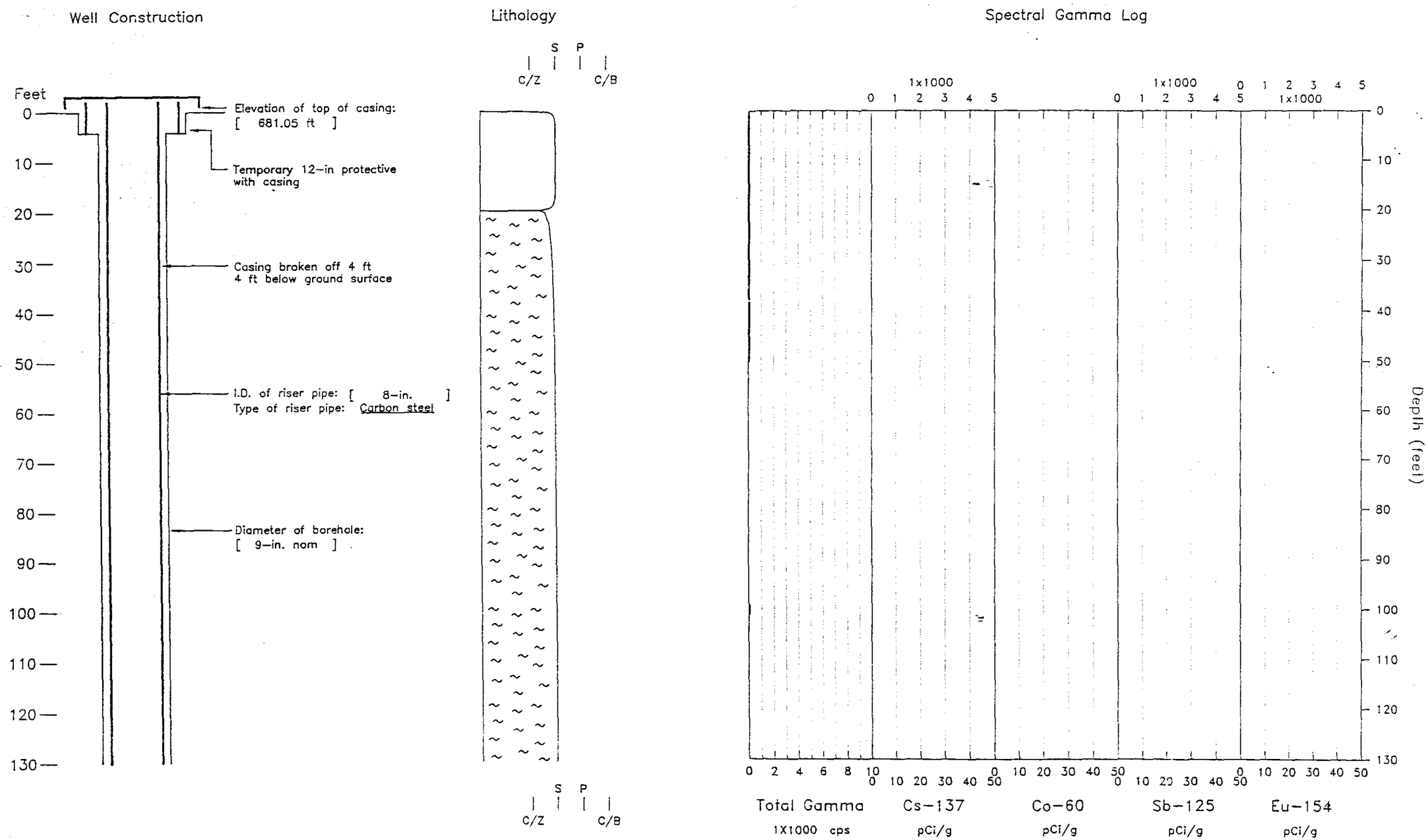
RLS Calibration Date: Nov 21, 1991
Calibration Report: WHC-SD-EN-TRP-001

Analyst Names: G. K. Jaeger R. K. Price
Analysis Date: Sep 1, 1992

Analysis Notes: 1987 survery indicated elevated counts below 316 ft
Radionuclides identified: No manmade radionuclides identified

RLS Spectral Gamma Ray Borehole Survey

Well 299-E27-1 | Crib 216-C-9 | Log Date 8/13/92

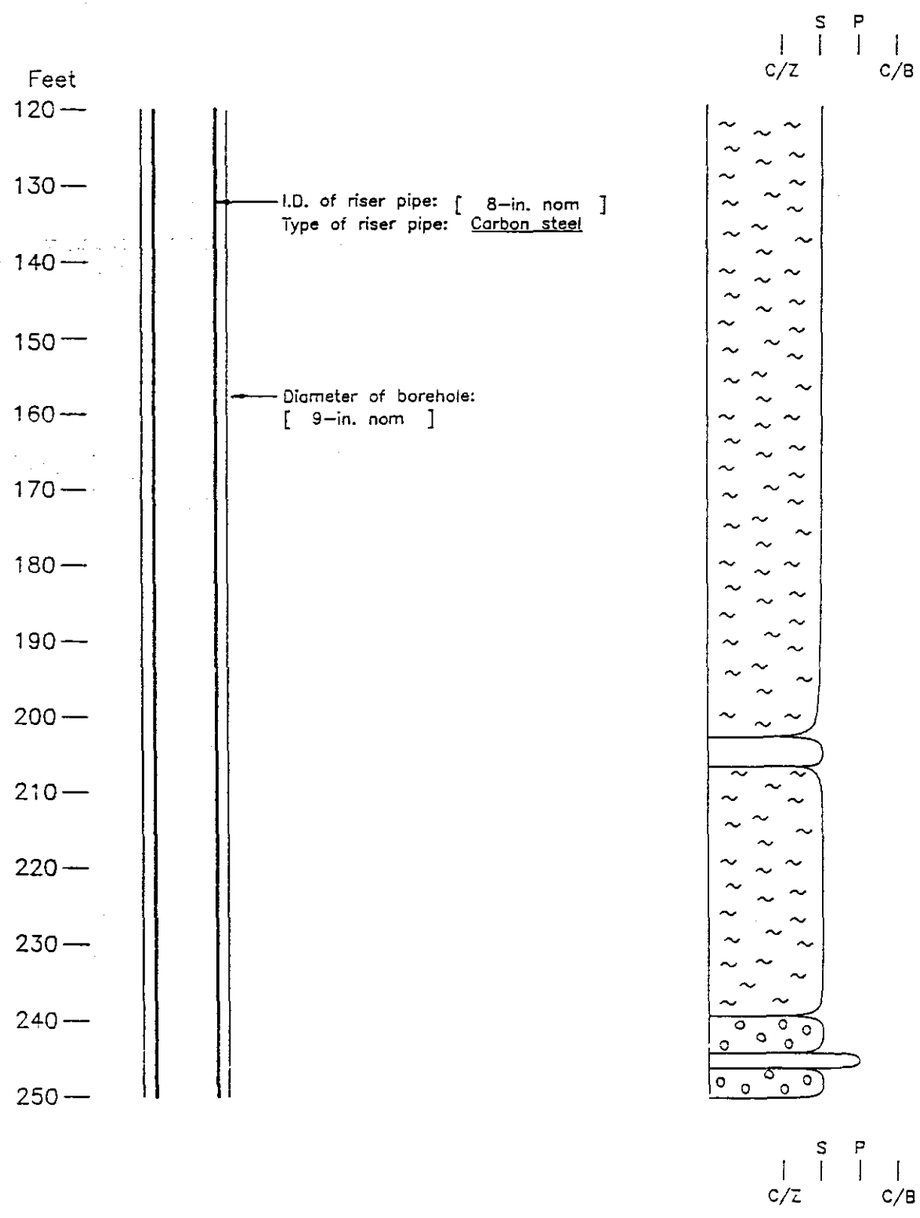


WELLS\E27-1A

RLS Spectral Gamma Ray Borehole Survey (Page 2)

Well 299-E27-1 | Crib 216-C-9 | Log Date 8/13/92

Well Construction | Lithology | Spectral Gamma Log

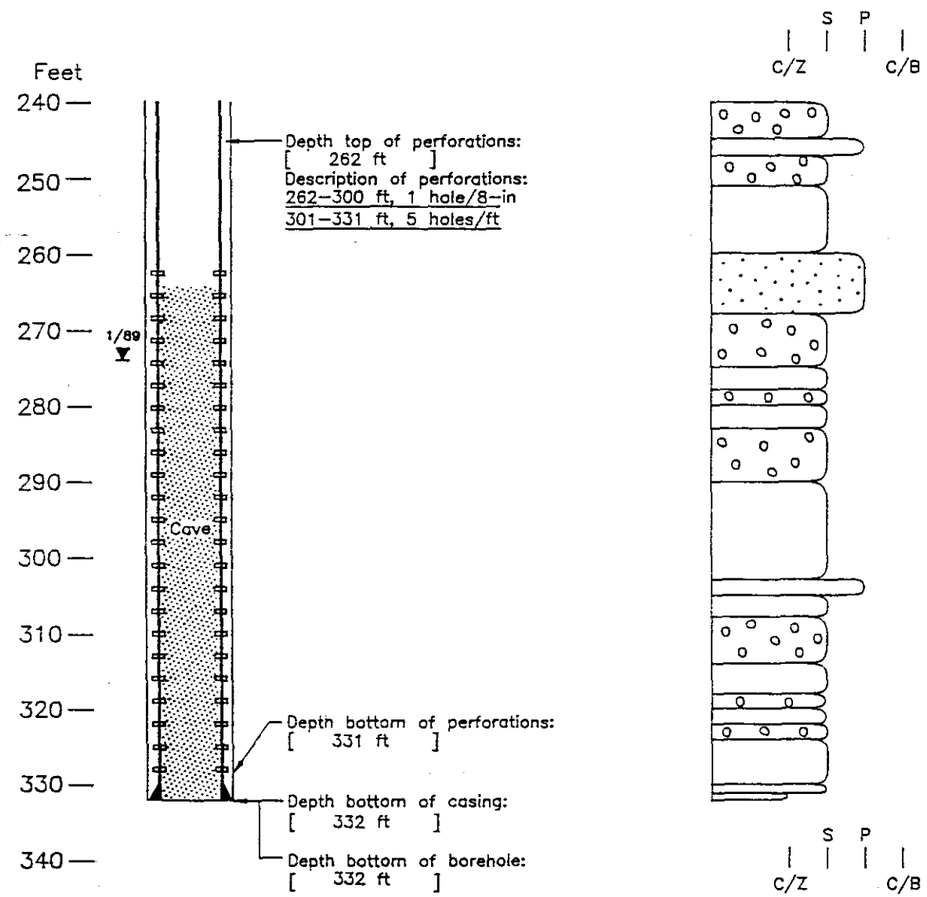


WELLS\E27-1B

RLS Spectral Gamma Ray Borehole Survey (Page 3)

Well 299-E27-1 | Crib 216-C-9 | Log Date 8/13/92

Well Construction | Lithology | Spectral Gamma Log



WELLS\E27-1C

RLS Borehole Survey Report

299-E27-1 216-C-9 Crib

Casing	Depth: 4 ft	Size: 12 in	Thickness: 0.37 in
	Depth: 332 ft	Size: 8 in	Thickness: 0.31 in
Water	Depth: none		
Survey	Depth: 0 - 50 ft	Mode: MSA 35 sec	Date: 8/13/92

General Notes:
No manmade radionuclides were identified by the RLS screening survey. Stationary spectral gamma ray measurements were also taken at 100, 150, 200, 250 and 261 feet. The stationary spectra count time was 500 seconds. No manmade radionuclides were identified in any spectra.

Gross gamma survey acquired on 7/14/87 indicated elevated gamma activity from 316 feet to the maximum survey depth of 322 feet. The average gross gamma activity above 316 feet in the borehole was 75 cps. The maximum gamma activity below 316 feet was 145 cps at 322 feet. This borehole was selected for a screening survey by the AAMS project. This was the only borehole adjacent to the 216-C-9 crib available for logging.

The RLS screening survey was unable to reach the maximum desired depth due to an obstruction in the borehole.

The primary casing broke 4 feet below ground surface some time between 7/14/87 and 2/90. The surface soil caved into the well and bridged at 264 feet. A temporary protective 12 inch casing has been added to prevent further cave-in of surface soils. The recommended decommissioning has not been performed.

Detector depth was checked every 50 feet to 250 feet with at steel tape. The tool depth was not adjusted. The logging cable was failing. The maxium depth error is 0.7% (ie. 1.77 ft at 250 ft).

Man-made Radionuclides:
No Cesium (Cs-137) was encountered in the borehole survey. The plot track is present only for uniformity of the displayed data.

No Cobalt (Co-60) was encountered in the borehole survey. The plot track is present only for uniformity of the displayed data.

No Antimony (Sb-125) was encountered in the borehole survey. The plot track is present only for uniformity of the displayed data.

No Europium-154 (Eu-154) was encountered in the borehole survey. The plot track is present only for uniformity of the displayed data.

299-E27-1

Westinghouse Hanford Company — LOG HEADER — Page 1 of 2

Well No. 299-E27-1 Area 200 East Date 8/7/92
Log Run #1 Log Type Gross Gamma
Elevation Datum Top of casing Elevation 651.05
Survey Coordinates N 42953 ; W 50440
Log Measured From Ground Surface
Location Description C-9 Crib
Ground Surface Elevation
Surface Temperature NA Weather Windy - Warm

BOREHOLE INFORMATION

Driller
Drill Rig Type | Bit Type/Diameter
Borehole Diameter/Depth 10"/50 | 9"/322'
Depth Driller 322' | Depth Logger 262.5' (slough)
Liquid Level NA (none) | Liquid Density NA
Temperature NA

CASING RECORD

Type 10" Carbon Steel Sch 40 Interval +1.6' - -50'
Type 8" Carbon Steel Sch 40 Interval ~50' - 322'
Type | Interval
Type | Interval
Well Screen Interval Perforated 262'-331'
Comments: Return Errors +0.2' high
Centralizer used

LOG HEADER — Page 2 of 2

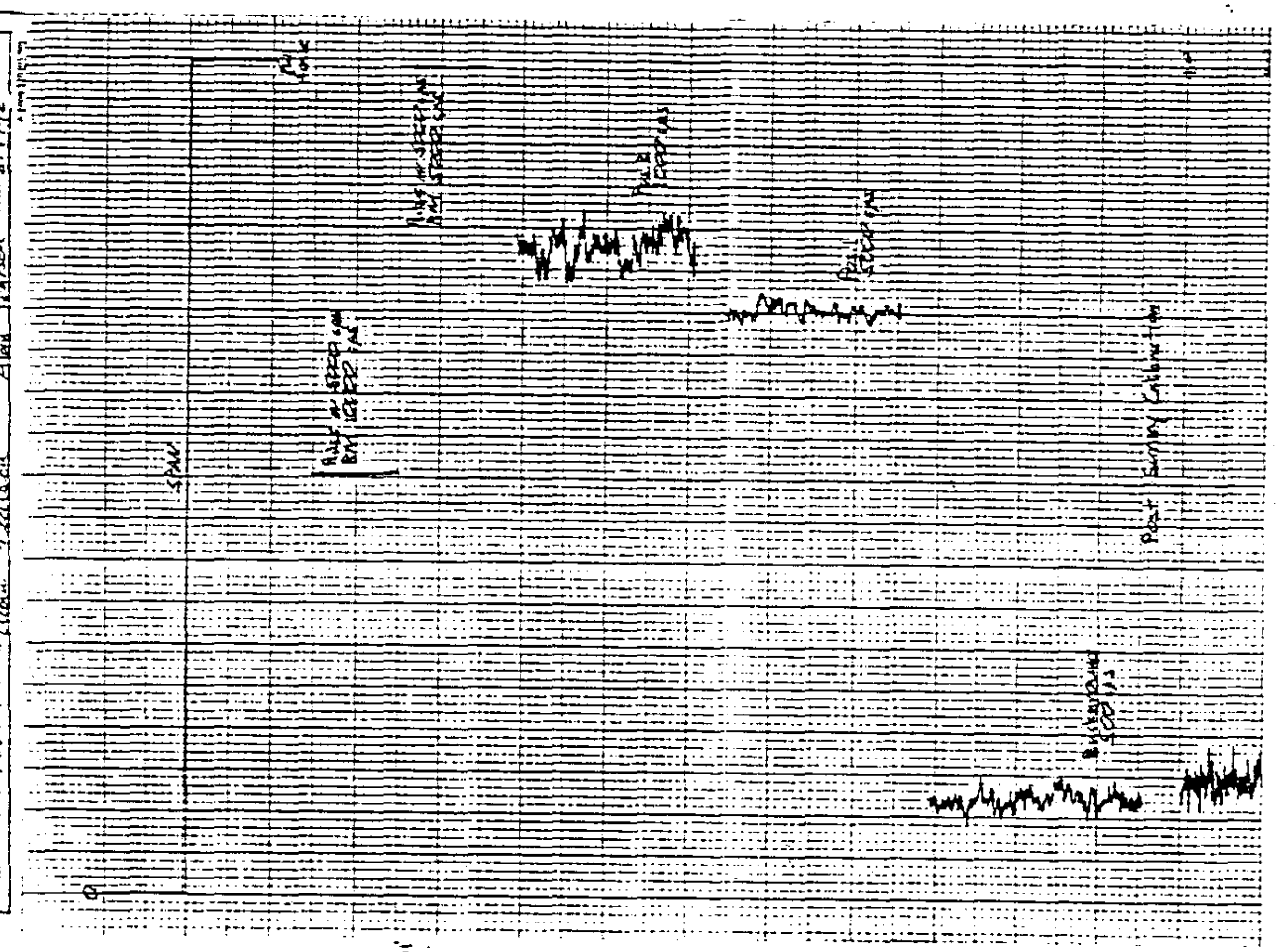
EQUIPMENT DATA

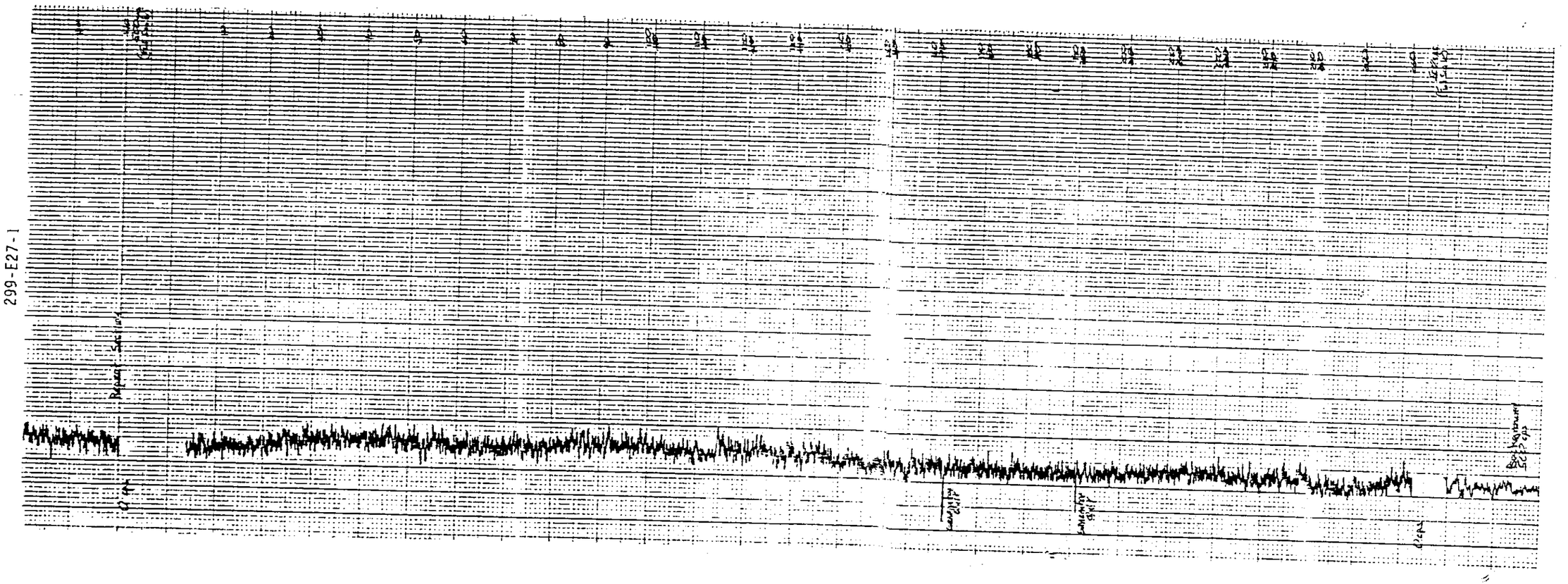
Logging Company PNL
Operator(s) Alan Pearson
Equipment Brand MIS Equipment Type Analog
Tool Type Gamma Ray Serial No C627811
Base Calibration Date 5/92 Calibration Reference PNL-87720 WC-6036
Calibration/Probe Factor 4.00 [illegible] Position 1 315.1 cll Position 2 651 cll
Dead Time 12.3 usec Warm Up Time >15 min

LOGGING INFORMATION

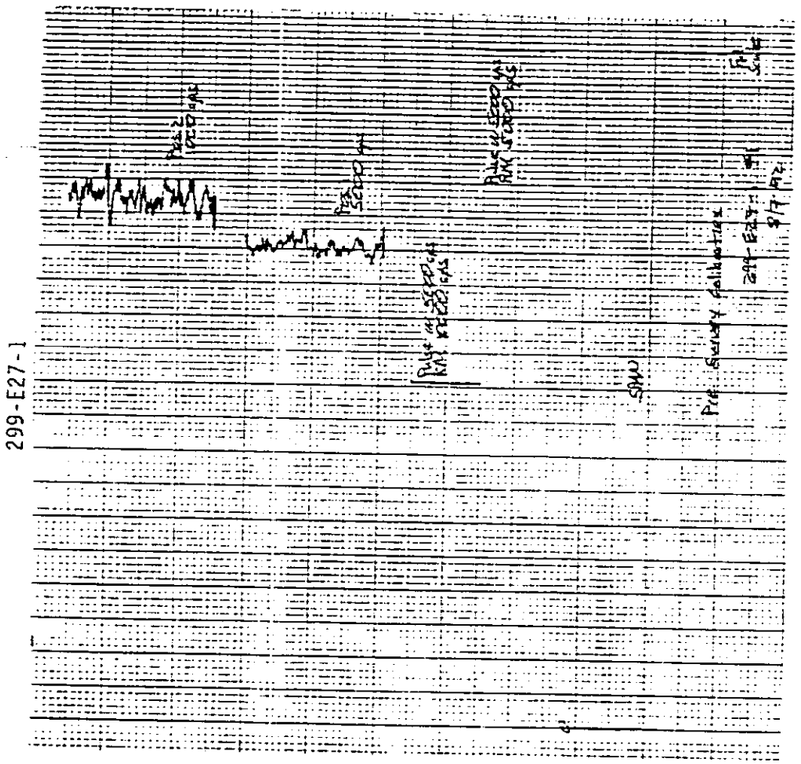
Log Interval From 262.5' In 35'
Rerun(s) 1100' to 1001
Pre Survey Verification: Position 1 311.6 cll Position 2 649.9 cll Background 60 cps
Base Calibration Difference: Position 1 0.5 cll Position 2 0.2 cll
Logging Speed 5 ft/min Ratio Scales, CPS/in 50 CPS/in
Start Time 1115 Completion Time 1400
Chart Speed(s) 10 ft/in
Chart Recorder Horizontal Scale, CPS/in 50 CPS/in Time Constant(s) 16-1
Post Survey Verification: Position 1 312.4 cll Position 2 649.4 cll Background 60 cps
Percent Change: Position 1 0.7% Position 2 0.0%
Comments Return Error +0.2' high
Centralizer used

Witnessed and Verified by: (Sign and print name) Alan Pearson Alan Pearson Date: 8/7/92





299-E27-1


299-E27-1

Crib Designation: 216-C-10

Type of Facility: 32 ft x 5 ft crushed rock crib

Location: N 42100, W 49870, 450 ft southeast of 2704-C building, near the hot semiworks complex

Service Dates: 11/64 to 10/69

Description of Waste: 897 x 10^3 liters of process condensate and liquid wawste from 201-C building, acidic

Radionuclide Release Summary:

Radionuclide	Quantity
gross Pu	<0.15 g
Sr-90	63 Ci
Ru-106	1.5 Ci
Cs-137	<0.15 Ci
Co-60	<0.15 Ci
gross U	<0.05 kg

Summary of Past Logging:

Boreholes	Date	Reference
299-E27-5	1976	Fecht, et al., 1977

Review of Current Logging:

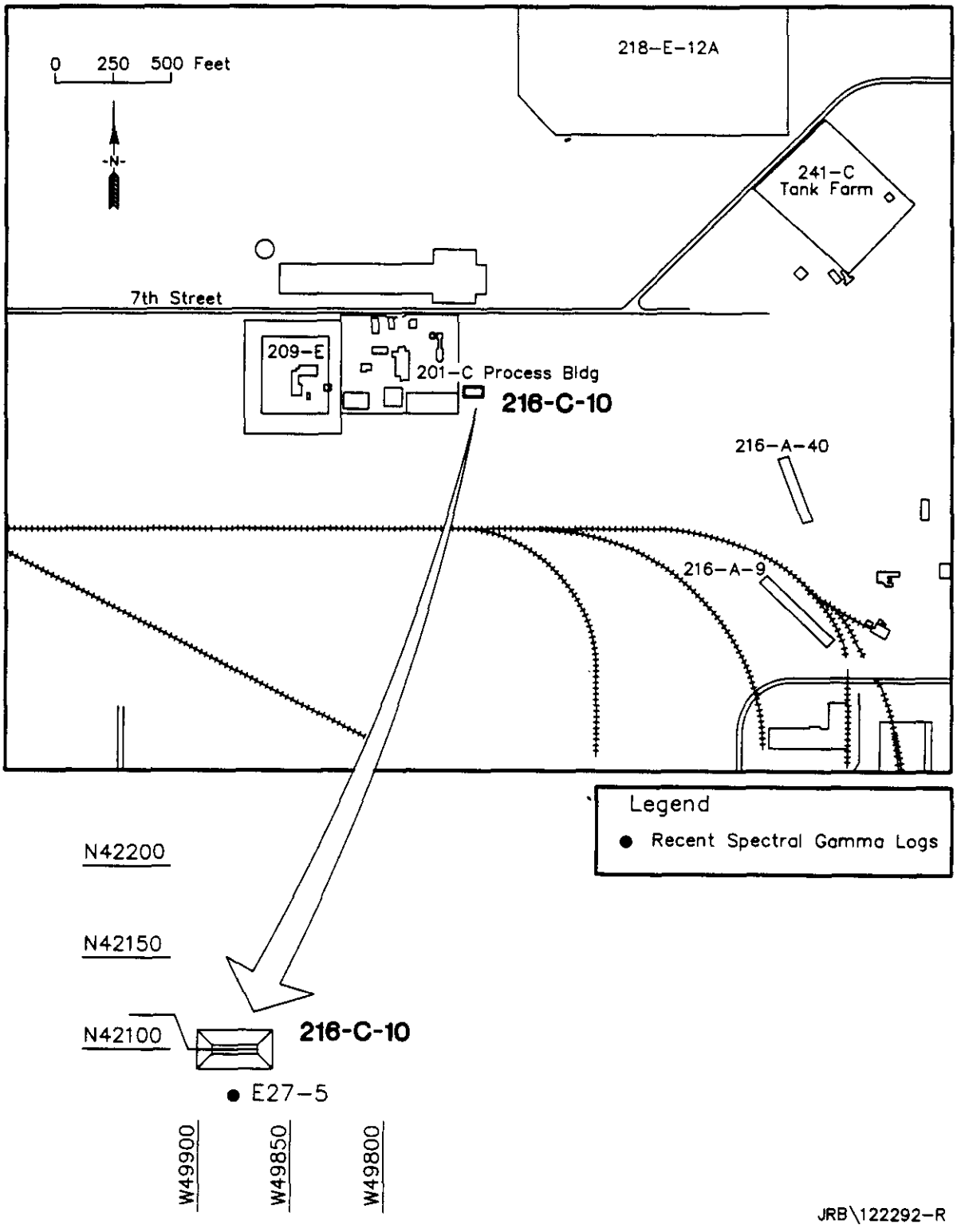
Borehole: 299-E27-5

Borehole 299-E27-5 was logged with the RLS spectral gamma logging system. This log identified man-made Co-60 below the water table from 275 feet to about 330 feet.

According to the records, very little cobalt was released at this site. Also, the records for all of the nearby sites indicate little if any cobalt releases. Therefore, the source of the cobalt in the groundwater is a mystery at this point and it must clearly be investigated further.

No other elevated activity and no other man-made nuclides were detected in this borehole.

The old gamma-ray log shows a similar elevated activity in the groundwater at this site.


0 250 500 Feet
-N-
218-E-12A
241-C
Tank Farm
7th Street
209-E
201-C Process Bldg
216-C-10
216-A-40
216-A-9
Legend
Recent Spectral Gamma Logs
N42200
N42150
N42100
216-C-10
E27-5
W49900
W49850
W49800
JRB\122292-R

Westinghouse Hanford Company
RLS Spectral Gamma-Ray Borehole Survey Log Header

Project: 200 East AAMS 216-C-10 Crib

Borehole	200-E27-5			
Coordinates	42,075 N	49,881 W	Feet	(Plant 200 E)
Elevation	685.01 feet		Top of Casing	(Plant 200 E)

Borehole Environment Information

Borehole Fluid Depth 277 (Feet) from Zero (0.0) Depth Reference of Log

Casing Size I.D. (inch)	Casing Thickness (inch)	Top Depth (feet)	Base Depth (feet)
8	0.38	0.0	335.0

RLS Passive Spectral Gamma Survey Information

Logging Engineers R. V. Cram S. E. Kos
Log Depth Reference at Zero (0.0) depth is Ground Level

Log Date	Archive File Names	Log Mode[1], Speed	Depth Interval (feet) Top	Base	Incr
Aug 24, 92	H2E2705\A228	MSA 30sec LT	0.0	199.5	0.5
Aug 25, 92	H2E2705\A229	MSA 35sec LT	195.0	330.5	0.5
		Station 300 s	75,150,225,313,324,331 ft		

[1]MSA: Move-Stop-Acquire Lt: Live Time Station: Long count at specified depths

Calibration and Analysis Information

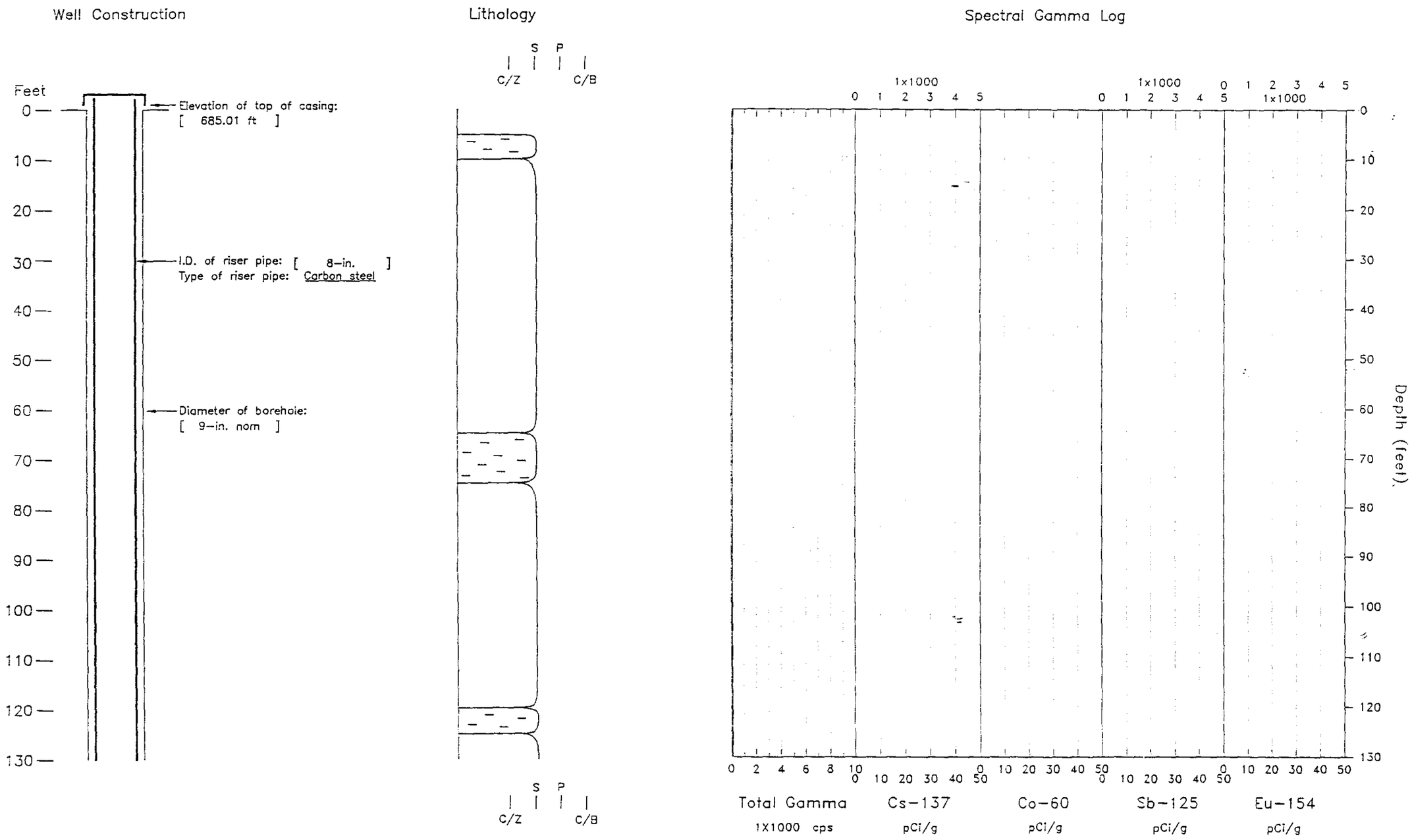
RLS Calibration Date: Nov 21, 1991
Calibration Report: WHC-SD-EN-TRP-001

Analyst Names: J. P. Kiesler
Analysis Date: Sept 23, 1992

Analysis Notes: Vadose zone has no manmade radionuclides
Radionuclides identified: Co-60

RLS Spectral Gamma Ray Borehole Survey

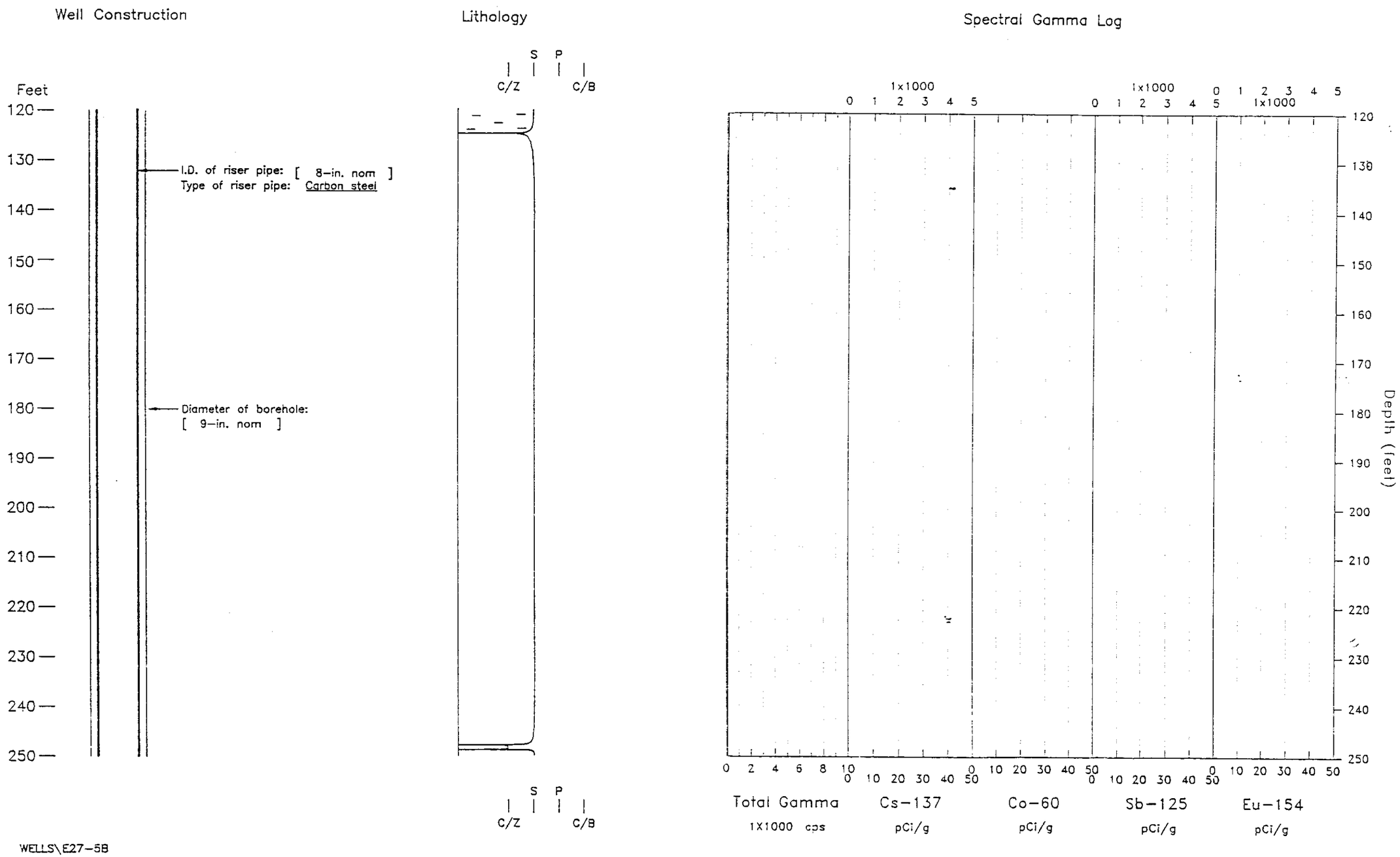
Well 299-E27-5 | Crib 216-C-10 | Log Date 8/24/92



WELLS\E27-5A

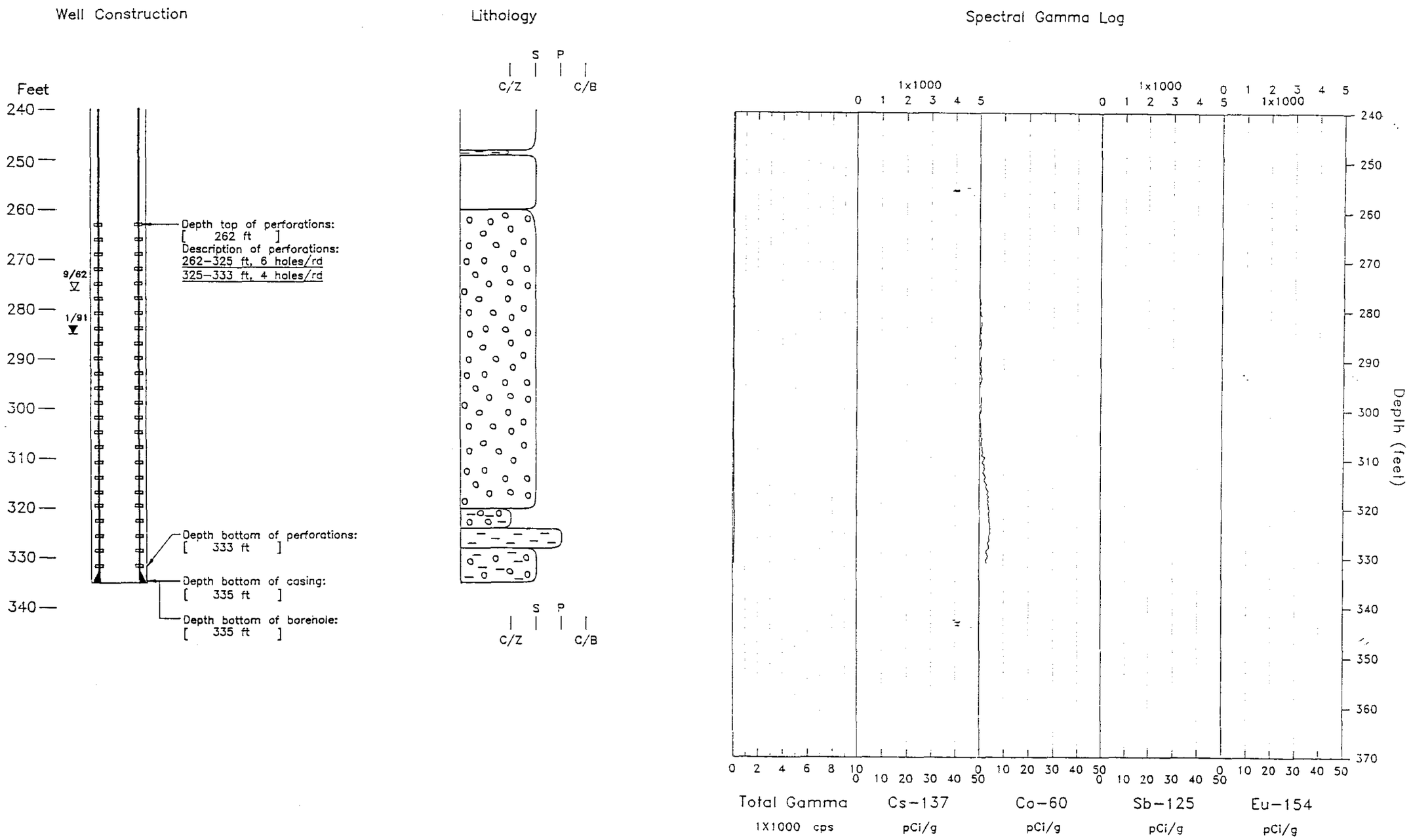
RLS Spectral Gamma Ray Borehole Survey (Page 2)

Well 299-E27-5 | Crib 216-T-3 | Log Date 5/11,14,15/92



RLS Spectral Gamma Ray Borehole Survey (Page 3)

Well 299-E27-5 | Crib 216-T-3 | Log Date 5/11,14,15/92



WELLS\E27-5C

RLS Borehole Survey Report

299-E27-5 216-C-10 Crib

Casing	Depth: 335 ft	Size: 8 in	Thickness: 0.38 in
Water	Depth: 277 ft		
Survey	Depth: 0 - 199 ft	Mode: MSA 30 sec	Date: 8/24/92
	195 - 330 ft	Mode: MSA 30 sec	Date: 8/25/92

General Notes:
No manmade radionuclides were encountered in the vadose zone in this well. The manmade radionuclides are identified just below the water table depth at 278 feet to the maximum survey depth of 331 feet.

Limited borehole access time and extended borehole depth required more than one day for screening survey of borehole.

Detector depth was checked and adjusted every 50 feet to 300 feet with a steel tape. The logging cable was failing. The maximum depth error is 0.9% on 8/25/92 (ie. 0.45 ft from 250 ft to 300 ft).

Man-made Radionuclides:
No Cesium (Cs-137) was encountered in the borehole survey. The plot track is present only for uniformity of the displayed data.

Cobalt (Co-60) was encountered in the borehole survey from 278 feet to the maximum survey depth of 331 feet. The cobalt decay activity detected was less than 5 pCi/g.

No Antimony (Sb-125) was encountered in the borehole survey. The plot track is present only for uniformity of the displayed data.

No Europium-154 (Eu-154) was encountered in the borehole survey. The plot track is present only for uniformity of the displayed data.

Crib Designation: 216-S-5

Type of Facility: Gravel base crib 210ft. X 210ft.

Location: N 32704, W 77000, South west of the south west corner of the West Area, outside of the fence

Service Dates: 3/54 to 3/57

Description of Waste: 4.1 x 10^9 liters of acidic steam condensate and cooling water from the Redox segregation process in the 202-S building. Contains "Low potential" portion of the effluent waste. "High potential" waste went to 216-S-6.

Radionuclide Release Summary:

Radionuclide	Quantity
Pu	580 g
Sr-90	130Ci
Ru-106	30 Ci
Cs-137	60 Ci
Co-60	< 0.10 Ci
U	270 kg

Summary of Past Logging:

Boreholes	Date	Reference
299-W26-1	1976	Fecht et al., 1977
299-W26-3	1976	"
299-W26-4	1976	"
299-W26-5	1976	"

Only borehole 299-W26-1 provides a clear indication of gamma-emitting nuclides. This borehole was drilled directly through the crib and very high gross gamma readings were found in the upper 40 feet of this hole in 1976.

Review of Current Logging:

Borehole 299-W26-1

Borehole 299-W26-1 was logged in 1992 with the PNL gross gamma logging system as well as the RLS system. The gross gamma log shows very high count rates from near surface to about 42 feet. The Cs-137 concentration in this zone was so high that it caused the gross gamma system to saturate. From the shape of the gross gamma profile, it does not appear that there has been any appreciable movement of the nuclides. There are significant differences in the shape of this recent log relative to the 1976 log. But, the shape changes are primarily due to differences in the data acquisition methods.

The spectral gamma-ray log identified Cs-137 as the only gamma-emitting nuclide. This is consistent with the estimated nuclide release information listed above. Plutonium (isotope not identified) is difficult, at best, to identify and quantify in

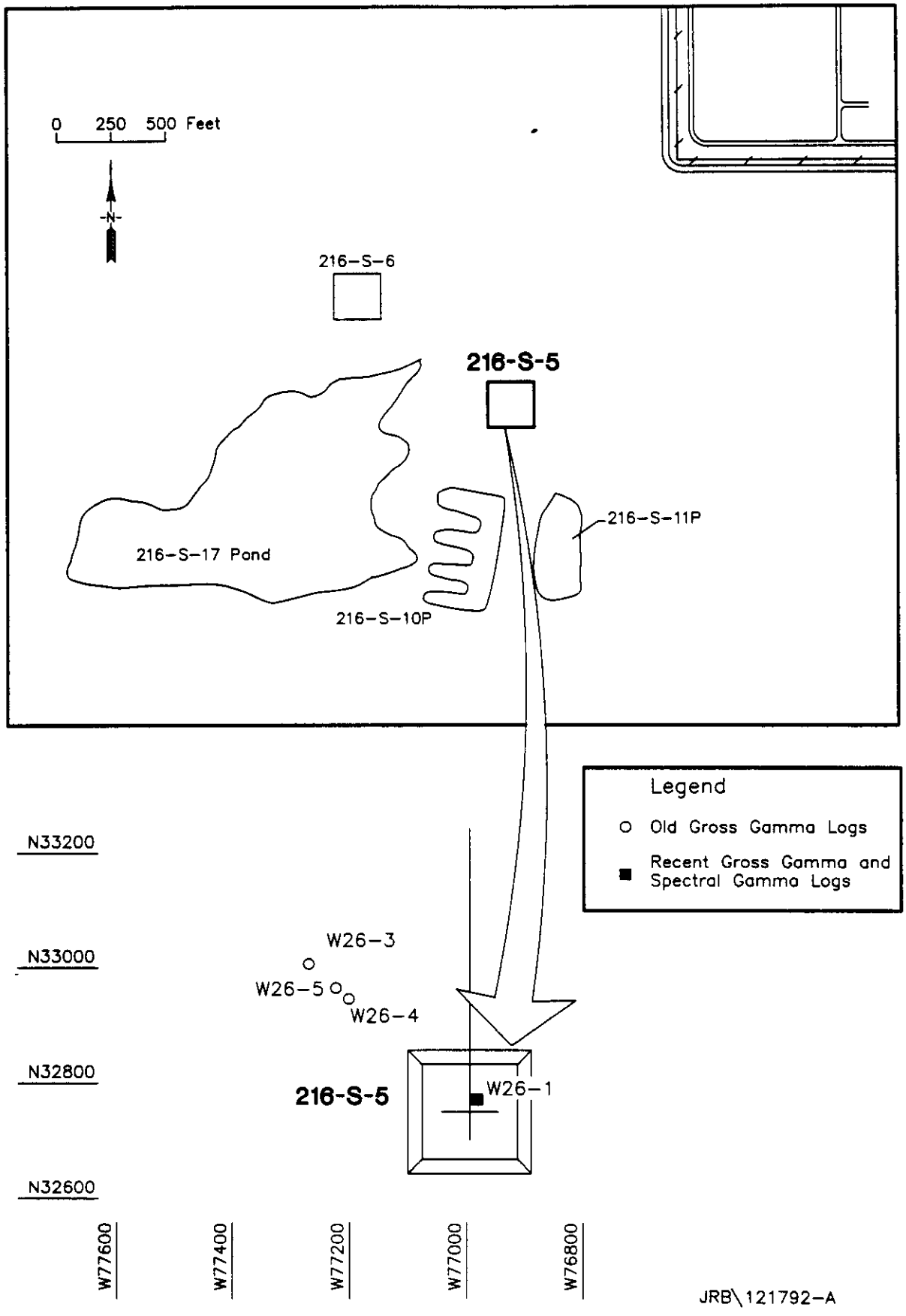
the presence of high cesium activity because it emits low-energy gamma rays that become lost in the compton and photoelectric noise of the spectrum.

The Ru-106 released at the site has decayed by now to such a low level that it cannot be identified in the spectra. Cobalt was not present in the release effluent to any appreciable level.

No uranium was detected with the spectral gamma-ray equipment. It is not known specifically which isotope of uranium was released at this site. U-235 and U-238 both have gamma-rays which are detectable. However, both isotopes have very long half lives and as a result, low specific activities. Therefore, both have to be present in high mass concentrations in order to be detected, especially when there is a high compton continuum background noise in the spectrum from the presence of other man-made nuclides as is the case in this borehole. The difficulty in detecting uranium is compounded by the fact that uranium is chemically very mobile within the unsaturated zone and the large volume of effluent released at this site resulted in an extensive flushing of the uranium through the unsaturated zone system. It is possible that all of the uranium released has migrated to the groundwater. Sediment sampling is recommended to resolve the question of the deposition of the uranium.

Except for a possible minor stratigraphic correlation at about 35 feet, there does not appear to be any relationship between the deposition of the Cs-137 and the stratigraphy, although detailed geology information is not available. This can be explained by the fact that there was a very large volume of liquid flowing through this system. In this case, the effluent flowpath would not be appreciably influenced by minor changes in the unsaturated zone flow properties of the strata.

The data from the past logging and the current logging do not provide evidence that radionuclides released at this site have contaminated the groundwater.


0 250 500 Feet
N
216-S-6
216-S-5
216-S-17 Pond
216-S-10P
216-S-11P
Legend
Old Gross Gamma Logs
Recent Gross Gamma and Spectral Gamma Logs
N33200
N33000
N32800
N32600
W26-3
W26-5
W26-4
W26-1
216-S-5
W77600
W77400
W77200
W77000
W76800
JRB\121792-A

Westinghouse Hanford Company
RLS Spectral Gamma-Ray Borehole Survey Log Header

Project: 200 AAMS, S-5 Crib

Borehole	299-W26-01		
Coordinates	33,211 N 77,493 W	Feet	(Plant 200 W)
Elevation	650. feet	Top of Casing	(Plant 200 W)

Borehole Environment Information

Borehole Fluid Depth none (Feet) from Zero (0.0) Depth Reference of Log

Casing Size I.D. (inch)	Casing Thickness (inch)	Top Depth (feet)	Base Depth (feet)
8.0	0.33	0.0	54.0

RLS Passive Spectral Gamma Survey Information

Logging Engineers R. V. Cram S. E. Kos
Log Depth Reference at Zero (0.0) depth is Ground Level

Log Date	Archive File Names	Log Mode[1] Speed	Depth Interval (feet) Top	Base	Incr
Dec 13, 91	H2W2601\A105	FIXED 0.6 fps	0.	51.	0.5

[1]FIXED: Fixed velocity of Cable Speed: fps: Feet per second

Calibration and Analysis Information

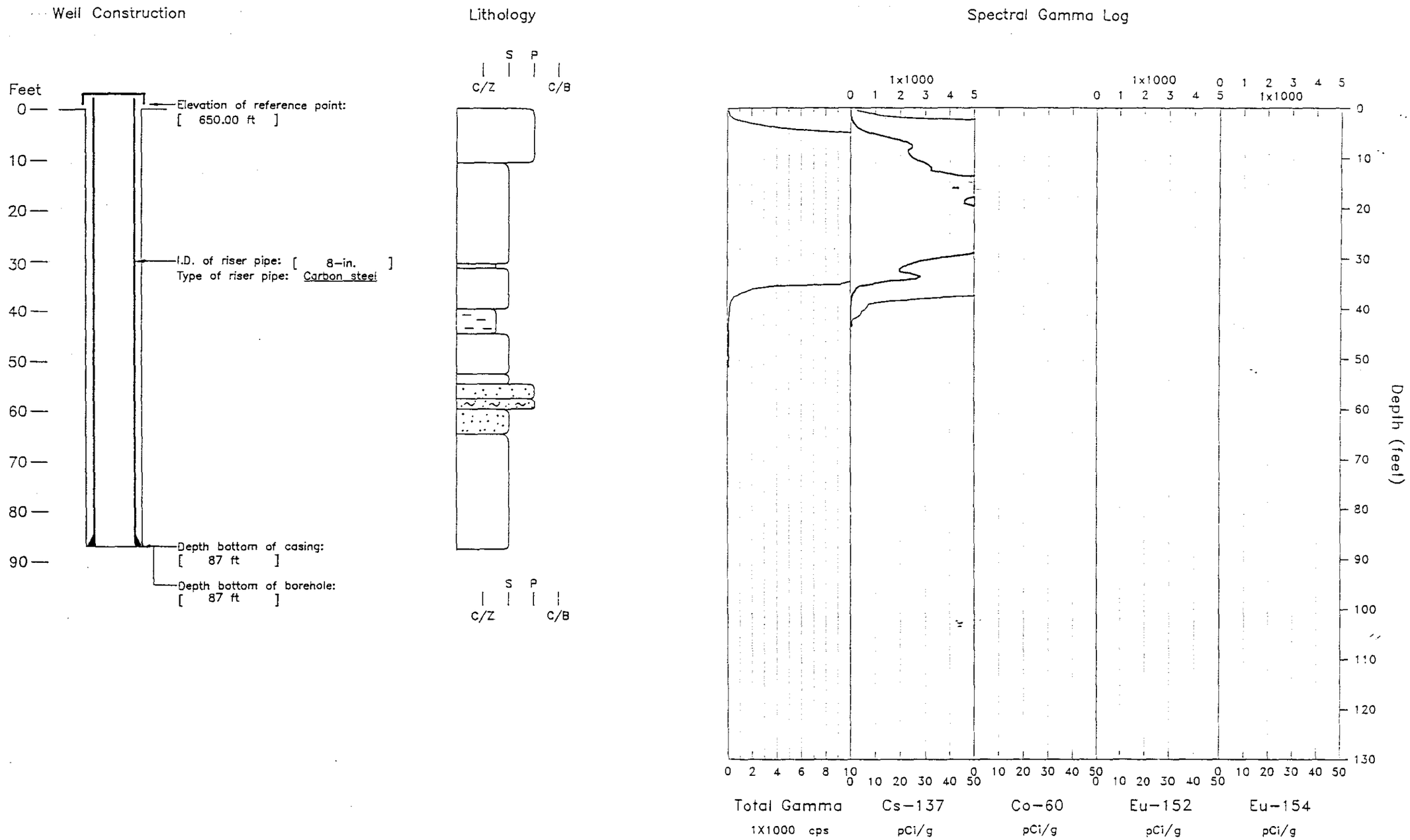
RLS Calibration Date: Nov 21, 1991
Calibration Report: WHC-SD-EN-TRP-001

Analyst Names: W. F. Nicaise R. K. Price
Analysis Date: July 13, 1992

Analysis Notes:
Radionuclides identified: Cs-137,

RLS Spectral Gamma Ray Borehole Survey

Well 299-W26-1 | Crib 216-S-5 | Log Date 12/13/91



GEOSCI\26-1A

299-W26-1 S-5 Crib

Casing	Depth: 54'	Size: 8"	Thickness: 0.33"
Water	Depth: none		
Survey	Depth: 0 - 51'	Date: 12/31/92	
	12 - 31'	(Lead Shield)	

General Notes:
The total gamma activity exceeded 200,000 cps in the borehole survey between 14 feet and 16 feet. The excessive system dead-time with the normal equipment configuration for borehole logging prevented accurate calculation of gamma activity. The lead shield was installed to reduce the number of low energy gamma-rays being counted by the detector. The maximum total gamma activity at 15 feet with the lead shield installed was 310,000 cps.

Man-made Radionuclides:
Cesium (Cs-137) was encountered from 1 feet to the maximum survey depth of 51 feet. With the lead shield installed the maximum activity encountered exceeded 33,000 pCi/g at 16 feet. The cesium activity exceeded 5000 pCi/g from 14 feet to 29 feet.

No Cobalt (Co-60) was encountered in the borehole. The plot track is present only for uniformity of the displayed data.

No Europium-152 (Eu-152) was encountered in the borehole. The plot track is present only for uniformity of the displayed data.

No Europium-154 (Eu-154) was encountered in the borehole. The plot track is present only for uniformity of the displayed data.

299-W26-1

Westinghouse Hanford Company | LOG HEADER | Page 1 of 2

Well No. 299-W26-1 Area 200 West Date 5/20/92
Log Run #1 Log Type Gamma Gamma
Elevation Datum Top of Casing Elevation 650
Survey Coordinates N 33211 W 72195
Log Measures From Ground Surface
Location Direction 216-S-5 Crib
Ground Surface Elevation
Surface Temperature NA Weather Clear Warm & Windy

SCREEN/LINER INFORMATION

Driller
Drill Rig Type Bit Type/Diameter
Screens Diameter/Gauge 8"/54"
Depth Driller 54' "4W" Depth Logger 530'
Liquid Level NA (none) Liquid Density N/A
Temperature N/A

CASING RECORD

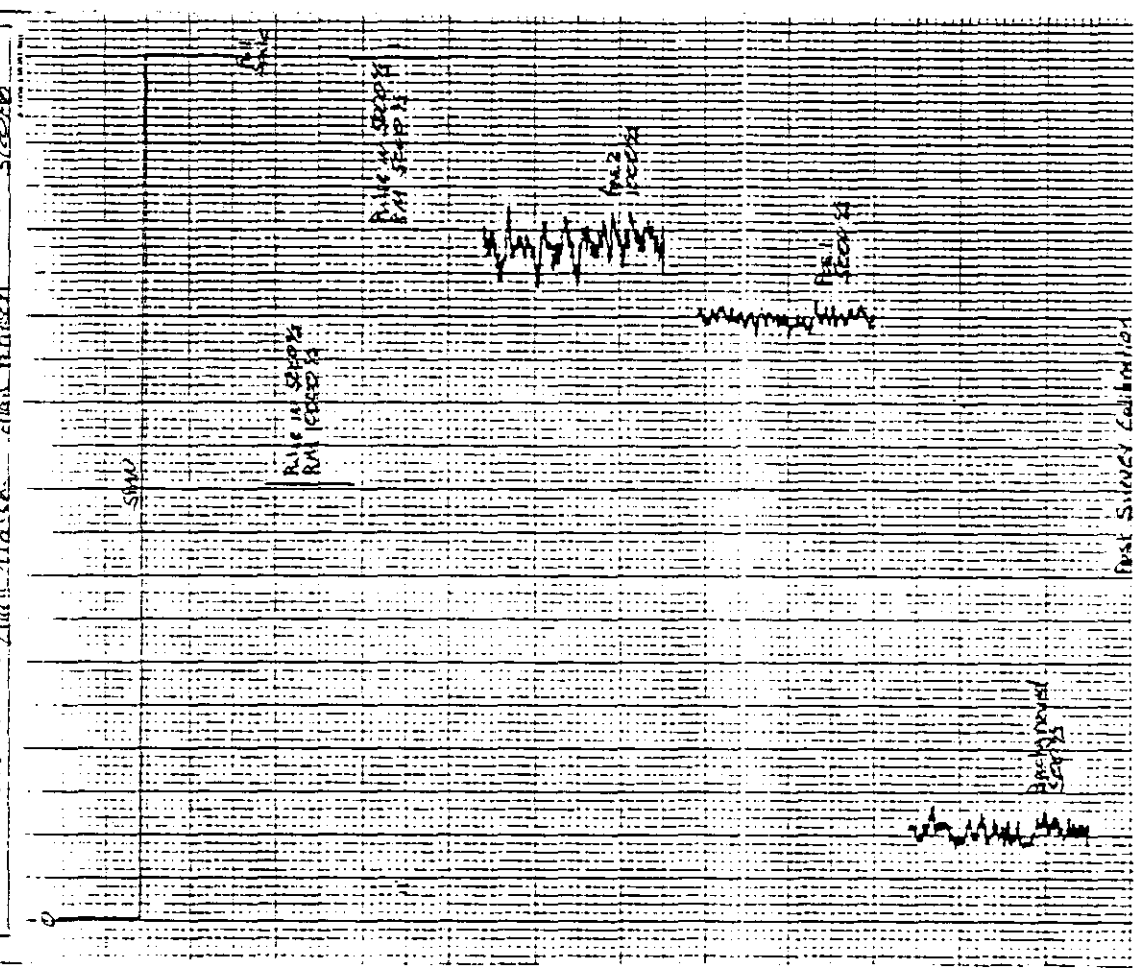
Type 8" Carbon Steel Sch 40 Interval +2.6'-7
Type Interval
Type Interval
Type Interval
Total Screen Interval NA
Comments: Casing Flows 102' high
Centralizer used

Page 2 of 2

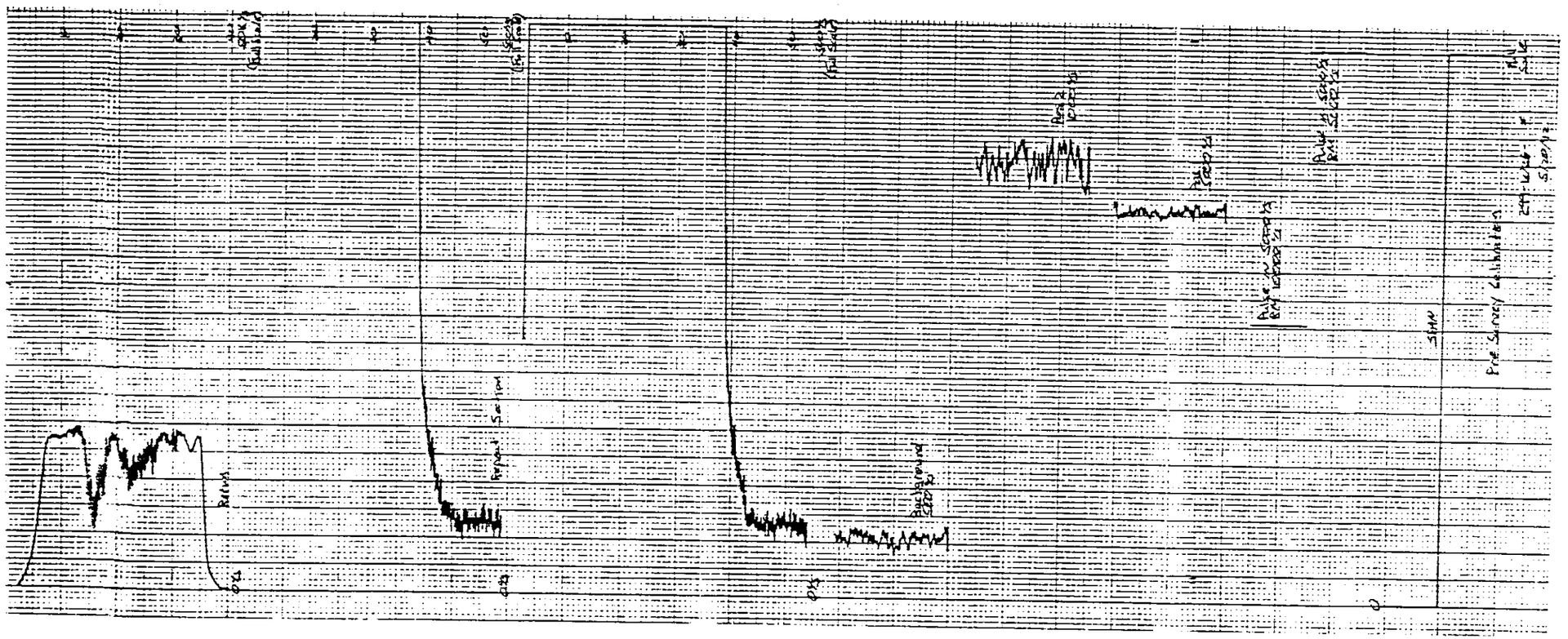
LOG HEADER

Logging Company PNL
Operator(s) Allen Hanson
Equipment Brand AMS
Tool Type Gamma Ray
Base Calibration Date 5/91
Calibration Reference (Ft) 8.0 x 10^4 cps (Minutes Elapsed) 2.4
Dead Time 11.0 usec
Logging Speed 5 ft/min
Log Interval From 539'
To 2.5'
Recorded 539' - 200' @ 5 ft/min & 200' - 2.5' @ 50 ft/min
Pre Survey Verification Position 1 3267.7 cps Background 555
Post Survey Verification Position 1 9.3 cps
Base Calibration Difference: Position 1 5.1%
Logging Speed 50 ft/min
Start Time 1245
Start Depth Min. 10 ft/min
Start Recorder Horizontal Scale CPS/in. 50 cps/in.
Start Recorder Vertical Scale 2 in/hr Background 52.5
Post Survey Verification Position 1 3018 cps Background 52.5
Percent Change: Position 1 0.4% Position 1 0.3%
Comments: Return time: 102' hours
Centralizer used

Witnessed and Verified by (sign and print name) Allen Hanson Date 5/20/92



299-W26-1



Crib Designation: 216-S-6

Type of Facility: Gravel base Crib 210ft. X 210ft.

Location: N 33250, W 77850, Southwest of the southwest corner of the west area

Service Dates: 11/54 to 7/72

Description of Waste: 4.5 x 10^9 liters of neutral to basic, low salt steam condensate and cooling water from the Redox segregation process in 202-S building. Contains "high potential" portion of the effluent waste. "Low potential" waste went to 216-S-5 crib.

Radionuclide Release Summary:

Radionuclide	Quantity
Pu	470 g
Sr-90	410 Ci
Ru-106	130 Ci
Cs-137	210 Ci
Co-60	2.9 Ci
U	270 kg

Summary of Past Logging:

Boreholes	Date	Reference
299-W26-2	1976	Fecht et al., 1977
299-W26-51	1987	Geophysics files

Review of Current Logging:

Borehole: 299-W26-51

Borehole 299-W26-51 was logged with the PNL gross gamma and the RLS spectral gamma system. The gross gamma logging system became saturated in several zones of high activity from 10 feet to 55 feet. Zones of lower activity were found at about 65 feet and 75 feet with a very low activity anomaly at 85 feet. Significant differences in the shapes of the latest gross gamma log and that of 1987 were not evident although there were some changes due to differences in the data acquisition methods. There is a 5 foot downward shift between the two logs, but this is probably the result of a tool positioning error.

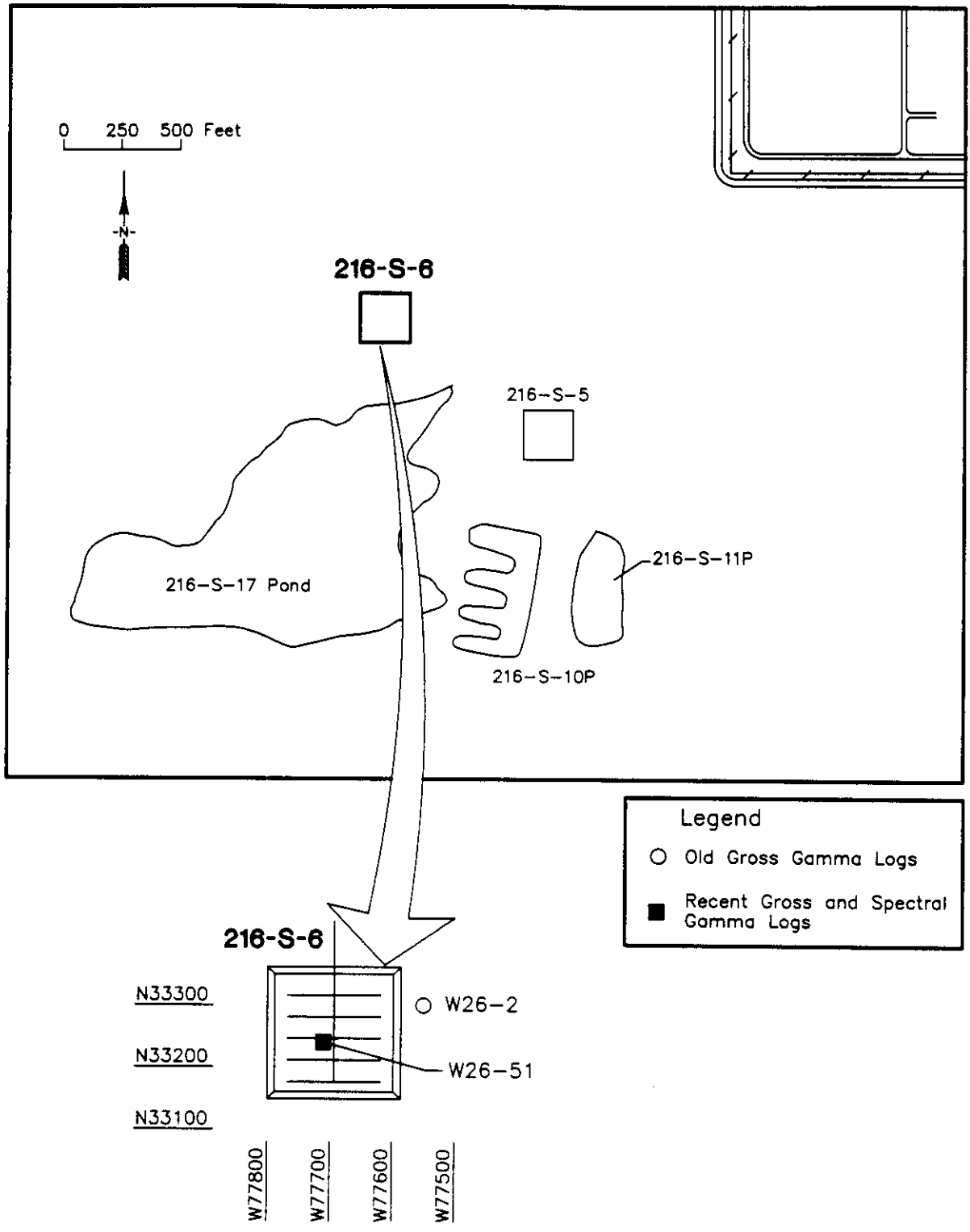
As with crib 216-A-5, the spectral gamma log data show that the only man-made gamma emitting nuclide in the borehole is Cs-137. The cesium is distributed into three upper zones of very high concentration with lower concentration zones in between. The three deeper low activity gross gamma anomalies are the result of low concentrations of cesium.

There does not appear to be a correlation between the deposition of the cesium and the geology although little detailed geology data are available. There is no data that would explain the lobe deposition pattern seen in this borehole. This

deposition may be due to large, discontinuous pulses of effluent released at this site. Release records should be reviewed to see if this was the effluent release pattern.

As with crib 216-S-5, no uranium is seen in the spectra and there is no evidence of plutonium.

Although it appears that most of the contamination was retained up in the upper vadose zone, there is no way to be certain that this is the case because this borehole does not reach the groundwater. A small amount of Co-60 was released at this site and, because it is more mobile than Cs-137, it is possible that some of this has reached the groundwater.


0 250 500 Feet
N
216-S-6
216-S-5
216-S-17 Pond
216-S-11P
216-S-10P
Legend
Old Gross Gamma Logs
Recent Gross and Spectral Gamma Logs
216-S-6
N33300
N33200
N33100
W26-2
W26-51
W77800
W77700
W77600
W77500

JRB\121792-B

Westinghouse Hanford Company
RLS Spectral Gamma-Ray Borehole Survey Log Header

Project: 200 AAMS, S-6 Crib

Borehole	299-W26-51			
Coordinates	33,240 N	77,710 W	Feet	(Plant 200 W)
Elevation	. feet		Top of Casing	(Plant 200 W)

Borehole Environment Information

Borehole Fluid Depth none (Feet) from Zero (0.0) Depth Reference of Log

Casing Size I.D. (inch)	Casing Thickness (inch)	Top Depth (feet)	Base Depth (feet)
8.0	0.313	0.0	105.0

RLS Passive Spectral Gamma Survey Information

Logging Engineers R. V. Cram S. E. Kos
Log Depth Reference at Zero (0.0) depth is Ground Level

Log Date	Archive File Names	Log Mode, Speed	Depth Interval (feet) Top	Base	Incr
Jan 24, 92	H2W2651\A123	FIXED 0.6 fps	0.	103.	0.5

[1]FIXED: Fixed velocity of Cable Speed: fps: Feet per second

Calibration and Analysis Information

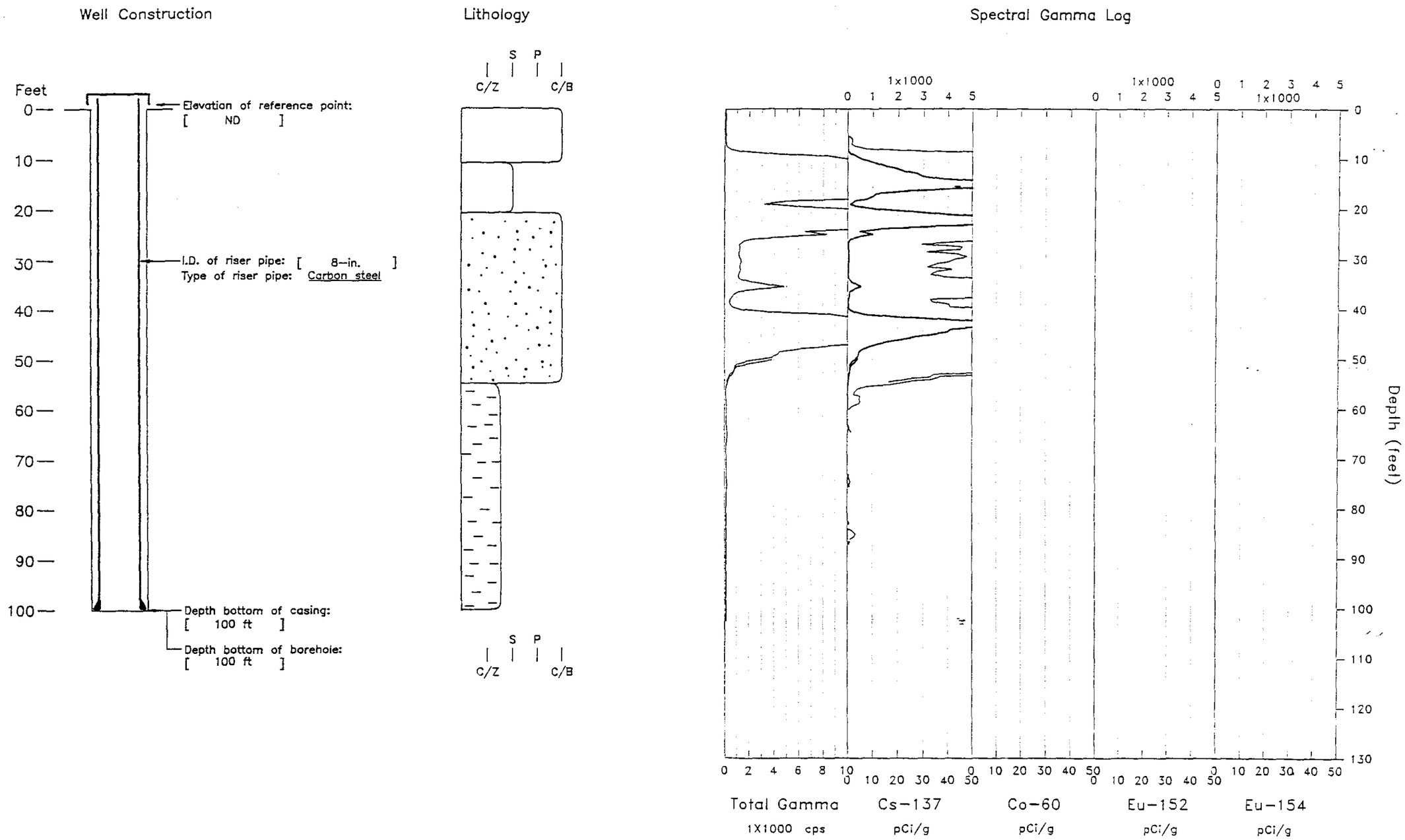
RLS Calibration Date: Nov 21, 1991
Calibration Report: WHC-SD-EN-TRP-001

Analyst Names: W. F. Nicaise R. K. Price
Analysis Date: July 08, 1992

Analysis Notes: Depth reset at 50 feet, error 0.5 feet
Radionuclides identified: Cs-137,

RLS Spectral Gamma Ray Borehole Survey

Well 299-W26-51 | Crib 216-S-6 | Log Date 1/24/92



GEOSCI\26-51A

299-W26-51 S-6 Crib

Casing	Depth: 105'	Size: 8"	Thickness: 0.313"
Water	Depth: none		
Survey	Depth: 0 - 55'	Date: 1/24/92	
	Depth: 50 - 103'		

General Notes:
Detector depth was checked at 55 feet with a tape measure. The tool was repositoned at 50 feet and the second set of data was collected. Overlap between the two data sets, 50 feet to 55 feet, was examined for a depth error. The total gamma log indicates a 0.5 feet depth error.

The total gamma activity at 15 feet reached 340,000 cps in the borehole survey. The total gamma activity exceeded 50,000 cps at depths between 12 to 16 feet, 21 to 23 feet, and 42 to 44 feet.

Man-made Radionuclides:
Cesium (Cs-137) was encountered from 5 feet to 92 feet. The maximum activity encountered was 10,000 pCi/g at 15 feet. Other intervals of high cesium activity was encountered from 21 to 23 feet at 6300 pCi/g and from 42 to 44 feet at 6100 pCi/g.

No Cobalt (Co-60) was encountered in the borehole. The plot track is present only for uniformity of the displayed data.

No Europium-152 (Eu-152) was encountered in the borehole. The plot track is present only for uniformity of the displayed data.

No Europium-154 (Eu-154) was encountered in the borehole. The plot track is present only for uniformity of the displayed data.

299-W26-51

Westinghouse Hanford Company | LOG HEADER | Page 1 of 2

Well No. 299-W26-51 Area 200 West Date 2/18/92
Log Run #1 Log Type Gamma Gamma
Elevation Datum Elevation
Survey Coordinates N 77274C W 77710
Log Measured From Ground Surface
Location Description Middle of 216-S-6 Crib
Ground Surface Elevation
Surface Temperature N/A Weather Rain, Windy, Cool

SCREENOUS INFORMATION

Driller
Drill Rig Type Bit Type/Diameter
Reference Depth and Datum 8" 405'
Depth Driller Depth Logger 104.7'
Liquid Level N/A (units) Liquid Density N/A
Temperature N/A

CASING RECORD

Type 8" Carbon Steel Sch 40 Interval +1.3'-~105'?
Type Interval
Type Interval
Type Interval
Well Screen Interval N/A
Comments: Casing Fitting +0.25' high
Centralizer used

Page 2 of 2

LOG HEADER

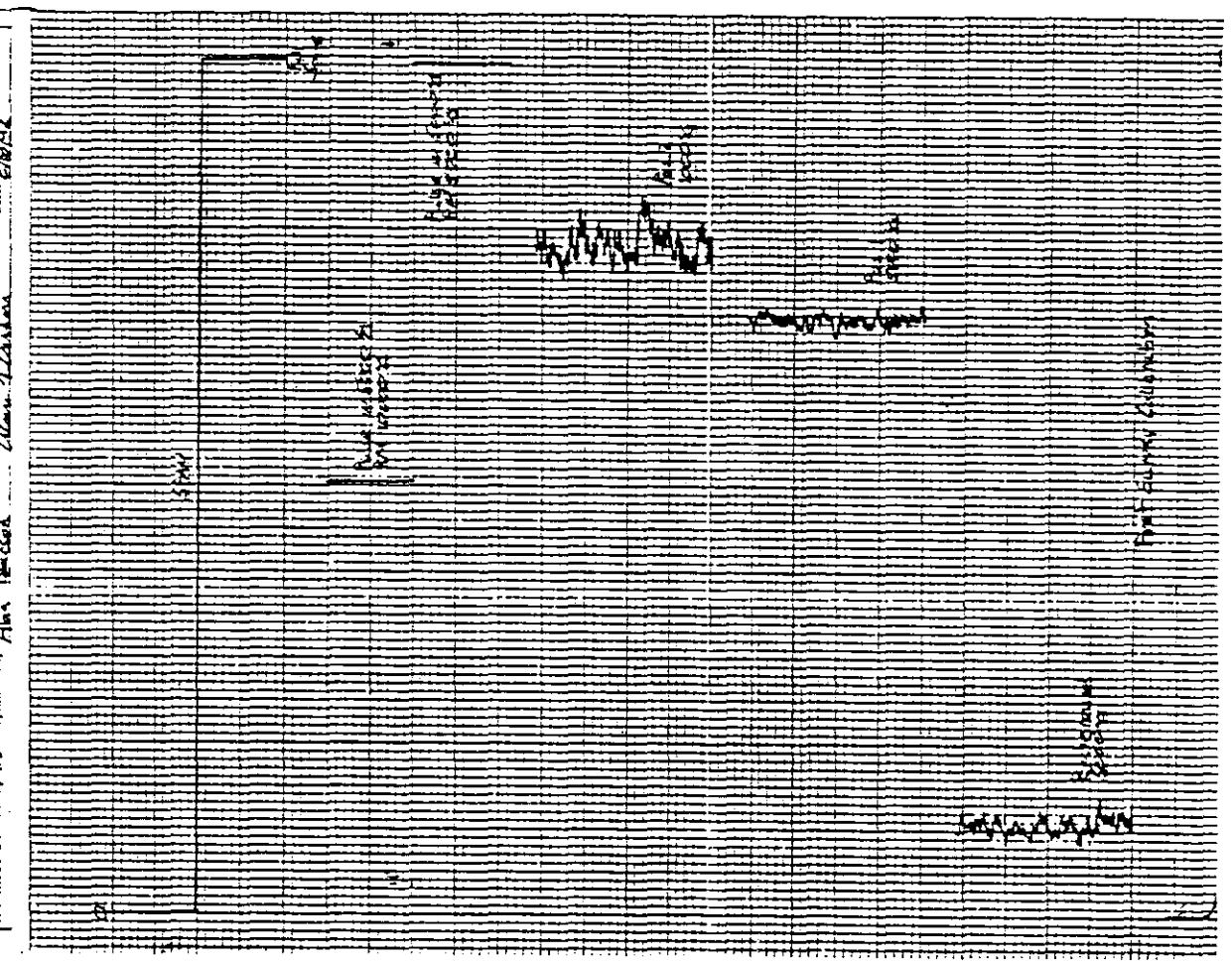
EQUIPMENT DATA

Logging Company PNL
Operator(s) Alan Pierson
Equipment Brand AMS Equipment Type Analog
Tool Type Gamma Bat Serial No. CC27011
Most Calibration Date 5/91 Calibration Reference PNL-7985 WC-606
Calibration Probe Factor 8.8 Elevation Datum (ref) Position 1 211.1 ell Position 2 611.3 ell
Dead Time 11.8 usec Wireline Type 715 esa

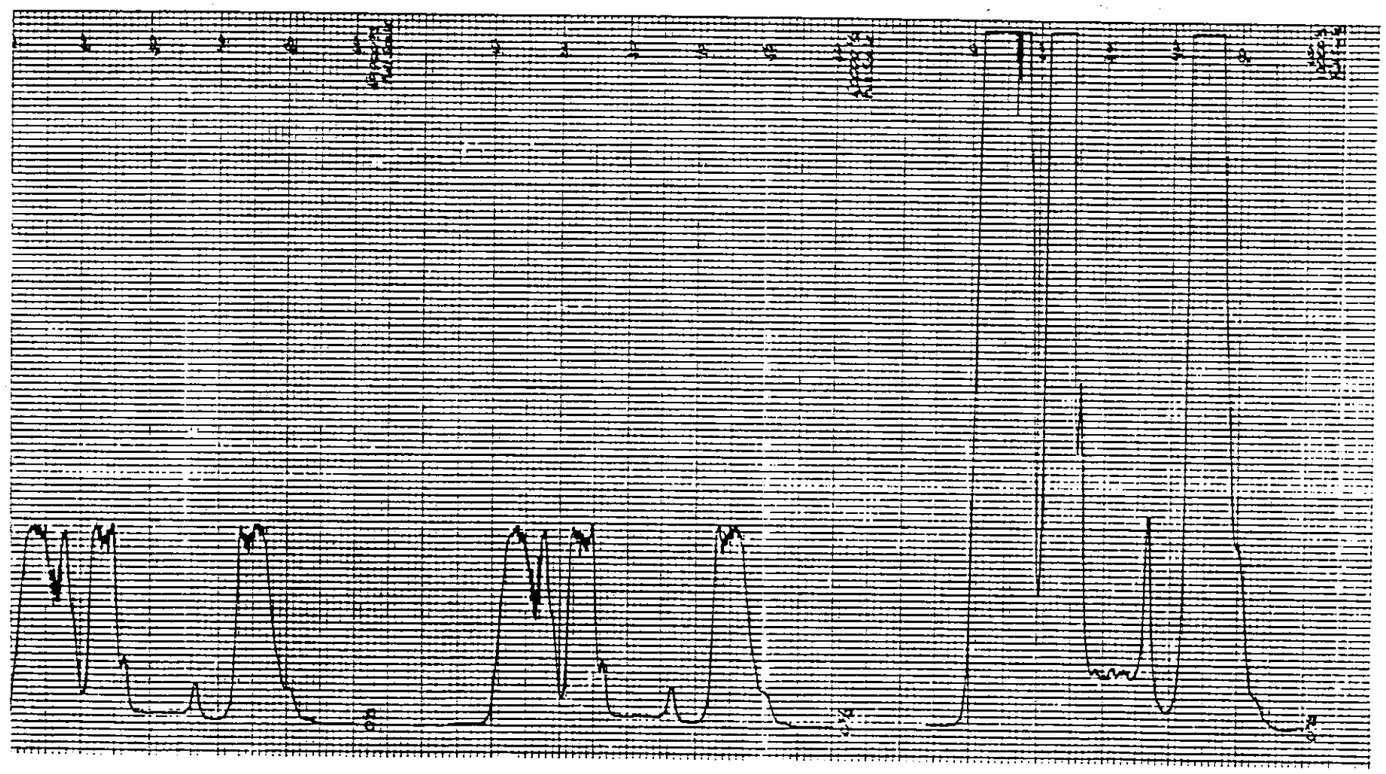
LOGGING CONDITION

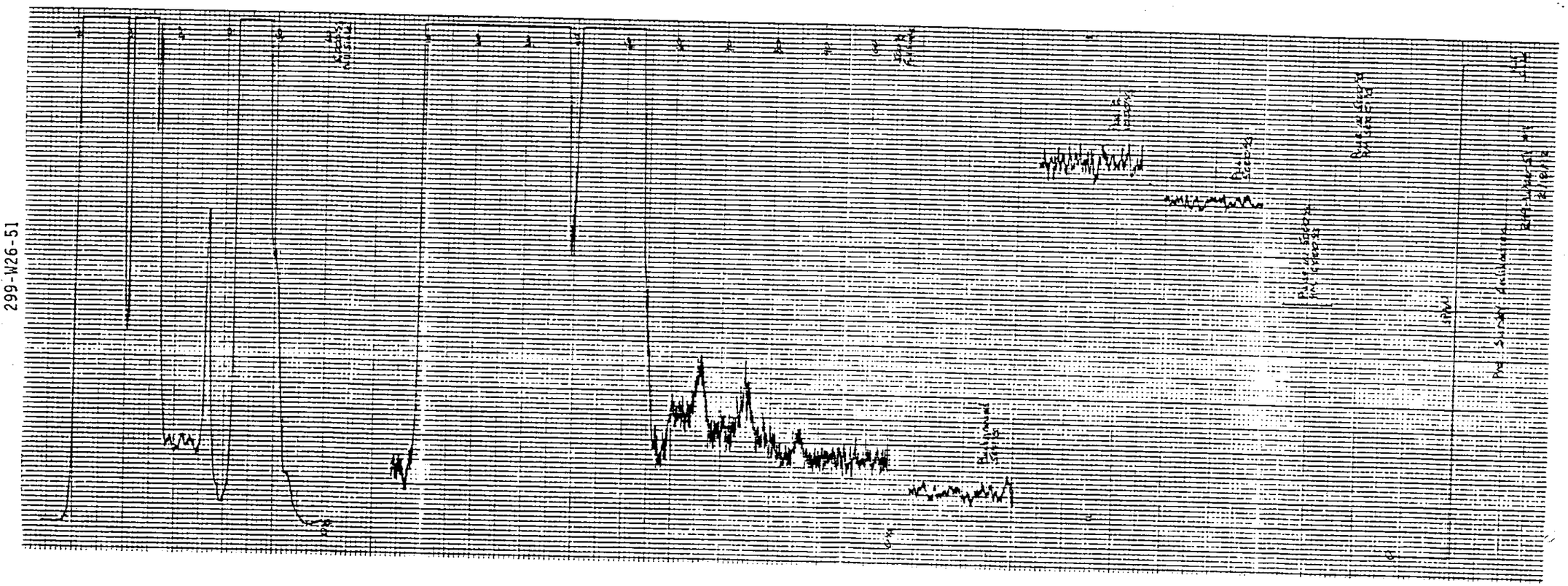
Log Interval From 104.7' to 38'
Records 100'-38' @ 5cccps ; 100'-38' @ 10cccps ; 100'-38' @ 5cccps
Pre Survey Verification Position 1 3.9 ell Position 2 61.5 ell Background 55cps
Post Calibration Reference: Position 1 11.6 ell Position 2 0.2 ell
Logging Speed 5'/min Alarm Setpoint (CPS) 50cps/4
Start Time 1010 Completion Time 1020
Chart Speed(s) 1cm/min Tool Constant(s) 'K-1
Chart Recorder Horizontal Scale, CPS/cm 50cps/cm Position 1 611.1 ell Background 55cps
Post Survey Verification: Position 1 302.3 ell Position 2 0.1 ell
Percent Change: Position 1 2.2% Position 2 0.0%
Comments: Casing Stick +0.25' high
Centralizer used

Witnessed and Verified by (sign and print name) Alan Pierson Date 2/18/92



299-W26-51





299-W26-51

Crib Designation: 216-S-7

Type of Facility: Wooden Crib Structure 50ft. X 100ft. Note: crib structure has collapsed and was backfilled.

Location: N 35132, W 74150, Northwest of the northwest corner of the Redox facility (202-S building)

Service Dates: 1/56 to 7/65

Description of Waste: 390 x 10^6 liters total of cell drainage from the Redox "D-1" receiver tank, process condensate from the "D-2" receiver tank and condensate from the "H-6 condenser all in 202-S. The pH of this effluent varied but measurements of pH as low as 2 have been recorded.

Radionuclide Release Summary:

Radionuclide	Quantity
Pu	440 g
Sr-90	3100 Ci
Ru-106	1500 Ci
Cs-137	14700 Ci
Co-60	2.5 Ci
U	2590 kg

Summary of Past Logging:

Boreholes	Date	Reference
299-W22-12	1976	Fecht, et al., 1977
299-W22-13	1976	Fecht, et al., 1977
299-W22-14	1976	Fecht, et al., 1977
	1987	Geophysics Files
299-W22-32	1976	Fecht, et al., 1977
299-W22-33	1976	Fecht, et al., 1977
	1987	Geophysics Files

Review of Current Logging:

Borehole 299-W22-32

This borehole was logged only with the spectral gamma-ray system. Two thick, high concentration zones of Cs-137 were found near the top of the borehole and lower concentrations of Cs were evident throughout the borehole. It is quite difficult to determine the actual concentration of the nuclides at this site from this borehole because the borehole has been double cased and grouted. The grout thickness and resulting gamma radiation attenuation varies in an unknown manner throughout the length of the borehole, thus the accuracy of the nuclide concentration data is poor and the uncertainty is high.

There is also some question about whether or not the log actually reflects the cesium profile in the unsaturated zone around this borehole. Before the borehole was sealed, it may have acted as a conduit for the contaminated effluent to flow downward, carrying the cesium with it. However, the old gross

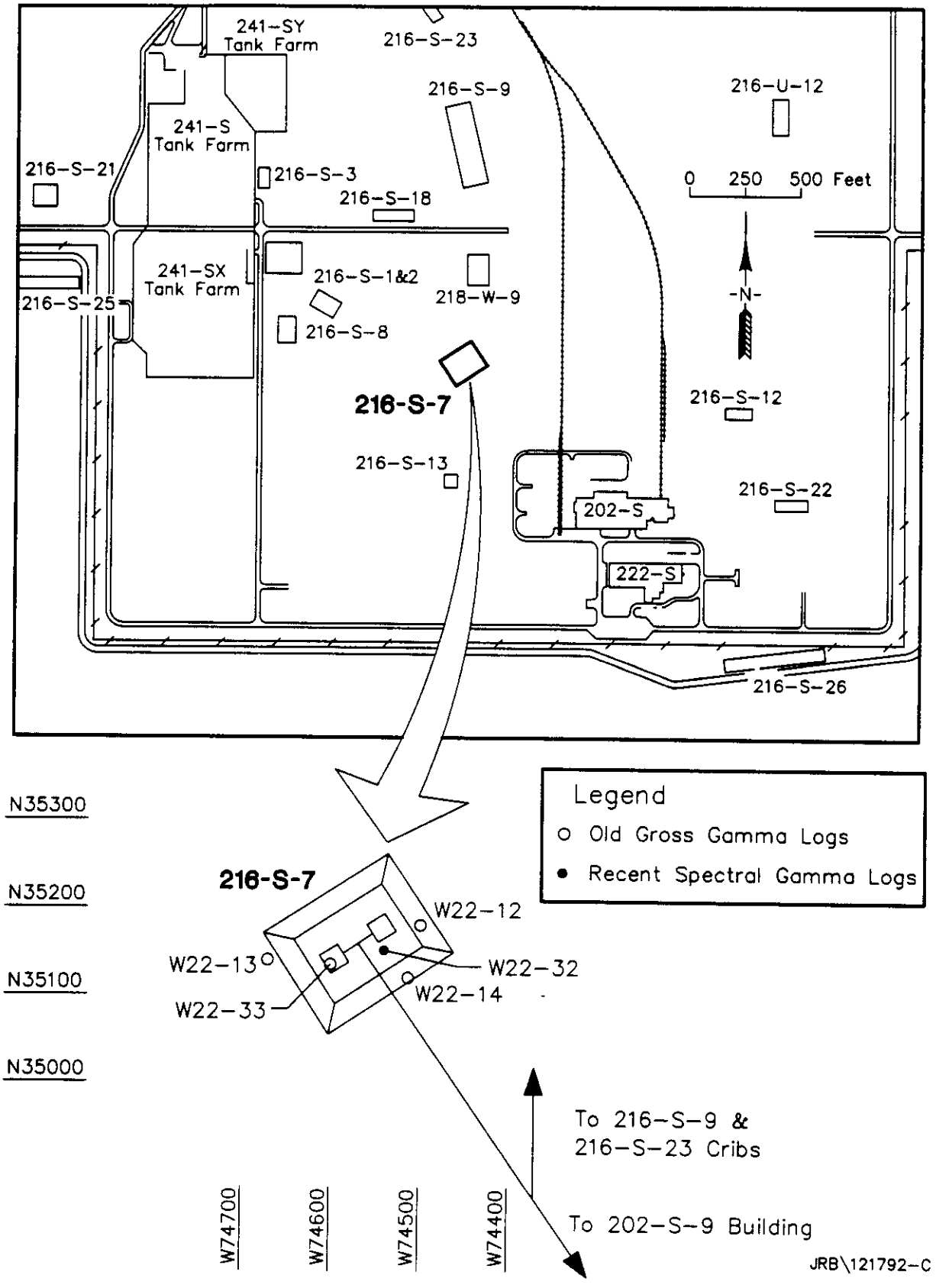
gamma-ray logs from other nearby boreholes all show zones of slightly elevated activity, down deep in the boreholes, indicating that there is, in fact, cesium deep in the unsaturated zone. In addition, the effluent released at this site had a very low pH which promotes the migration of the nuclides in the unsaturated zone.

Other boreholes around this crib should be logged with the spectral gamma system to determine the actual Cs-137 concentration pattern at this site.

The spectral log data from this borehole and the old gross gamma logs from the other boreholes clearly indicate that cesium has migrated at this site, down to the groundwater. If the cesium migrated this deep, it is certain that at least the uranium and the small amount of cobalt released at this site also migrated to the groundwater.

No other nuclides were identified in the spectra and no relationship between the geology and the cesium deposition pattern is evident.

9413137.1663


241-SY Tank Farm
216-S-23
216-S-9
216-U-12
241-S Tank Farm
216-S-21
216-S-3
216-S-18
0 250 500 Feet
241-SX Tank Farm
216-S-1&2
218-W-9
216-S-25
216-S-8
-N-
216-S-7
216-S-12
216-S-13
216-S-22
202-S
222-S
216-S-26
Legend
Old Gross Gamma Logs
Recent Spectral Gamma Logs
N35300
N35200
N35100
N35000
216-S-7
W22-12
W22-13
W22-32
W22-14
W22-33
To 216-S-9 &
216-S-23 Cribs
To 202-S-9 Building
W74700
W74600
W74500
W74400
JRB\121792-C

Westinghouse Hanford Company
RLS Spectral Gamma-Ray Borehole Survey Log Header

Project: 200 AAMS, S-7 Crib

Borehole	299-W22-32			
Coordinates	35,151 N	74,540 W	Feet	(Plant 200 W)
Elevation	675. feet		Top of Casing	(Plant 200 W)

Borehole Environment Information

Borehole Fluid Depth none (Feet) from Zero (0.0) Depth Reference of Log

Casing Size I.D. (inch)	Casing Thickness (inch)	Top Depth (feet)	Base Depth (feet)
8.0	0.313	0.0	209.0
4.0	0.250	0.0	209.0

RLS Passive Spectral Gamma Survey Information

Logging Engineers R. V. Cram S. E. Kos
Log Depth Reference at Zero (0.0) depth is Ground Level

Log Date	Archive File Names	Log Mode,[1] Speed	Depth Interval (feet) Top	Base	Incr
Dec 18, 91	H2W2232\A109	FIXED 0.6 fps	0.	206.	0.5

[1] FIXED: Fixed velocity of Cable Speed: fps: Feet per second

Calibration and Analysis Information

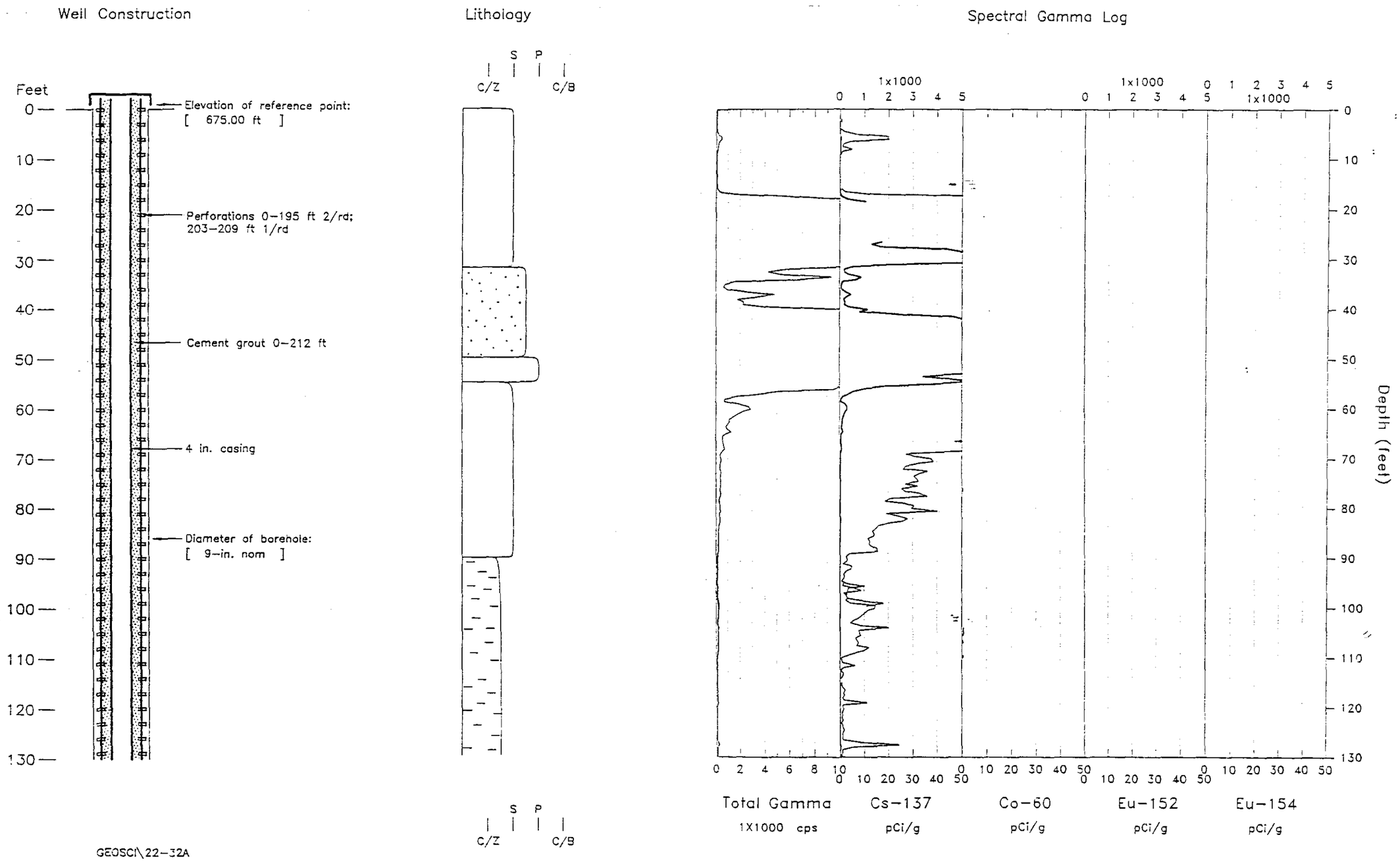
RLS Calibration Date: Nov 21, 1991
Calibration Report: WHC-SD-EN-TRP-001

Analyst Names: W. F. Nicaise R. K. Price
Analysis Date: May 27, 1992

Analysis Notes: Depth reset at 95 feet, error 1 foot
Radionuclides identified: Cs-137, Co-60, (Eu-154, Eu-152 not confirmed)

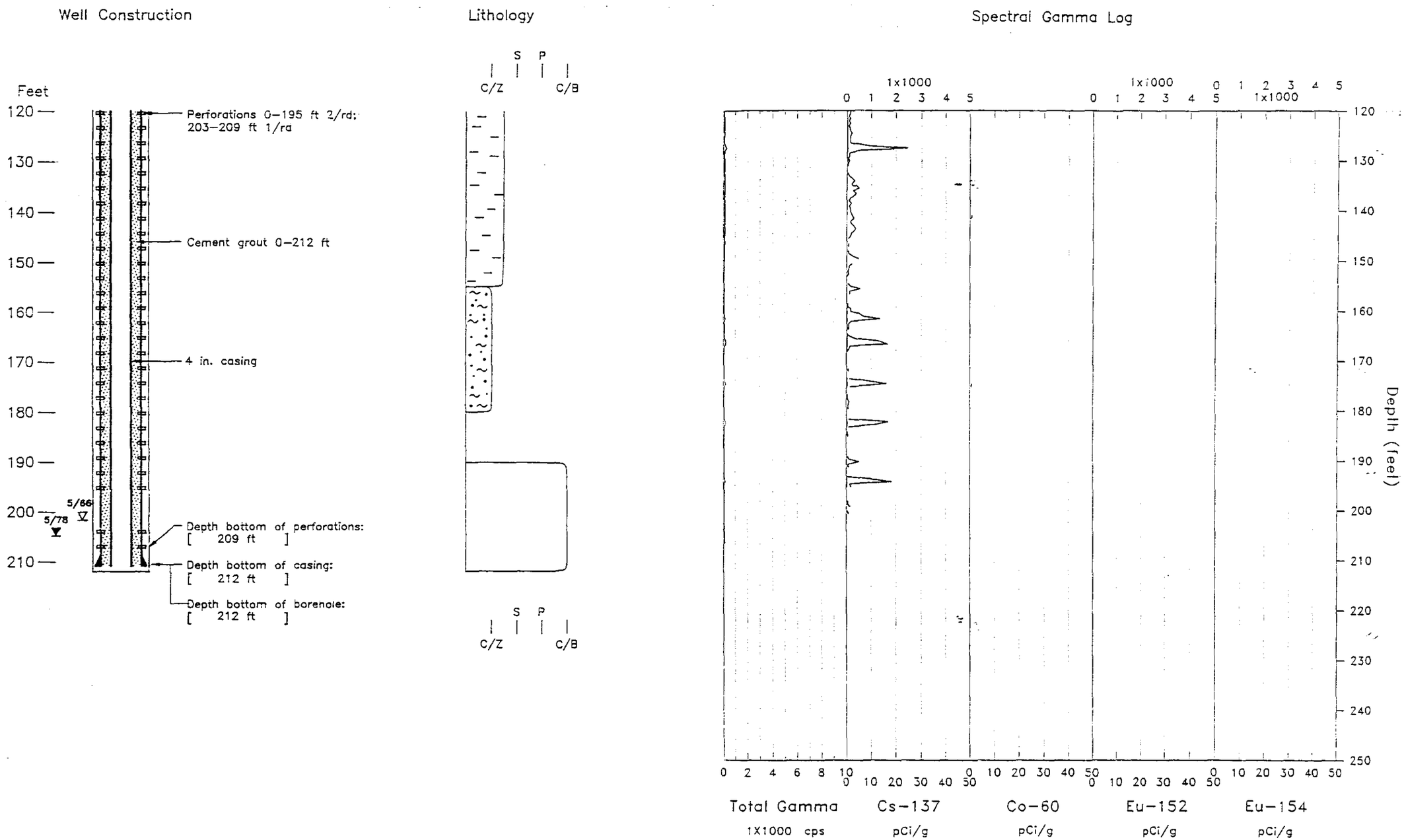
RLS Spectral Gamma Ray Borehole Survey

Well 299-W22-32 | Crib 216-S-7 | Log Date 2/18/91



RLS Spectral Gamma Ray Borehole Survey (Page 2)

Well 299-W22-32 | Crib 216-S-7 | Log Date 2/18/91



GEOSCI\22-328

299-W22-32 S-7 Crib

Casing	Depth: 209.'	Size: 8"	Thickness: 0.313"
	Depth: 209.'	Size: 4"	Thickness: 0.250"
Water	Depth: none		
Survey	Depth: 0 - 100'	Date: 12/18/91	
	95 - 200'		
	198 - 206'		

General Notes:
The survey is plotted on two pages. The survey data from 120 feet to 130 feet are plotted on both pages.

Detector depth was checked at 100 feet and 200 feet. The log data acquire program was halted to check the depth with a tape measure. The tool was repostioned at 95 feet and the second data set was collected. Overlap between the two data sets, 95 feet to 100 feet, were examined for a depth error. The total gamma log indicates a 1.0 foot depth error. Overlap between 198 feet and 200 feet did not indicate an error.

The total gamma activity in the intervals, 18 feet to 26 feet and 43 feet to 50 feet appeared to exceed 200,000 cps in the borehole survey. The excessive system dead-time with the normal equipment configuration for borehole logging prevents accurate calculation of gamma activity in those intervals.

The maximum calibrated casing correction of 0.40 inches was applied to the survey data. The computed activity for data recorded through multiple casing strings will be underestimated.

Man-made Radionuclides:
Cesium (Cs-137) was encountered from 2 feet to 204 feet. The maximum activity encountered exceeded 10,000 pCi/g in the zones 18 feet to 26 feet and 43 feet to 50 feet. The cesium activity from 160 feet to the bottom at 206 feet is discontinuous with concentrations from 0 to 30 pCi/g and may indicate well construction difficulties.

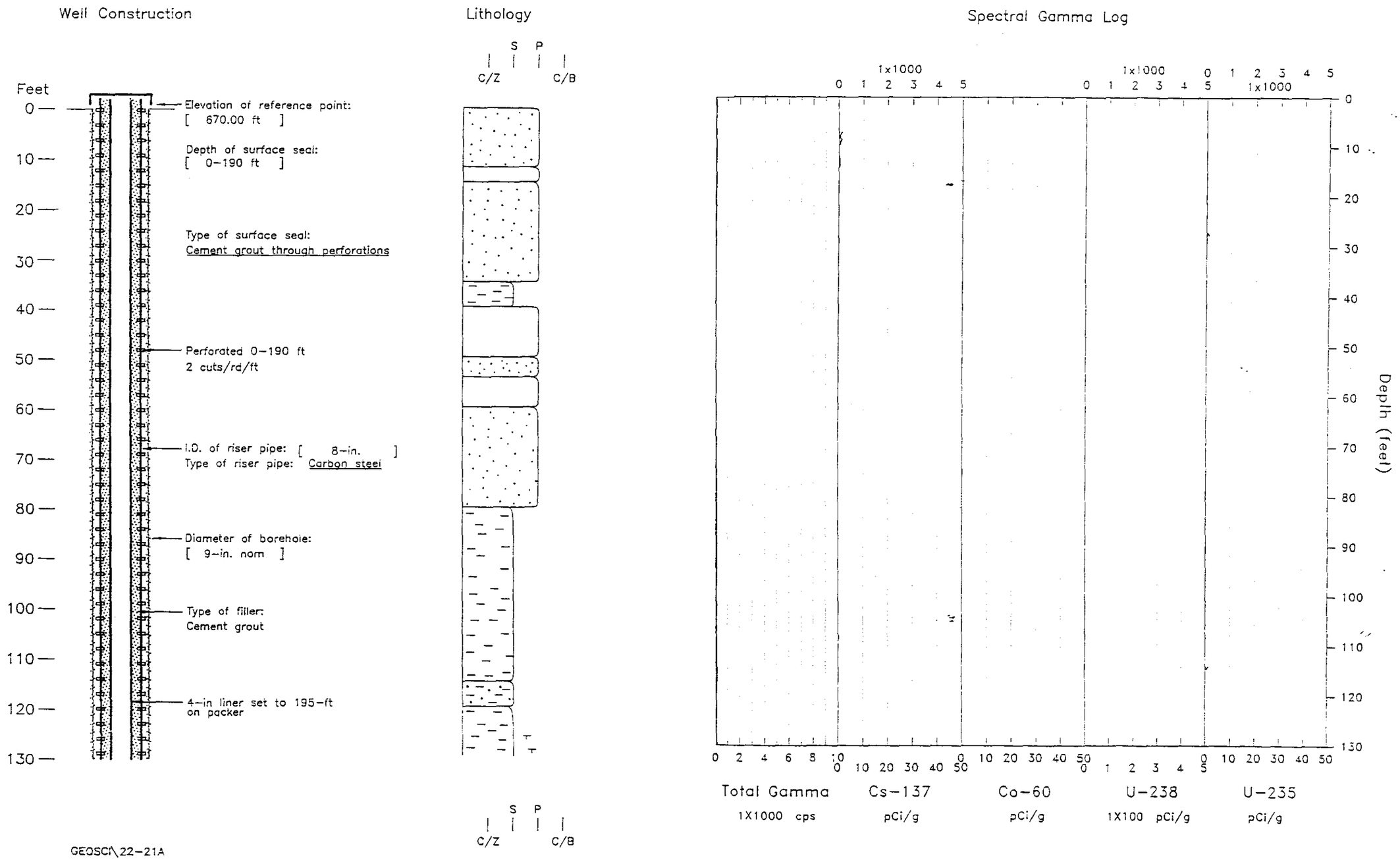
Cobalt (Co-60) was observed from 26 feet to 226 feet with no continuous depth measurements and all computed activities were less than 1 pCi/g the approximate threshold of detection.

No Europium-152 (Eu-152) was confirmed in the screening survey and the plot track is present only for uniformity of the displayed data.

No Europium-154 (Eu-154) was confirmed in the screening survey and the plot track is present only for uniformity of the displayed data.

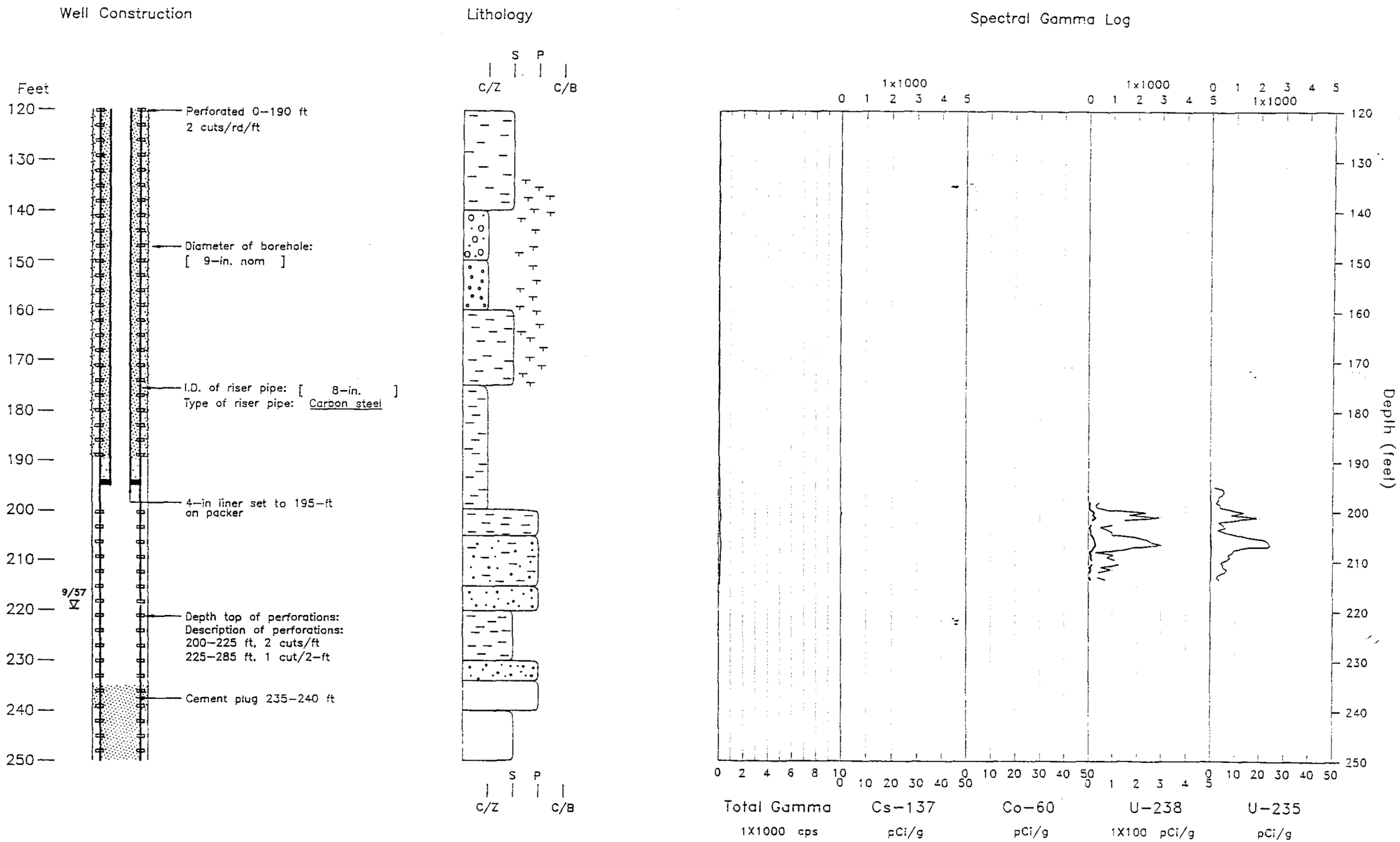
RLS Spectral Gamma Ray Borehole Survey

Well 299-W22-21 | Crib 216-S-13 | Log Date 2/13/92



RLS Spectral Gamma Ray Borehole Survey (Page 2)

Well 299-W22-21 | Crib 216-S-13 | Log Date 2/13/92

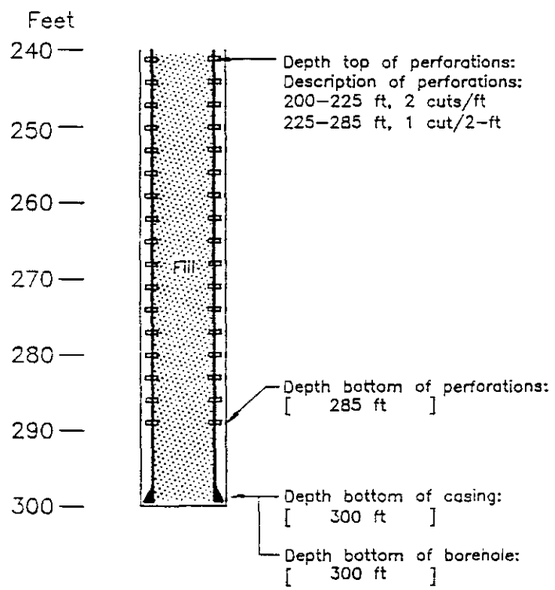


GEOSCI\22-21B

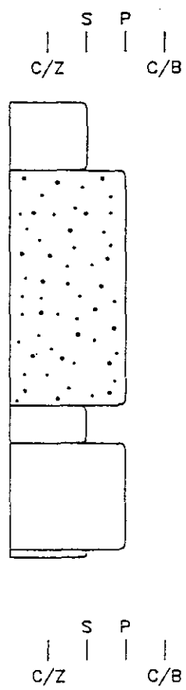
RLS Spectral Gamma Ray Borehole Survey (Page 3)

Well 299-W22-21 | Crib 216-S-13 | Log Date 2/13/92

Well Construction



Lithology



Spectral Gamma Log

GEOSCI\22-21C

299-W22-21 S-13 Crib

Casing	Depth: 222'	Size: 8"	Thickness: 0.312"
-	Depth: 194'	Size: 4"	Thickness: 0.25"
Water	Depth: none		
Survey	Depth: 0 - 214'	Date: 2/15/92	

General Notes:
The survey is plotted on two pages. The first page is nearly blank since only trace amounts of man-made radionuclides were detected above 190 feet.

The maximum calibrated casing correction of 0.40 inches was applied to the survey data. The computed activity for data recorded through multiple casing strings will be underestimated.

The total gamma activity did not exceed 250 cps in the borehole survey. The total gamma activity is not representative of the levels of radionuclide concentration computed in the borehole. The maximum decay activity of Uranium-238 (U-238) is about 300 pico-curies per gram (pCi/g).

Man-made Radionuclides:
Cesium (Cs-137) was encountered from 7 to 14 feet and from 200 to 214 feet. The maximum activity encountered was 1 pCi/g at 7 feet.

No Cobalt (Co-60) was encountered in the borehole. The plot track is present only for uniformity of the displayed data.

Uranium-238 (U-238) was encountered in the borehole from 196 feet to 213 feet. The maximum activity was 300 pCi/g at 206 feet. The U-238 identified in this borehole must not be confused with naturally occuring uranium. Natural uranium (U-238) will be in secular equilibrium with all of its daughters. The U-238 radionuclide identified in borehole 299-W22-21 was not in secular equilibrium because the daughters below radium (Ra-226) were not identified on the gamma-ray spectra.

Uranium-235 (U-235) was encountered in the borehole from 195 feet to 214 feet. The computed activity is not considered accurate. The identifying gamma-ray at 185.7 keV is at the lower energy range of the valid calibration data. The maximum activity computed from the calibration algorithm was 25 pCi/g.

299-W22-21

Westinghouse Hanford Company | LOG HEADER | Page 1 of 2

Well No. 299-W22-21 Area 200 West Date 2/15/92
Log Run #1 Log Type Gamma Gamma
Elevation Datum Top of casing Elevation 620
Survey Coordinates N 34600' x W 34600
Log Measured From Ground Surface
Location Description ~300 ft West of S-Plant
Ground Surface Elevation
Surface Temperature NA Weather Rainy - Cool

SOREHOLE INFORMATION

Driller
Drill Rig Type Bit Type/Diameter
Borehole Diameter and Depth 8"/ 4"/195.0'
Depth Driller 220.0' Depth Logger 219.7'
Liquid Level ? - 209.0' Liquid Density NA
Temperature ?

CASING RECORD

Type 8" Carbon Steel Interval +1.9' - 220.0'
Type 4" Threaded Carbon Steel Interval 2.7 - 95.0'
Type Interval
Type Interval
Well Screen Interval NA ?
Comments Drive Point ~2.06' high
Centralizer used
Pump on bottom of well

LOG HEADER | Page 2 of 2

EQUIPMENT USAGE

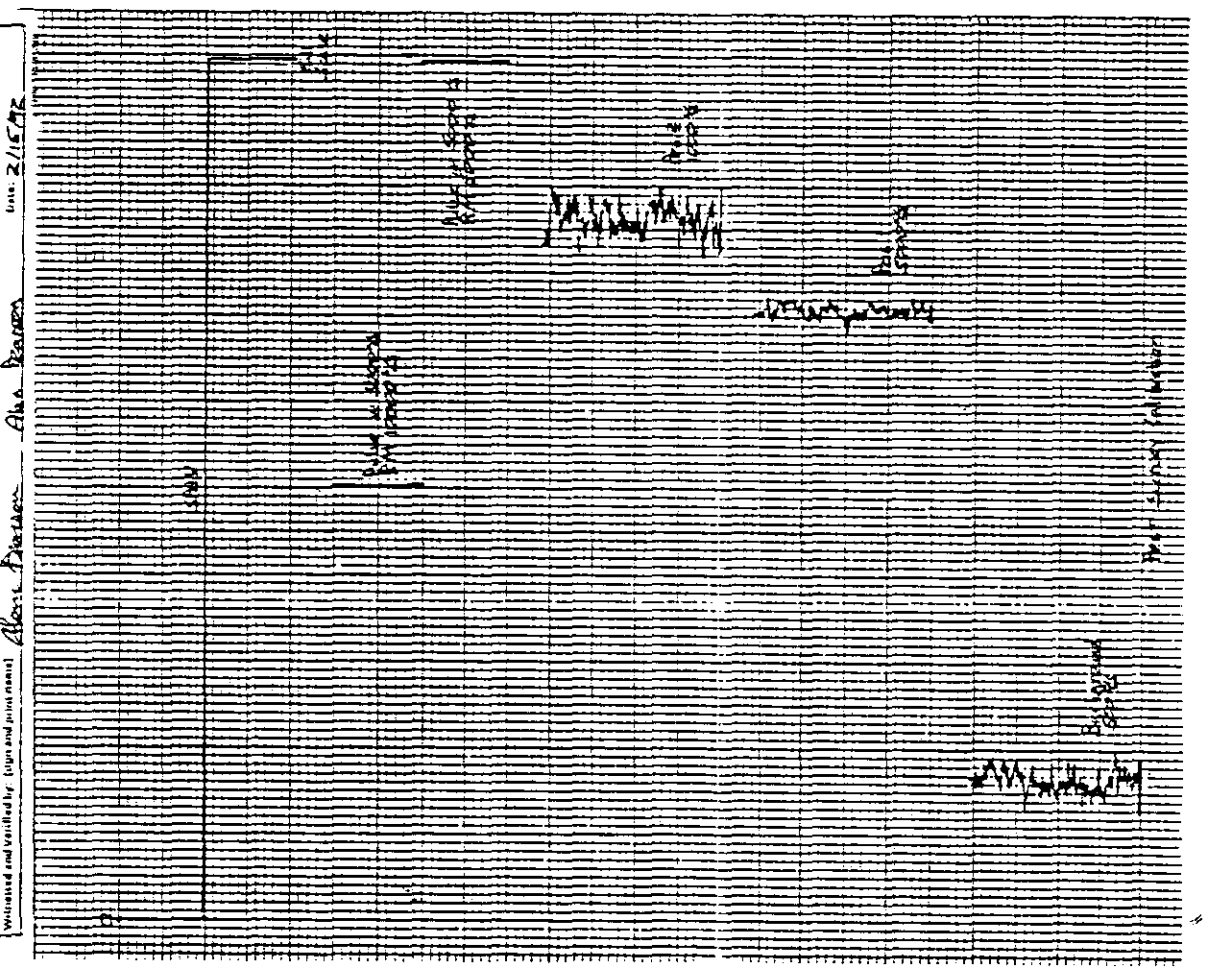
Logging Company PNL
Operator(s) Alan Pearson
Equipment Brand MIS
Tool Type Gamma Ray
Base Calibration Date
Calibration Probe Factor 8.84 cts/hr/pCi/g Calibration Datum (with) Position 1 Position 2
Used Time 11.8 hrs

Equipment Type Analog
Serial No. CG27M11
Calibration Reference RDL-7485 HC-6006
Position 1 219.7 cell Position 2 611.3 cell
Warm Up Time 15 min

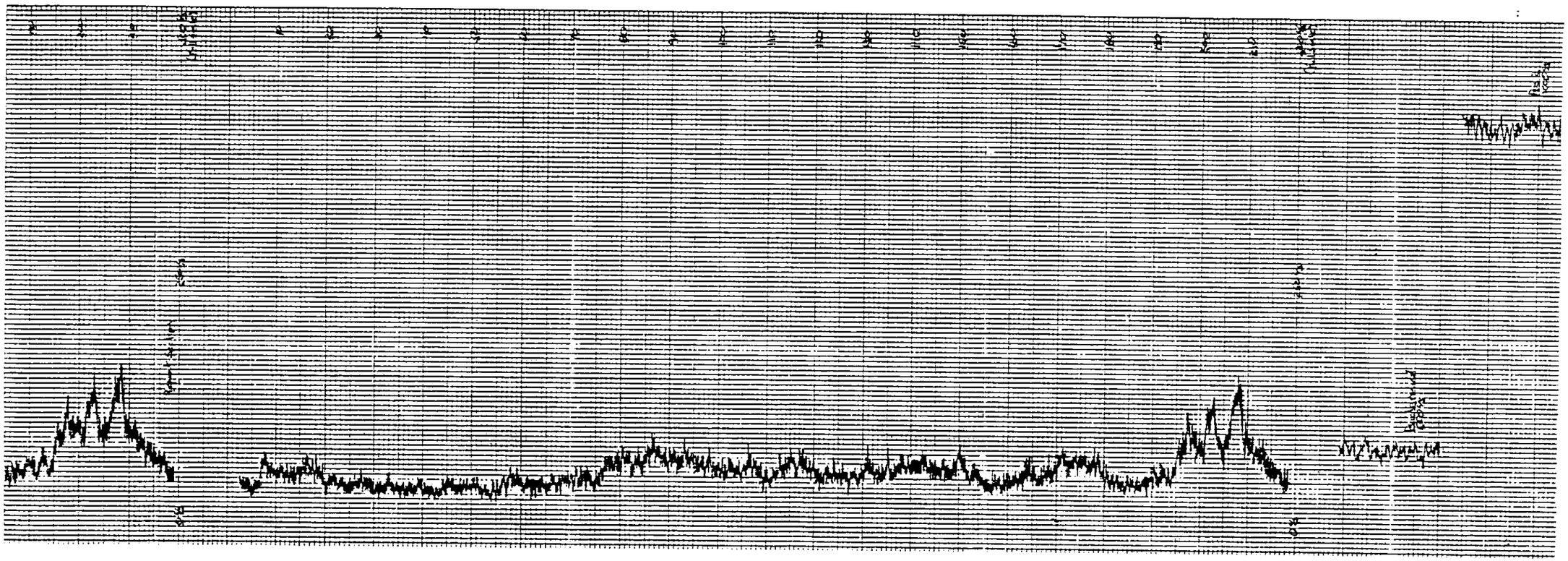
LOGGING INFORMATION

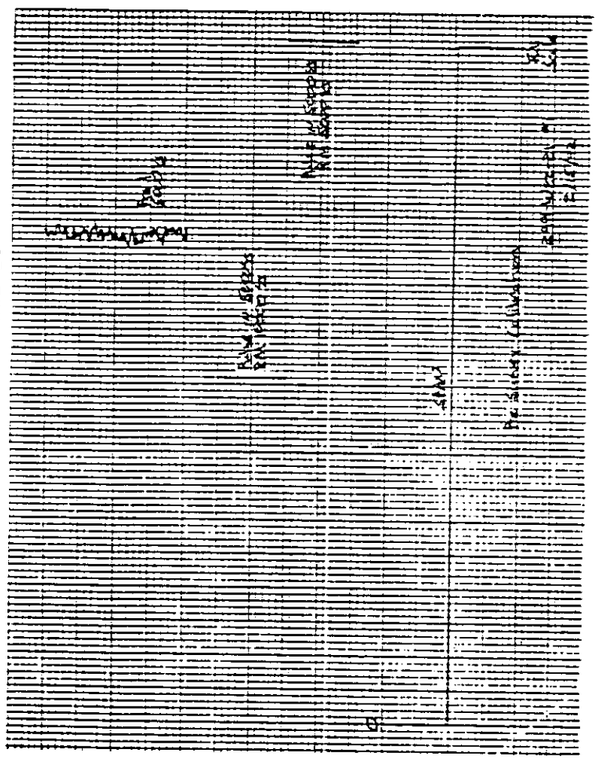
Log Interval from 219.7' to 21'
Record(s) 219.7'
Pre Survey Verification: Position 1 659 cell Position 2 Background 85 cs
Base Calibration Difference: Position 1 1.6 cell Position 2
Logging Speed 5 ft/min Recorder Sensitivity, CPS/in 50 cps/in
Start Time 0730 Completion Time 1000
Chart Speed(s), in/hr 10 ft/in Time Constant(s) TC-1
Chart Recorder Horizontal Scale, CPS/in 50 cps/in
Post Survey Verification: Position 1 304.4 cell Position 2 611.4 cell Background 82 cs
Percent Change: Position 1 1.3% Position 2 2.3%
Comments Return Stress ~2.06' high
Centralizer used

Witnessed and Verified by (sign and print name) Alan Pearson Alan Pearson Date 2/15/92



299-W22-21




299-W22-21

Crib Designation: 216-S-20

Type of Facility: Two wooden crib structures on a 90 ft. x 40 ft. gravel base

Location: N 34296, W 73337 , just east of buildings 202-S and 222-S

Service Dates: 1/52 to 5/73

Description of Waste: 135 x 10^6 liters of liquid waste from 222-S labs and 300 Area labs via 207-SL retention basin

Radionuclide Release Summary:

Radionuclide	Quantity
Pu	170 g
Sr-90	45 Ci
Ru-106	100 Ci
Cs-137	110 Ci
Co-60	1.4 Ci
U	38 kg

Summary of Past Logging:

Boreholes	Date	Reference
299-W22-20	1976	Fecht et al., 1977
299-W22-74	1984	Geophysics Files
	1987	Geophysics Files

Review of Current Logging:

Borehole: 299-W22-74

Borehole 299-W22-74 was logged with the PNL gross gamma system as well as the RLS spectral system. The gross gamma log showed a small activity anomaly at 35 feet. The spectral log show this anomaly to be due to the presence of Co-60. The older gross gamma-ray logs show the same anomaly at this depth with the same approximate shape. Therefore, it is reasonable to conclude that this site is stable.

Previous logs of this borehole show this to be the only zone of man-made radionuclides (gamma-emitters). However, in borehole 299-W22-20, there is an anomaly at the 150 foot depth in the borehole. The identity of the nuclide in this borehole is not known because the hole was not logged with the spectral gamma system.

Some Cs-137 was released at this site but the data available do not provide any evidence as to it's location. Additional drilling and logging would be required to locate that cesium.

The Pu is probably retained on the sediment very close to the release point and was not intersected by the drill hole.

The small amount of uranium released at this site is probably not detectable above background.

The cobalt is one of the more mobile radionuclides and it is only found up high in the unsaturated zone. Therefore it is

highly unlikely that the radionuclides released at this site have contaminated the groundwater.

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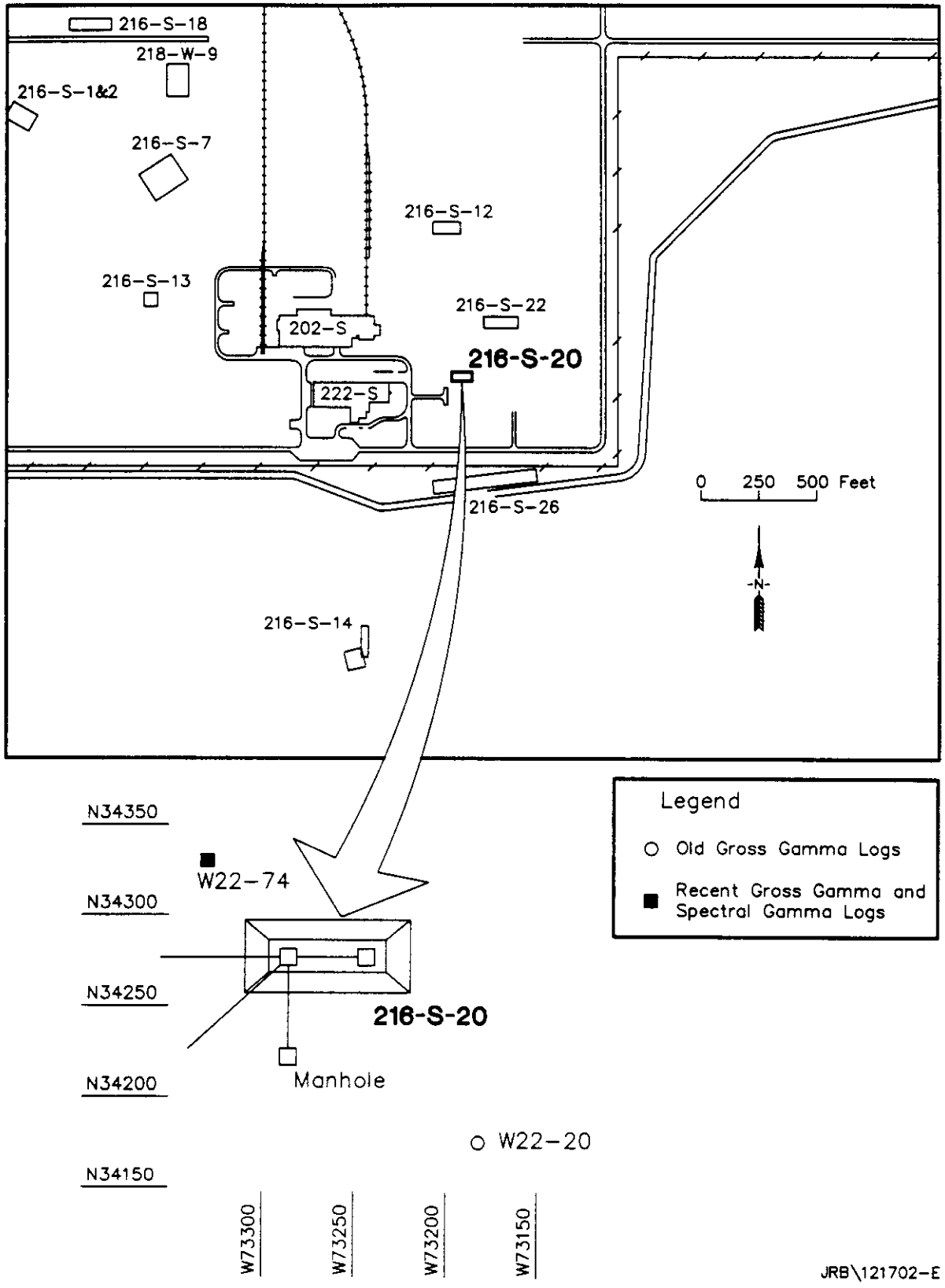

216-S-18
218-W-9
216-S-1&2
216-S-7
216-S-12
216-S-13
216-S-22
202-S
216-S-20
222-S
216-S-26
0 250 500 Feet
N
216-S-14
Legend
Old Gross Gamma Logs
Recent Gross Gamma and Spectral Gamma Logs
N34350
W22-74
N34300
N34250
216-S-20
N34200
Manhole
W22-20
N34150
W73300
W73250
W73200
W73150
JRB\121702-E

Westinghouse Hanford Company
RLS Spectral Gamma-Ray Borehole Survey Log Header

Project: 200 AAMS, S-20 Crib

Borehole	299-W22-74		
Coordinates	34,330 N 73,330 W	Feet	(Plant 200 W)
Elevation	. feet	Top of Casing	(Plant 200 W)

Borehole Environment Information

Borehole Fluid Depth 172.0 (Feet) from Zero (0.0) Depth Reference of Log

Casing Size I.D. (inch)	Casing Thickness (inch)	Top Depth (feet)	Base Depth (feet)
8.0	0.33	0.0	173.0

RLS Passive Spectral Gamma Survey Information

Logging Engineers R. V. Cram S. E. Kos
Log Depth Reference at Zero (0.0) depth is Ground Level

Log Date	Archive File Names	Log Mode, Speed	Depth Interval (feet) Top	Base	Incr
Jan 15, 92	H2W2274\A115	FIXED 0.6 fps	0.	122.	0.5

[1]FIXED: Fixed velocity of Cable Speed: fps: Feet per second

Calibration and Analysis Information

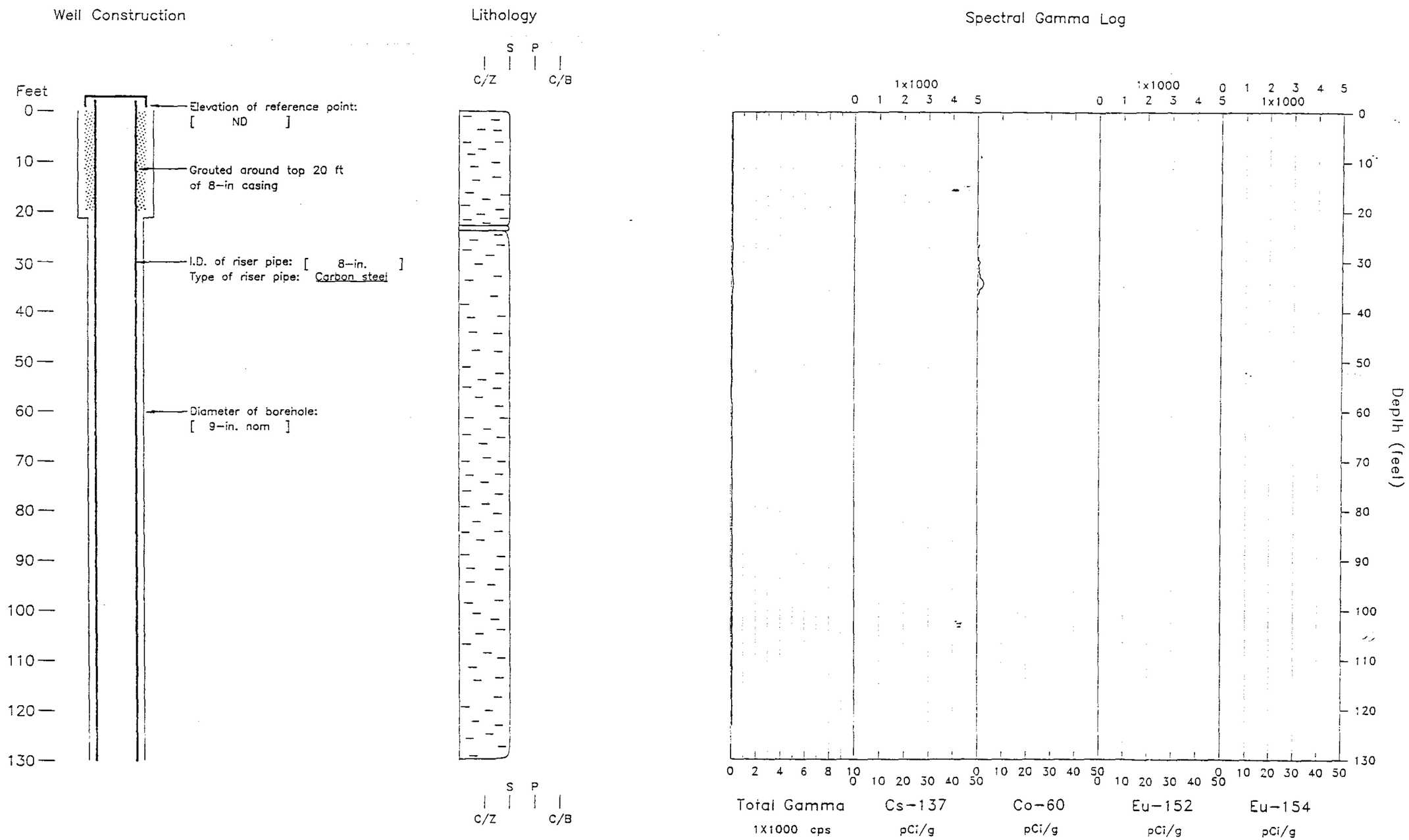
RLS Calibration Date: Nov 21, 1991
Calibration Report: WHC-SD-EN-TRP-001

Analyst Names: W. F. Nicaise R. K. Price
Analysis Date: May 12, 1992

Analysis Notes: Very low concentration of man-made radionuclides
Radionuclides identified: Co-60

RLS Spectral Gamma Ray Borehole Survey

Well 299-W22-74 | Crib 216-S-20 | Log Date 1/15/92

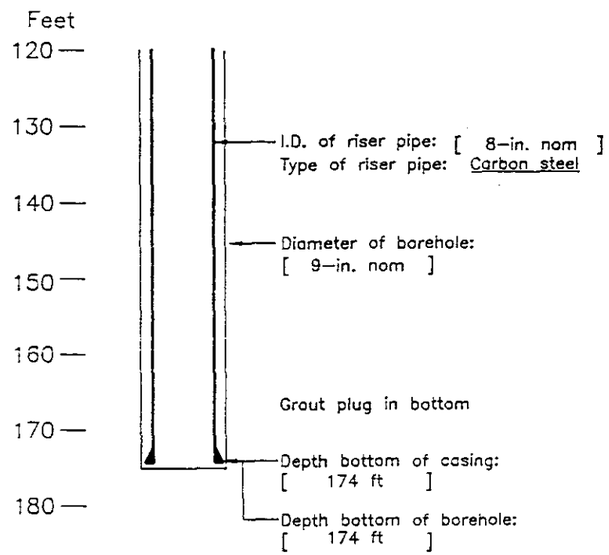


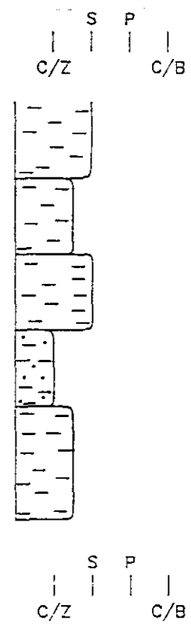
GEOSCI\22-74A

RLS Spectral Gamma Ray Borehole Survey (Page 2)

Well 299-W22-74 | Crib 216-S-20 | Log Date 1/15/92

Well Construction | Lithology | Spectral Gamma Log





GEOSCI\22-74B

299-W22-74 S-20 Crib

Casing	Depth: 173'	Size: 8"	Thickness: 0.33"
Water	Depth: 172'		
Survey	Depth: 0 - 122'	Date: 1/15/92	

General Notes:
Depth measurement problems prevented the survey from reaching the maximum hole depth.

The total gamma activity did not exceed 200 cps in the borehole survey.

Very low concentrations of man-made radionuclides were indicated.

Man-made Radionuclides:
No Cesium-137 (Cs-137) was encountered in the borehole. The plot track is present only for uniformity of the display data.

Cobalt (Co-60) was observed from 26 feet to 40 feet. The maximum activity encountered was 2 pCi/g at 34 feet.

No Europium-152 (Eu-152) was confirmed in the screening survey and the plot track is present only for uniformity of the display data.

No Europium-154 (Eu-154) was confirmed in the screening survey and the plot track is present only for uniformity of the display data.

299-W22-74

Hydrogeologic Hanford Company | LOG HEADER | Page 1 of 2

Well No. 299-W22-74 Area 200 West Date 5/7/92
Log Run #1 Log Type Gamma Gamma
Elevation Datum Elevation
Survey Coordinates Y 34330 X 73330 W 2
Log Measured From Ground Surface
Location Description 10 ft North of S-30 CAP
Ground Surface Elevation
Surface Temperature N/A Weather Partly Cloudy - Warm

BOREHOLE INFORMATION

Driller
Drill Rig Type Bit Type/Diameter
Borehole Diameter/Depth 8" / 122'
Casing Driller Cased Depth 122'
Fluid Level N/A Fluid Density N/A
Temperature N/A

CASING RECORD

Type 8" Carbon Steel Sch 40 Diameter 8" - ?
Type Diameter
Type Diameter
Type Diameter
Well Screen Intervals N/A
Comments: Casing Stick 0.25' high
Centralizer used

LOG HEADER | Page 2 of 2

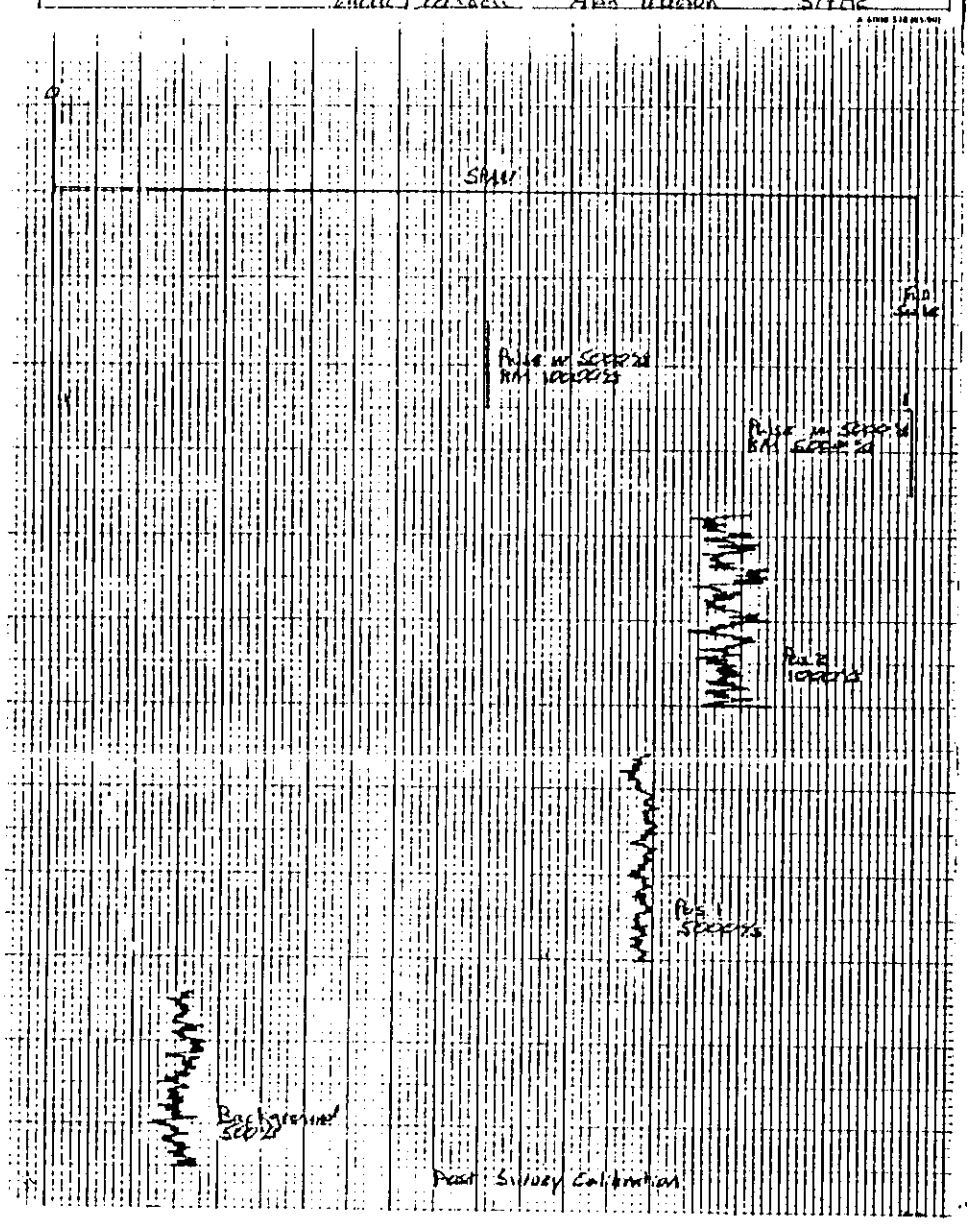
EQUIPMENT DATA

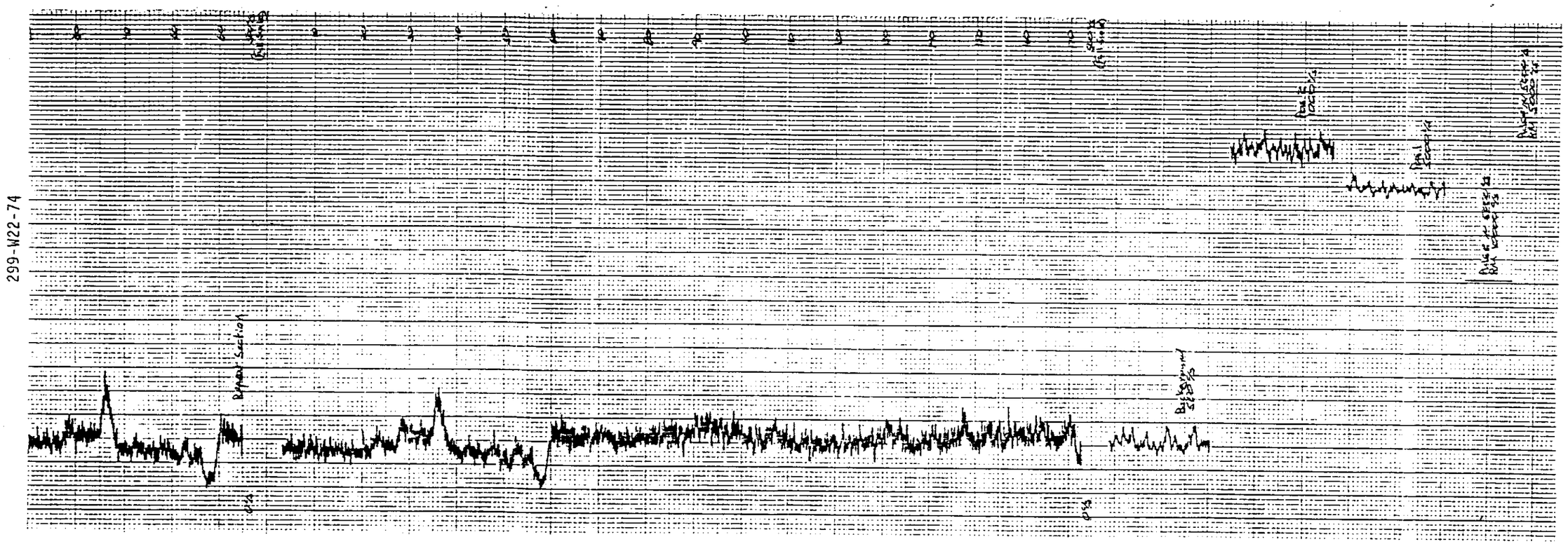
Logging Company PNL
Operator(s) Alan Pearson
Equipment Brand MIS Equipment Type Analog
Tool Type Gamma Ray Serial No. 6627A37
Base Calibration Date 5/91 Calibration Reference PNL-7485 HC-606
Calibration/Probe Factor 8.84 Base Calibration Datum (cts): Position 1 297.4 cts Position 2 61.3 cts
Dead Time 11.8 μsec Warm Up Time >15 min

LOGGING INFORMATION

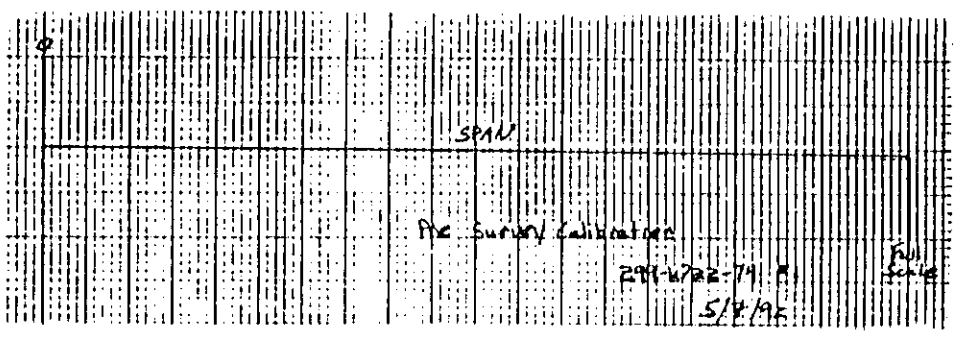
Log Interval from 178.7' to 3.2'
Run(s) 650' to 200'
Pre Survey Verification Position 1 300.3 cts Position 2 62.1 cts Background 78 cts
Base Calibration Difference: Position 1 2.9 cts Position 2 2.2 cts
Logging Speed 5 ft/min Ratem Scales, CPS/in 50 cts/in
Start Time 0630 Completion Time 0830
Chart Speed(s), ft/in 10 ft/in
Chart Recorder Horizontal Scale, CPS/in 50 cts/in Time Constant(s) 1/2 - 1
Post Survey Verification: Position 1 298.0 cts Position 2 62.1 cts Background 78 cts
Percent Change: Position 1 0.8% Position 2 0.0%
Comments Below Casing 0.25' high
Centralizer used

Witnessed and Verified by: (sign and print name) Alan Pearson Alan Pearson Date: 5/7/92




299-W22-74
Bypass Section
Background

299-W22-74



299-W23-4 S-21 Crib

Casing	Depth: 253'	Size: 6"	Thickness: 0.3"
	Depth: 185'	Size: 4"	Thickness: 0.2"
Water	Depth: 195.5'		
Survey	Depth: 0 - 100'	Date: 12/09/92	
	Depth: 95 - 194'	Date: 12/09/92	
	Depth: 192 - 215'	Date: 12/09/92	

General Notes:
The survey is plotted on two pages. The second plot page is blank since no man-made radionuclides were detected below 60 feet.

Detector depth was checked at 100 feet with a tape measure. The tool was repositioned to 95 feet and the second set of data was collected. Overlap between the two data sets, 95 feet to 100 feet was examined for a depth error. The total gamma log indicates a 0.5 feet depth error.

Field problems forced restart of the log data acquire program. The tool was repositoned at 192 feet and the third data set was collected. Overlap between the two data sets, 192 feet to 194 feet, was examined for a depth error. The total gamma log indicates a 0.5 feet depth error.

The total gamma activity did not exceed 1000 cps in the borehole survey. The total gamma activity and Co-60 ratio is not normal.

The maximum calibrated casing correction of 0.40 inches was applied to the survey data. The computed activity for data recorded through multiple casing strings will be underestimated.

Man-made Radionuclides:
No Cesium (Cs-137) was encountered in the borehole. The plot track is present only for uniformity of the displayed data.

Cobalt (Co-60) was observed from 37 feet to 60 feet. The maximum activity encountered was 11 pCi/g at 39 feet.

No Europium-152 (Eu-152) was encountered in the borehole. The plot track is present only for uniformity of the displayed data.

No Europium-154 (Eu-154) was encountered in the borehole. The plot track is present only for uniformity of the displayed data.

Crib Designation: 216-S-21

Type of Facility: Wooden crib with a 50 ft. x 50 ft. bottom

Location: N 35920, W 76400 Just west of the SX tank farm

Service Dates: 11/54 to 12/70

Description of Waste: 87.1 x 10^6 liters of condensate from the SX tank farms, neutral to basic, low salt content

Radionuclide Release Summary:

Radionuclide	Quantity
Pu	2.1 g
Sr-90	<43 Ci
Ru-106	44 Ci
Cs-137	160 Ci
Co-60	<0.41 Ci
U	4.2 kg

Summary of Past Logging:

Boreholes	Date	Reference
299-W23-4	1976	Fecht, et al., 1977

Review of Current Logging:

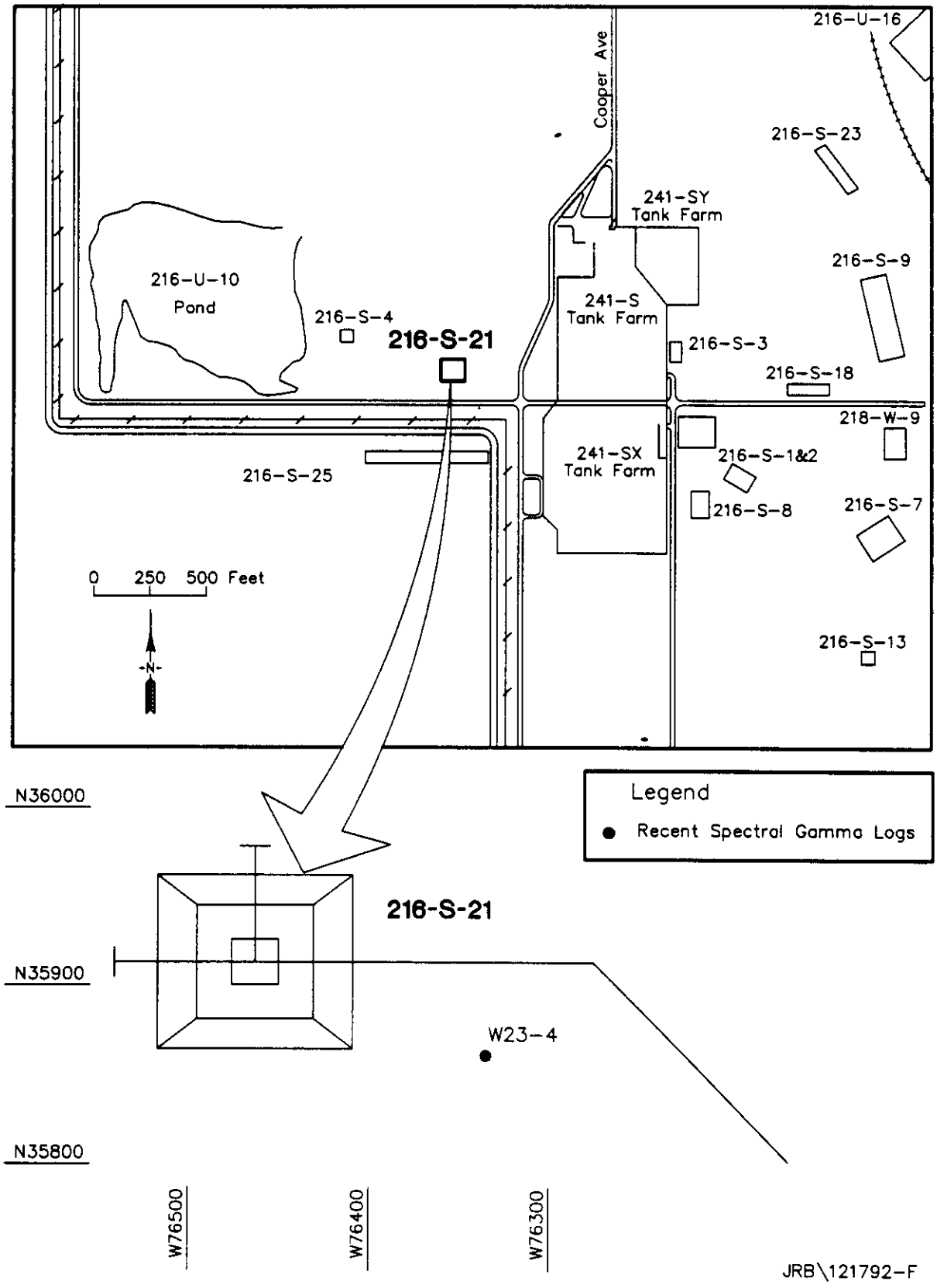
Borehole: 299-W23-4

This borehole was logged with the spectral gamma system. It showed only one zone of Co-60 near the 40 foot depth. This is not consistent with the effluent release records.

There may be some relationship between the deposition of the cobalt and the stratigraphy as seen in the lithology pictograph. A detailed assessment of the stratigraphy is required to properly ascertain any relationship.

Old gross gamma-ray logs do not show any other zones of elevated gamma-ray activity. It is likely that the other man-made nuclides released at this site including Cs-137, were retained in close to the cribs and that the zone of cobalt at 45 feet represents the maximum extent of nuclide migration.

The radionuclides released at this site were retained high up in the unsaturated zone and did not migrate to the groundwater.


216-U-16
Cooper Ave
216-S-23
241-SY
Tank Farm
216-S-9
216-U-10
Pond
216-S-4
216-S-21
241-S
Tank Farm
216-S-3
216-S-18
218-W-9
241-SX
Tank Farm
216-S-1&2
216-S-25
216-S-8
216-S-7
0 250 500 Feet
N
216-S-13
Legend
Recent Spectral Gamma Logs
N36000
216-S-21
N35900
W23-4
N35800
W76500
W76400
W76300
JRB\121792-F

Westinghouse Hanford Company
RLS Spectral Gamma-Ray Borehole Survey Log Header

Project: 200 AAMS, S-21 Crib

Borehole	299-W23-04		
Coordinates	35,861 N 76,335 W	Feet	(Plant 200 W)
Elevation	662.8 feet	Top of Casing	(Plant 200 W)

Borehole Environment Information

Borehole Fluid Depth none (Feet) from Zero (0.0) Depth Reference of Log

Casing Size I.D. (inch)	Casing Thickness (inch)	Top Depth (feet)	Base Depth (feet)
6.0	0.3	0.0	253.0
4.0	0.2	0.0	185.0

RLS Passive Spectral Gamma Survey Information

Logging Engineers R. V. Cram S. E. Kos
Log Depth Reference at Zero (0.0) depth is Ground Level

Log Date	Archive File Names	Log Mode[1], Speed	Depth Interval (feet) Top	Base	Incr
Dec 09, 91	H2W2304\A102	FIXED 0.6 fps	0.	194.	0.5
Dec 09, 91	H2W2304\A103	FIXED 0.6 fps	192.	215.	0.5

[1]FIXED: Fixed velocity of Cable Speed: fps: Feet per second

Calibration and Analysis Information

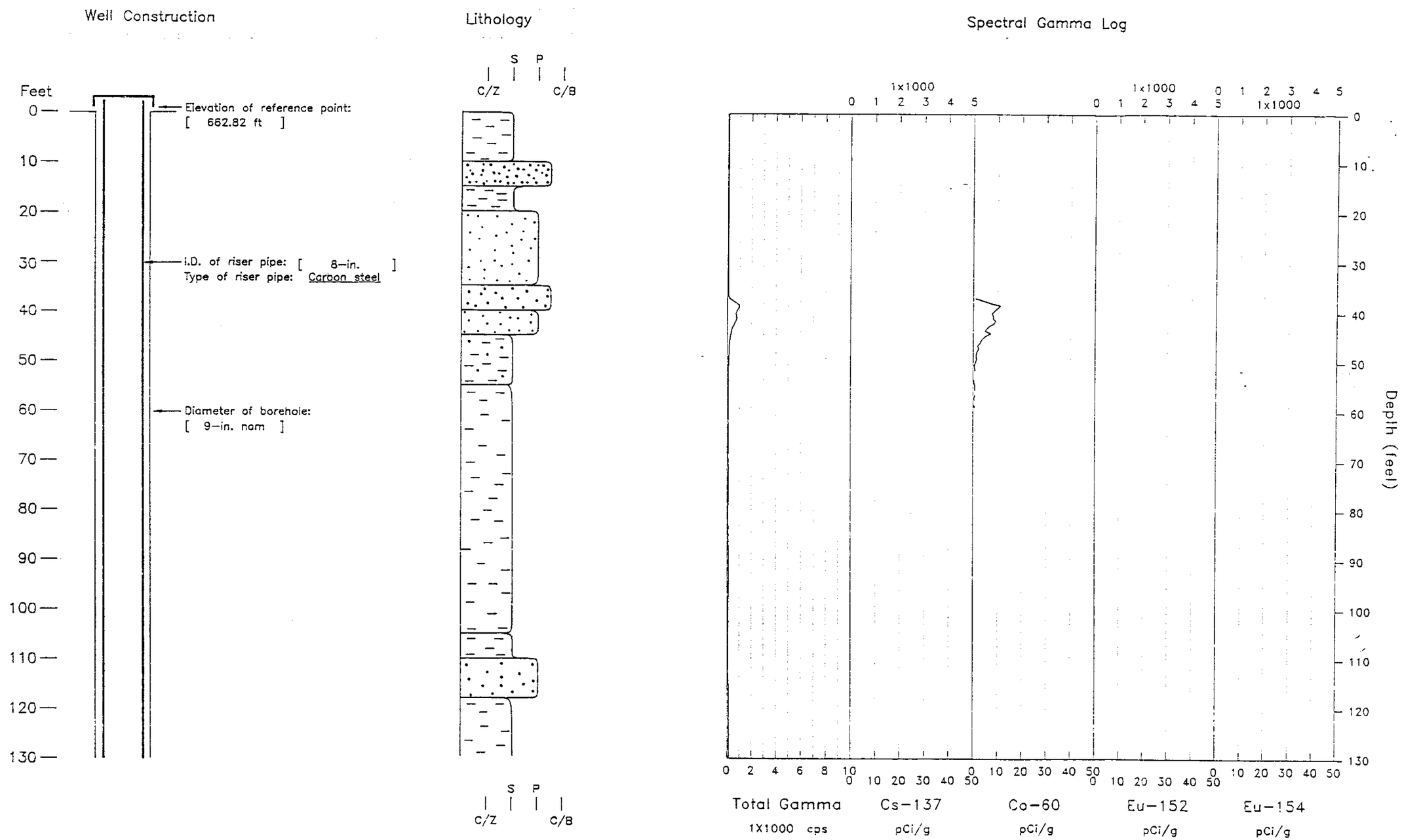
RLS Calibration Date: Nov 21, 1991
Calibration Report: WHC-SD-EN-TRP-001

Analyst Names: W. F. Nicaise R. K. Price
Analysis Date: April 06, 1992

Analysis Notes: Total gamma activity and Co-60 ratio is not normal
Radionuclides identified: Co-60

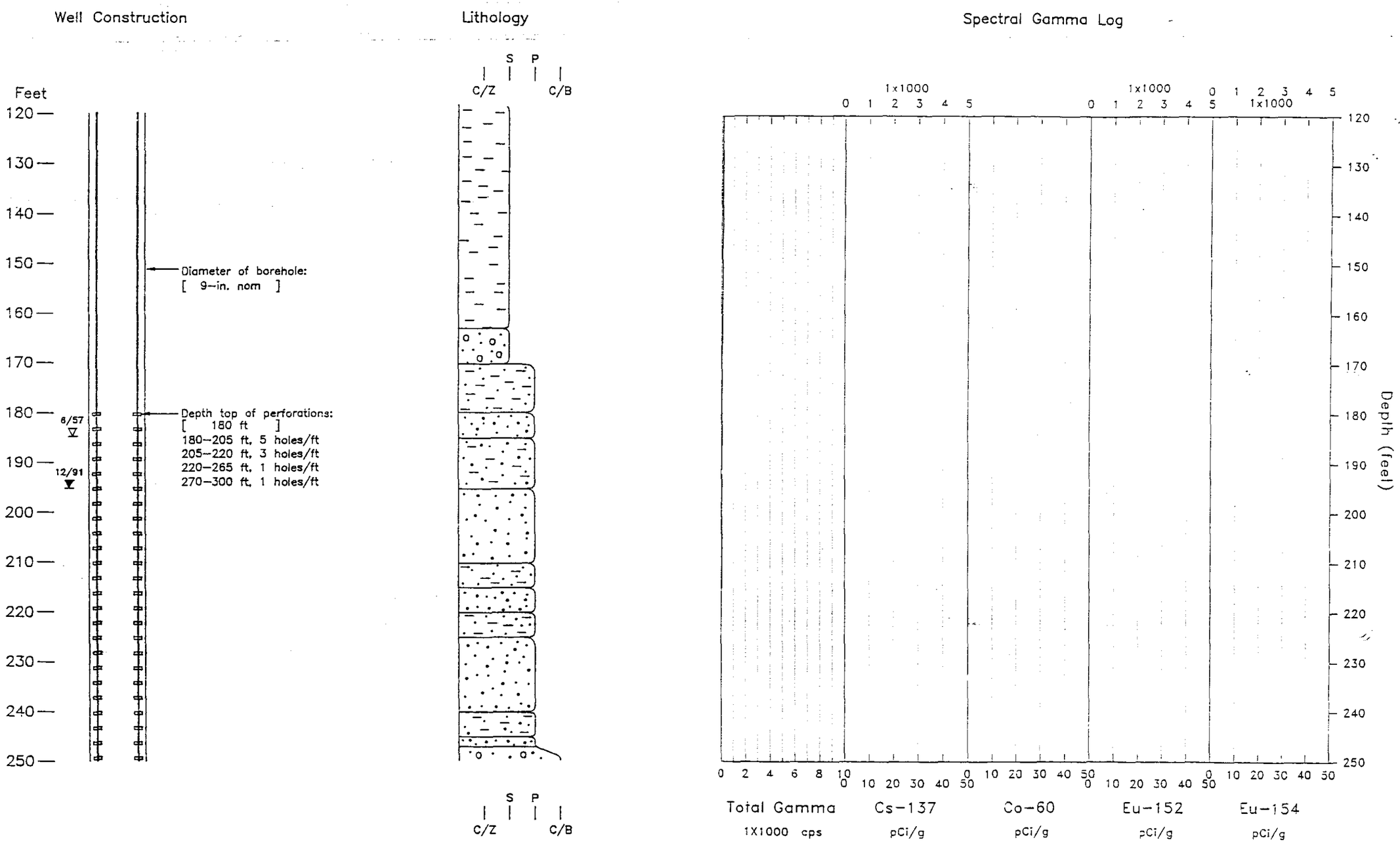
RLS Spectral Gamma Ray Borehole Survey

Well 299-W23-4 | Crib 216-S-21 | Log Date 12/9/91



RLS Spectral Gamma Ray Borehole Survey (Page 2)

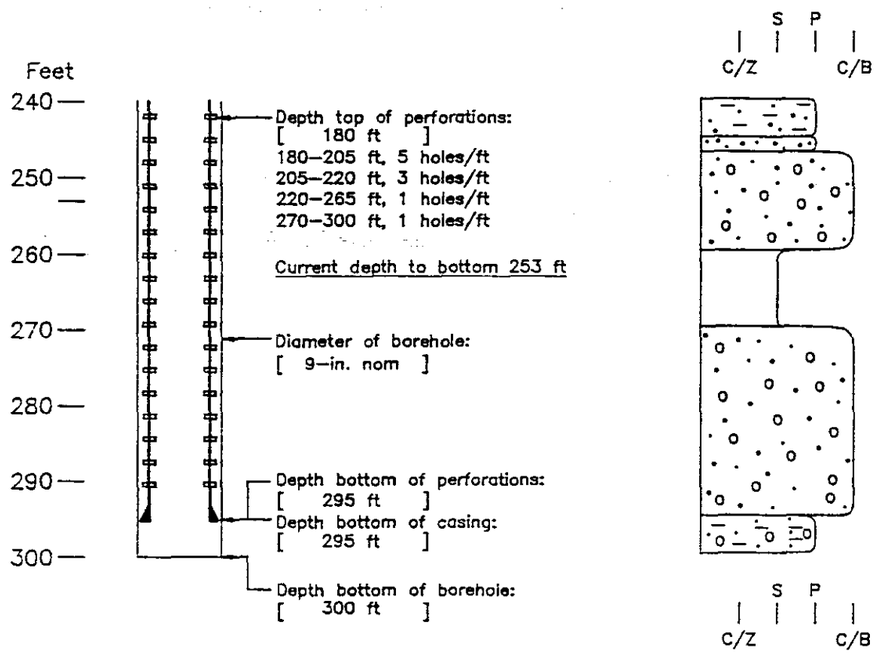
Well 299-W23-4 | Crib 216-S-21 | Log Date 12/9/91



RLS Spectral Gamma Ray Borehole Survey (Page 3)

Well 299-W23-4 | Crib 216-S-21 | Log Date 12/9/91

Well Construction | Lithology | Spectral Gamma Log



GEOSCI\23-4C

Crib Designation: 216-T-3

Type of Facility: Injection well

Location: N 43335, W 74250 Just southwest of the southwest corner of T-plant; Also located approx. 200 ft. east of 216-T-6 cribs

Service Dates: 6/45 to 8/46

Description of Waste: 11.3 x 10^6 liters of cell drainage from tank 5-6 in building 221-T and waste from 224-T via overflow from 241-T-361 settling Tank.
Note: This injection well was removed from service after it could not handle the flow rate and overflowed onto the ground surface. This created sinkholes around the well which were subsequently filled. The ground surface was "decontaminated" and leveled in 1975.

Radionuclide Release Summary:

Radionuclide	Quantity
Pu	3350 g
Sr-90	55.7 Ci
Ru-106	120 Ci
Cs-137	59.5 Ci
Co-60	none
U	none

Summary of Past Logging:

Boreholes	Date	Reference
299-W11-7	1976	Fecht, et al., 1977
	1986	Geophysics files
	1987	Geophysics files

Review of Current Logging:
Borehole: 299-W11-7

This borehole is located a few feet away from the injection well. It was logged with the RLS spectral gamma system and showed extensive Cs-137 at many depth locations in the borehole. Process records do not show an extensive quantity of cesium released at this site.

Previous assessments of this site (Fecht, et al., 1977) suggest that the cesium may be from either the nearby T-6 cribs or the T-361 settling tank. Review of the old gross gamma-ray logs from boreholes located between the T-6 crib and this injection well do not support the theory of this crib being the source. Activity levels of these intermediate boreholes were much lower than the activity level in 299-W11-7 and the contamination was less extensive in the unsaturated zone at these intermediate boreholes.

The T-361 settling tank may contribute to the cesium in this monitoring borehole but it is most likely that the source is the injection well. Cesium does not migrate very far, but because the monitoring borehole is so close to the injection well, it

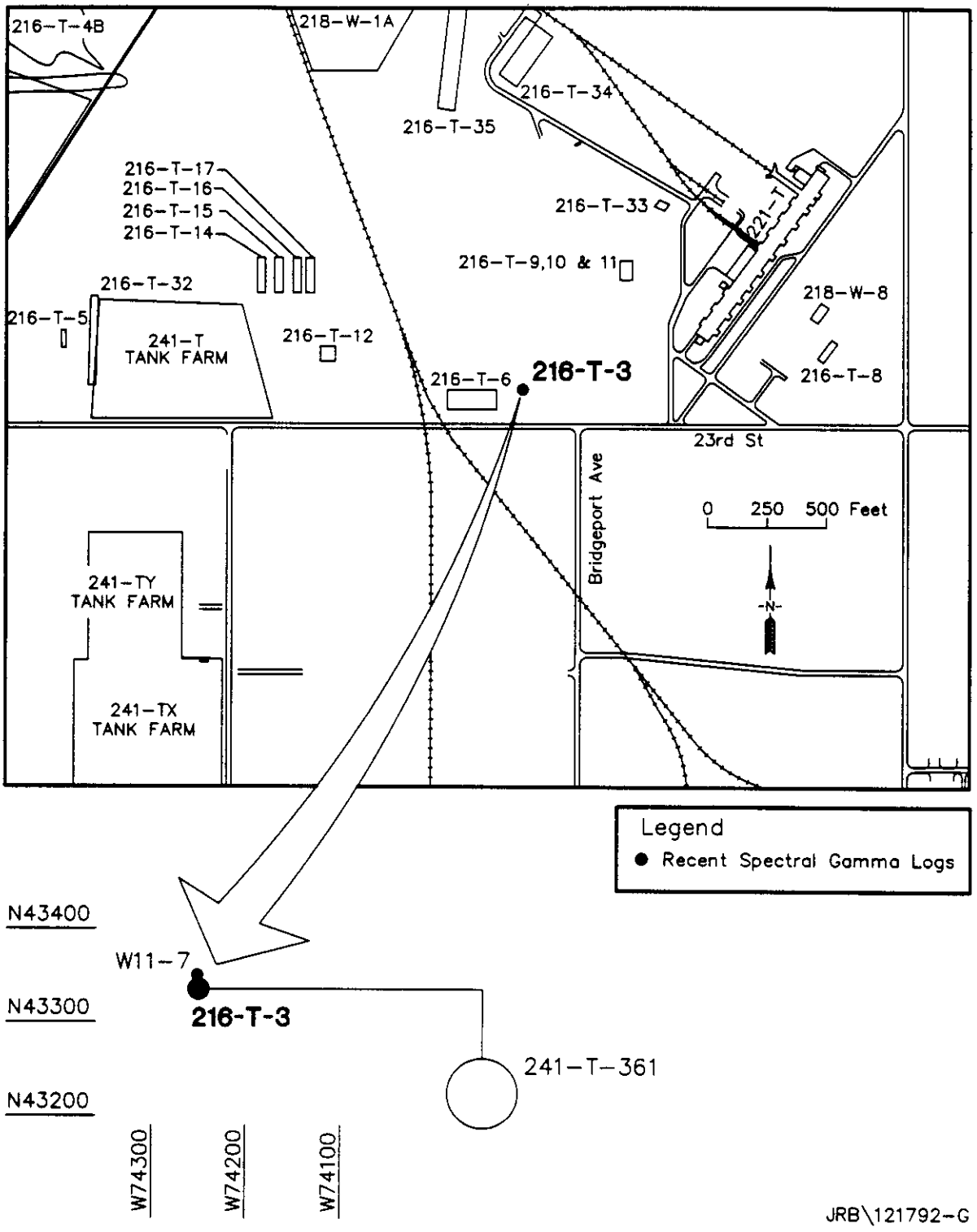
would not take much migration to generate high cesium activity concentrations in the adjacent monitoring borehole. Additionally, this injection well clearly overflowed in the past, causing caving around the well casing and obviously causing the contaminated effluent to travel down the outside of the casing.

Therefore, it is probable that the cesium found in the monitoring borehole represents the actual cesium contamination profile at this site resulting from injection of effluent to this injection well.

The process records show that a large mass quantity of plutonium was released at this site. Plutonium should have been detected in the borehole when it was not. This may be due to the very high compton background noise resulting from the high cesium activity. A very long counting time measurement may be useful in the future to detect the plutonium if it is present.

Further assessment of this site is needed along with the T-6 crib site and other nearby facilities to determine the areal distribution of the radionuclides in the unsaturated zone.

The cesium contamination at this site is found as deep as 175 feet which is about 80 feet above the groundwater table. It is likely that none of the cesium released at this site reached the groundwater but it is possible that the strontium did. The strontium has a higher mobility in the unsaturated zone, but it is not detectable in low concentrations by the gamma-ray detectors.


216-T-4B
218-W-1A
216-T-34
216-T-35
216-T-17
216-T-16
216-T-15
216-T-14
216-T-33
221-T
216-T-9,10 & 11
216-T-32
216-T-5
241-T
TANK FARM
216-T-12
218-W-8
216-T-6
216-T-3
216-T-8
23rd St
Bridgeport Ave
0 250 500 Feet
N
241-TY
TANK FARM
241-TX
TANK FARM
Legend
Recent Spectral Gamma Logs
N43400
W11-7
N43300
216-T-3
241-T-361
N43200
W74300
W74200
W74100
JRB\121792-G

Westinghouse Hanford Company
RLS Spectral Gamma-Ray Borehole Survey Log Header

Project: 200 West AAMS / T-3 Crib

Borehole	299-W11-7		
Coordinates	43350 N	74251 W	Feet (Plant 200 W)
Elevation	709.11 feet		Top of Casing (Plant 200 W)

Borehole Environment Information

Borehole Fluid Depth none (Feet) from Zero (0.0) Depth Reference of Log

Casing Size I.D. (inch)	Casing Thickness (inch)	Top Depth (feet)	Base Depth (feet)
8.0	0.308	0.0	306

RLS Passive Spectral Gamma Survey Information

Logging Engineers R. V. Cram S. E. Kos
Log Depth Reference at Zero (0.0) depth is Ground Level

Log Date	Archive File Names	Log Mode Speed	Depth Interval (feet) Top	Base	Incr
May 14, 92	H2W1107\A181	FIXED 0.6 fpm	0.	234.7	0.5
May 15, 92	H2W1107\A182	FIXED 0.6 fpm	220.0	303.0	0.5

Calibration and Analysis Information

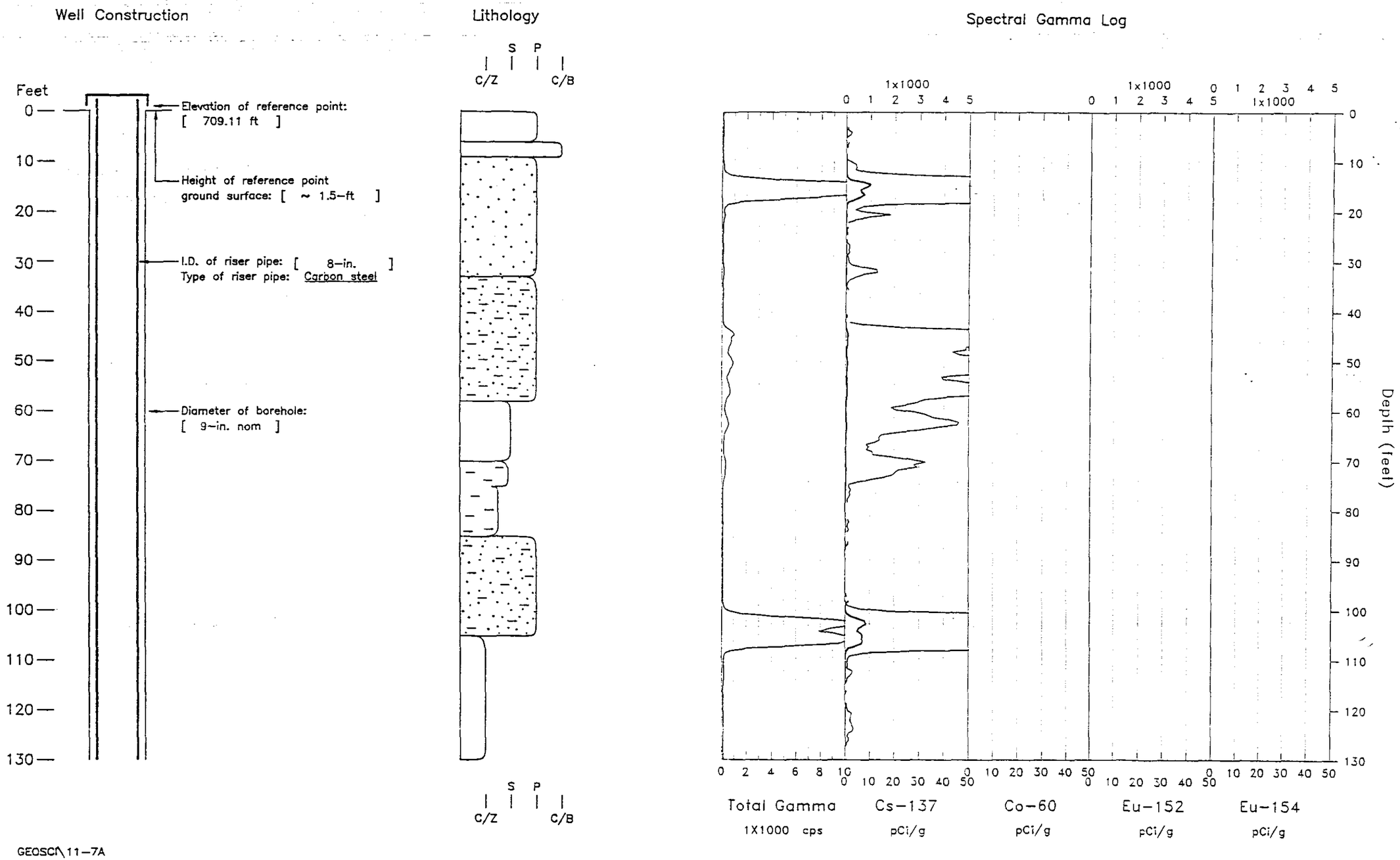
RLS Calibration Date: Nov 21, 1991
Calibration Report: WHC-SD-EN-TRP-001

Analyst Names: J. E. Meisner R. K. Price
Analysis Date: July 9, 1992

Analysis Notes: No Man-made radionuclides detected below 169 feet
Radionuclides identified: Cs-137

RLS Spectral Gamma Ray Borehole Survey

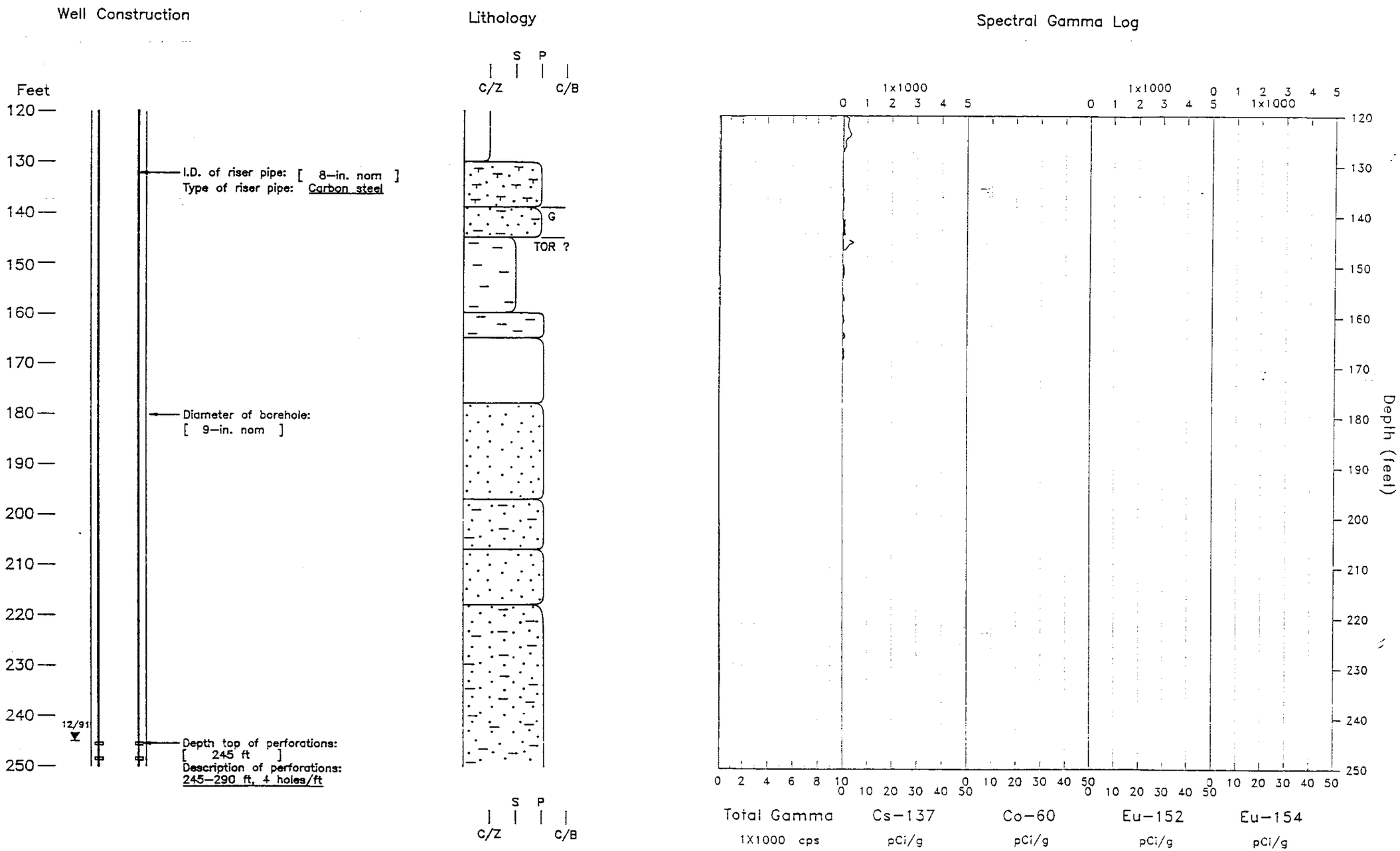
Well 299-W11-7 | Crib 216-T-3 | Log Date 5/11,14,15/92



GEOSCI\11-7A

RLS Spectral Gamma Ray Borehole Survey (Page 2)

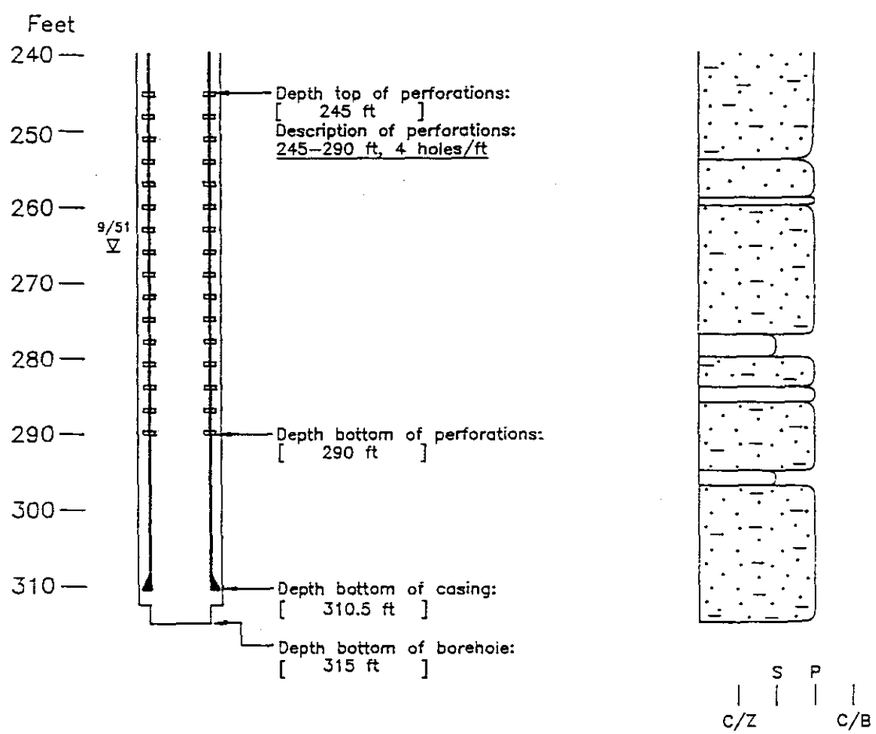
Well 299-W11-7 | Crib 216-T-3 | Log Date 5/11,14,15/92



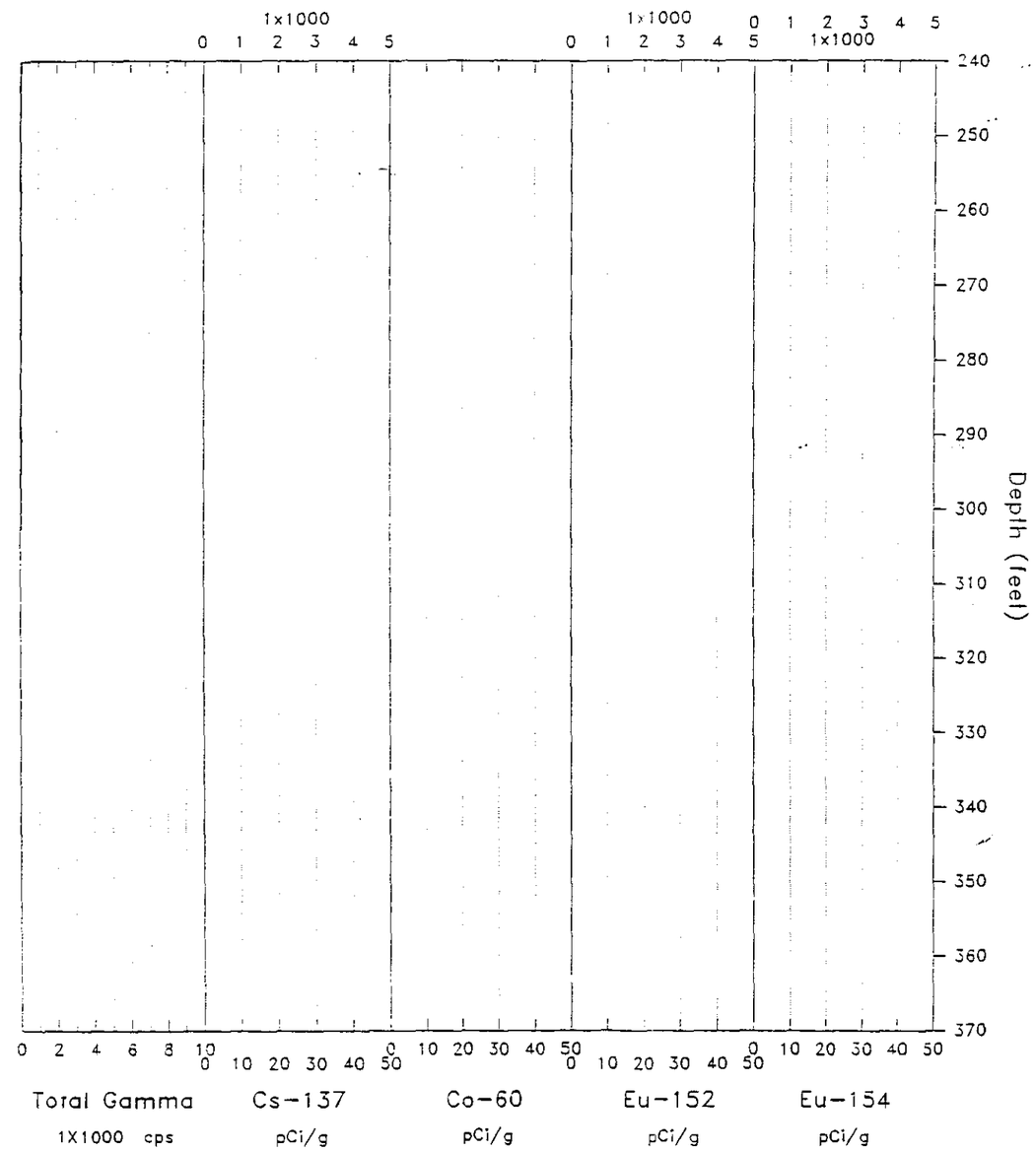
GEOSCI\11-7B

RLS Spectral Gamma Ray Borehole Survey (Page 3)

Well 299-W11-7 | Crib 216-T-3 | Log Date 5/11,14,15/92



Spectral Gamma Log



GEOSCI\11-7C

299-W11-7 T-3 Crib

Casing	Depth: 306'	Size: 8"	Thickness: 0.308"
Water	Depth: none		
Survey	Depth: 0 - 234'	Date: 5/14/92	
	Depth: 220 - 303'	Date: 5/15/92	

General Notes:
The survey is plotted on three pages. The survey data from 120 feet to 130 feet are plotted on both pages. The third page is blank since no man-made radionuclides were detected below 169 feet.

The total gamma activity reached 19,000 cps at 15 feet.

Man-made Radionuclides:
Cesium (Cs-137) was encountered from 3 to 169 feet. The maximum activity encountered was 1000 pCi/g at 15 feet.

No Cobalt (Co-60) was encountered in the borehole. The plot track is present only for uniformity of the displayed data.

No Europium-152 (Eu-152) was encountered in the borehole. The plot track is present only for uniformity of the displayed data.

No Europium-154 (Eu-154) was encountered in the borehole. The plot track is present only for uniformity of the displayed data.

Crib Designation: 216-T-6

Type of Facility: Two wooden cribs, each 14 ft. x 14 ft. Crib #1 overflows into crib #2

Location: N 43315, W 74442, Southwest of T plant

Service Dates: 8/46 to 6/51

Description of Waste: 4.5 x 10^7 liters of cell drainage from tank 5-6 in 221-T and waste from building 224-T via overflow from the T-361 settling tank

Radionuclide Release Summary:

Radionuclide	Quantity
Pu	390 g
Sr-90	18,000 Ci
Ru-106	600 Ci
Cs-137	300 Ci
Co-60	5 Ci
U	23 kg

Summary of Past Logging:

Boreholes	Date	Reference
299-W11-1	1976	Fecht, et al., 1977
	1987	Geophysics files
299-W11-54	1976	Fecht, et al., 1977
299-W11-55	1976	"
299-W11-56	1976	"
299-W11-57	1976	"
	1987	Geophysics files
299-W11-58	1976	Fecht, et al., 1977
299-W11-59	1976	"
	1987	Geophysics files
299-W11-60	1976	Fecht, et al., 1977
299-W11-61	1976	"
299-W11-62	1976	"
299-W11-63	1976	"
	1987	Geophysics files
299-W11-64	1976	Fecht, et al., 1977
299-W11-65	1976	"
	1987	Geophysics files
299-W11-66	1976	Fecht, et al., 1977
	1987	Geophysics files
299-W11-67	1976	Fecht, et al., 1977
	1987	Geophysics files

Review of Current Logging:
Borehole: 299-W11-61

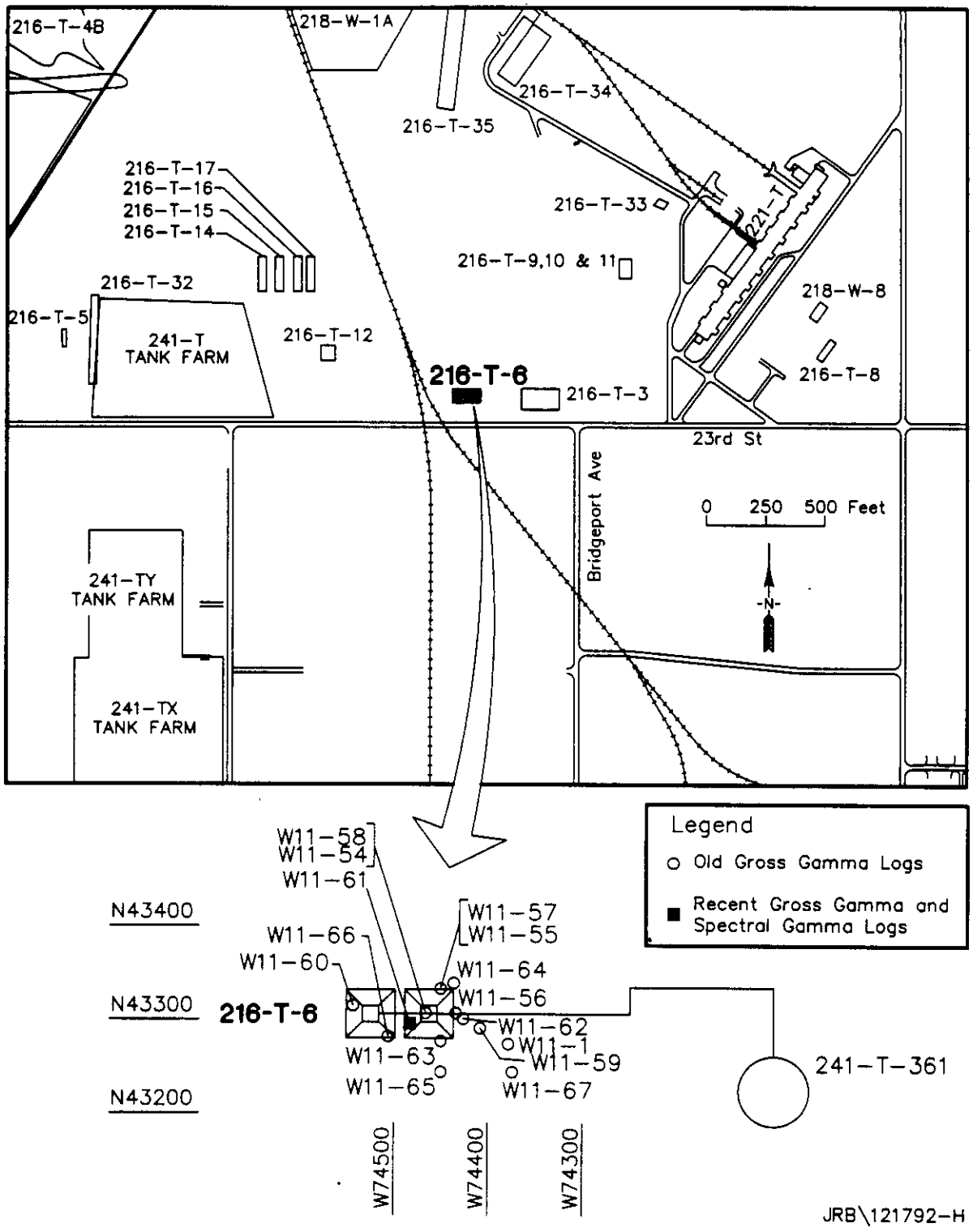
This borehole was logged with the PNL gross gamma system as well as the RLS spectral gamma system. Cs-137 was identified from about 20 feet to about 50 feet in the borehole. No other man-made nuclides were identifiable.

The ruthenium released at this site has decayed to undetectable levels by now and no other gamma-emitting nuclides were released in any quantities that would permit detection.

A large quantity of Sr-90 is reported to have been released at this site yet no bremsstrahlung spectra were evident and no gross gamma anomalies were found that could not be explained by the cesium deposition. The Sr-90 is probably still present in the unsaturated zone but it is not found in the high concentrations required to produce a bremsstrahlung spectra. It would be advantageous to quantify the Sr-90 concentrations needed to produce measurable bremsstrahlung radiation in the Hanford cased borehole environment so that we would know how well the gamma-ray detectors function as indicators of Sr-90.

The logs from this borehole and the old gross gamma-ray logs from the other monitoring boreholes at this crib all indicate that the gamma-ray emitting nuclides released at this site are all held up in the unsaturated zone, close to the crib. Migration of these contaminants is not a problem at this site.

There does not appear to be any correlation between the stratigraphy and the deposition of the cesium, although there is a paucity of stratigraphic information.


216-T-4B
218-W-1A
216-T-34
216-T-35
216-T-17
216-T-16
216-T-15
216-T-14
216-T-33
221-T
216-T-9,10 & 11
216-T-32
216-T-5
241-T
TANK FARM
216-T-12
216-T-6
216-T-3
218-W-8
216-T-8
23rd St
Bridgeport Ave
0 250 500 Feet
-N-
241-TY
TANK FARM
241-TX
TANK FARM
Legend
Old Gross Gamma Logs
Recent Gross Gamma and Spectral Gamma Logs
W11-58
W11-54
W11-61
N43400
W11-57
W11-55
W11-66
W11-60
W11-64
N43300
216-T-6
W11-56
W11-62
W11-1
W11-63
W11-59
241-T-361
W11-65
W11-67
N43200
W74500
W74400
W74300
JRB\121792-H

Westinghouse Hanford Company
RLS Spectral Gamma-Ray Borehole Survey Log Header

Project: 200 AAMS, T-6 Crib

Borehole	299-W11-61		
Coordinates	43,296 N 74,483 W	Feet	(Plant 200 W)
Elevation	706.2 feet	Top of Casing	(Plant 200 W)

Borehole Environment Information

Borehole Fluid Depth none (Feet) from Zero (0.0) Depth Reference of Log

Casing Size I.D. (inch)	Casing Thickness (inch)	Top Depth (feet)	Base Depth (feet)
8.0	0.25	0.0	80.0

RLS Passive Spectral Gamma Survey Information

Logging Engineers R. V. Cram S. E. Kos
Log Depth Reference at Zero (0.0) depth is Ground Level

Log Date	Archive File Names	Log Mode[1], Speed	Depth Interval (feet) Top	Base	Incr
Apr 24, 92	H2W1161\A172	FIXED 0.6 fps	0.	77.	0.5

[1] FIXED: Fixed velocity of Cable Speed: fps: Feet per second

Calibration and Analysis Information

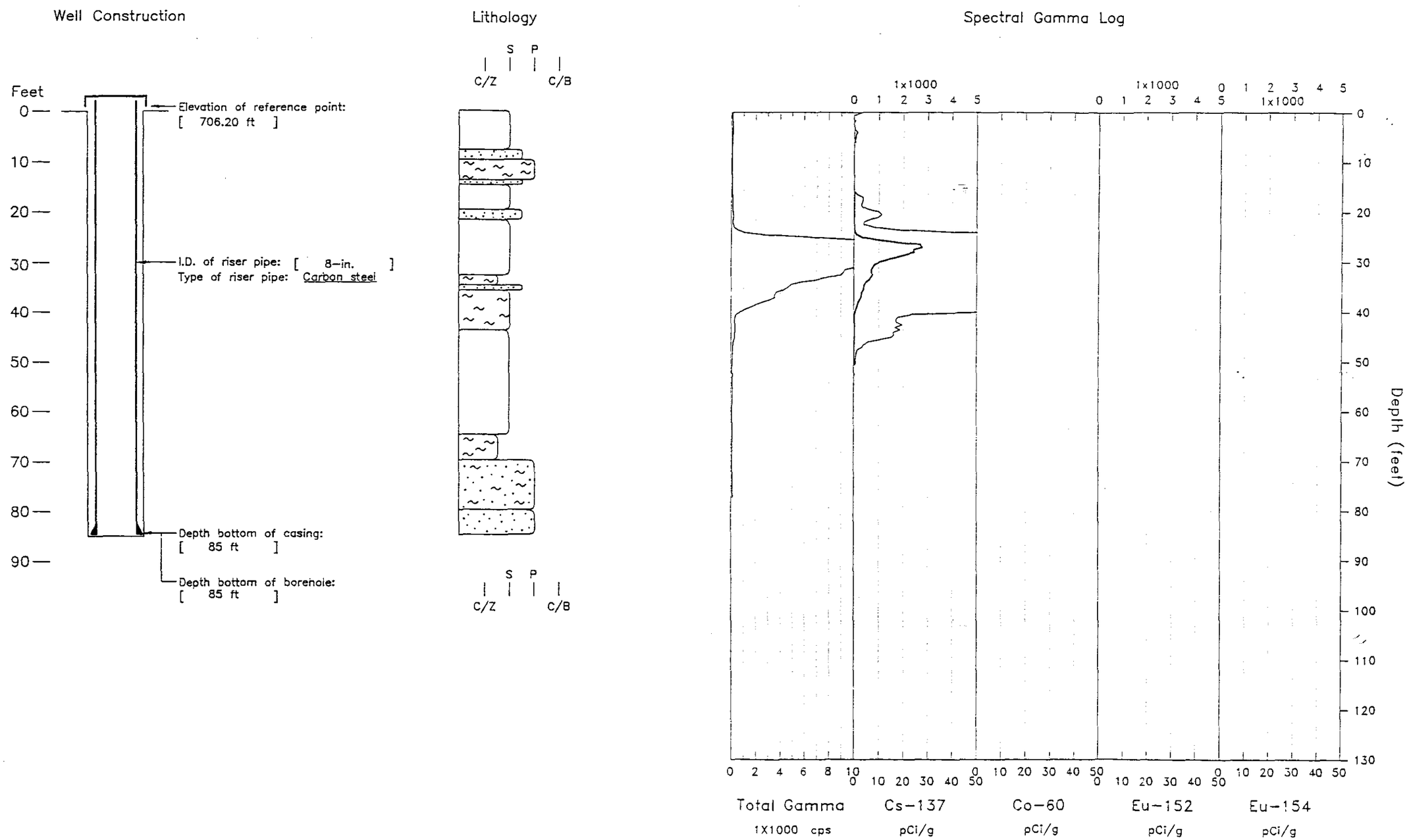
RLS Calibration Date: Nov 21, 1991
Calibration Report: WHC-SD-EN-TRP-001

Analyst Names: W. F. Nicaise R. K. Price
Analysis Date: June 19, 1992

Analysis Notes:
Radionuclides identified: Cs-137,

RLS Spectral Gamma Ray Borehole Survey

Well 299-W11-61 | Crib 216-T-6 | Log Date 4/24/92



GEOSC\11-61A

299-W11-61 T-6 Crib

Casing	Depth: 80'	Size: 8"	Thickness: 0.25"
Water	Depth: none		
Survey	Depth: 0 - 80'	Date: 4/24/92	

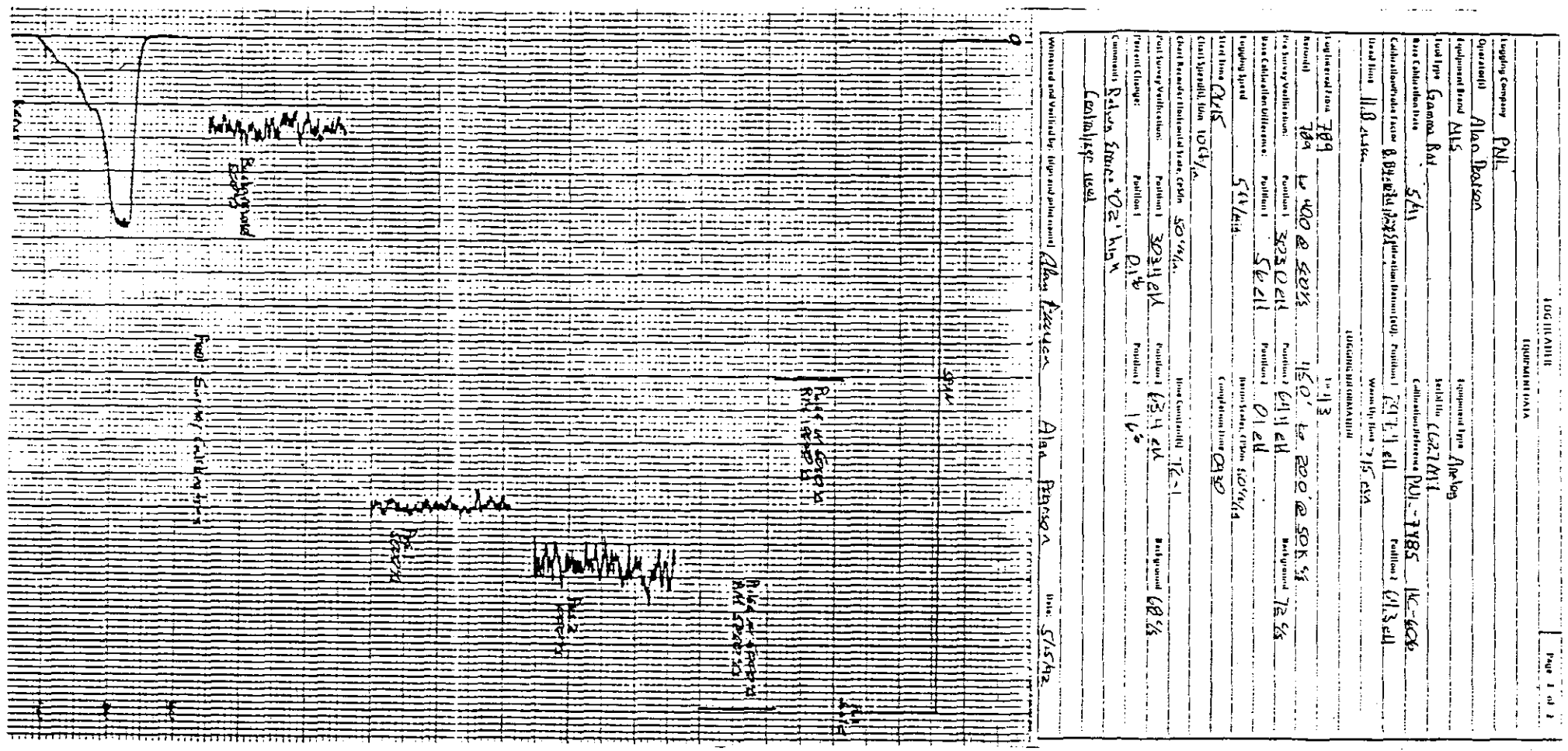
General Notes:
The total gamma activity did not exceed 54,000 cps in the borehole survey.

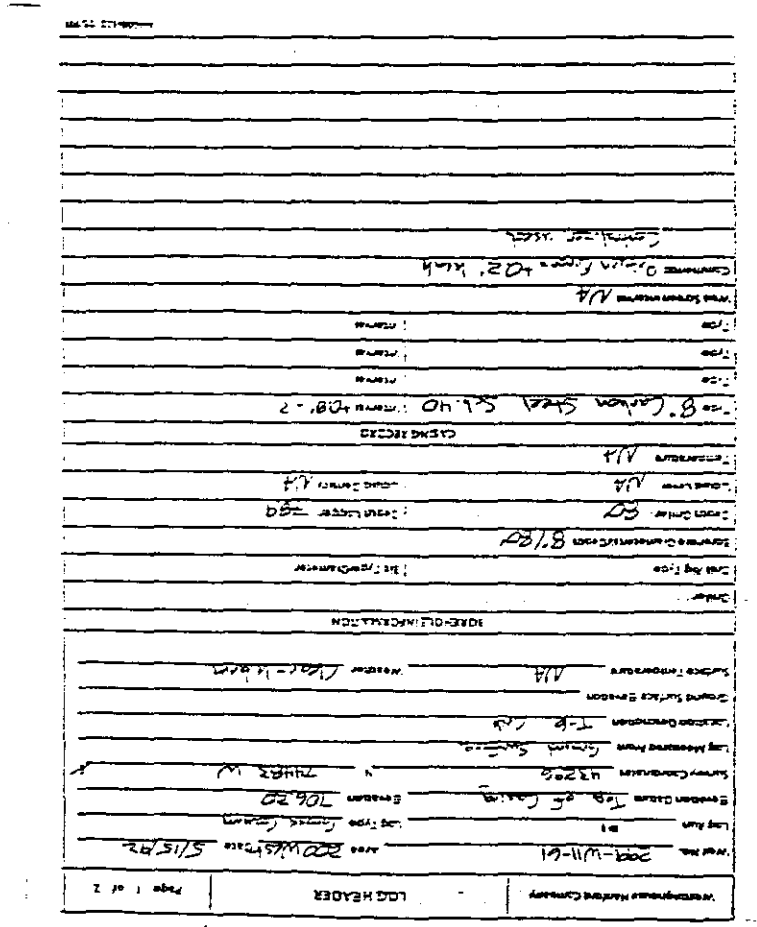
Man-made Radionuclides:
Cesium (Cs-137) was encountered in two locations in the borehole. The surface and near surface activity extended from 0 to 6 feet. The near surface activity reached a maximum of 1.2 pCi/g at 4 feet. The prominent borehole contamination was encountered between 16 feet and 55 feet. The maximum activity encountered was 2800 pCi/g at 27 feet.

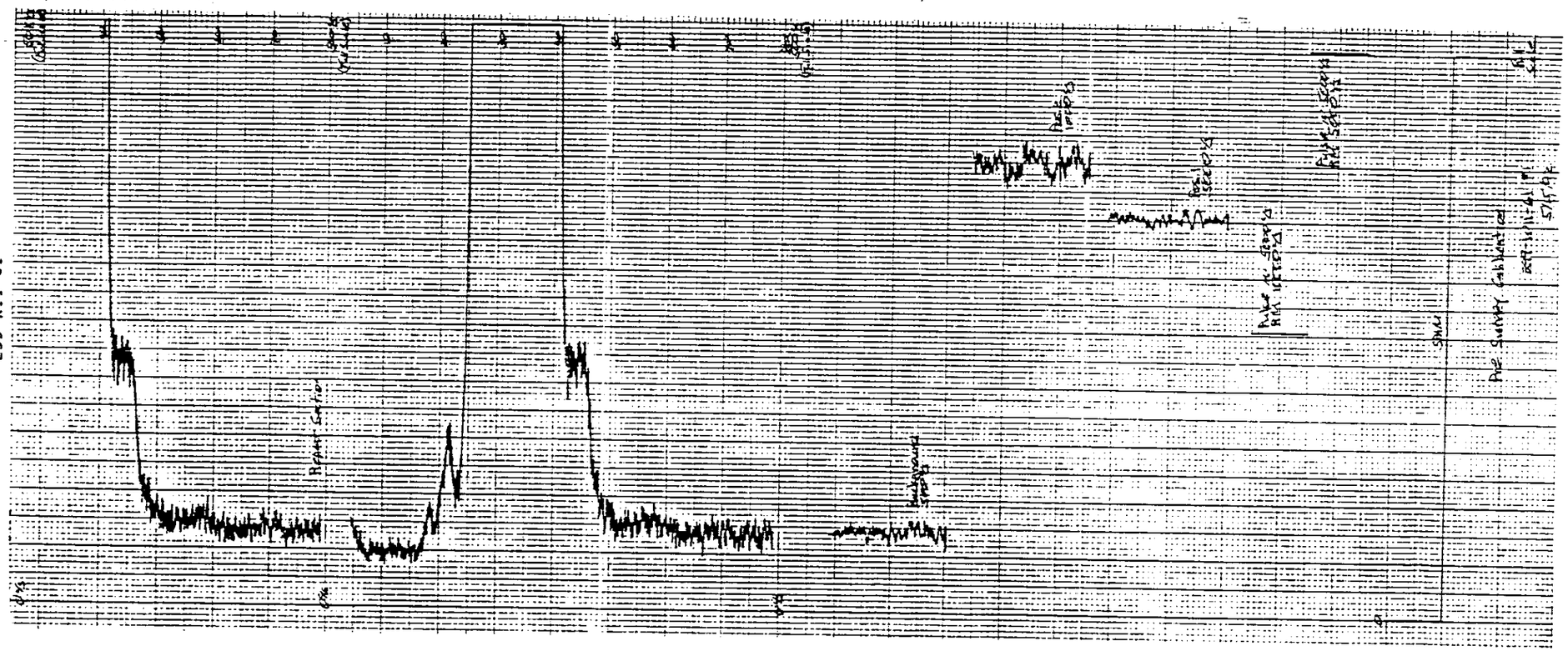
No Cobalt-60 (Co-60) was encountered in the borehole. The plot track is present only for uniformity of the displayed data.

No Europium-152 (Eu-152) was encountered in the borehole. The plot track is present only for uniformity of the displayed data.

No Europium-154 (Eu-154) was encountered in the borehole. The plot track is present only for uniformity of the displayed data.


Logging Company PNL
Operator(s) Alan Pearson
Equipment Brand NLS
Tool Type Gamma Rad
Base Calibration Date 5/11
Cable Calibration Factor 0.84
Dead Time 11.0
Logging Speed 50 ft/min
Chart Speed(s) Non 10 ft/in
Post Survey Verification: Position 1 30.11 cps
Comments Raised since 402 high
Witnessed and Verified by: Alan Pearson
Date 5/15/92
Alan Pearson


LOG HEADER
Page 1 of 2
299-W11-61
5/15/92
Alan Pearson
Gamma Ray
Page 1 of 2



299-W11-61

Crib Designation: Cribs 216-T-14, 216-T-15, 216-T-16, 216-T-17

Type of Facility:
216-T-14: 220 ft. x 10 ft. trench structure
216-T-15: 240 ft. x 10 ft. trench structure
216-T-16: 240 ft. x 10 ft. trench structure
216-T-17: 275 ft. x 10 ft. trench structure

Location: All four trench structures are located approximately N 43760, W 75050, just northeast of the T tank farms fence.

Service Dates:
216-T-14: 1/54 to 1/54
216-T-15: 1/54 to 2/54
216-T-16: 2/54 to 2/54
216-T-17: 2/54 to 6/54

Description of Waste:
216-T-14: 1 x 10^6 liters
216-T-15: 1 x 10^6 liters
216-T-16: 1 x 10^6 liters
216-T-17: 7.85 x 10^5 liters

These cribs all received first cycle supernatant waste from the 221-T facility via the T-104, 105 and 106 tanks. All was high salt, neutral to basic composition.

Radionuclide Release Summary:

216-T-14:

Radionuclide	Quantity
Pu	0.88 g
Sr-90	6.0 Ci
Ru-106	15.0 Ci
Cs-137	470 Ci
Co-60	1.5 Ci
U	30 kg

216-T-15

Radionuclide	Quantity
Pu	0.94 g
Sr-90	21.0 Ci
Ru-106	12.0 Ci
Cs-137	1000 Ci
Co-60	1.2 Ci
U	27 kg

216-T-16

Radionuclide	Quantity
Pu	0.65 g
Sr-90	8.0 Ci
Ru-106	13.0 Ci
Cs-137	522 Ci
Co-60	1.3 Ci
U	22.2 kg

216-T-17

Radionuclide	Quantity
Pu	0.53 g
Sr-90	3.0 Ci
Ru-106	10 Ci
Cs-137	370 Ci
Co-60	1.0 Ci
U	20 kg

Summary of Past Logging:

Boreholes	Date	Reference
299-W11-68	1976	Fecht et al., 1977
	1986	Geophysics files
	1987	Geophysics files
299-W11-69	1976	Fecht et al., 1977
	1987	Geophysics files
299-W11-81	1984	Geophysics files
	1986	Geophysics files

Review of Current Logging:

Borehole: 299-W11-81

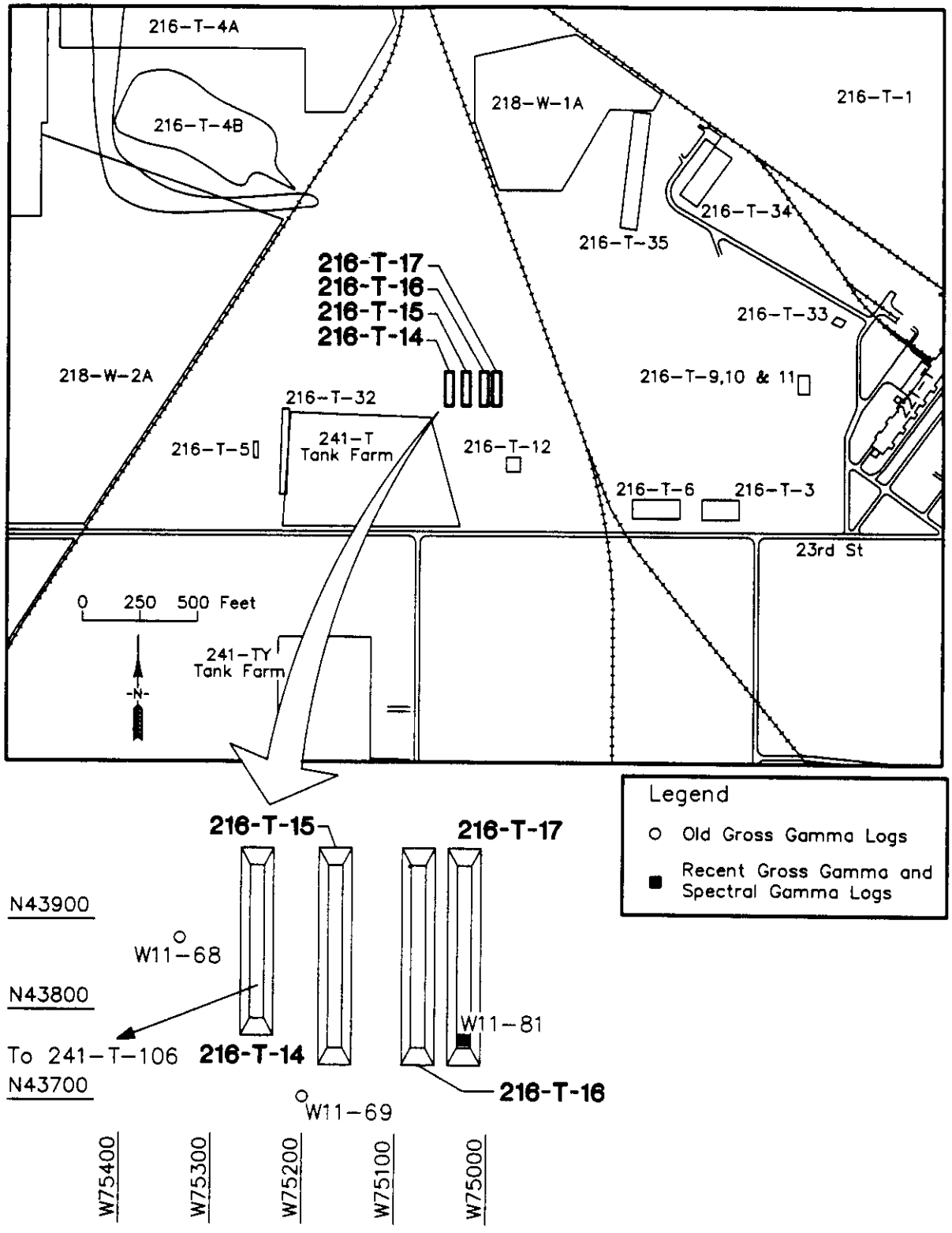
This borehole was logged with the PNL gross gamma system as well as the spectral gamma system. This borehole was only 51 feet deep and does not provide a good picture of the entire unsaturated zone. The spectral gamma system shows Cs-137 contamination throughout but, because the hole is only 51 feet deep, there is no way to fully assess the extent of the migration of the nuclides at this site.

It is particularly unfortunate that no additional spectral logs are available yet for this site because the site received the first cycle waste which is typically higher in radionuclide content and fission products than the second cycle waste.

Very little can be determined about the stability and the nuclide deposition at this site from the current log data or from previous log data because none of the boreholes reach the groundwater. Additionally, two of the logs show man-made contamination at the bottom of the boreholes, indicating that the boreholes have not intersected all of the contamination.

Statements in previous reports that breakthrough to groundwater has not occurred at this site (Fecht, et al., 1977) are not supported by the data.

It is recommended to drill monitoring boreholes at this site that travel to the groundwater particularly because this site received first cycle effluent waste.


216-T-4A
216-T-4B
218-W-1A
216-T-1
216-T-34
216-T-35
216-T-17
216-T-16
216-T-15
216-T-14
216-T-33
218-W-2A
216-T-9,10 & 11
216-T-32
241-T
Tank Farm
216-T-5
216-T-12
216-T-6
216-T-3
23rd St
0 250 500 Feet
241-TY
Tank Farm
N
Legend
Old Gross Gamma Logs
Recent Gross Gamma and Spectral Gamma Logs
216-T-15
216-T-17
N43900
W11-68
N43800
W11-81
To 241-T-106
216-T-14
N43700
216-T-16
W11-69
W75400
W75300
W75200
W75100
W75000

JRB\121792-J

Westinghouse Hanford Company
RLS Spectral Gamma-Ray Borehole Survey Log Header

Project: 200 AAMS, T-14 thru T-17 Cribs

Borehole	299-W11-81		
Coordinates	43,768 N 75,025 W	Feet	(Plant 200 W)
Elevation	. feet	Top of Casing	(Plant 200 W)

Borehole Environment Information

Borehole Fluid Depth none (Feet) from Zero (0.0) Depth Reference of Log

Casing Size I.D. (inch)	Casing Thickness (inch)	Top Depth (feet)	Base Depth (feet)
8.0	0.329	0.0	51.0

RLS Passive Spectral Gamma Survey Information

Logging Engineers R. V. Cram S. E. Kos
Log Depth Reference at Zero (0.0) depth is Ground Level

Log Date	Archive File Names	Log Mode[1], Speed	Depth Interval (feet) Top	Base	Incr
May 22, 92	H2W1181\A185	FIXED 0.6 fps	0.	48.	0.5

[1]FIXED: Fixed velocity of Cable Speed: fps: Feet per second

Calibration and Analysis Information

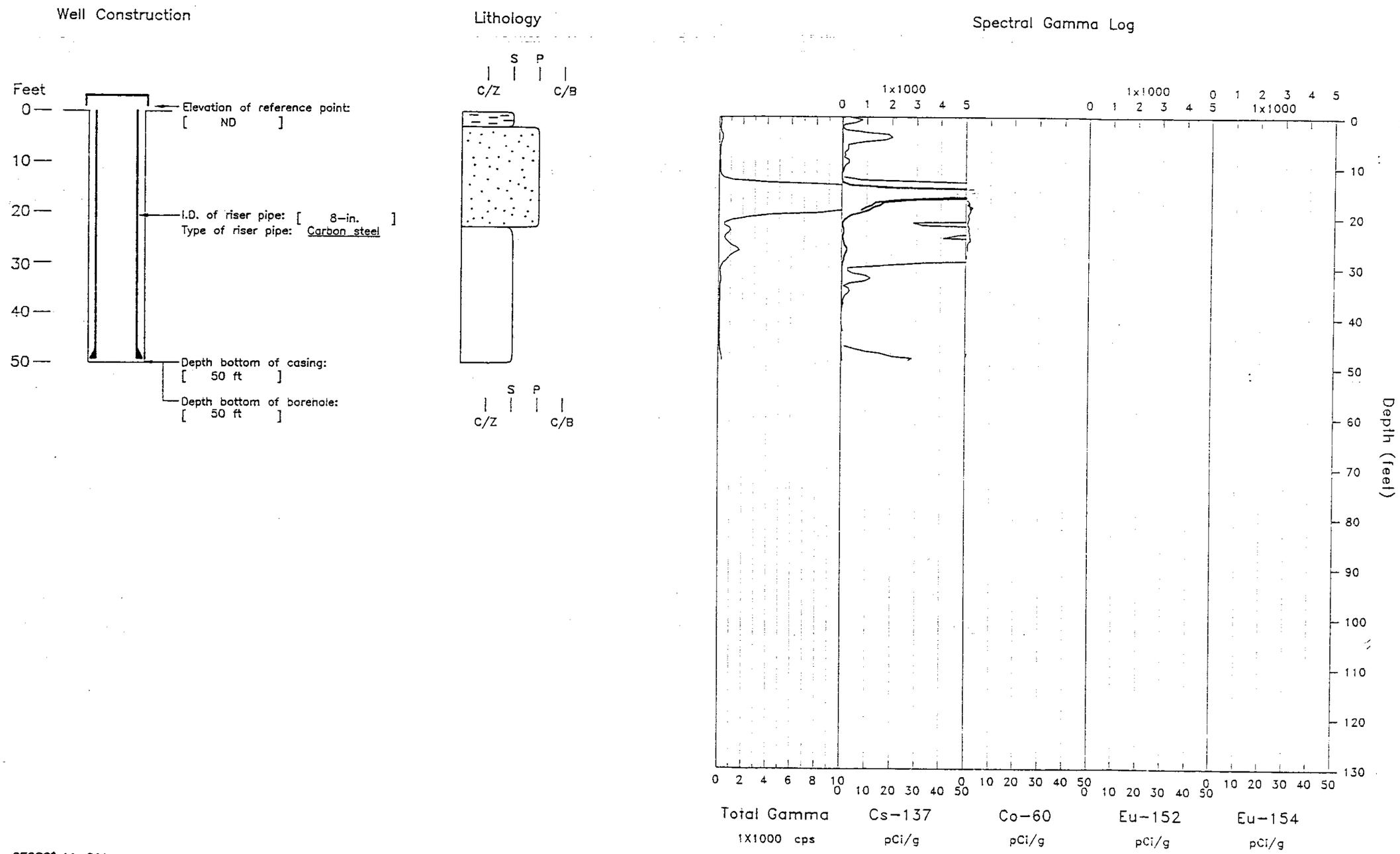
RLS Calibration Date: Nov 21, 1991
Calibration Report: WHC-SD-EN-TRP-001

Analyst Names: G. K. Jaeger R. K. Price
Analysis Date: July 21, 1992

Analysis Notes: Cs-137 high activity zone logged with & w/out Pb shield
Radionuclides identified: Cs-137, Co-60

RLS Spectral Gamma Ray Borehole Survey

Well 299-W11-81 | Crib 216-T-14:17 | Log Date 5/22/92



GEOSCI\11-81A

299-W11-81 T-14 thru T-17 Cribs

Casing	Depth: 80'	Size: 8"	Thickness: 0.329"
Water	Depth: none		
Survey	Depth: 0 - 48'	Date: 5/22/92	
	Depth: 14 - 19'	(Lead Shield)	

General Notes:
The total gamma activity exceeded 200,000 cps with the standard borehole survey configuration. The excessive system dead-time with the normal equipment configuration prevented accurate calculation of gamma activity. The lead shield was installed to reduce the number of low energy gamma-rays being counted by the detection system. The maximum total gamma activity at 15 feet with the lead shield was 51,000 cps. Both sets of data are presented on the plot.

Man-made Radionuclides:
Cesium (Cs-137) was encountered for the full length of the borehole from 0 feet to 48 feet. The maximum activity encountered was 19,000 pCi/g at 15 feet. The cesium encountered at the bottom of the borehole indicates an increasing activity with depth up to about 30 pCi/g.

Cobalt-60 (Co-60) was encountered in the borehole from 16 feet to the bottom (48 feet). The maximum activity encountered was 2 pCi/g at 18 feet. The average activity from 16 feet to 28 feet is about 1.5 pCi/g. The detection of cobalt from 28 to 46 feet was not continuous.

No Europium-152 (Eu-152) was encountered in the borehole. The plot track is present only for uniformity of the displayed data.

No Europium-154 (Eu-154) was encountered in the borehole. The plot track is present only for uniformity of the displayed data.

299-W11-81

Westinghouse Hanford Company | LOG HEADER | Page 1 of 2

Hole No. 299-W11-81 Area 200 West Date 5/26/92
Log Run #9 Log Type Gross Gamma
Elevation Datum Elevation
Survey Coordinates N 47718 W 75325
Log Measured from Ground Surface
Location Description B Tank Farm
Ground Surface Elevation
Surface Temperature N/A Weather Clear Warm & Windy

BOREHOLE INFORMATION

Driller
Drill Rig Type Bit Type/Diameter
Borehole Diameter(s)/Depth 8"/50'
Depth Driller 50' Depth Logger 50'
Liquid Level N/A (Dry) Liquid Density N/A
Temperature N/A

CASING RECORD

Type 8" Carbon Steel Sch 40 Interval 4 to -7
Type Interval
Type Interval
Type Interval
Well Screen Interval NA
Comments: 8" Casing Extends 0.2' High
Centralizer used

LOG HEADER | Page 2 of 2

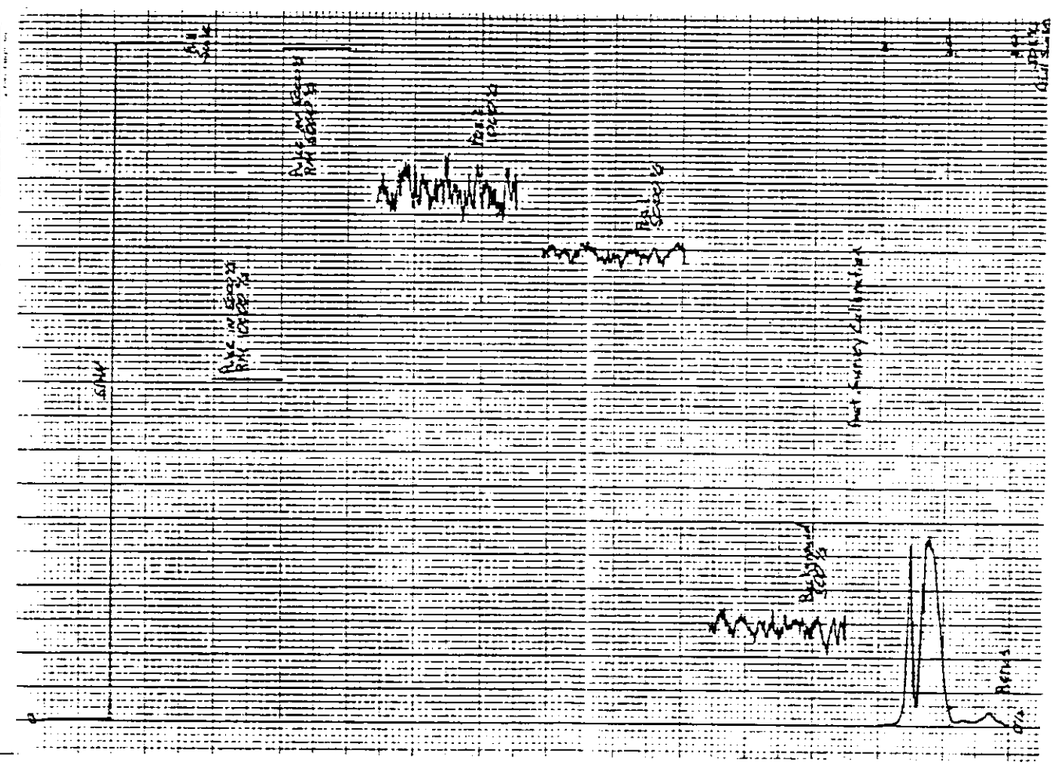
EQUIPMENT DATA

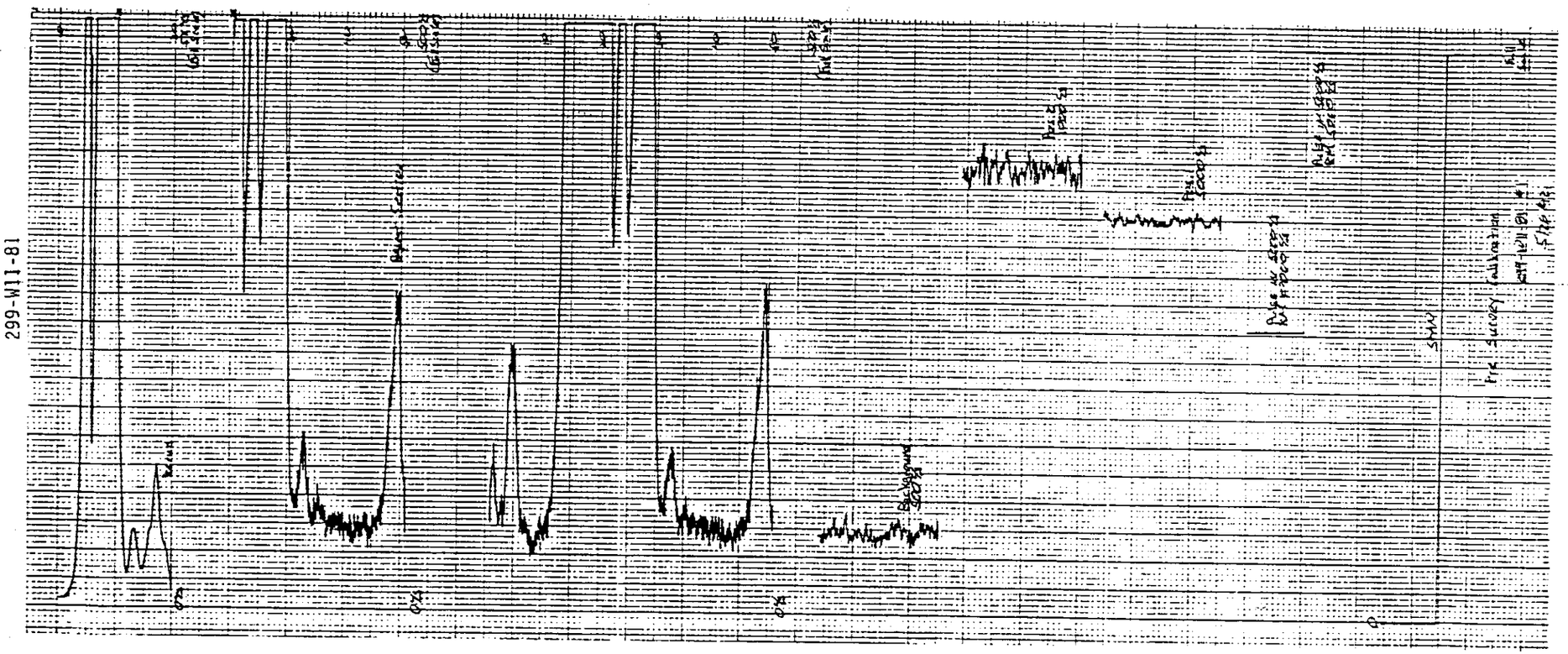
Logging Company PNL
Operator(s) Alan Pearson
Equipment Brand AMS Equipment Type NaI
Tool Type Gamma Ray Serial No. GG27AB11
Base Calibration Date 5/92 Calibration Reference PNL-WC-
Calibration/Probe Factor 1.00/1.00 Base Calibration Datum (cps) Position 1 315.1 cll Position 2 651.1 cll
Dead time 12.2 usec Warm Up Time 7/15 min

LOGGING INFORMATION

Log Interval from 50' to 1-08"
Retrieved: 50' to 200 @ 50 ft/hr 300 to 100 @ 50 ft/hr 300 to 100 @ 50 ft/hr
Pre Survey Verification: Position 1 309.0 cll Position 2 641 cll Background 72%
Base Calibration Difference: Position 1 61 cll Position 2 0 cll
Logging Speed 50 ft/min Recorder Scale, CPM 50 cpm/in
Start time 0845 Completion time 1130
Chart Speed(s) Min 10 cm/hr Time Constant(s) TC-1
Chart Recorder Horizontal Scale, CPM 50 cpm/in
Post Survey Verification: Position 1 309.7 cll Position 2 641 cll Background 72%
Percent Change: Position 1 0.2% Position 2 0.0%
Comments: Casing Extends 0.02' high
Centralizer used

Witnessed and Verified by (Supervisor name/initials) Alan Pearson Date 5/26/92





299-W11-81

Crib Designation: 216-T-18

Type of Facility: 10 ft. x 10 ft. concrete crib structure

Location: N 42790, W 75300, just north of cribs 216-T-26, 27, 28

Service Dates: 12/53 to 12/53

Description of Waste: Approx. 1.0 x 10^6 liters of Scavenged first cycle waste from 221-T, High salt, neutral to basic pH

Radionuclide Release Summary:

Radionuclide	Quantity
Pu	1800 g
Sr-90	7.0 Ci
Ru-106	200 Ci
Cs-137	57 Ci
Co-60	10 Ci
U	27.2 kg

Summary of Past Logging:

Boreholes	Date	Reference
299-W11-11	1976	Fecht et al., 1977

Review of Current Logging:

Borehole: 299-W11-11

This borehole is the only borehole at this crib. It was logged with the RLS spectral gamma system which showed a high concentration of Cs-137 down to about 40 feet and a low concentration of Co-60 spread out from about 50 feet to about 90 feet.

This distribution of man-made nuclides is consistent with the release records and with what might be expected. Cobalt is chemically more mobile that the cesium as is shown by the deposition pattern at this site.

There is concern at this site about the fact that a large amount of plutonium was released at this site in the first cycle effluent, and none was detected up near the bottom of the crib as might be expected. However, the logging operation was not necessarily designed to detect plutonium. Because the gamma-ray line intensities are so low, a very long counting time may help to detect plutonium even in the presence of other gamma emitters.

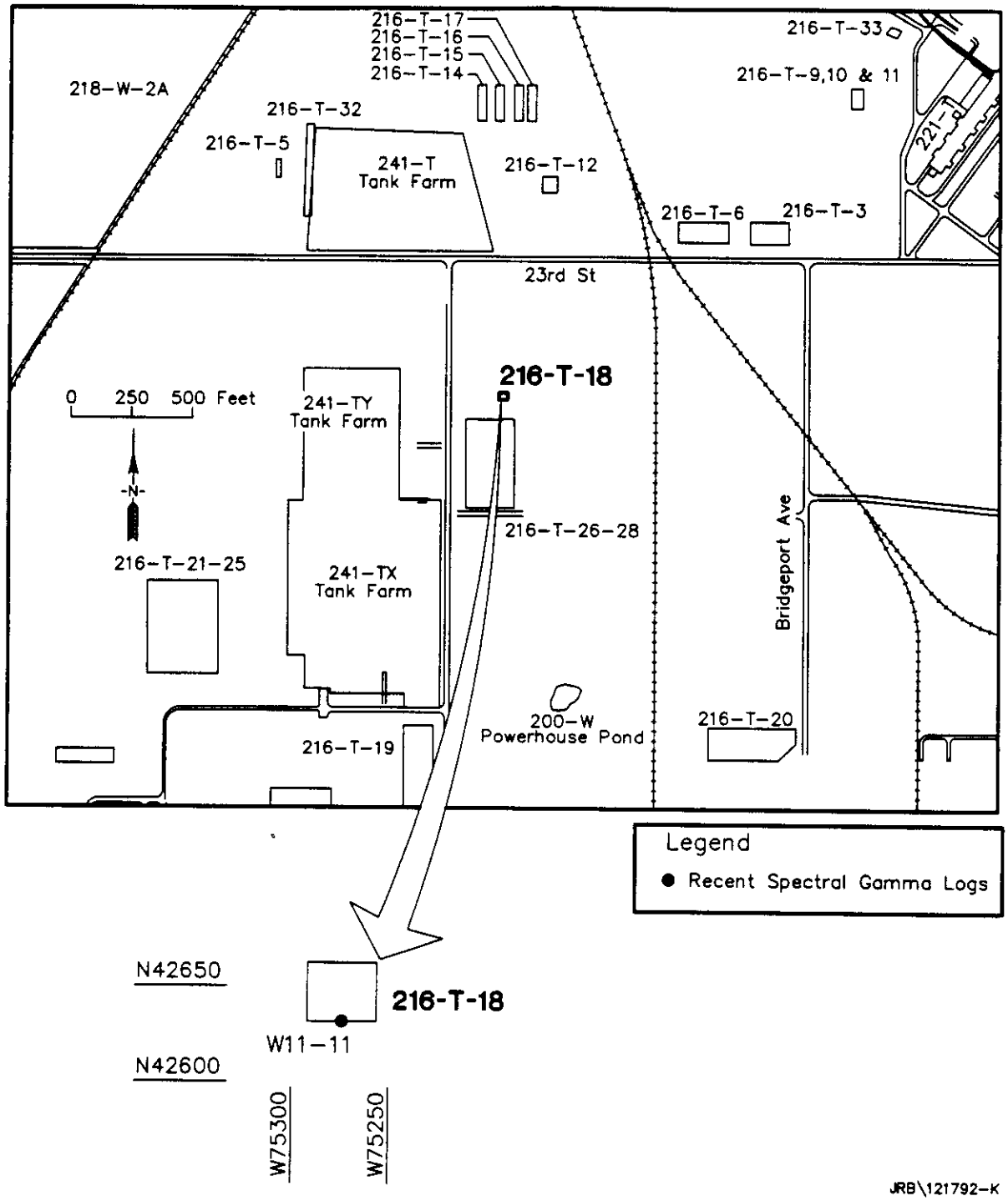
To resolve this, some long counting time spectra should be recorded near the bottom of the crib.

The uranium is probably not present in sufficient concentration to be detected.

There may be a relationship between the deposition of the cesium and a silt layer-to-sand layer interface. When a coarser grained material is overlain by a finer grained material, a high hydrologic potential barrier may develop. The water transporting the nuclide is retained up within the finer grained material

until the unsaturated soil potential is exceeded. This can cause the water to migrate horizontally and it can cause the water to be retained within the fine grained material long enough for the cobalt to be adsorbed onto the sediment.

Additional monitoring boreholes are recommended at this site although the existing data suggest that this site is stable, the man-made nuclides have not migrated to the groundwater and no other nearby releases have influenced the site.


216-T-17
216-T-16
216-T-15
216-T-14
216-T-33
216-T-9,10 & 11
218-W-2A
216-T-32
216-T-5
241-T
Tank Farm
216-T-12
221-T
216-T-6
216-T-3
23rd St
216-T-18
0 250 500 Feet
241-TY
Tank Farm
-N-
216-T-26-28
216-T-21-25
241-TX
Tank Farm
Bridgeport Ave
200-W
Powerhouse Pond
216-T-20
216-T-19
Legend
Recent Spectral Gamma Logs
N42650
216-T-18
W11-11
N42600
W75300
W75250
JRB\121792-K

Westinghouse Hanford Company
RLS Spectral Gamma-Ray Borehole Survey Log Header

Project: 200 AAMS, T-18 Crib

Borehole	299-W11-11			
Coordinates	42,632 N	75,274 W	Feet	(Plant 200 W)
Elevation	670.8 feet		Top of Casing	(Plant 200 W)

Borehole Environment Information

Borehole Fluid Depth none (Feet) from Zero (0.0) Depth Reference of Log

Casing Size I.D. (inch)	Casing Thickness (inch)	Top Depth (feet)	Base Depth (feet)
8.0	0.313	0.0	208.4

RLS Passive Spectral Gamma Survey Information

Logging Engineers R. V. Cram S. E. Kos
Log Depth Reference at Zero (0.0) depth is Ground Level

Log Date	Archive File Names	Log Mode[1], Speed	Depth Interval (feet) Top	Base	Incr
Mar 31, 92	H2W1111\A161	FIXED 0.6 fps	0.	205.	0.5

[1]FIXED: Fixed velocity of Cable Speed: fps: Feet per second

Calibration and Analysis Information

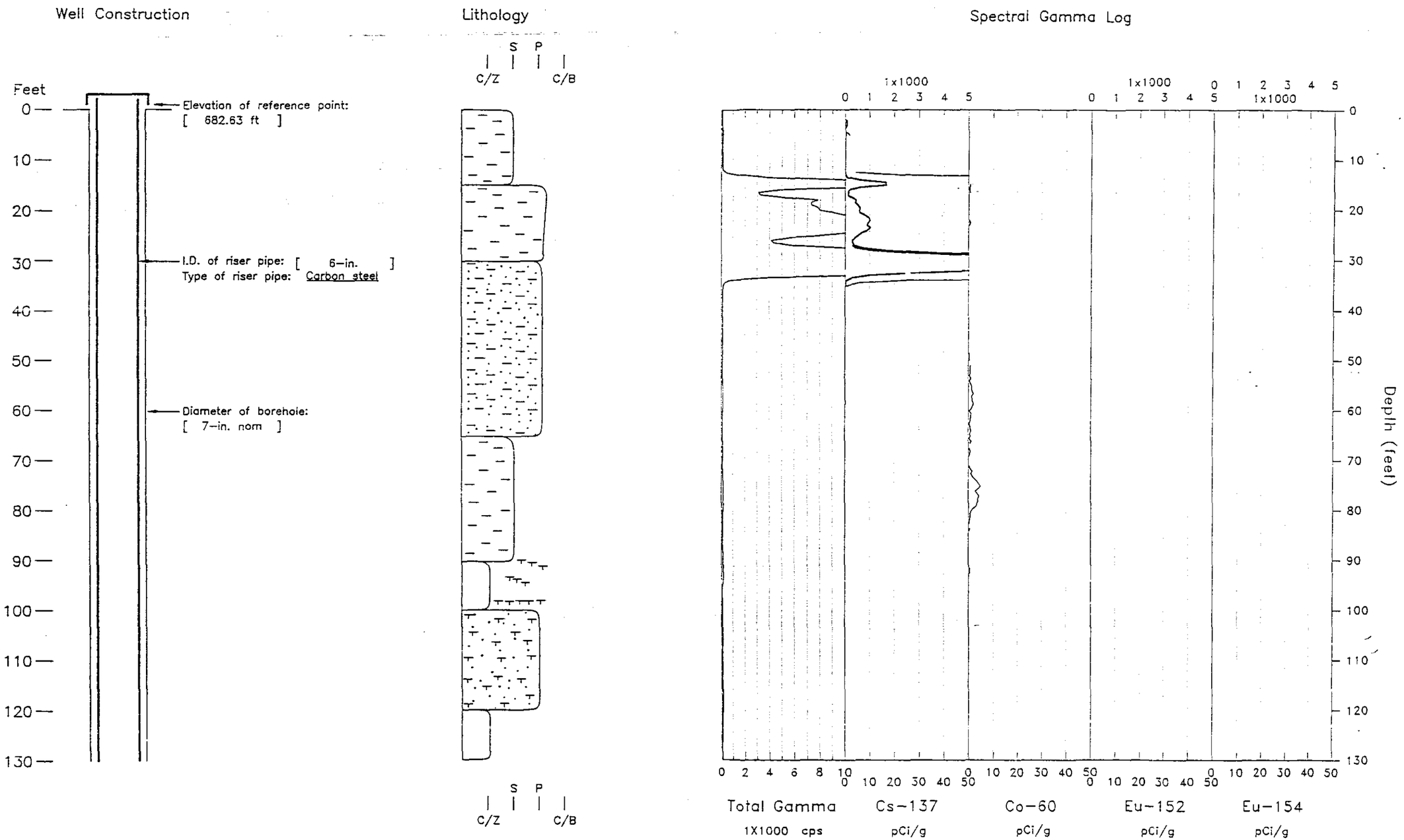
RLS Calibration Date: Nov 21, 1991
Calibration Report: WHC-SD-EN-TRP-001

Analyst Names: W. F. Nicaise R. K. Price
Analysis Date: June 19, 1992

Analysis Notes: No man-made radionuclides plotted on Pg 2 of data plot
Radionuclides identified: Cs-137, Co-60,

RLS Spectral Gamma Ray Borehole Survey

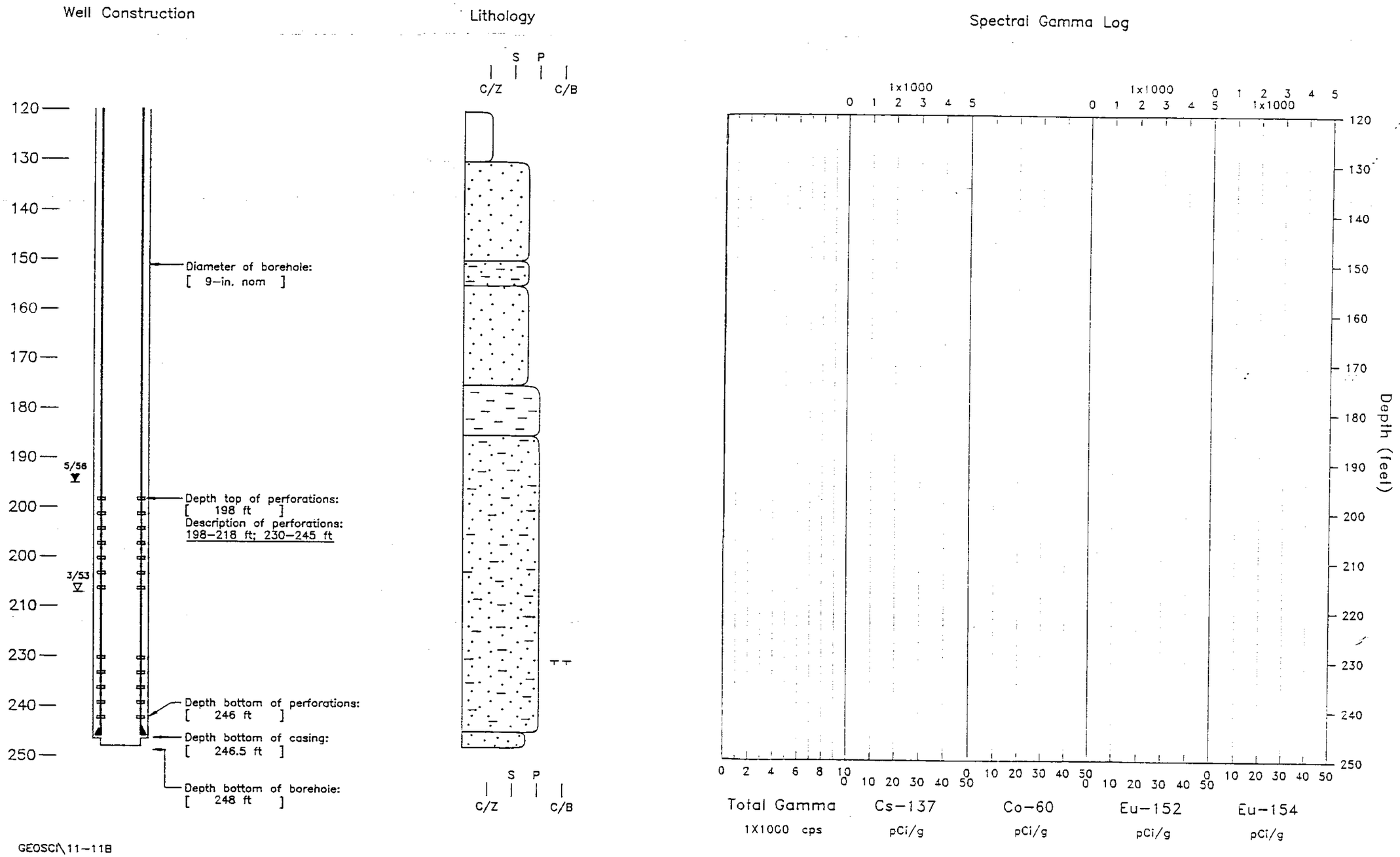
Well 299-W11-11 | Crib 216-T-18 | Log Date 3/31/92



GEOSCI\11-11A

RLS Spectral Gamma Ray Borehole Survey (Page 2)

Well 299-W11-11 | Crib 216-T-18 | Log Date 3/31/92



299-W11-11 T-18 Crib

Casing	Depth: 208.4'	Size: 8"	Thickness: 0.313"
Water	Depth: none		
Survey	Depth: 0 - 205'	Date: 3/31/92	
	27 - 33'	(Lead Shield)	

General Notes:
The survey is plotted on two pages. The second plot page is blank since no man-made radionuclides were detected below 95 feet.

The total gamma activity at 30 feet appeared to exceed 1,000,000 cps in the borehole survey. The excessive system dead-time with the normal equipment configuration for borehole logging prevents accurate calculation of gamma activity. The lead shield was installed to reduce the number of low energy gamma-rays being counted by the detector. The maximum total gamma activity at 30 feet with the lead shield installed was 21,000 cps.

Man-made Radionuclides:
Cesium (Cs-137) was encountered from 2 feet to 59 feet. The maximum activity encountered was 10,000 pCi/g at 30 feet. With out the lead shield the maximum activity before detector saturation occured was 12,000 pCi/g at 29 feet. This value, without the lead shield, is suspect because of high system dead-time. With the lead shield installed the maximum apparent activity was 10,000 pCi/g at 30.5 feet.

Cobalt (Co-60) was encountered between 14 feet and 95 feet. The main zone where cobalt was encountered is between 48 feet and 84 feet. The maximum activity encountered was 5 pCi/g at 75 feet.

No Europium-152 (Eu-152) was encountered in the borehole. The plot track is present only for uniformity of the displayed data.

No Europium-154 (Eu-154) was encountered in the borehole. The plot track is present only for uniformity of the displayed data.

Crib Designation: 216-T-19 Crib

Type of Facility: 12 ft. x 12 ft wooden crib and tile field

Location: N 41270, W 75600 Just south of the 241-TX tank farms

Service Dates: 9/51 to 6/90

Description of Waste: 455 x 10^6 liters of: 9/51 to 7/55 - Condensate from the 242-T evaporator; Cell drainage from tank 5-6; second cycle supernatant waste from 221-T, waste from 224-T; 12/65 to 6/90 process and steam condensate from 242-T evaporator

Radionuclide Release Summary:

Radionuclide	Quantity
Am-241	9.82 x 10^-4 Ci
Cs-137	17.5 Ci
H-3	4.25 Ci
Sr-90	27.8 Ci

note: above values are reported as of 12/89

Summary of Past Logging:

Boreholes	Date	Reference
299-W14-51	1976	Fecht et al., 1977
	1984	Geophysics files
	1986	"
299-W14-52	1976	Fecht et al., 1977
	1986	Geophysics files
299-W15-4	1976	Fecht et al., 1977
299-W15-65	1976	"
	1986	Geophysics files
299-W15-66	1976	Fecht et al., 1977
	1984	Geophysics files
	1986	"

Review of Current Logging:

Borehole: 299-W15-4

This borehole is the only borehole of any appreciable depth at this site. It was logged with the RLS spectral gamma-ray system and shows two zones containing Cs-137, one thick zone between 40 and 50 feet and a small lower concentration zone at about 150 feet.

The grout around the inner casing in this borehole makes the reported radionuclide concentrations inaccurate and the uncertainty very high although obviously if a nuclide is detected, it is most certainly in the sediment.

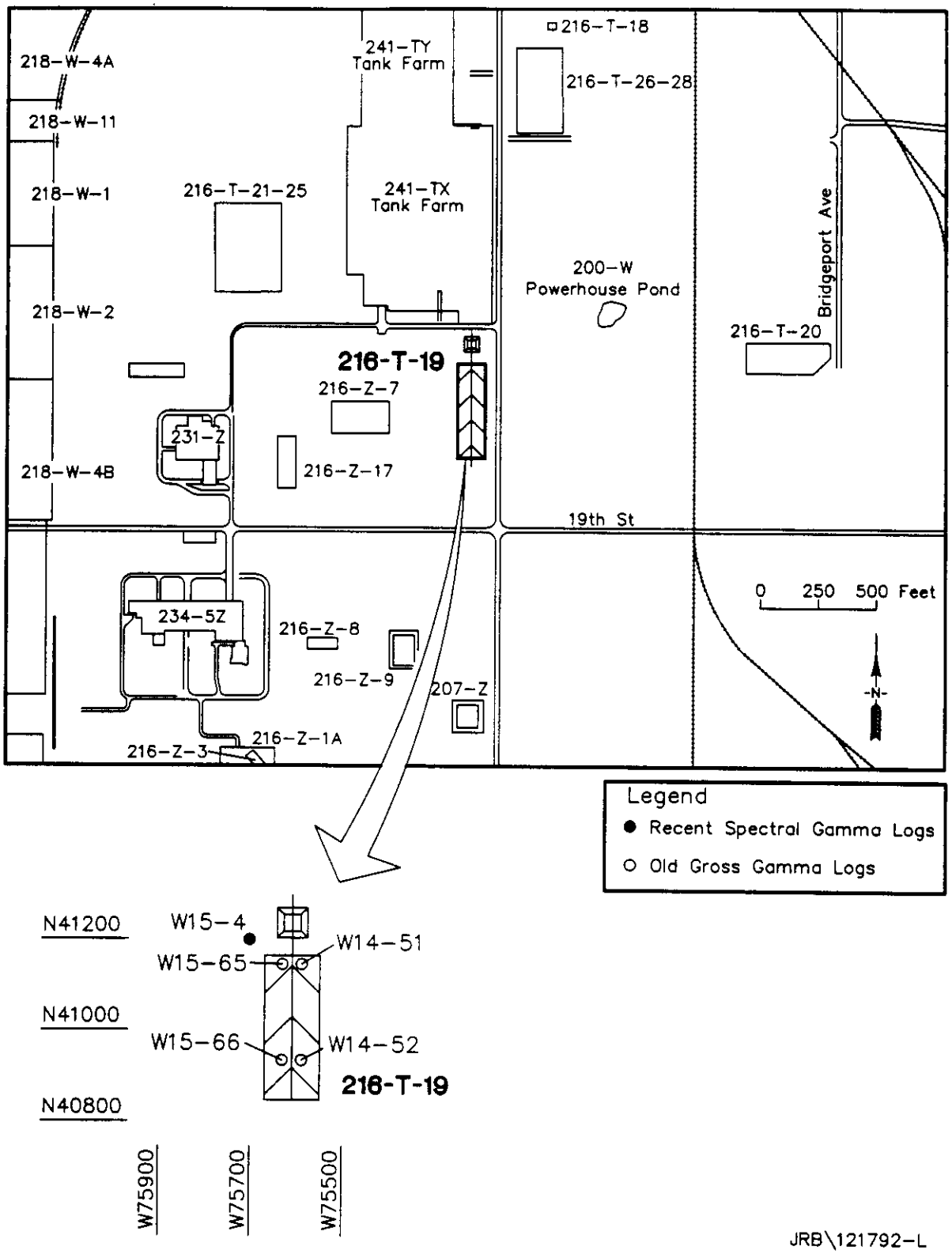
The upper zone of Cs-137 appears to correlate with the stratigraphy although the lack of good stratigraphic data precludes developing any solid conclusions about this.

The lower zone is somewhat of a puzzle. It is unlikely that this was carried down all the way through the unsaturated zone

from above. If it had, there would be trace cesium throughout the length of the borehole. It also seems unlikely that it was carried down along the outside of the casing for the same reason. It is possible that the contamination originated from the TX tank farms immediately to the north of this waste site and was carried in and deposited by the groundwater. This possible scenario should be investigated by reviewing groundwater data in the area. It is also recommended that a new borehole be drilled near this site to investigate the nuclide deposition profile without the interference of the grout.

The records show that only Cs-137 was released at this site in any quantities large enough to be detectable with logging techniques. That cesium is seen in the upper zone of contamination.

It is not known if the cesium released at this site has reached the groundwater and it is not known if the source of the lower contamination zone is this site or another.


218-W-4A
218-W-11
218-W-1
218-W-2
218-W-4B
241-TY Tank Farm
241-TX Tank Farm
216-T-21-25
216-T-18
216-T-26-28
200-W Powerhouse Pond
Bridgeport Ave
216-T-20
216-T-19
216-Z-7
231-Z
216-Z-17
19th St
234-5Z
216-Z-8
216-Z-9
207-Z
216-Z-1A
216-Z-3
0 250 500 Feet
N
Legend
Recent Spectral Gamma Logs
Old Gross Gamma Logs
N41200
N41000
N40800
W15-4
W14-51
W15-65
W15-66
W14-52
216-T-19
W75900
W75700
W75500
JRB\121792-L

Westinghouse Hanford Company
RLS Spectral Gamma-Ray Borehole Survey Log Header

Project: 200 AAMS, T-19 Crib

Borehole	299-W15-4			
Coordinates	41,200 N	75,700 W	Feet	(Plant 200 W)
Elevation	662. feet		Top of Casing	(Plant 200 W)

Borehole Environment Information

Borehole Fluid Depth none (Feet) from Zero (0.0) Depth Reference of Log

Casing Size I.D. (inch)	Casing Thickness (inch)	Top Depth (feet)	Base Depth (feet)
6.0	0.25	0.0	195.0

RLS Passive Spectral Gamma Survey Information

Logging Engineers R. V. Cram S. E. Kos
Log Depth Reference at Zero (0.0) depth is Ground Level

Log Date	Archive File Names	Log Mode, Speed	Depth Interval (feet) Top	Base	Incr
Apr 02, 92	H2W1504\A162	FIXED 0.6 fps	0.	192.	0.5

[1]FIXED: Fixed velocity of Cable Speed: fps: Feet per second

Calibration and Analysis Information

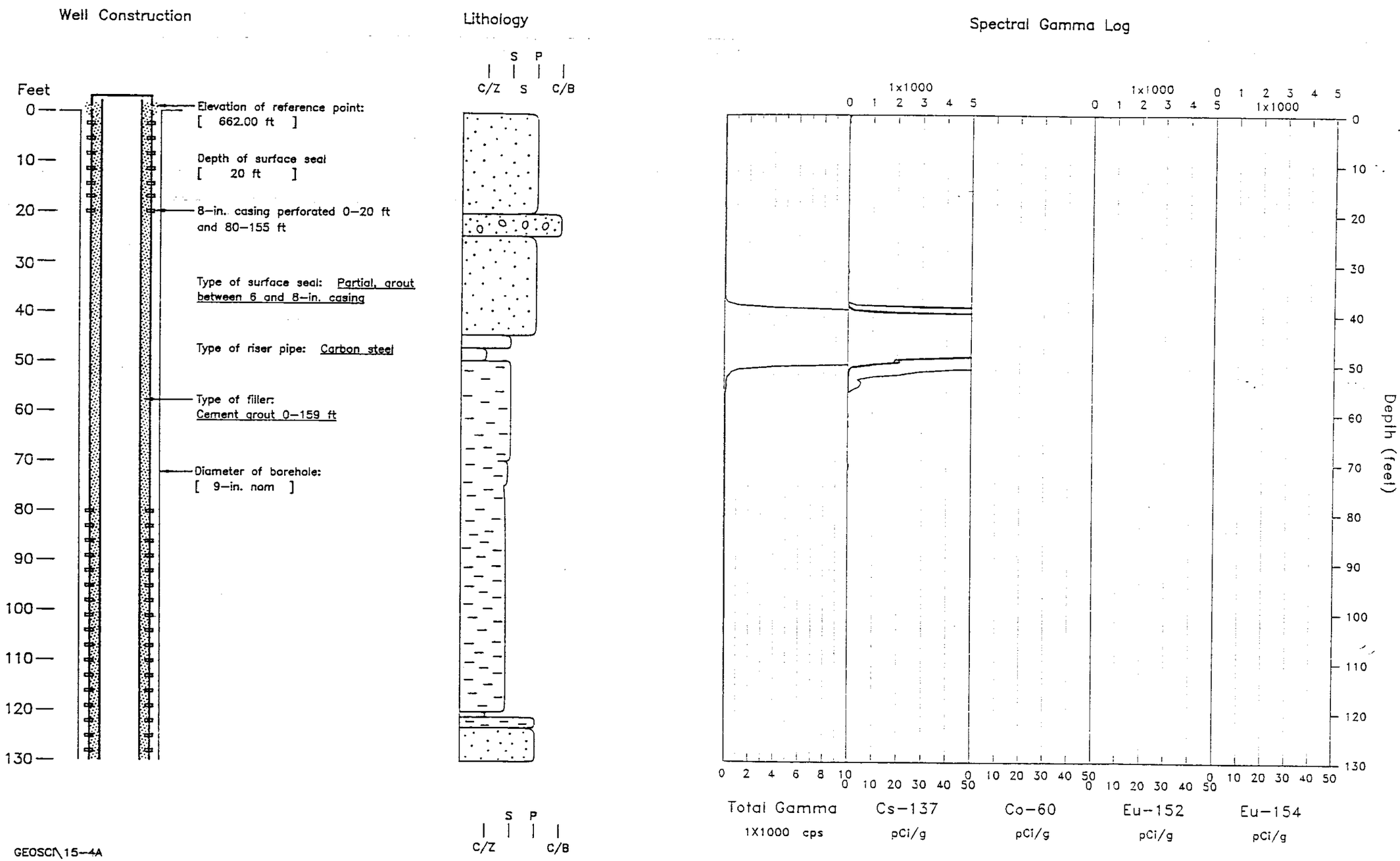
RLS Calibration Date: Nov 21, 1991
Calibration Report: WHC-SD-EN-TRP-001

Analyst Names: W. F. Nicaise R. K. Price
Analysis Date: June 24, 1992

Analysis Notes: Cs-137 high activity zone logged with & w/out Pb shield
Radionuclides identified: Cs-137

RLS Spectral Gamma Ray Borehole Survey

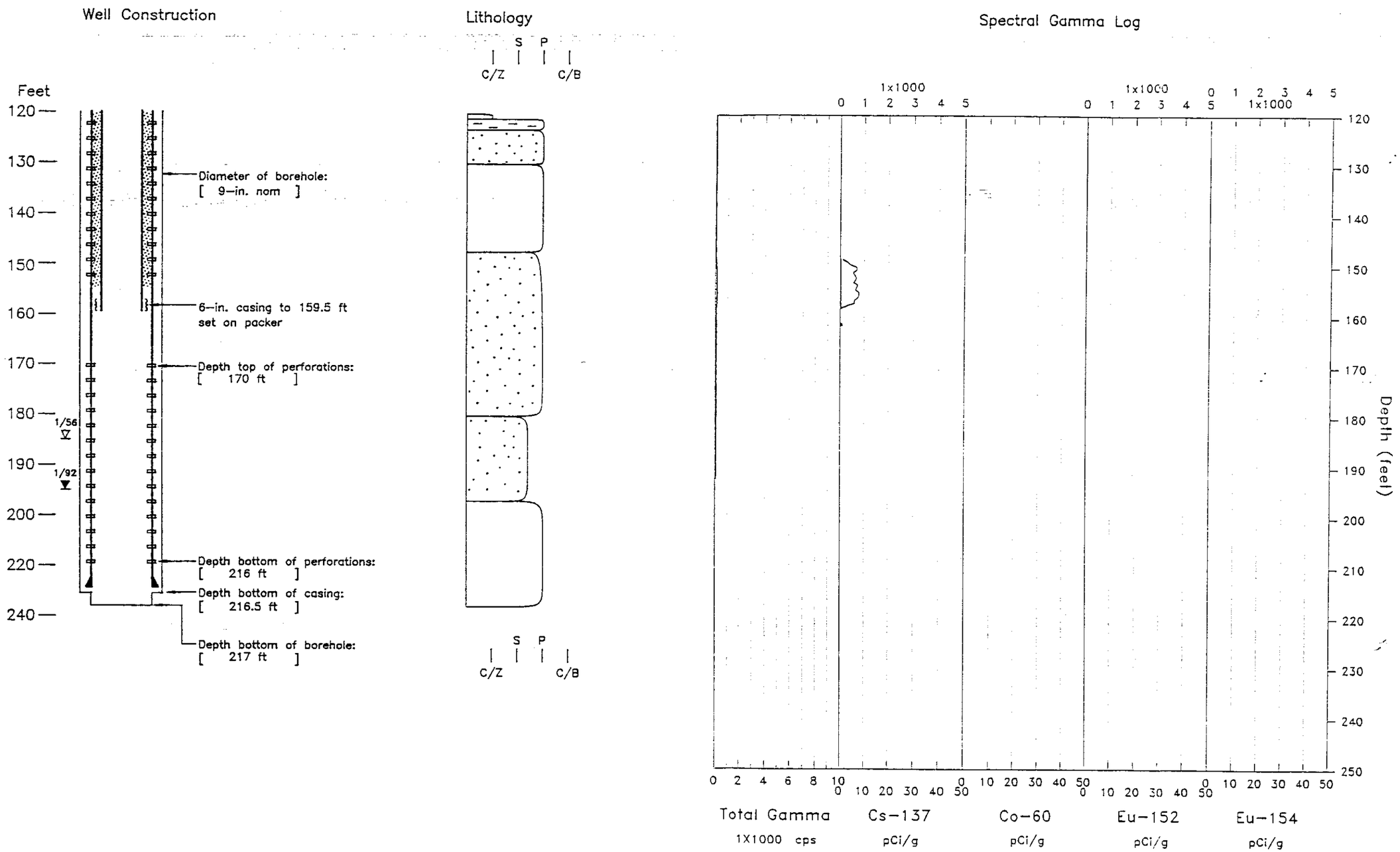
Well 299-W15-4 | Crib T-19 | Log Date 4/2/92



GEOSCI\15-4A

RLS Spectral Gamma Ray Borehole Survey (Page 2)

Well 299-W15-4 | Crib T-19 | Log Date 4/2/92



GEOSCI\15-4B

299-W15-4 T-19 Crib

Casing	Depth: 195'	Size: 6"	Thickness: 0.25"
Water	Depth: none		
Survey	Depth: 0 - 192'	Date: 4/02/92	
	38 - 48'	(Lead Shield)	
	38 - 51'	(Lead Shield)	

General Notes:
The total gamma activity with the standard logging equipment configuration exceeded 200,000 cps before the gamma activity saturated the counting system. The system was saturated from 39 feet to 49 feet. The lead shield was installed to reduce the number of low energy gamma-rays being counted by the detector. The maximum total gamma activity with the lead shield installed was 330,000 cps at 42 feet.

The survey is plotted on two pages. The survey data from 120 feet to 130 feet are plotted on both pages.

Both sets of lead shield data are plotted with the standard configuration data. The depth agreement appears to be very good with less than 0.5 feet error at 50 feet.

Man-made Radionuclides:
Cesium (Cs-137) was encountered at the surface from 0 feet to 1.5 feet and from 37 feet to 162 feet. The maximum activity encountered was greater than 33,000 pCi/g from 41 feet to 44 feet. Cesium activity exceeds 10,000 pCi/g from 40 feet to 48 feet. An interval of continuous cesium activity was encountered from 148 feet to 158 feet with a maximum activity of 8 pCi/g. Identification of cesium is discontinuous from 72 feet to 148 feet.

No Cobalt-60 (Co-60) was encountered in the borehole. The plot track is present only for uniformity fo the displayed data.

No Europium-152 (Eu-152) was encountered in the borehole. The plot track is present only for uniformity of the displayed data.

No Europium-154 (Eu-154) was encountered in the borehole. The plot track is present only for uniformity of the displayed data.

Crib Designation: 216-T-21 through 216-T-25

Type of Facility: All of these cribs are long trenches (180 feet or 240 feet long by 10 feet wide). They are gravel filled.

Location: N 41468 to N 42000, W 76394 to W 76754, Located just west of TX tank farms

Service Dates: All were used sometime between 6/54 and 9/54

Description of Waste:
All received first cycle supernatant waste from 221-T via the 109,110 and 111-TX tanks in the TX tank farm. All effluent was high salt, neutral to basic. The effluent quantity released at each crib is as follows:

216-T-21: 460 x 10^3 liters
216-T-22: 1.53 x 10^6 liters
216-T-23: 1.48 x 10^6 liters
216-T-24: 1.53 x 10^6 liters
216-T-25: 3.0 x 10^6 liters

Radionuclide Release Summary:

216-T-21

Radionuclide	Quantity
Pu	1.0 g
Sr-90	8.0 Ci
Ru-106	62 Ci
Cs-137	400 Ci
Co-60	2.0 Ci
U	1.0 kg

216-T-22

Radionuclide	Quantity
Pu	2.0 g
Sr-90	51 Ci
Ru-106	30 Ci
Cs-137	1900 Ci
Co-60	1.0 Ci
U	2.0 kg

216-T-23

Radionuclide	Quantity
Pu	1.0 g
Sr-90	41 Ci
Ru-106	26 Ci
Cs-137	1300 Ci
Co-60	1.0 Ci
U	1.0 kg

216-T-24

Radionuclide	Quantity
Pu	2.0 g
Sr-90	40 Ci
Ru-106	62 Ci
Cs-137	1400 Ci

Co-60	1.0 Ci
U	8.3 kg

216-T-25

Radionuclide	Quantity
Pu	1.0 g
Sr-90	4.0 Ci
Ru-106	100 Ci
Cs-137	8900 Ci
Co-60	<0.1 Ci
U	0.91 kg

Summary of Past Logging:

Boreholes	Date	Reference
299-W15-210	1984	Geophysics files
	1986	Geophysics files'

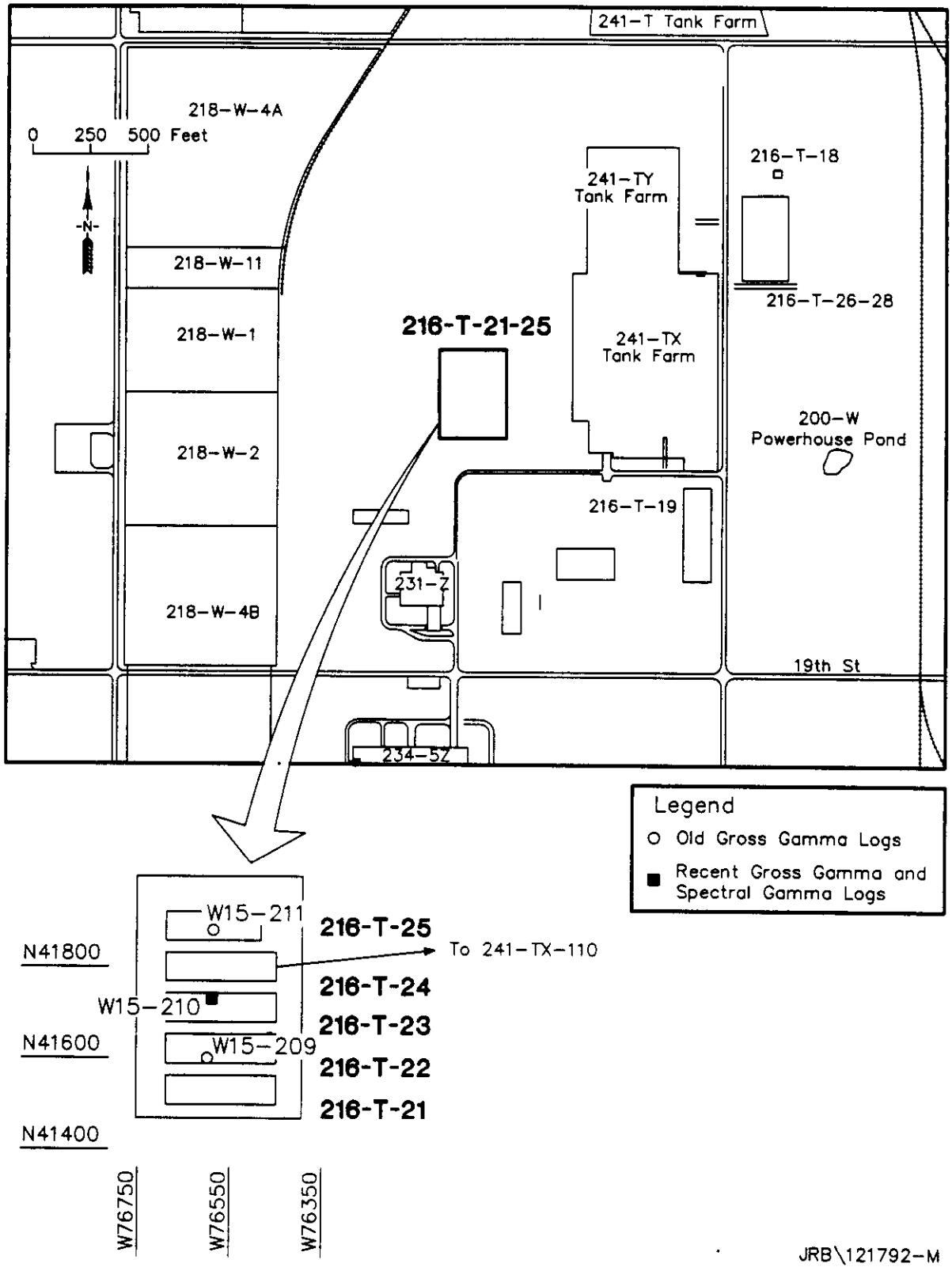
Review of Current Logging:

Borehole: 299-W15-210

This borehole was logged with the PNL gross gamma and the RLS spectral gamma system. According to the release records, Cs-137 was the principle nuclide released at this site and high concentrations of Cs-137 were found down to about 75 feet in this borehole. No other nuclides were found.

It is evident that more data are needed to properly evaluate this site. A large area is covered by only one monitoring borehole and this borehole is not very deep. Additional monitoring boreholes should be drilled at this site.

From the information available, it is not possible to assess whether or not the cesium released at this site has contaminated the groundwater. The only borehole at this group of cribs is not deep enough to provide that information.


241-T Tank Farm
218-W-4A
0 250 500 Feet
-N-
218-W-11
218-W-1
218-W-2
218-W-4B
216-T-21-25
241-TY Tank Farm
241-TX Tank Farm
216-T-18
216-T-26-28
200-W Powerhouse Pond
216-T-19
231-Z
19th St
234-52
Legend
Old Gross Gamma Logs
Recent Gross Gamma and Spectral Gamma Logs
W15-211
216-T-25
To 241-TX-110
N41800
216-T-24
W15-210
216-T-23
N41600
W15-209
216-T-22
216-T-21
N41400
W76750
W76550
W76350
JRB\121792-M

Westinghouse Hanford Company
RLS Spectral Gamma-Ray Borehole Survey Log Header

Project: 200 AAMS, T-21 thru T-24 Cribs

Borehole	299-W15-210			
Coordinates	41,730 N	76,590 W	Feet	(Plant 200 W)
Elevation	. feet		Top of Casing	(Plant 200 W)

Borehole Environment Information

Borehole Fluid Depth none (Feet) from Zero (0.0) Depth Reference of Log

Casing Size I.D. (inch)	Casing Thickness (inch)	Top Depth (feet)	Base Depth (feet)
8.0	0.324	0.0	98.0

RLS Passive Spectral Gamma Survey Information

Logging Engineers R. V. Cram S. E. Kos
Log Depth Reference at Zero (0.0) depth is Ground Level

Log Date	Archive File Names	Log Mode, Speed	Depth Interval (feet) Top	Base	Incr
May 07, 92	H2W15210\A179	FIXED 0.6 fps	0.	94.	0.5

[1]FIXED: Fixed velocity of Cable Speed: fps: Feet per second

Calibration and Analysis Information

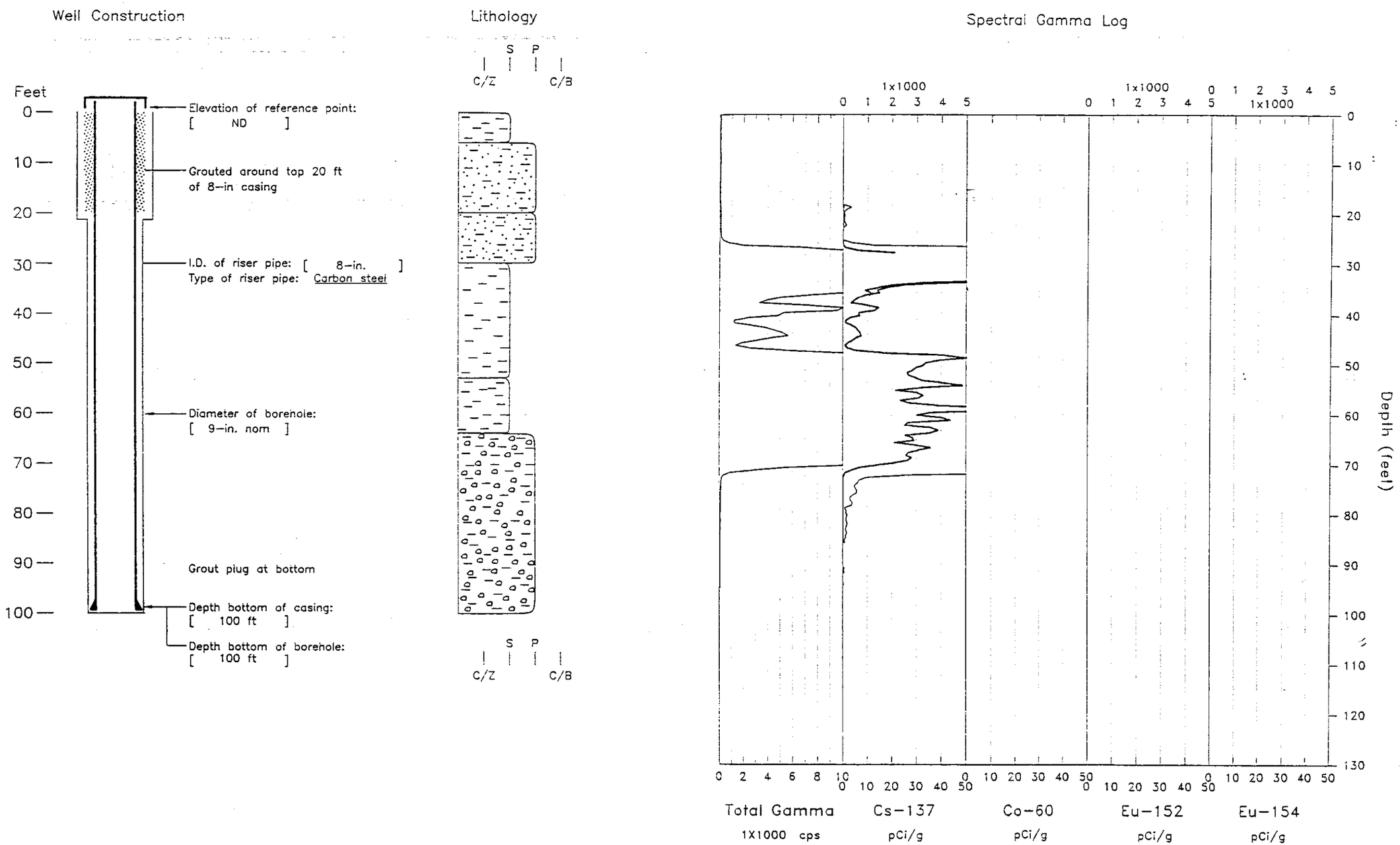
RLS Calibration Date: Nov 21, 1991
Calibration Report: WHC-SD-EN-TRP-001

Analyst Names: J. Meisner R. K. Price
Analysis Date: July 22, 1992

Analysis Notes:
Radionuclides identified: Cs-137

RLS Spectral Gamma Ray Borehole Survey

Well 299-W15-210 | Crib 216-T-21:24 | Log Date 5/7/92



GEOSC:\15-210A

299-W15-210 T-21 thru T-24 Cribs

Casing	Depth: 98'	Size: 8"	Thickness: 0.324"
Water	Depth: none		
Survey	Depth: 0 - 94'	Date: 5/07/92	
	28 - 36'	(Lead Shield)	

General Notes:
The total gamma activity appeared to exceed 1,000,000 cps in the survey before saturation of the counting system. The excessive system dead-time with the normal equipment configuration for borehole logging prevents accurate calculation of gamma activity. The lead shield was installed to reduce the number of low energy gamma-rays being counted by the detector. The maximum total gamma activity at 29 feet with the lead shield installed was 172,000 cps.

Man-made Radionuclides:
Cesium (Cs-137) was encountered from 18 feet to 94 feet. The maximum activity encountered was 32,000 pCi/g at 29 feet from the lead shield survey. The cesium activity exceeded 10,000 pCi/g from 28 feet to 33 feet. The standard equipment configuration saturated at 28 feet. The last valid reading was 2070 pCi/g at 27.5 feet. The first lead shield reading was 8370 pCi/g at 28 feet which exceeds the standard plot scale of 5000 pCi/g.

No Cobalt (Co-60) was encountered in the borehole. The plot track is present only for uniformity of the displayed data.

No Europium-152 (Eu-152) was encountered in the borehole. The plot track is present only for uniformity of the displayed data.

No Europium-154 (Eu-154) was encountered in the borehole. The plot track is present only for uniformity of the displayed data.

Westinghouse Hanford Company | LOG HEADER | Page 1 of 2

Well No. 299-W15-210 Area 200 West Area Site 42

Log Run 4 Log Type Gamma Gamma

Elevation Datum Elevation

Survey Coordinates N 41370 Y -1580 W

Logs Measured From Ground Surface

Location Coordinates T21, 24 Cribs

Ground Surface Elevation

Surface Temperature N/A Weather Clear Hot

BOREHOLE INFORMATION

Drilled

Drill Bit Type Bit Diameter

Borehole Diameter/Casing 8"/9 7/8"

Drilled Depth 100' Total Depth 0-24

Mud Level N/A Mud Density N/A

Temperature N/A

CASING RECORD

Type 8" Carbon Steel Sch 40 Wall 7/8"

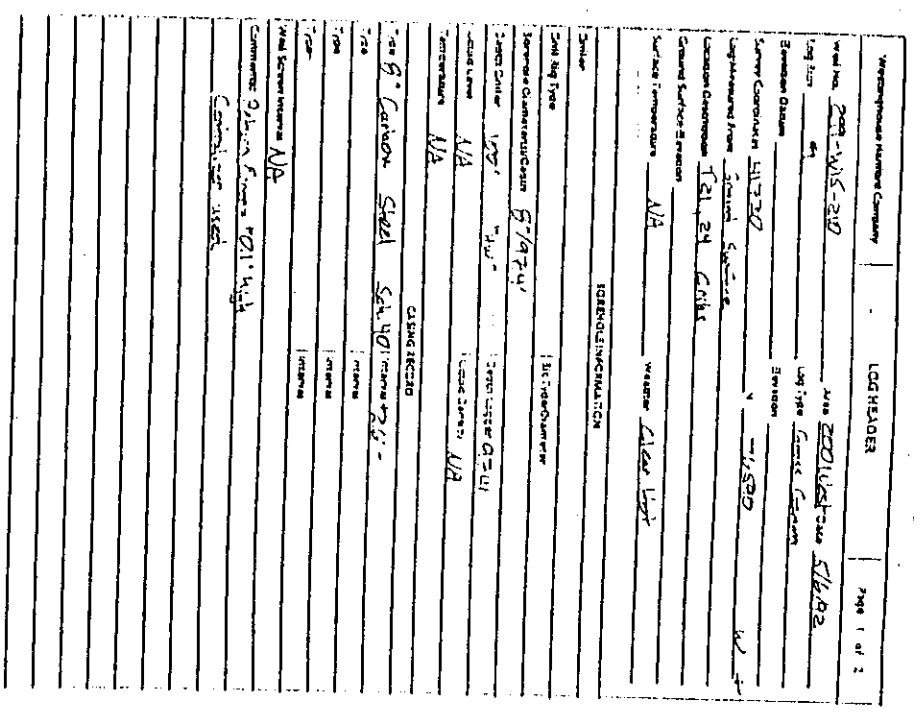
Type Weight

Type Weight

Well Screen Interval N/A

Comments: Probe Error: +0.1' high

Centralizer used



LOG HEADER | Page 2 of 2

EQUIPMENT DATA

Logging Company PNL

Operator(s) Alan Pearson

Equipment Brand MIS Equipment Type Analog

Tool Type Gamma Bat Serial No. CG27MXI

Base Calibration Date 5/91 Calibration Reference PNL-7785 HC-606

Calibration/Probe Factor 0.0[illegible] Calibration Datum (cU) Position 1 [illegible] cell Position 2 [illegible] cell

Dead Time 11.8 usec Warm Up Time 15 min

LOGGING INFORMATION

Log Interval from 974 to 25

Datum(s) 250' to 25 @ 50cps 750' to 700' @ 50cps

Pre Survey Verification: Position 1 3028 cell Position 2 619 cell Background 75 cps

Base Calibration Difference: Position 1 54 cell Position 2 24 cell

Logging Speed 5'/min Ratio Scale, CPS/in 50 cps/in

Start Time 1230 Completion Time 1415

Chart Speed(s), l/min 10'/in

Chart Recorder Horizontal Scale, CPS/in 50 cps/in Time Constant(s) 10-1

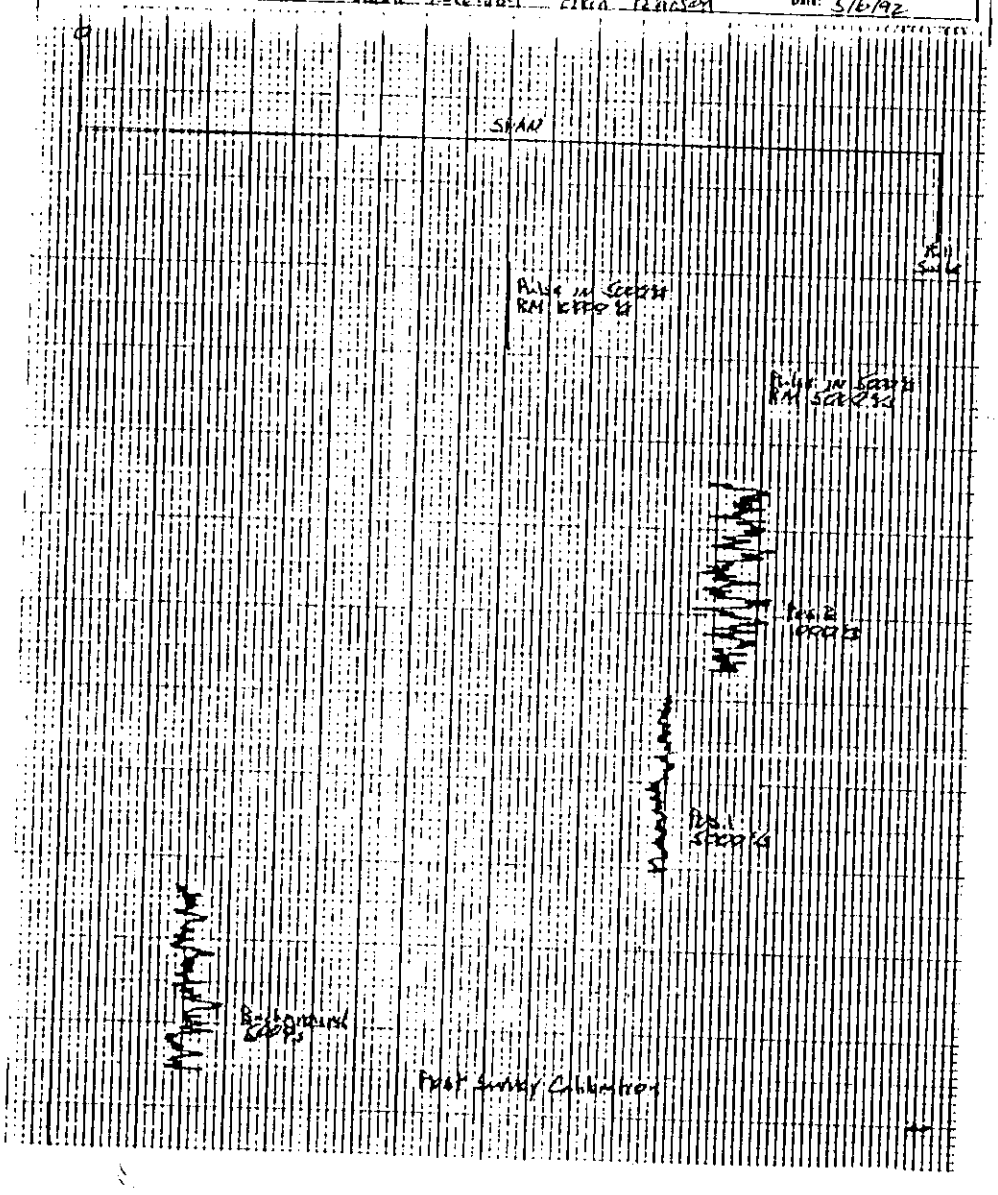
Post Survey Verification: Position 1 3028 cell Position 2 619 cell Background 75 cps

Percent Change: Position 1 00% Position 2 00%

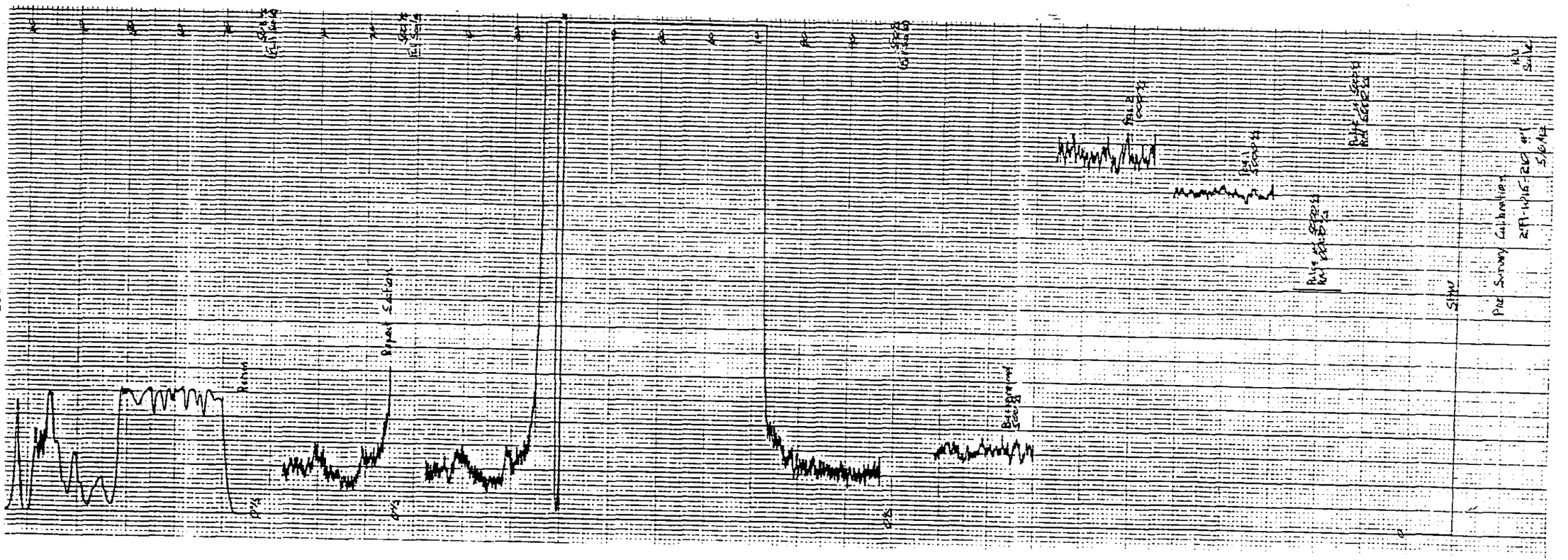
Comments: Probe Error: +0.1' high

Centralizer used

Witnessed and Verified by: (sign and print name) Alan Pearson Alan Pearson Date: 5/6/92



299-W15-210



Crib Designation: Cribs 216-T-26, 216-T-27, 216-T-28

Type of Facility: All three are 30 ft x 30 ft concrete structures

Location: N 42275 to N 42445, W 75330, Just east of TY tank farms

Service Dates:
216-T-26: 8/55 to 11/56
216-T-27: 9/65 to 11/65
216-T-28: 2/60 to 2/66

Description of Waste:
216-T-26: 12 x 10^6 liters of scavenged first cycle waste from 221-T, High salt, neutral to basic
216-T-27: 7.19 x 10^6 liters of 300 Area laboratory waste from the 340 building, low salt, neutral to basic
216-T-28: 42.3 x 10^6 liters of steam condensate, decontamination waste and misc. effluents from 221-T, 300 Area laboratory waste from 340 building, low salt, neutral to basic

Radionuclide Release Summary:

216-T-26

Radionuclide	Quantity
Pu	59.0 g
Sr-90	670 Ci
Ru-106	2600 Ci
Cs-137	170 Ci
Co-60	1.0 Ci
U	150 kg

216-T-27

Radionuclide	Quantity
Pu	13. g
Sr-90	140 Ci
Ru-106	1500 Ci
Cs-137	100 Ci
Co-60	1.0 Ci
U	7.3 kg

216-T-28

Radionuclide	Quantity
Pu	70 g
Sr-90	200 Ci
Ru-106	1000 Ci
Cs-137	350 Ci
Co-60	5.0 Ci
U	390 kg

Summary of Past Logging:

Boreholes	Date	Reference
299-W11-70	1976	Fecht, et al., 1977
	1984	Geophysics files

	1987	"
299-W14-1	1976	Fecht, et al., 1977
299-W14-2	1976	"
299-W14-3	1976	"
	1986	Geophysics files
	1987	"
299-W14-4	1976	Fecht, et al., 1977
	1986	Geophysics files
	1987	"
299-W14-53	1976	Fecht, et al., 1977]
	1984	Geophysics files
	1986	"
	1987	"

Review of Current Logging:

Boreholes: 299-W11-70
299-W14-4

Both of these boreholes were logged with the PNL gross gamma and the RLS spectral gamma systems. Cs-137, Co-60, Eu-152 and Eu-154 were all detected in both of these boreholes. This is not surprising considering the quantity and variety of effluent waste released at these cribs.

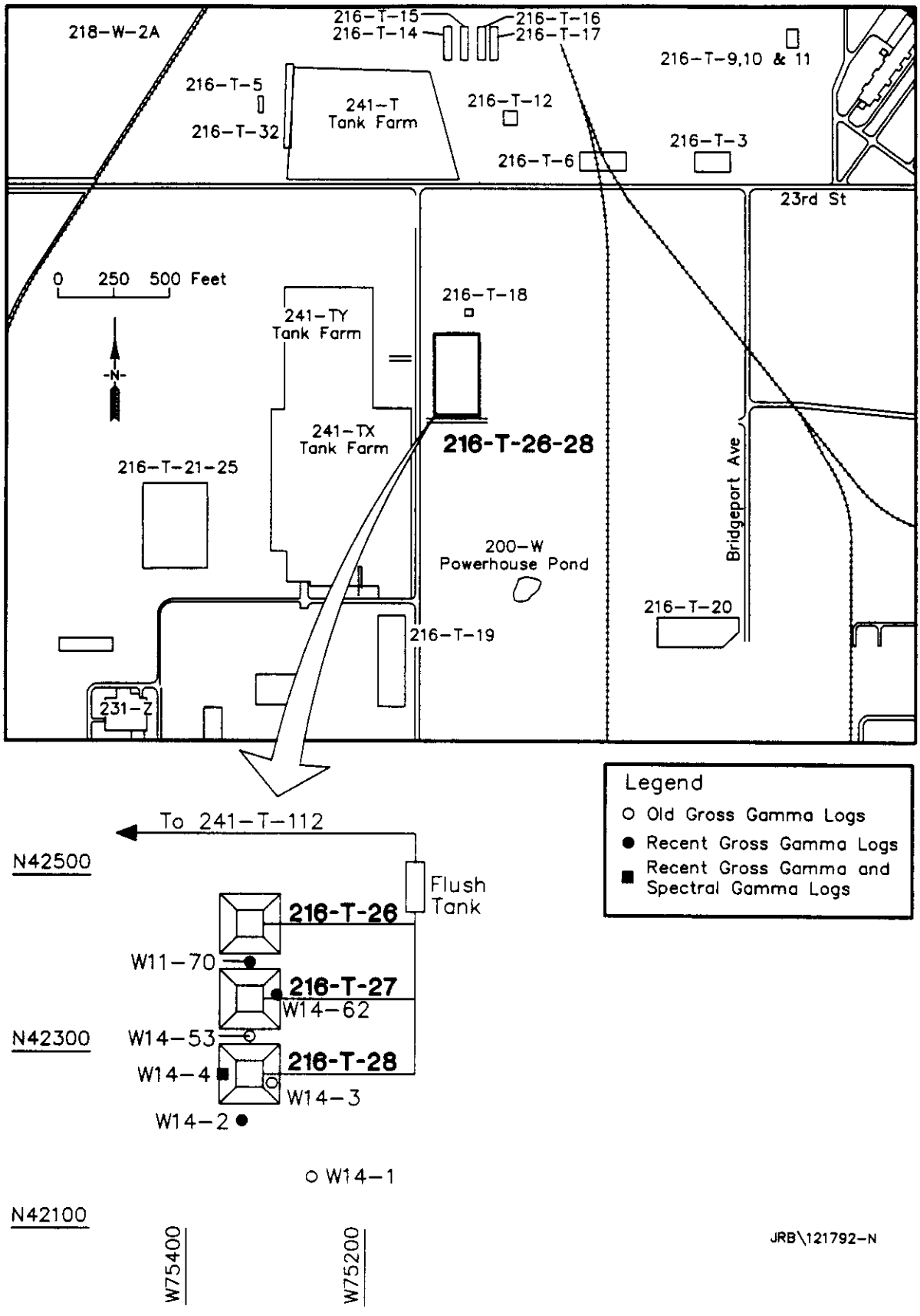
Because of the grout behind the casing, none of the reported concentrations are accurate and the uncertainty of the measurements is very high.

Upon review of the old gross gamma-ray logs, it is clear that the effluent did, at one time carry man-made, gamma-emitting nuclides down to the groundwater. That gross gamma activity previously detected has now decayed away, indicating that those nuclides were short lived nuclides such as Ru-106. This is reasonable considering the high mobility of ruthenium and the documented large quantity of this isotope released at this site.

Low concentrations of cobalt and europium were found deeper in the boreholes but most of the cesium was found higher up in the unsaturated zone. It is reasonable to conclude that the cesium has not migrated down to the groundwater but the more mobile cobalt and europium have.

Because of the large volume of effluent released at this site, there does not appear to be any stratigraphic control over the deposition of the nuclides.

It would be advantageous to log all of the existing boreholes at this site to determine the areal extent of the contamination.


218-W-2A
216-T-15
216-T-14
216-T-16
216-T-17
216-T-9,10 & 11
216-T-5
216-T-32
241-T
Tank Farm
216-T-12
216-T-3
216-T-6
23rd St
0 250 500 Feet
-N-
241-TY
Tank Farm
216-T-18
241-TX
Tank Farm
216-T-26-28
216-T-21-25
Bridgeport Ave
200-W
Powerhouse Pond
216-T-20
216-T-19
231-Z
Legend
Old Gross Gamma Logs
Recent Gross Gamma Logs
Recent Gross Gamma and Spectral Gamma Logs
To 241-T-112
N42500
Flush
Tank
216-T-26
W11-70
216-T-27
W14-62
N42300
W14-53
216-T-28
W14-4
W14-3
W14-2
W14-1
N42100
W75400
W75200
JRB\121792-N

Westinghouse Hanford Company
RLS Spectral Gamma-Ray Borehole Survey Log Header

Project: 200 AAMS, T 26 Crib

Borehole	299-W11-70			
Coordinates	42,404 N	75,330 W	Feet	(Plant 200 W)
Elevation	670. feet		Top of Casing	(Plant 200 W)

Borehole Environment Information

Borehole Fluid Depth none (Feet) from Zero (0.0) Depth Reference of Log

Casing Size I.D. (inch)	Casing Thickness (inch)	Top Depth (feet)	Base Depth (feet)
6.0	0.313	0.0	150.0

RLS Passive Spectral Gamma Survey Information

Logging Engineers R. V. Cram S. E. Kos
Log Depth Reference at Zero (0.0) depth is Ground Level

Log Date	Archive File Names	Log Mode[1], Speed	Depth Interval (feet) Top	Base	Incr
Feb 27, 92	H2W1170\A143	FIXED 0.6 fps	0.	144.	0.5

[1]FIXED: Fixed velocity of Cable Speed: fps: Feet per second

Calibration and Analysis Information

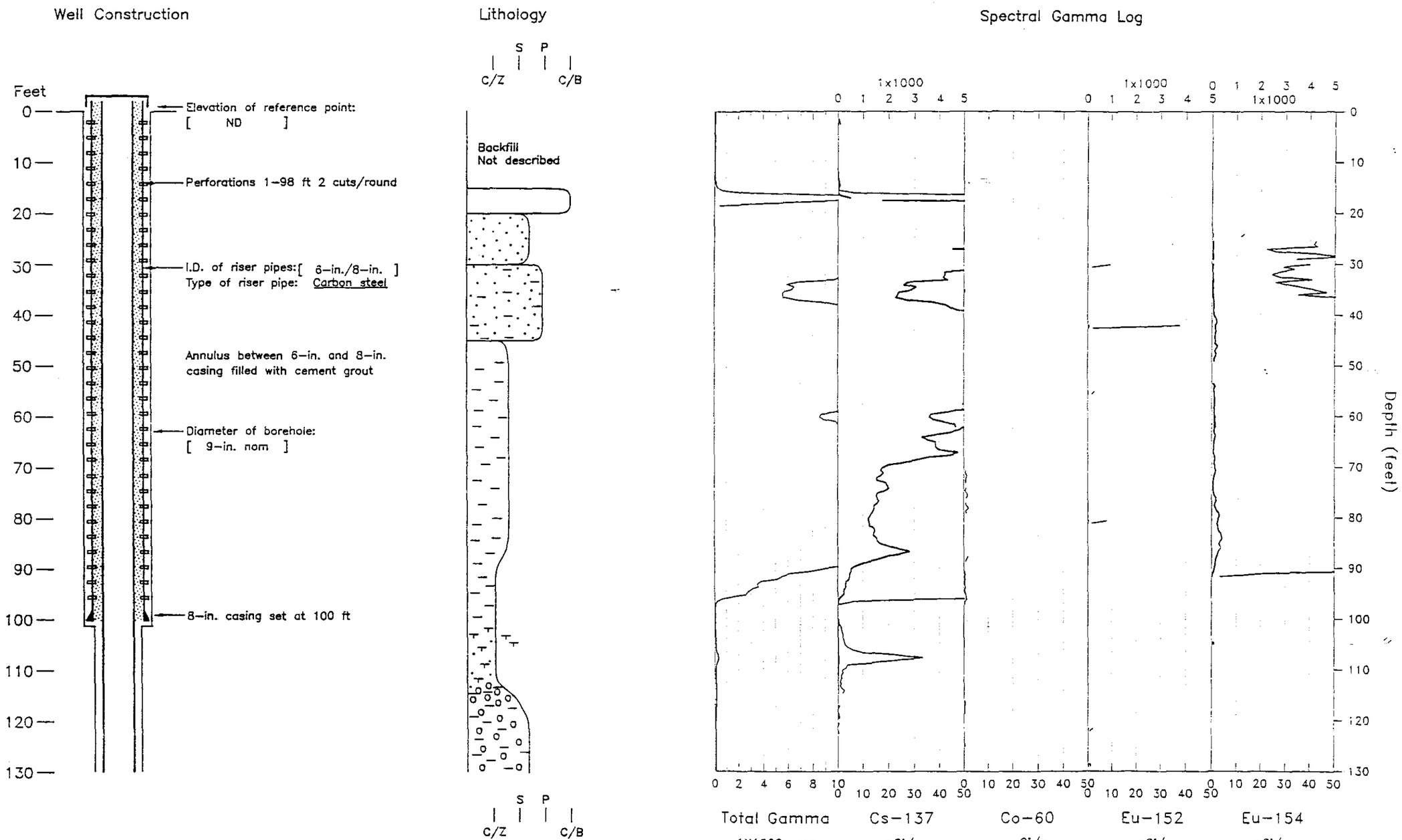
RLS Calibration Date: Nov 21, 1991
Calibration Report: WHC-SD-EN-TRP-001

Analyst Names: W. F. Nicaise R. K. Price
Analysis Date: July 13, 1992

Analysis Notes: No continuous zones of Eu-152 identified
Radionuclides identified: Cs-137, Co-60, Eu-154, Eu-152

RLS Spectral Gamma Ray Borehole Survey

Well 299-W11-70 | Crib 216-T-26 | Log Date 2/27/92

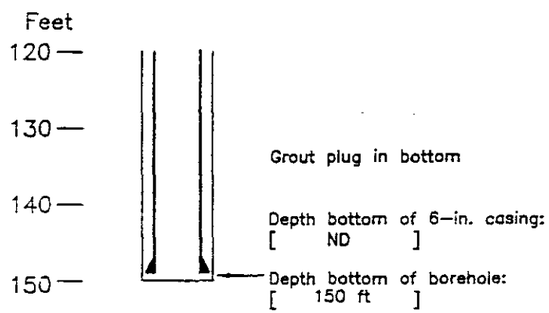


GEOSCI\11-70A

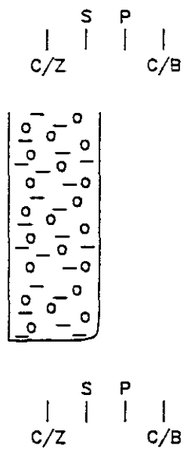
RLS Spectral Gamma Ray Borehole Survey (Page 2)

Well 299-W11-70 | Crib 216-T-26 | Log Date 2/27/92

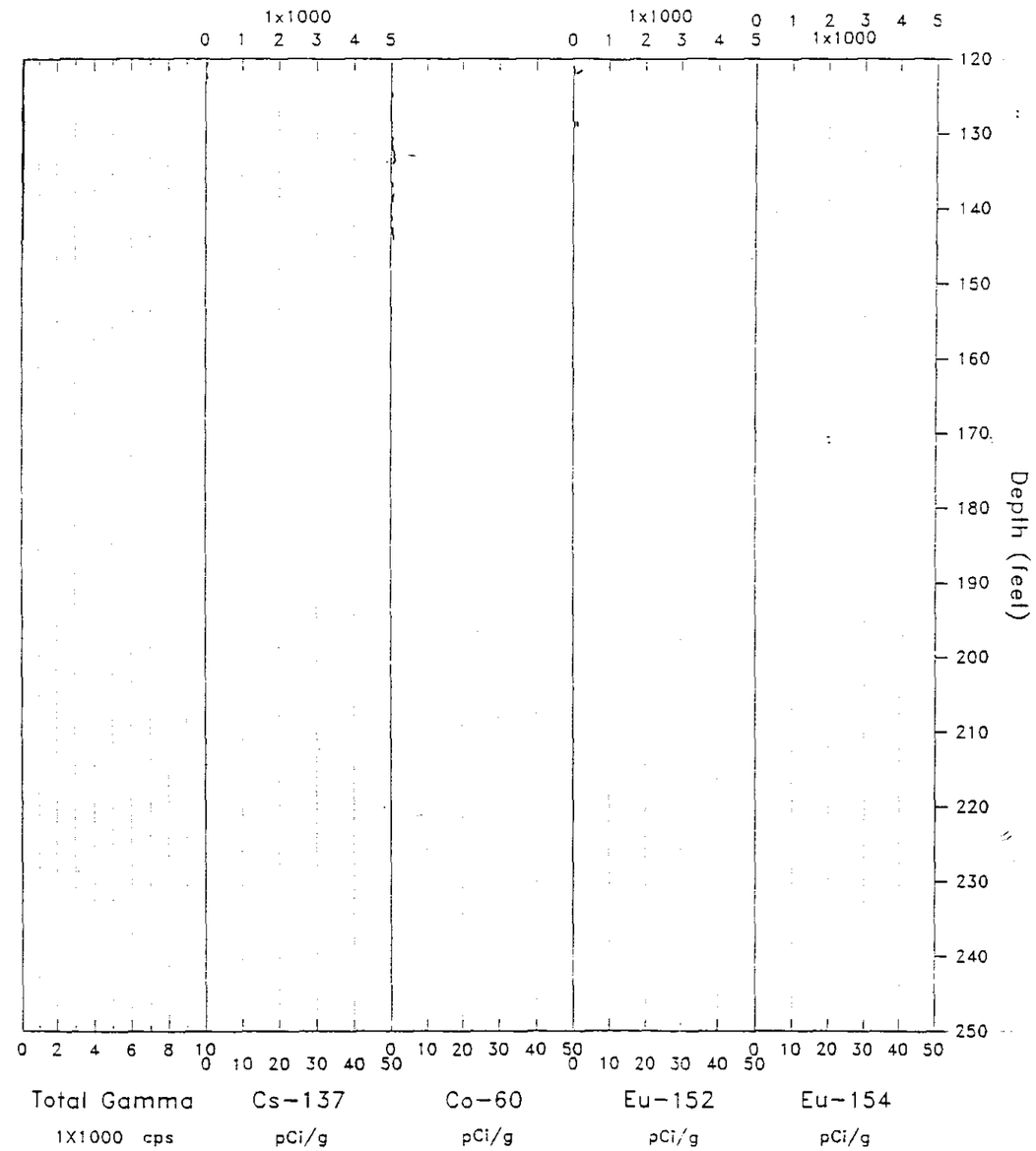
Well Construction



Lithology



Spectral Gamma Log



GEOSCA\11-70B

299-W11-70 T-26 Crib

Casing	Depth: 150'	Size: 6"	Thickness: 0.313"
Water	Depth: none		
Survey	Depth: 0 - 18'	Date: 2/27/92	
	Depth: 60 - 144'		
	Depth: 18 - 62'	(Lead Shield)	

General Notes:
The survey is plotted on two pages. Log survey data was acquired with the standard logging configuration between the depths of 0 to 18 feet and 60 to 144 feet. Log survey data with the standard logging configuration was not acquired from 18 feet to 60 feet due to very high count rates. The lead shield was installed and log survey data was acquired from 18 feet to 62 feet. The total gamma activity from the lead shield is plotted from 18 feet to 62 feet since no standard configuration data was acquired in this interval.

The total gamma activity reached 150,000 cps in the borehole survey at 61 feet with the standard logging configuration, ie. no lead sheild. The total gamma activity with the lead shield reached 700,000 cps at 19 feet before the system was saturated. The RLS system was saturated from 19 feet to 21 feet, with the lead shield installed and electronics configuration adjusted for maximum counting efficiency.

Man-made Radionuclides:
Cesium (Cs-137) was encountered near the surface from 1 foot to 3 feet and lower in the borehole from 12 feet to 123 feet. The maximum activity exceeded 33,000 pCi/g from 19 feet to 23 feet. Cesium activity exceeded 5,000 pCi/g from 18 to 31 feet and from 40 to 62 feet. The activity exceeded 10,000 pCi/g from 18 to 26 feet and from 40 to 55 feet. The activity exceeded 33,000 pCi/g from 19 to 23 feet and from 49 to 53 feet. Cesium activity is less than 50 pCi/g from 96 feet to 123 feet.

Cobalt (Co-60) was observed from 70 feet to the bottom (144 feet). The maximum activity encountered was 2 pCi/g. Generally the Cobalt activity is less than 1 pCi/g. The high cesium activity from 18 to 90 feet is potentially perturbing the detection of cobalt.

Europium-152 (Eu-152) was encountered in the borehole from 69 feet to 87 feet. The maximum activity was 8 pCi/g at 80 feet. The presence of Eu-152 was not continuously identified in the spectra files.

Europium-154 (Eu-154) was encountered in the borehole from 24 feet to 92 feet. The maximum activity encountered was 400 pCi/g at 84 feet. The high cesium activity may have caused Eu-154 activity to be underestimated from 49 feet to 53 feet. The Eu-154 activity is greater than 100 pCi/g for the following depth intervals: 40-48', 54-72', and 75-90'.

Westinghouse Hanford Company
RLS Spectral Gamma-Ray Borehole Survey Log Header

Project: 200 AAMS, T-28 Crib

Borehole	299-W14-04			
Coordinates	42,275 N	75,360 W	Feet	(Plant 200 W)
Elevation	662. feet		Top of Casing	(Plant 200 W)

Borehole Environment Information

Borehole Fluid Depth none (Feet) from Zero (0.0) Depth Reference of Log

Casing Size I.D. (inch)	Casing Thickness (inch)	Top Depth (feet)	Base Depth (feet)
5.0	0.219	0.0	204.0

RLS Passive Spectral Gamma Survey Information

Logging Engineers R. V. Cram S. E. Kos
Log Depth Reference at Zero (0.0) depth is Ground Level

Log Date	Archive File Names	Log Mode[1], Speed	Depth Interval (feet) Top	Base	Incr
Mar 10, 92	H2W1404\A152	FIXED 0.6 fps	0.	140.	0.5

[1]FIXED: Fixed velocity of Cable Speed: fps: Feet per second

Calibration and Analysis Information

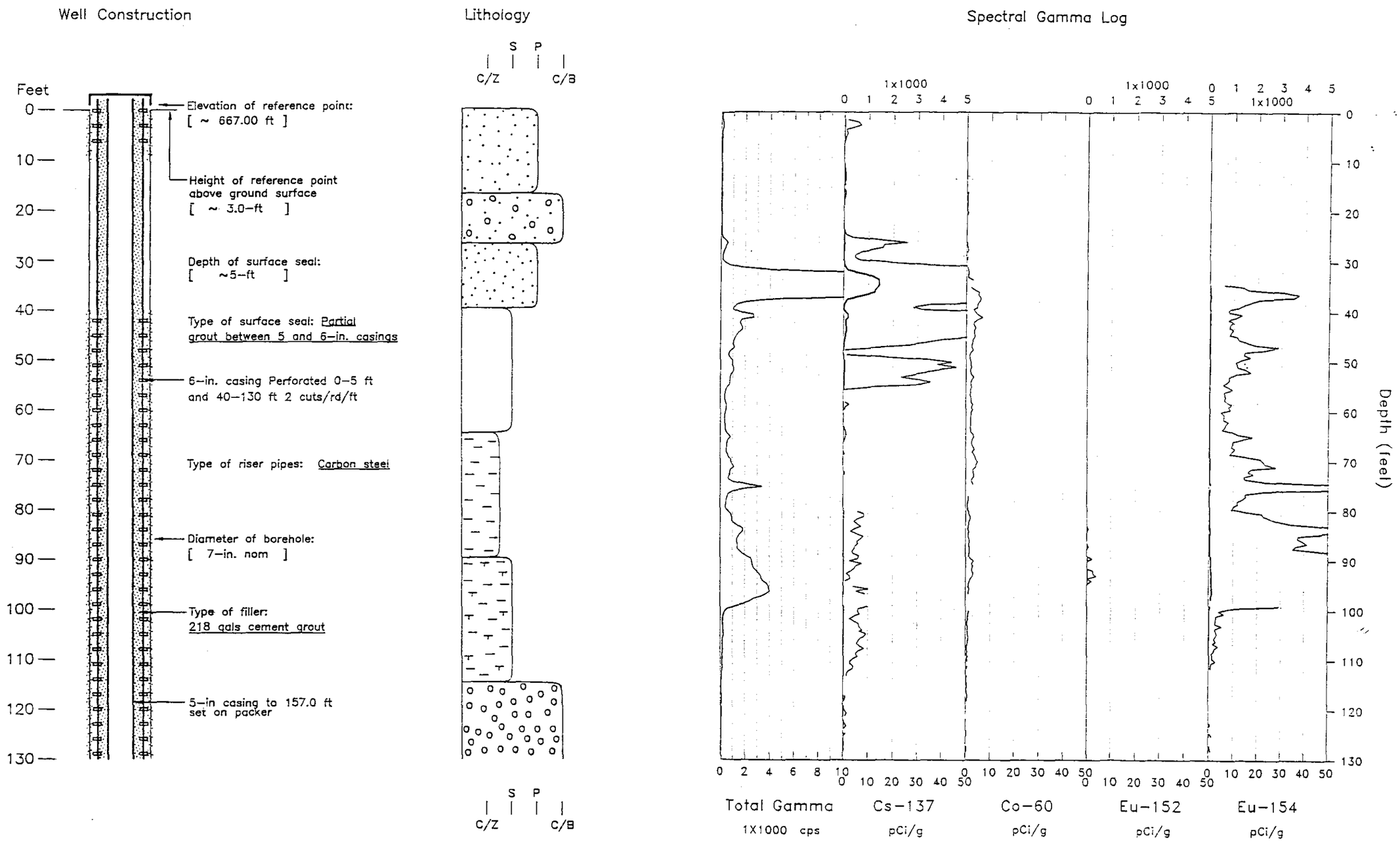
RLS Calibration Date: Nov 21, 1991
Calibration Report: WHC-SD-EN-TRP-001

Analyst Names: W. F. Nicaise R. K. Price
Analysis Date: July 23, 1992

Analysis Notes: Obstruction in hole at 143 ft. terminated log survey.
Radionuclides identified: Cs-137, Co-60, Eu-154, Eu-152

RLS Spectral Gamma Ray Borehole Survey

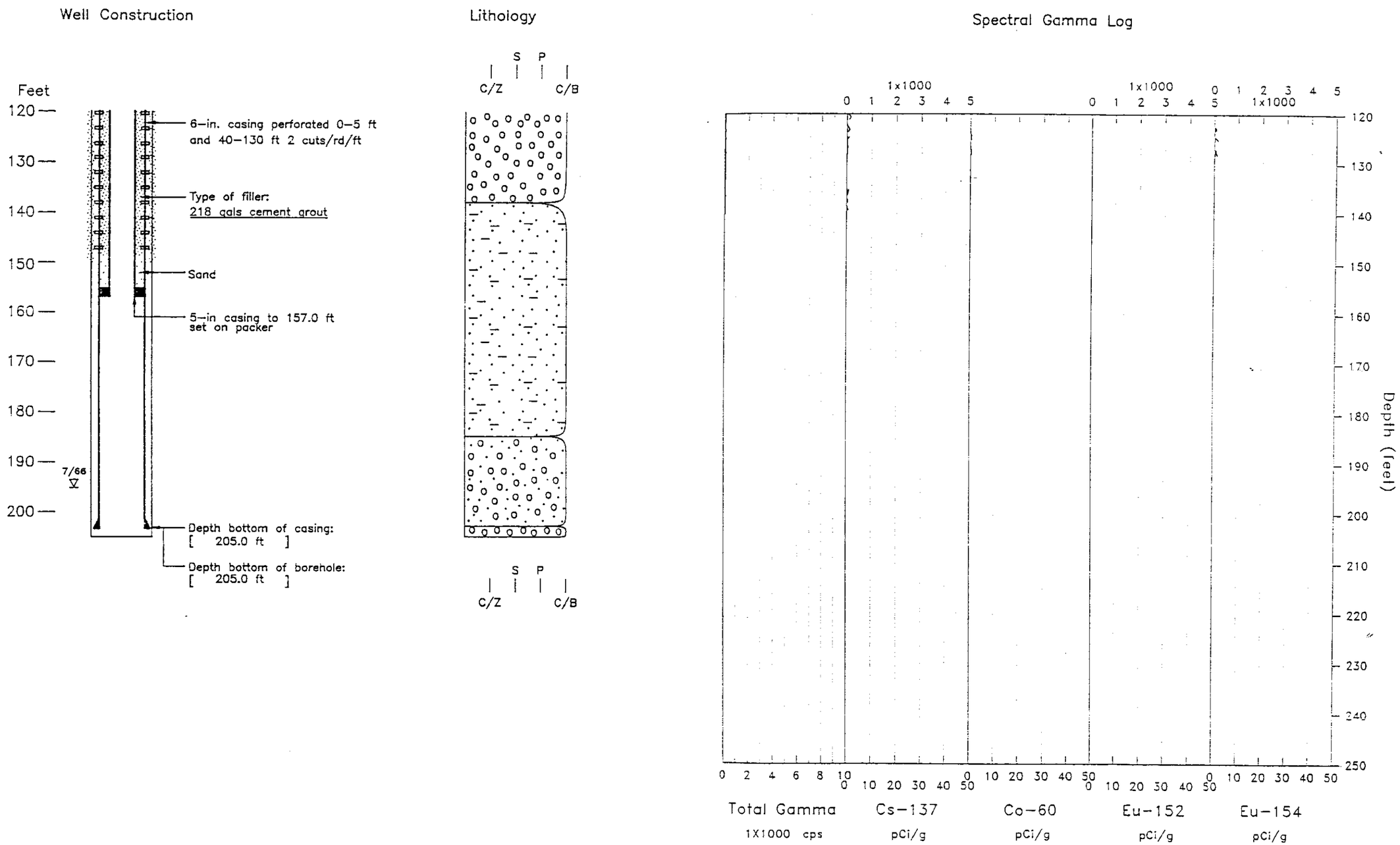
Well 299-W14-4 | Crib 216-T-28 | Log Date 3/10/92



GEOSCI\14-4A

RLS Spectral Gamma Ray Borehole Survey (Page 2)

Well 299-W14-4 | Crib 216-T-28 | Log Date 3/10/92



GEOSCI\14-4B

299-W14-4 T-28 Crib

Casing	Depth: 204'	Size: 5"	Thickness: 0.219"
Water	Depth: none		
Survey	Depth: 0 - 140'	Date: 3/10/92	

General Notes:
An obstruction in the borehole at 143 feet prevented the detector from reaching the maximum hole depth.

The survey is plotted on two pages. The survey data from 120 feet to 130 feet are plotted on both pages.

The total gamma activity did not exceed 32,000 cps in the survey.

Man-made Radionuclides:
Cesium (Cs-137) was encountered from 1 foot to the maximum survey depth of 140 feet. The maximum activity observed was 1450 pCi/g at 34 feet.

Cobalt (Co-60) was observed from 16 feet to the maximum survey depth of 140 feet. The maximum activity encountered was 6 pCi/g at 37 feet.

Europium-152 (Eu-152) was encountered in the borehole from 83 feet to 94 feet. The maximum activity was 4 pCi/g at 93 feet. The presence of Eu-152 was not continuously identified in the spectra files. The detection of Eu-152 is impacted by the high logging speed required for screening.

Europium-154 (Eu-154) was encountered in the borehole from 17 feet to 140 feet. The maximum activity encountered was 130 pCi/g at 96 feet. The identification of Eu-154 is nearly continuous from 17 feet to 112 feet.

299-W11-70

Westinghouse Hanford Company	LOG HEADER	Page 1 of 2

Well No. 299-W11-70 Area 200 West Date 2/27/92
Log Run #1 Log Type Gross Gamma
Elevation Datum Top of Casing Elevation [illegible] 6 71 GW
Survey Coordinates [illegible] N 2225 N 15220 W
Log Measured From Ground Surface
Location Description Near 216-T-26 Cribs
Ground Surface Elevation
Surface Temperature N/A Weather Overcast-Cool

BOREHOLE INFORMATION

Driller
Drill Rig Type Bit Type/Diameter
Borehole Diameter/Depth 6"/ Casing Diameter/Depth 6"/150.3' Casing Diameter/Depth 5.4"
Depth Driller 143.0' Depth Logger 143.2'
Liquid Level N/A (Dry) Liquid Density N/A
Temperature N/A

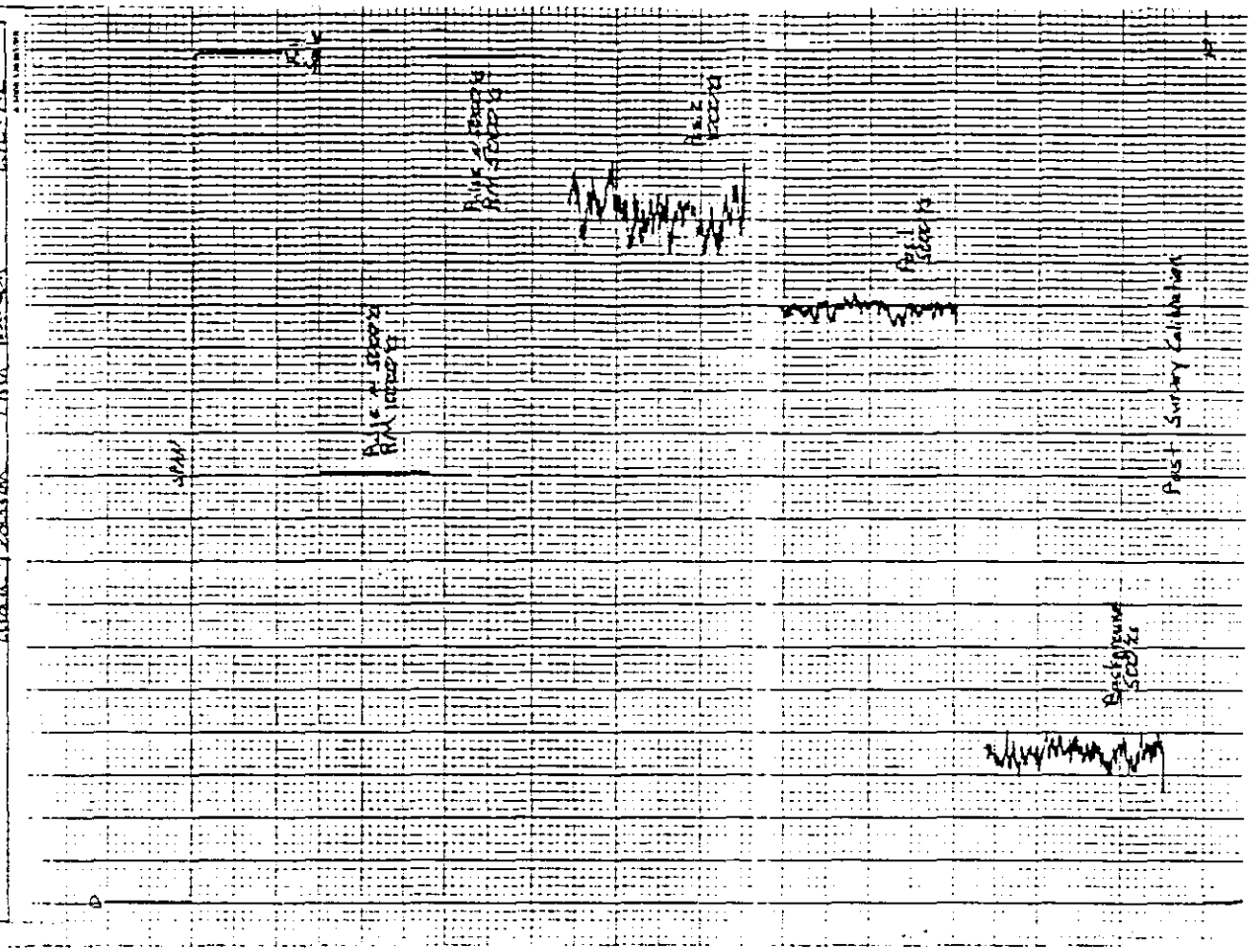
CASING RECORD

Type 6" Carbon Steel Interval ?
Type 5" Carbon Steel Interval ?-?
Type Interval
Type Interval
Well Screen Interval N/A
Comments: Spacer Ferrule 0.2' high
Centralizer used
Grout between 6" & 5" Casing
Info from Hanford Wells

LOG HEADER
EQUIPMENT DATA
Page 2 of 2

Logging Company PNL
Operator(s) Alan Pearson
Equipment Brand AMS Equipment Type Ratemeter
Tool Type Gamma Ray Serial No. 6027AB11
Base Calibration Date 5/91 Calibration Reference PNL-7485 NC-606
Calibration/Probe Factor 8.8 x 10^-6 R/hr/cps Calibration Datum (ft) Position 1 297.1 ft Position 2 641.3 ft
Grad Line 11.8 cps Warm Up Time 7.15 min
LOGGING INFORMATION
Log Interval From 147.2' To 1.8'
Records 1400 @ 1000 @ 5000 KEEP @ 500 @ 100 @ 50 @ 10 @ 10 @ 50 @ 100 @ 500 @ 1000 @ 1400
Pre Survey Verification: Position 1 305.7 ft Position 2 641.5 ft Background 90 cps
Post Survey Verification: Position 1 6.2 ft Position 2 0.2 ft
Base Calibration Difference: Noise Spike CPS/cps 50 cps/cps
Logging Speed 5 ft/min Completion Time
Start Time 0850 Time Constant(s) TC-1
Chart Speed(s) Div 10 div/in Chart Recorder Horizontal Scale CPS/in 50 cps/in
Post Survey Verification: Position 1 297.7 ft Position 2 641.1 ft Background 85 cps
Percent Change: Position 1 1.3% Position 2 0.1%
Comments: Spacer Ferrule 0.2' high
Centralizer used

Witnessed and Verified by: (sign and print name) Alan Pearson Alan Pearson Date 2/27/92



299-W14-4

Westinghouse Hanford Company	LOG HEADER	Page 1 of 2

Well No. 299-W14-4 Area 200 West Date 3/13/92
Log Run #1 Log Type Gross Gamma
Elevation Datum Top of Casing Elevation [illegible] 6 71 GW
Survey Coordinates [illegible] N 2293 N [illegible] W
Log Measured From Ground Surface
Location Description Near 216-T-26, 27, 29 Cribs
Ground Surface Elevation
Surface Temperature NA Weather Clear - Warm

BOREHOLE INFORMATION

Driller
Drill Rig Type Bit Type/Diameter
Borehole Diameter/Depth 6"/205' Casing Diameter/Depth 5"/143'
Depth Driller 198'/(HW) Depth Logger 205.5'
Liquid Level 194' (HW) Liquid Density Clean
Temperature NA

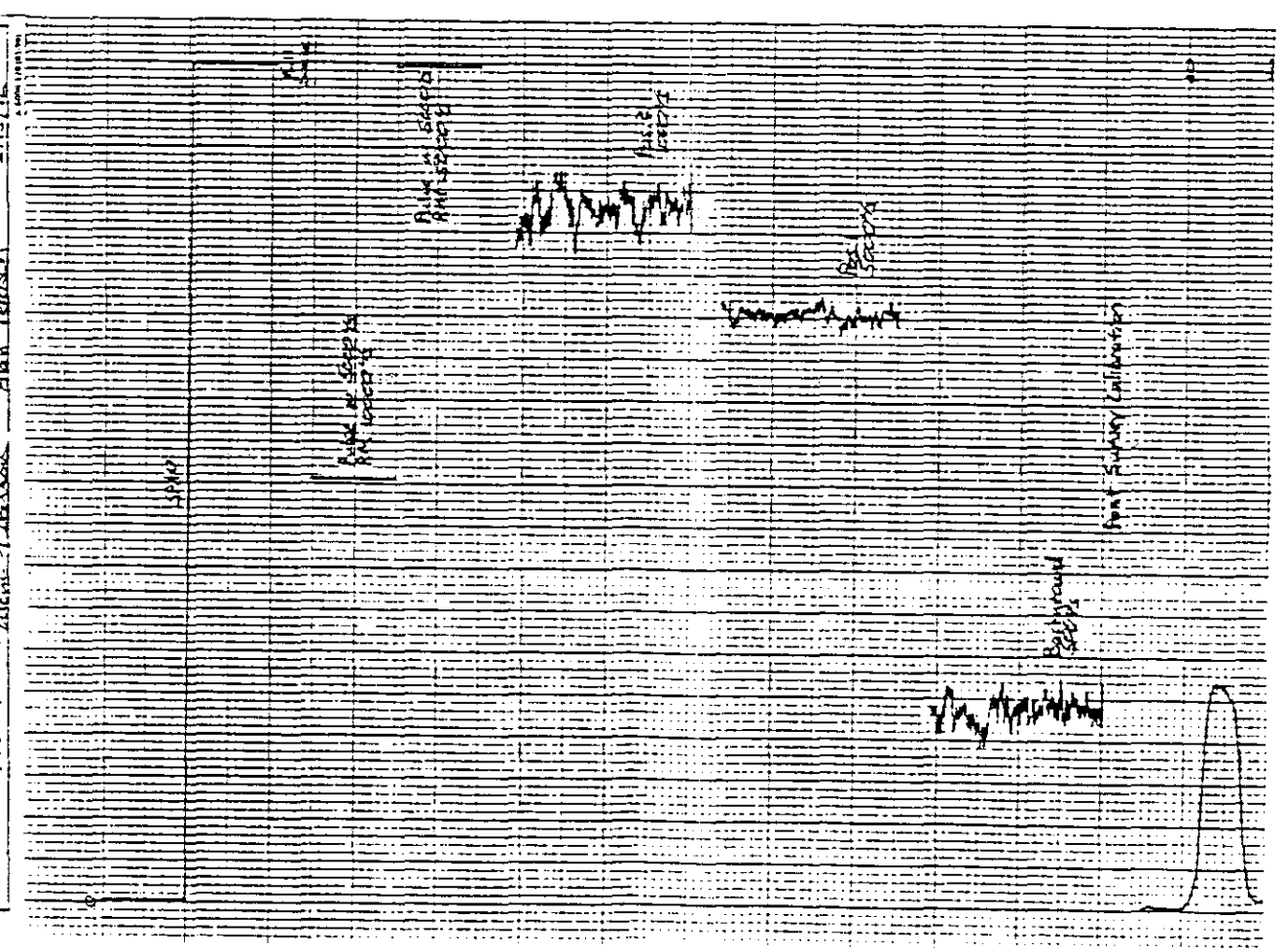
CASING RECORD

Type 6" Carbon Steel Interval ?3.1' - 198?
Type 5" Carbon Steel Interval ?' - 143'
Type Interval
Type Interval
Well Screen Interval NA
Comments: Spacer Ferrule 0.0'
~~Spacer used~~
Casing Collar Locator was used to locate 5" Casing bottom at 143'.

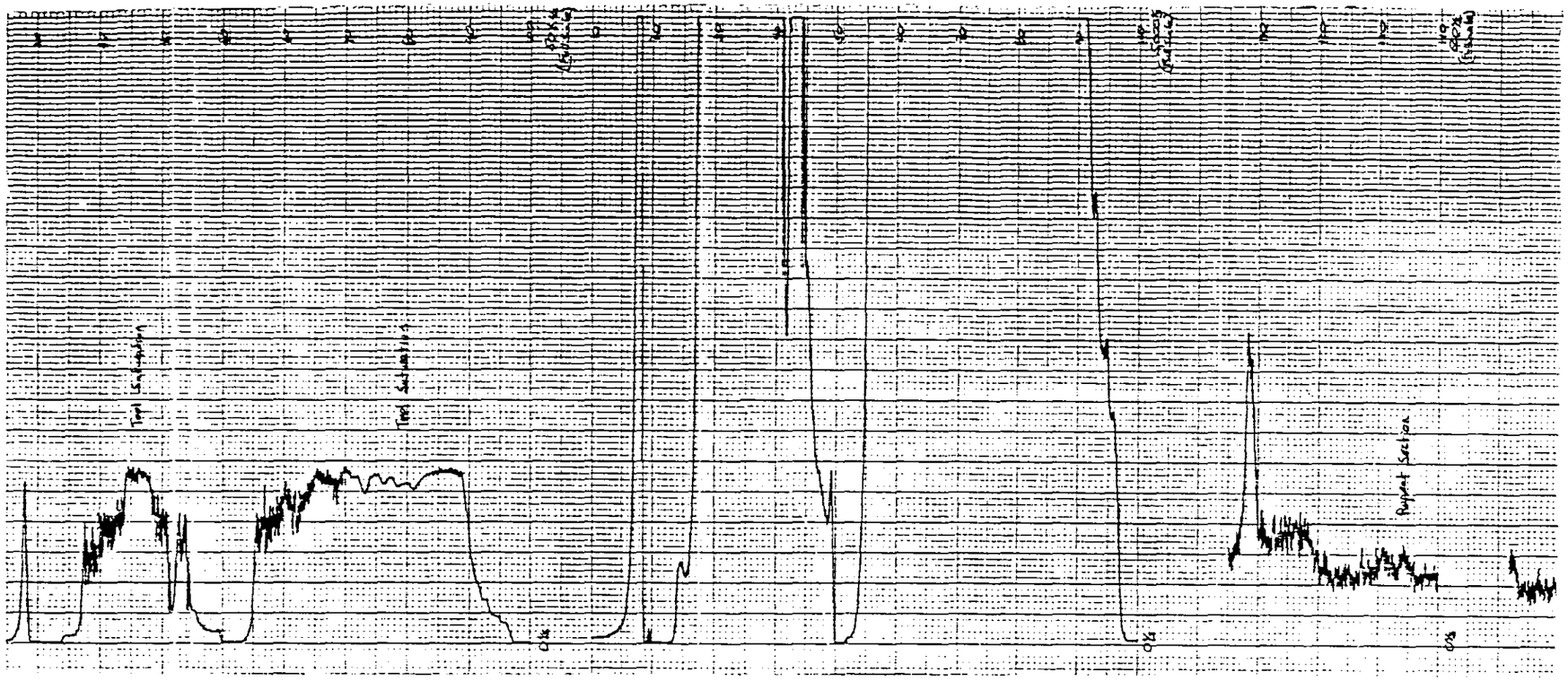
LOG HEADER
EQUIPMENT DATA
Page 2 of 2

Logging Company PNL
Operator(s) Alan Pearson
Equipment Brand AMS Equipment Type Ratemeter
Tool Type Gamma Ray Serial No. 6027AB11
Base Calibration Date 5/91 Calibration Reference PNL-7485 NC-606
Calibration/Probe Factor 8.8 x 10^-6 R/hr/cps Calibration Datum (ft) Position 1 297.1 ft Position 2 641.3 ft
Grad Line 11.8 cps Warm Up Time 7.15 min
LOGGING INFORMATION
Log Interval From 205.5' To 2.0'
Records 1400 @ 1000 @ 5000 KEEP @ 500 @ 100 @ 50 @ 10 @ 10 @ 50 @ 100 @ 500 @ 1000 @ 1400
Pre Survey Verification: Position 1 297.8 ft Position 2 63.2 ft Background 115 cps
Post Survey Verification: Position 1 2.6 ft Position 2 11 ft
Base Calibration Difference: Noise Spike CPS/cps 50 cps/cps
Logging Speed 5 ft/min Completion Time 1310
Start Time 1000 Time Constant(s) TC-1
Chart Speed(s) Div 10 div/in Chart Recorder Horizontal Scale CPS/in 50 cps/in
Post Survey Verification: Position 1 297.0 ft Position 2 62.5 ft Background 115 cps
Percent Change: Position 1 1.1% Position 2
Comments: Spacer Ferrule 0.0'
Centralizer used

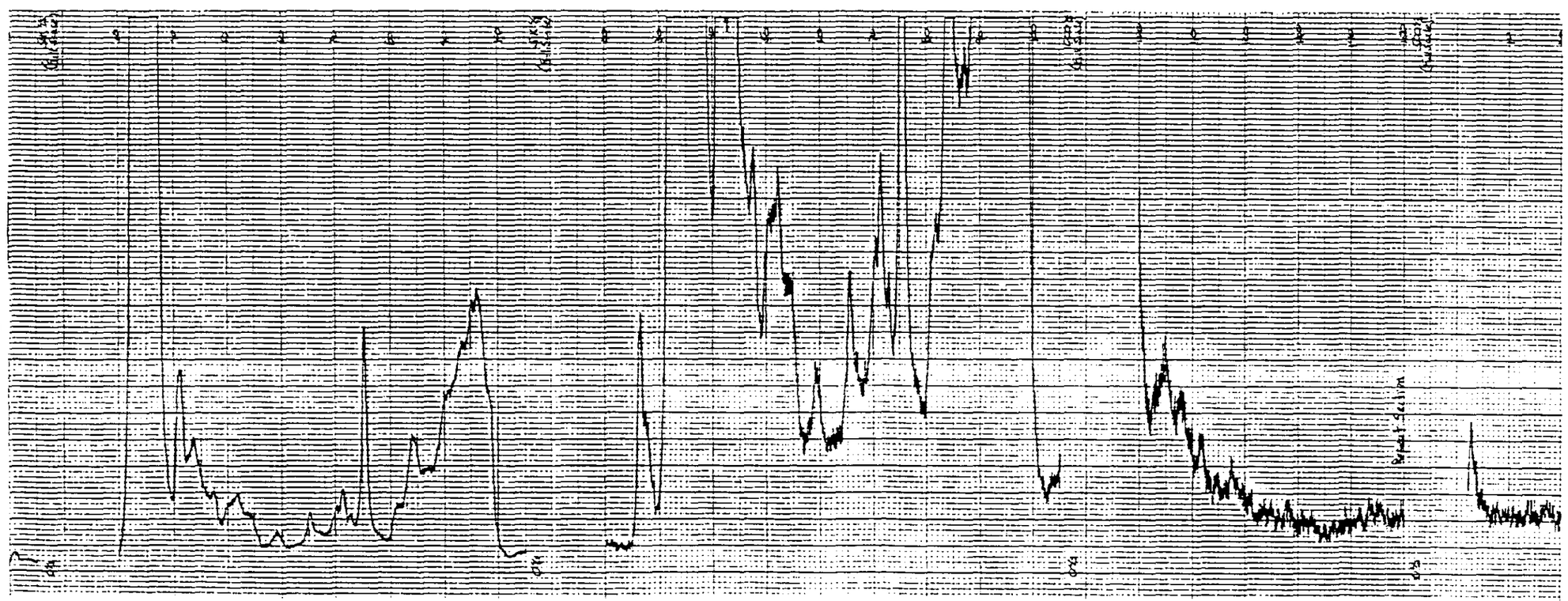
Witnessed and Verified by: (sign and print name) Alan Pearson Alan Pearson Date 3/13/92



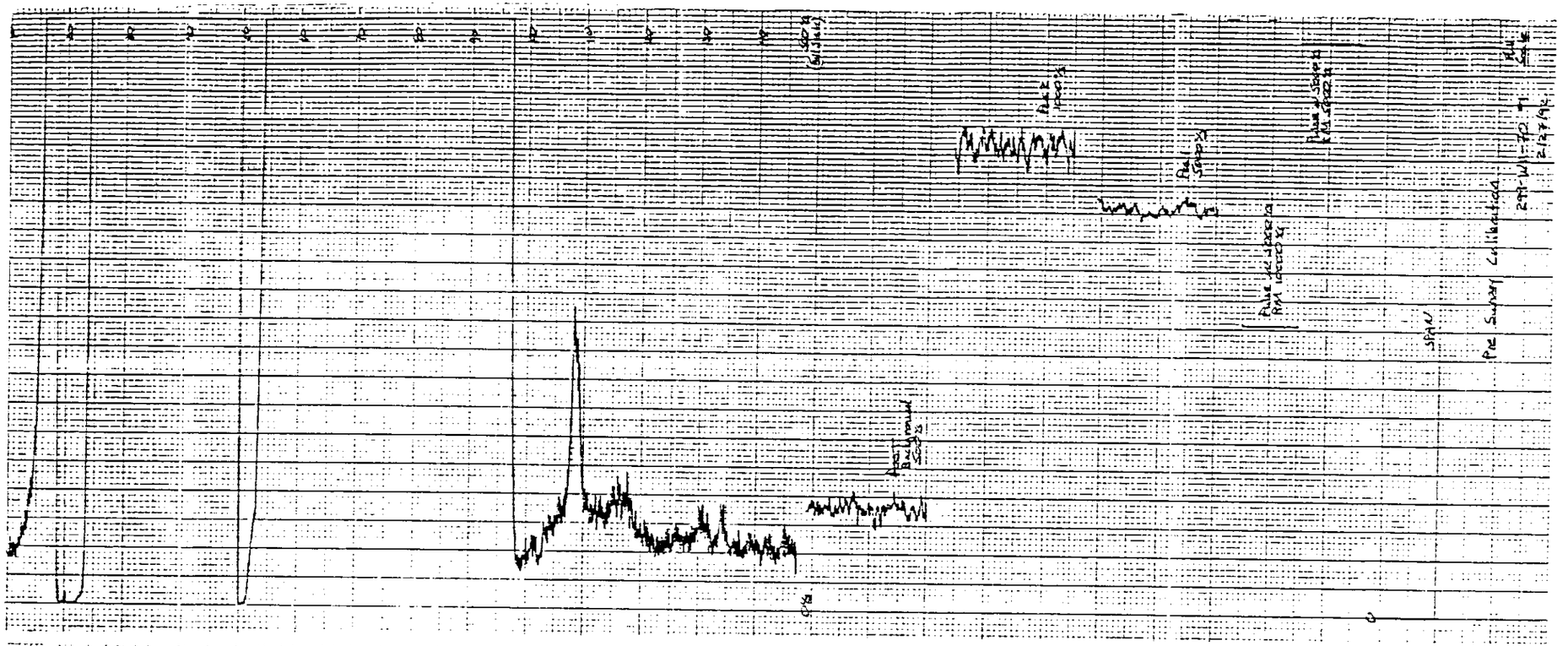
299-W11-70



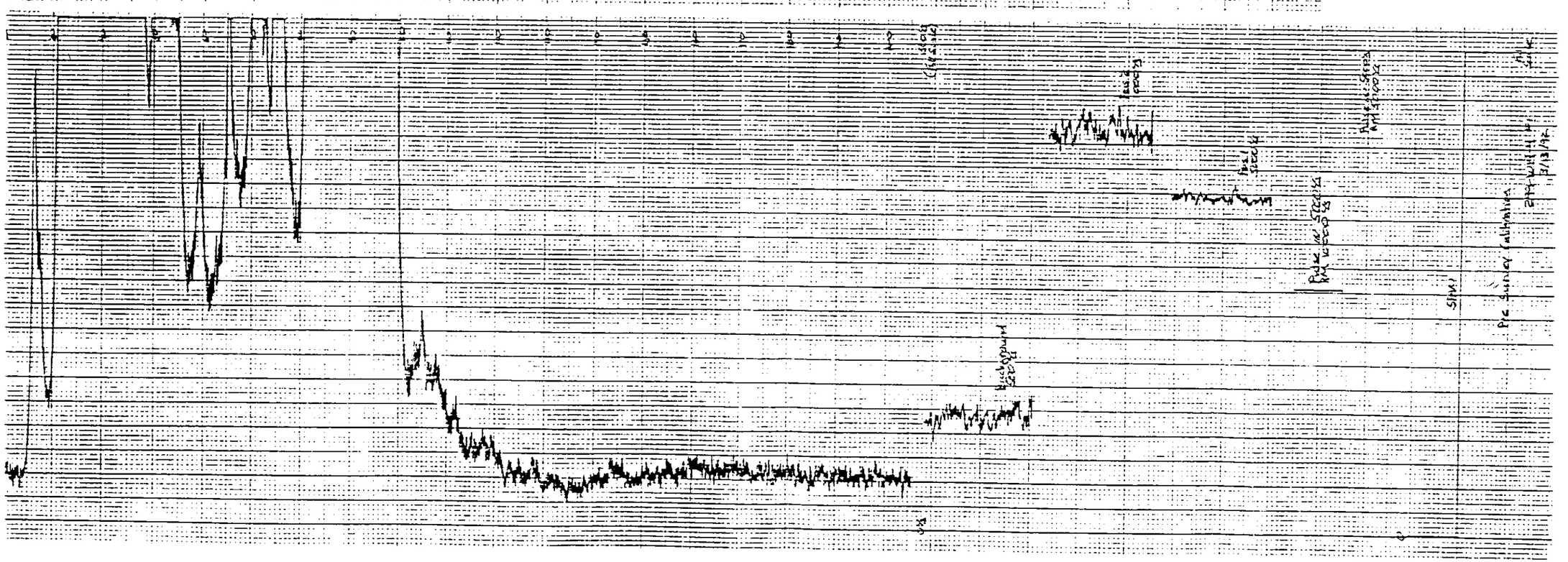
299-W14-4



299-211-70



299-W14-4



Crib Designation: Two cribs 216-T-34, 216-T-35

Type of Facility:
216-T-34: Gravel Crib, 200 ft x 30 ft
216-T-35: Rock filled crib, 450 ft x 10 ft

Location:
216-T-34: N 44220, W 73900
216-T-35: N 44558 to N 45015, W 74575 to W 74520

Service Dates:
216-T-34: 5/66 to 3/67
216-T-35: 3/67 to 1/68

Description of Waste: Both cribs received lab wastes from the 340 building, 300 Area. This was brought in via tanker truck at an unloading station at the northeast corner of 216-T-34.
216-T-34: 17.3 x 10^6 liters
216-T-35: 5.72 x 10^6 liters

Radionuclide Release Summary:

216-T-34:

Radionuclide	Quantity
Pu	110 g
Sr-90	320 Ci
Ru-106	110 Ci
Cs-137	280 Ci
Co-60	7.3 Ci
U	4.1 kg

216-T-35:

Radionuclide	Quantity
Pu	66 g
Sr-90	<20 Ci
Ru-106	130 Ci
Cs-137	20 Ci
Co-60	3.4 Ci
U	49 kg

Summary of Past Logging:

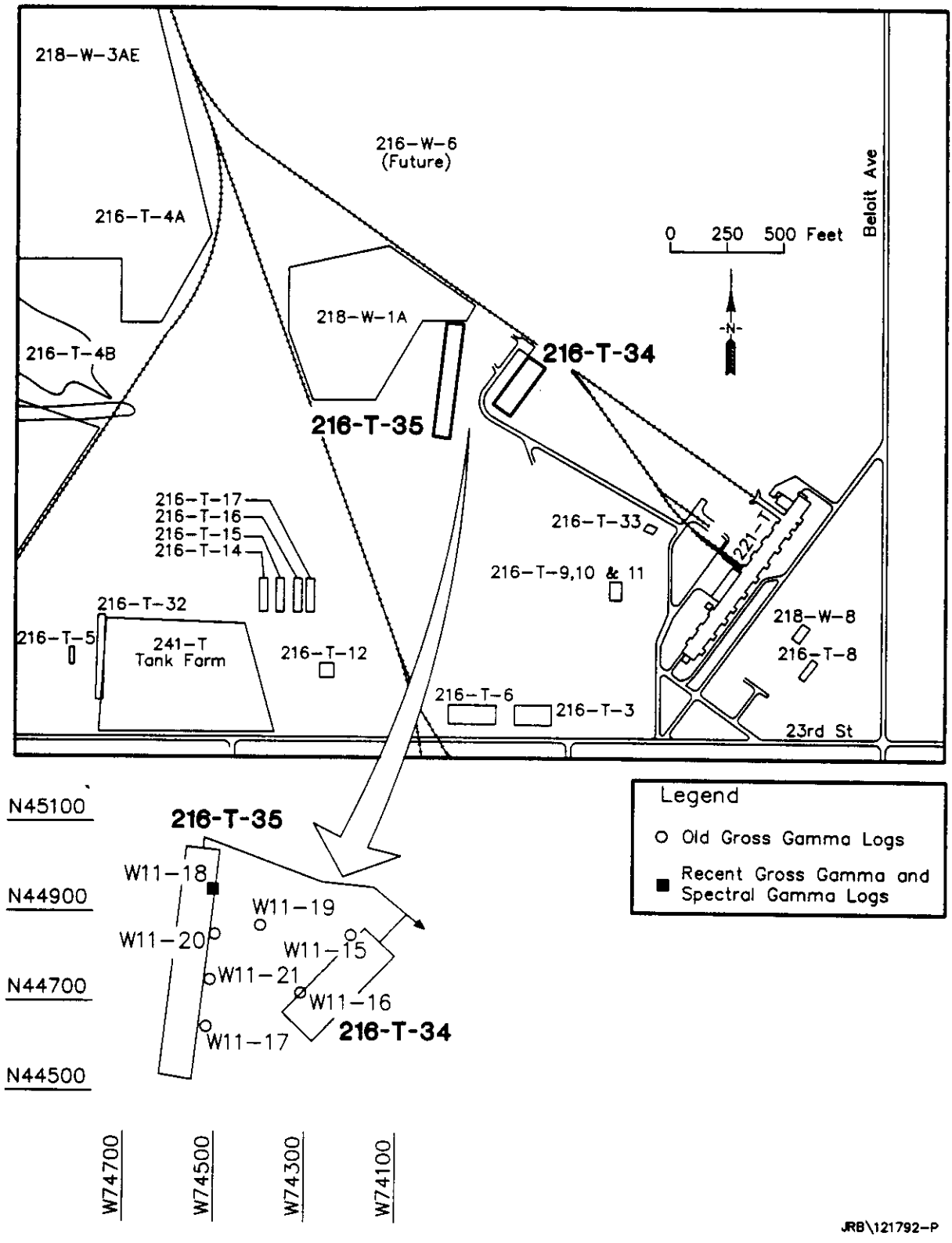
Boreholes	Date	Reference
299-W11-15	1976	Fecht, et al., 1977
299-W11-16	1976	"
	1987	Geophysics files
299-W11-17	1976	Fecht, et al., 1977
	1987	Geophysics files
299-W11-18	1976	Fecht, et al., 1977
299-W11-19	1976	"
	1987	Geophysics files
299-W11-20	1976	Fecht, et al., 1977
	1987	Geophysics files
299-W11-21	1976	Fecht, et al., 1976
	1987	Geophysics files

Review of Current Logging:
Borehole: 299-W11-18

This borehole is closest to the discharge pipe of the long crib, T-35. It was logged with both the PNL gross gamma and the RLS spectral gamma system. The spectral gamma log shows a typical deposition pattern found when a variety of nuclides are released. The Cs-137 is found up high near the release point. The bulk of the Co-60 and Eu-154 are also near the release point but there is some downward migration of these nuclides. These current data show that the nuclides have been retained fairly high up in the unsaturated zone.

However, older gamma-ray logs show elevated activity near or in the groundwater at these cribs. Boreholes 299-W11-15 through W11-20 all show elevated gross gamma activity beginning at about 245 feet. This could be due to groundwater contamination from another site or it is due to the rapid downward migration of Ru-106. Ruthenium is chemically, very mobile in the unsaturated zone. It tends to travel with the moisture front. Also, it has a short half life (364 days) and decays very quickly. This may explain the absence of activity in recent logs. It is recommended to make very long counting time measurements in the groundwater in some of these boreholes to see if Ru-106 can be detected.

Except for elevated activity in older gross gamma logs, it there is no data suggesting that radionuclides released at this site have contaminated the groundwater.


218-W-3AE
216-W-6
(Future)
216-T-4A
216-T-4B
218-W-1A
216-T-35
216-T-34
0 250 500 Feet
N
Beloit Ave
216-T-17
216-T-16
216-T-15
216-T-14
216-T-33
221-T
216-T-9,10 & 11
216-T-32
216-T-5
241-T
Tank Farm
216-T-12
218-W-8
216-T-8
216-T-6
216-T-3
23rd St
Legend
Old Gross Gamma Logs
Recent Gross Gamma and Spectral Gamma Logs
N45100
N44900
N44700
N44500
216-T-35
W11-18
W11-19
W11-20
W11-15
W11-21
W11-16
W11-17
216-T-34
W74700
W74500
W74300
W74100
JRB\121792-P

Westinghouse Hanford Company
RLS Spectral Gamma-Ray Borehole Survey Log Header

Project: 200 AAMS, T-35 Crib

Borehole	299-W11-18		
Coordinates	44,950 N 74,505 W	Feet	(Plant 200 W)
Elevation	707.0 feet	Top of Casing	(Plant 200 W)

Borehole Environment Information

Borehole Fluid Depth 243.0 (Feet) from Zero (0.0) Depth Reference of Log

Casing Size I.D. (inch)	Casing Thickness (inch)	Top Depth (feet)	Base Depth (feet)
8.0	0.313	0.0	300.0

RLS Passive Spectral Gamma Survey Information

Logging Engineers R. V. Cram S. E. Kos
Log Depth Reference at Zero (0.0) depth is Ground Level

Log Date	Archive File Names	Log Mode, Speed	Depth Interval (feet) Top	Base	Incr
Feb 22, 92	H2W1118\A141	FIXED 0.6 fps	0.	90.	0.5
Feb 22, 92	H2W1118\A142	FIXED 0.6 fps	88.	250.	0.5

[1]FIXED: Fixed velocity of Cable Speed; fps: Feet per second

Calibration and Analysis Information

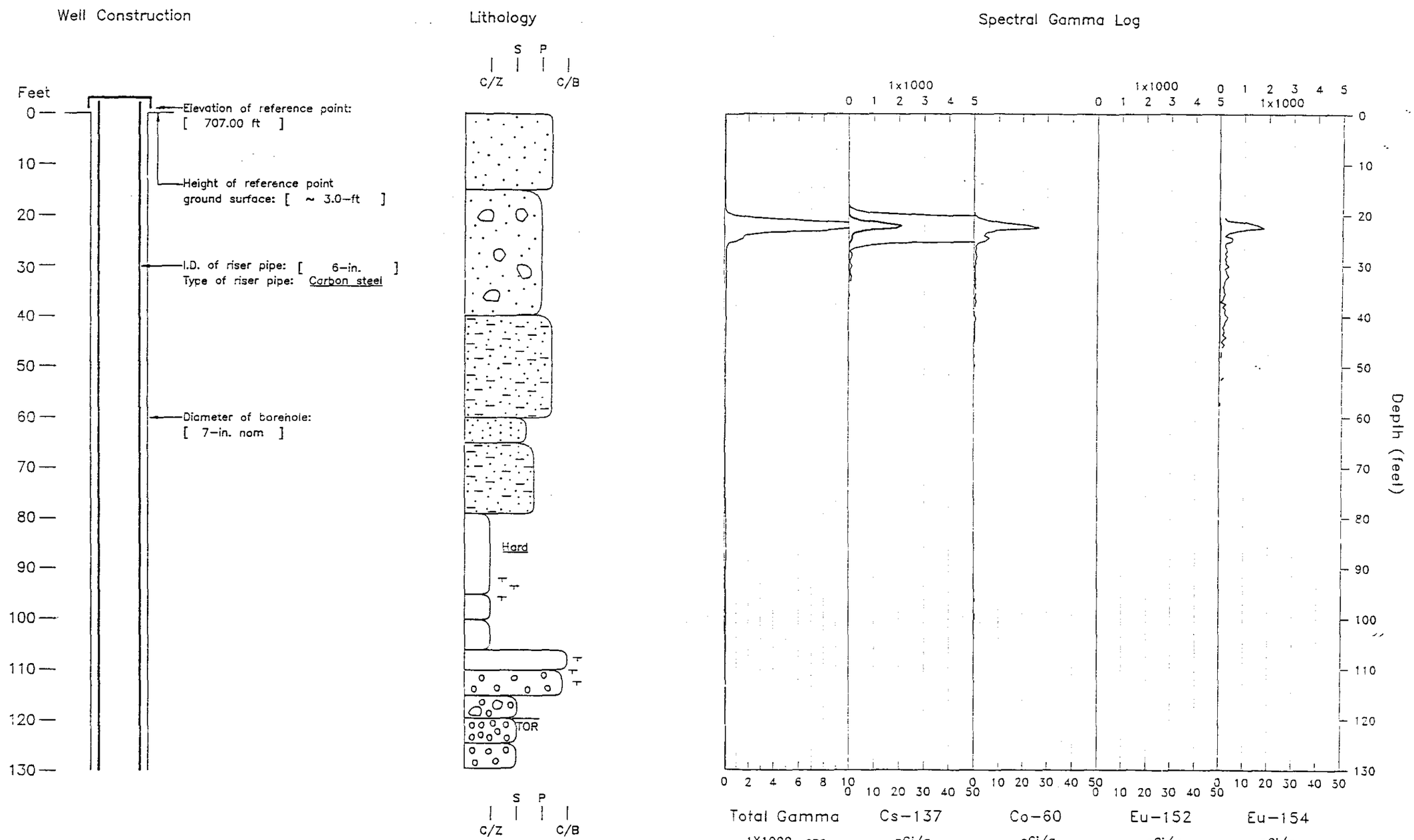
RLS Calibration Date: Nov 21, 1991
Calibration Report: WHC-SD-EN-TRP-001

Analyst Names: W. F. Nicaise R. K. Price
Analysis Date: Apr 24, 1992

Analysis Notes: No man-made radionuclides plotted on Pg 2 of data plot
Radionuclides identified: Cs-137, Co-60, Eu-154, NO Eu-152

RLS Spectral Gamma Ray Borehole Survey

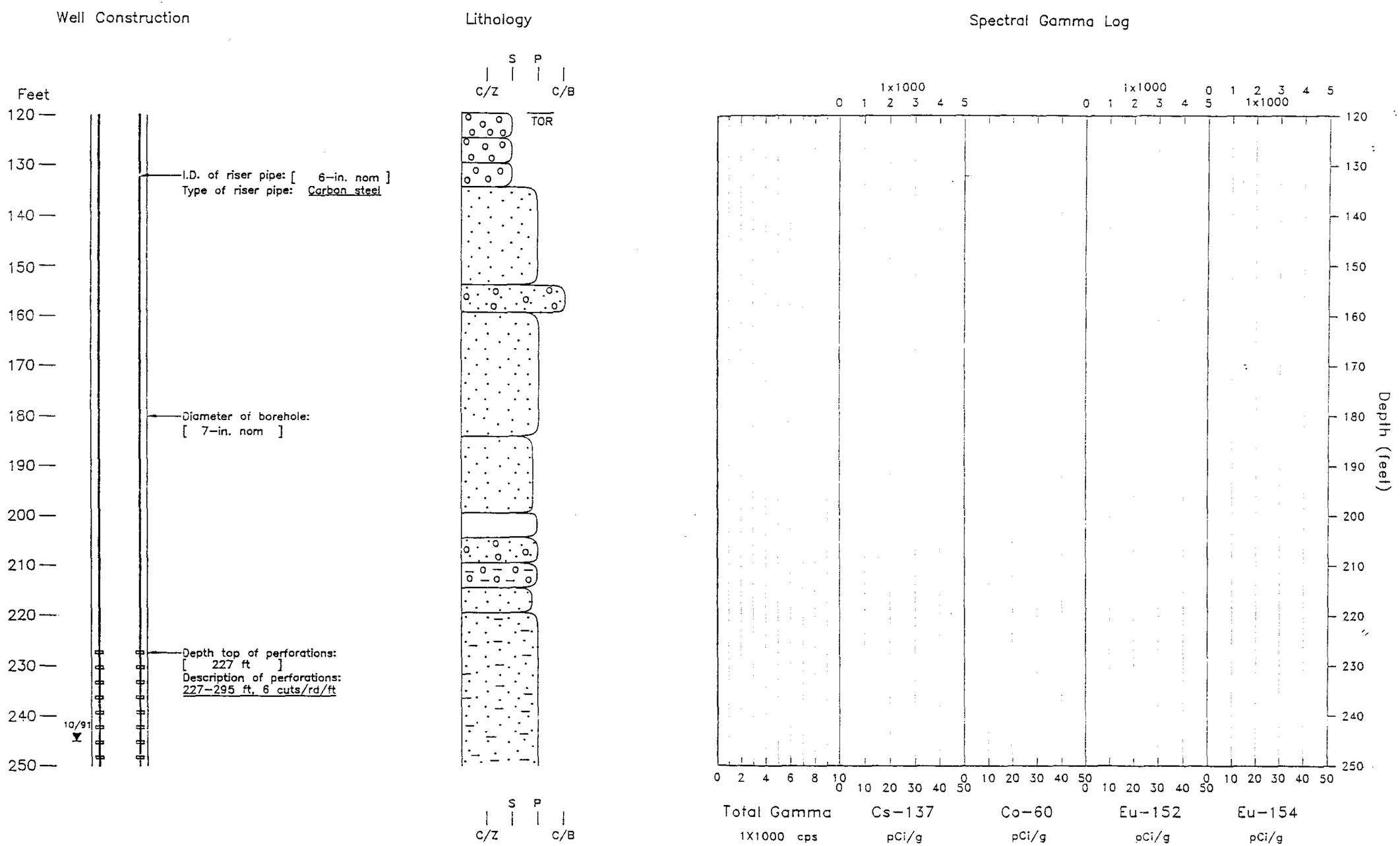
Well 299-W11-18 | Crib 216-T-35 | Log Date 2/22/92



GEOSCI\11-18A

RLS Spectral Gamma Ray Borehole Survey (Page 2)

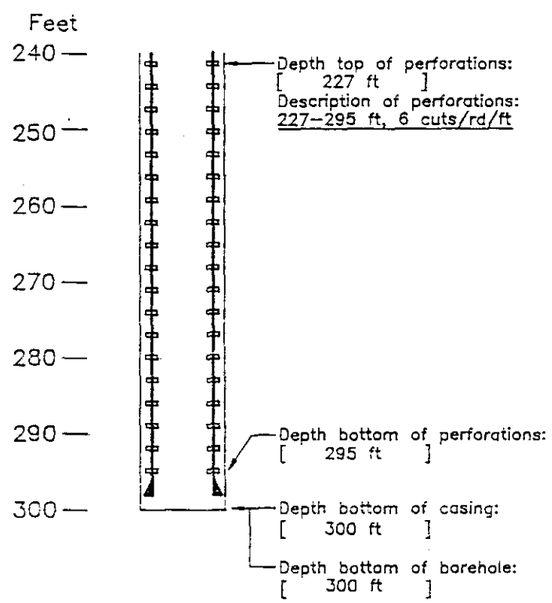
Well 299-W11-18 | Crib 216-T-35 | Log Date 2/22/92



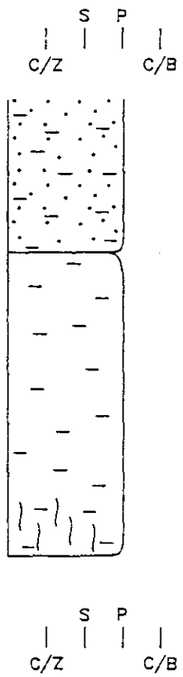
RLS Spectral Gamma Ray Borehole Survey (Page 3)

Well 299-W11-18 | Crib 216-T-35 | Log Date 2/22/92

Well Construction



Lithology



Spectral Gamma Log

299-W11-18 T-35 Crib

Casing	Depth: 300'	Size: 8"	Thickness: 0.313"
Water	Depth: 243'		
Survey	Depth: 0 - 90'	Date: 2/22/92	
	Depth: 88 - 250'	Date: 2/22/92	

General Notes:
Field problems forced restart of the log data acquire program. The tool was repositioned at 88 feet and the second data set was collected. Overlap between the two data sets, 88 feet to 90 feet, was examined for a depth error. The total gamma log indicates a 0.5 feet depth error.

The survey is plotted on two pages. The second plot page is blank since no man-made radionuclides were detected below 100 feet.

The total gamma activity did not exceed 25,000 cps in the borehole survey.

Man-made Radionuclides:
Cesium (Cs-137) was encountered from 18 feet to 53 feet. The maximum activity encountered was 2100 pCi/g at 22 feet. The cesium activity from 25 feet to 53 feet is less than 1 pCi/g.

Cobalt (Co-60) was observed from 20 feet to 100 feet. The maximum activity encountered was 26 pCi/g at 22 feet. The cobalt activity from 26 feet to 50 feet is less than 1 pCi/g. Other depth locations where the Co-60 gamma-rays were encountered had no continuous depth measurements and all computed activities were less than 1 pCi/g.

No Europium-152 (Eu-152) was encountered in the borehole. The plot track is present only for uniformity of the displayed data.

Europium-154 (Eu-154) was observed from 20 feet to 59 feet. The maximum activity encountered was 20 pCi/g at 22 feet.

299-W11-18

Westinghouse Hanford Company	LOG HEADER	Page 1 of 2

Well No. 299-W11-18 Area 200 West Date 2/22/82

Log Run #1 Log Type Gross Gamma

Elevation Datum Top of Casing Elevation 707 ft

Survey Coordinates N 34952 W 74505

Log Measured From Ground Surface

Location Description ~1000 ft West of T-Plant (216-T-35 Crib)

Ground Surface Elevation 699 ft

Surface Temperature N/A Weather Clear - Cool - Windy

BOREHOLE INFORMATION

Driller

Drill Rig Type | Bit Type/Diameter

Borehole Diameter/Depth 6"/300'

Depth Driller (300') | Depth Logger 299.4

Liquid Level 244.6' | Liquid Density Clean

Temperature N/A

CASING RECORD

Type 8" Carbon Steel Sch. 40 | Interval 54.7'

Type | Interval

Type | Interval

Type | Interval

Well Screen Interval 227'-295' (Perforations)

Comments Return Times *0.05' high

Centralizer used

Probe felt like it sank ~2' into mud on bottom of hole.

LOG HEADER	Page 2 of 2

EQUIPMENT DATA

Logging Company PNL

Operator(s) Alan Watson

Equipment Brand MIS Equipment Type Analog

Tool Type Gamma Ray Serial No. CC21811

Base Calibration Date 5/81 Calibration Reference PNL-7485 HC-606

Calibration/Probe Factor B.Dewell 2x2 Position 1 2711.1 ell Position 2 613 ell

Dead Time 11.8 µsec Warm Up Time 715 cm

LOGGING INFORMATION

Log Interval From 298.4' to 0.4'

Range(s) 500 to 100' @ 500%, 350' to 150' @ 1000%, 300' to 15.0' @ 500%

Pre Survey Verification: Position 1 3040 ell Position 2 65.0 ell Background 55%

Base Calibration Difference: Position 1 11.6 ell Position 2 0.7 ell

Logging Speed 5'/min Recorder Scale 10%/A

Start Time 0700 Completion Time 1020

Chart Speed(s) 10 ft/in.

Chart Recorder Horizontal Scale 50%/in. Time Constant 12-1

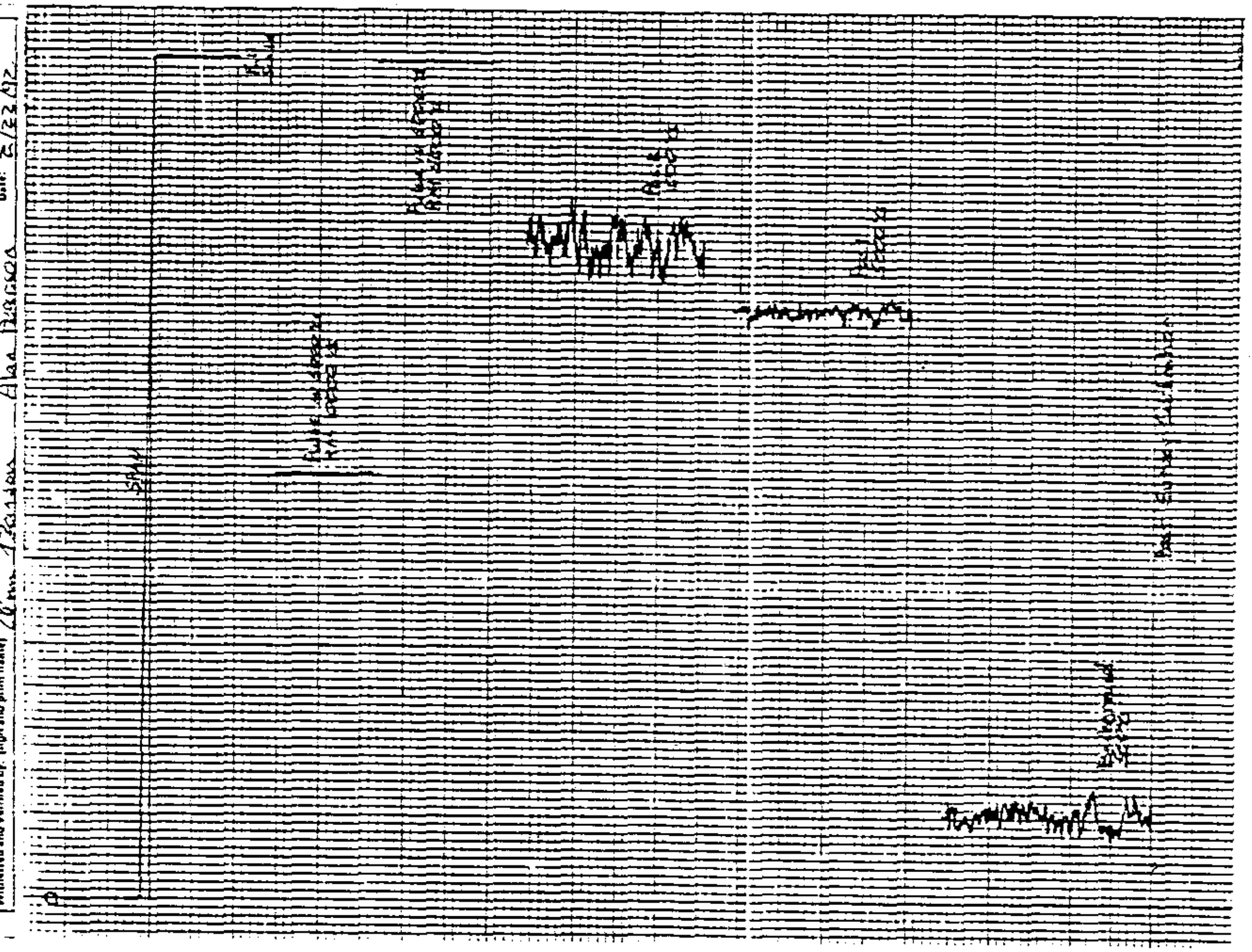
Post Survey Verification: Position 1 3018 ell Position 2 63.9 ell Background 52%

Percent Change: Position 1 1.1% Position 2 1.7%

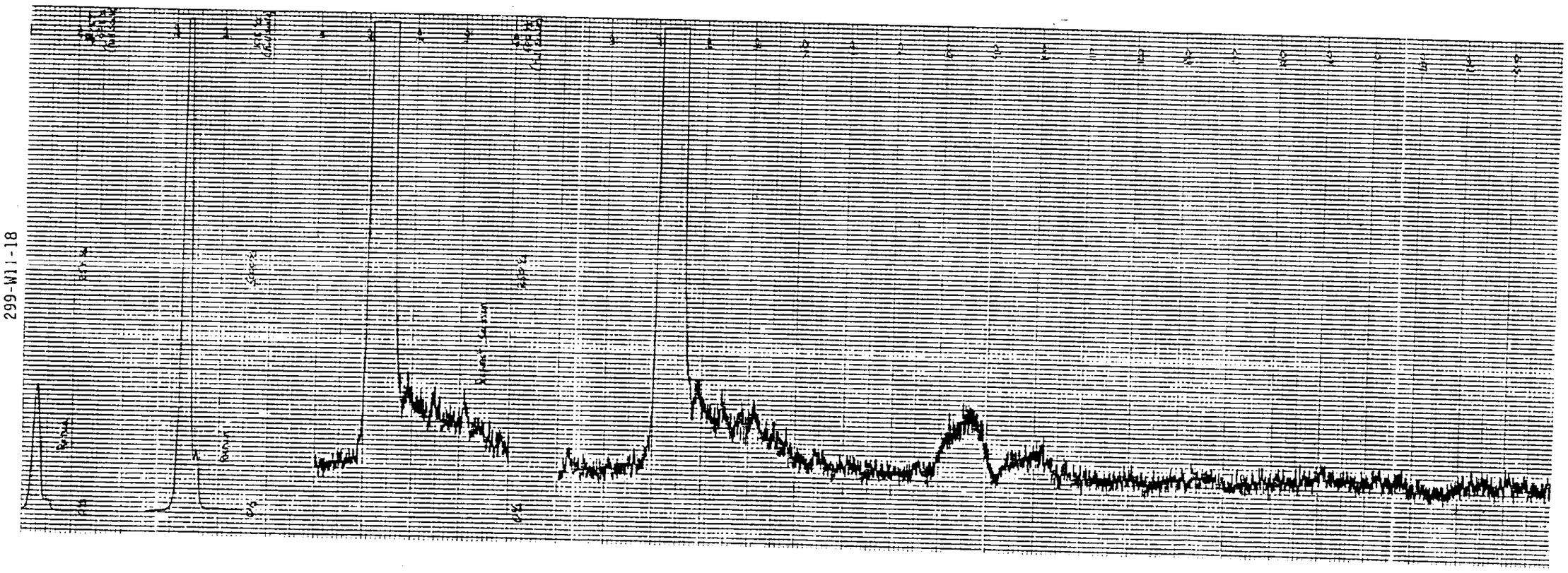
Comments: Return Times *0.05' high

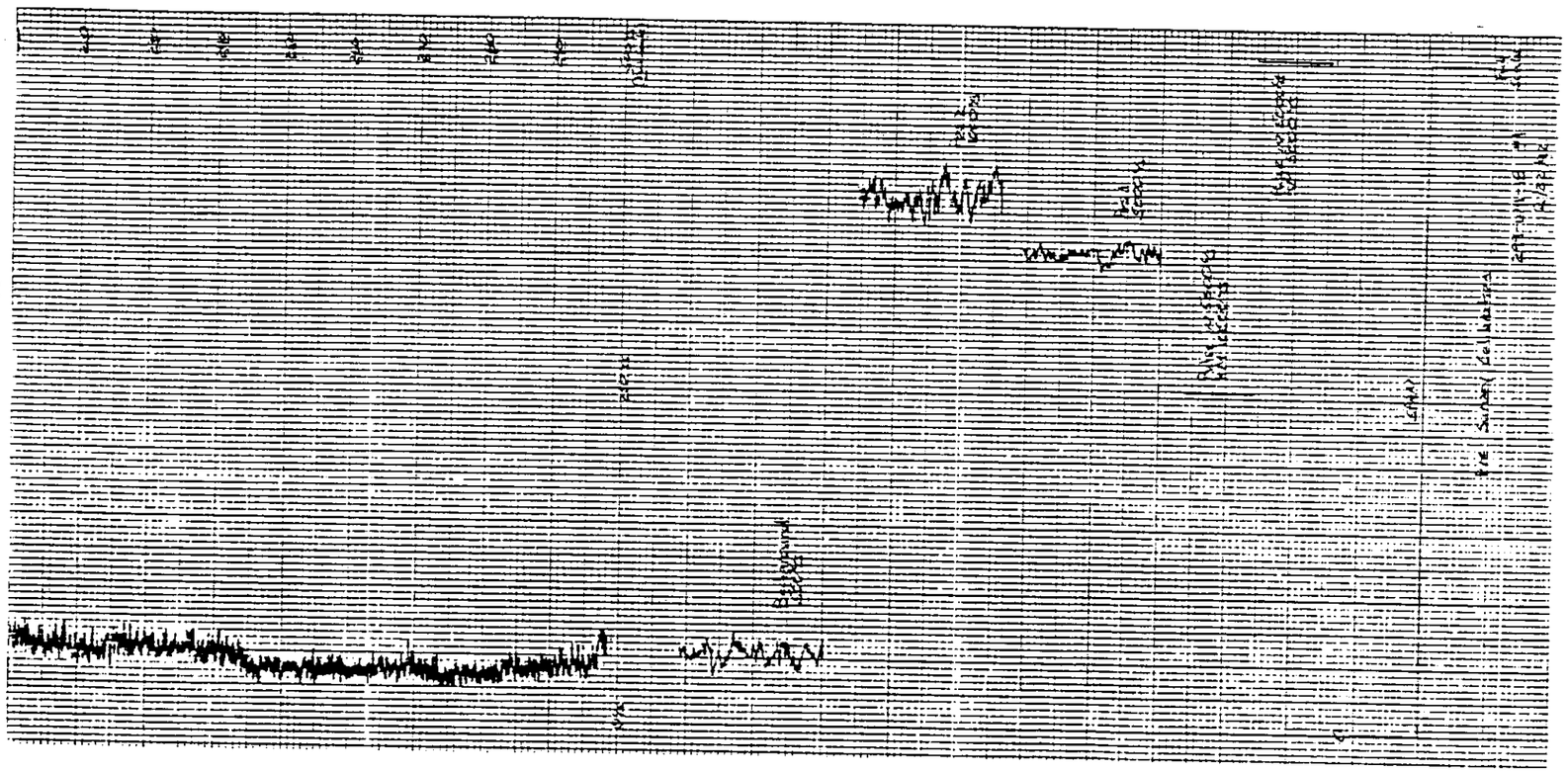
Centralizer used

Witnessed and Verified by: (sign and print name) [signature] Alan Watson Date: 2/23/82



299-W11-18





299-W11-18

Crib Designation: 216-U-1, 216-U-2

Type of Facility: Two wooden crib structures, 12 ft. x 12 ft. bottom dimensions

Location: N 37860, W 74242

Service Dates:
216-U-1: 11/51 to 6/67
216-U-2: 3/52 to 5/67

Description of Waste: 0.159 x 10^9 liters of low salt, neutral to basic waste from the following: cell drainage from tank 5-6 in 221-U, waste from 224-U via overflow from 241-U-361 settling tank, contaminated solvent from 276-U solvent storage area, equipment decontamination and reclamation wastes from 221-U canyon.

Radionuclide Release Summary:

Radionuclide	Quantity
Pu	43 g
Sr-90	4.0 Ci
Ru-106	500
Cs-137	10
Co-60	<0.1
U	4000 kg

Summary of Past Logging:

Boreholes	Date	Reference
299-W19-3	1976	Fecht, et al., 1977
	1985	Geophysics files
299-W19-9	1985	"
299-W19-11	1985	"
299-W19-16	1985	"
299-W19-17	1985	"
299-W19-18	1985	"

Review of Current Logging:
Boreholes: 299-W19-9, 299-W19-11

The 216-U-1, U-2 cribs have been the subject of extensive investigations due to uranium contamination of the groundwater in the area (DeFord, 1991 and Baker, et al., 1988,). The most widely accepted theory as to the source of this contamination relates to water discharged from the nearby U-16 crib flowing along an impermeable caliche layer toward the U1,U2 cribs. At these cribs, it is surmised that the water picked up the uranium previously deposited there and carried it down to the groundwater along the outside of the monitoring well casings.

The groundwater beneath these cribs was subjected to a pump and treat program which removed some of the uranium. The current status of these cribs is that the groundwater still has elevated uranium and it will be evaluated as a part of the RI/FS process.

Two boreholes at this site were logged with the spectral gamma-ray system. They both showed zones of high Cs-137 concentrations, high up in the unsaturated zone close to the discharge depths of these cribs.

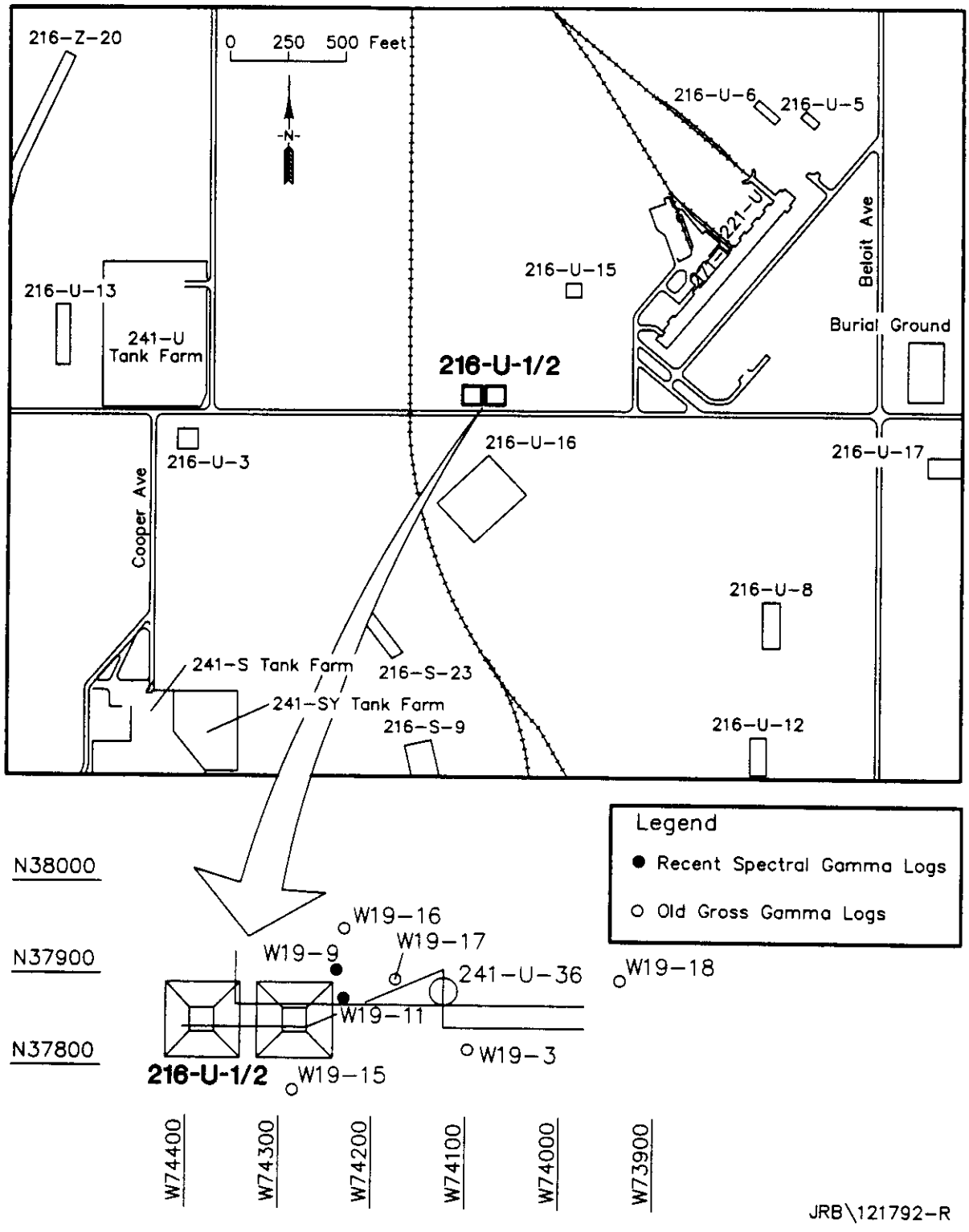
Little uranium was found up high although the detection concentration of uranium in these wells is not known. Logging in these wells is difficult because of the high attenuation effects of the multiple casings and grout around the wells and because there is no way to accurately calculate the attenuation. Therefore, if separated uranium is not found in these boreholes, one cannot conclude that it is not present.

Once the logging tool reached the groundwater, U-235 and U-238 (not in secular equilibrium) was detected. It is not know if the uranium is in the groundwater or if it has precipitated out into the sediment. Comparisons should be made with groundwater concentration data.

It is apparent that the cesium at this site is stable.

In order to properly monitor the unsaturated zone at this site, it is recommended that several monitoring boreholes be installed in such a manner that they do not allow downward migration of contaminants, while providing access for the logging tools.

Additional logging is recommended for this site to demonstrate the nuclides present in the unsaturated zone are not migrating.


216-Z-20
0 250 500 Feet
-N-
216-U-6
216-U-5
221-U
Beloit Ave
216-U-15
216-U-13
241-U
Tank Form
Burial Ground
216-U-1/2
216-U-3
216-U-16
216-U-17
Cooper Ave
216-U-8
241-S Tank Farm
216-S-23
241-SY Tank Farm
216-S-9
216-U-12
Legend
Recent Spectral Gamma Logs
Old Gross Gamma Logs
N38000
N37900
N37800
W19-16
W19-17
W19-9
241-U-36
W19-18
W19-11
W19-3
216-U-1/2
W19-15
W74400
W74300
W74200
W74100
W74000
W73900
JRB\121792-R

Westinghouse Hanford Company
RLS Spectral Gamma-Ray Borehole Survey Log Header

Project: 200 AAMS, U-1 Crib

Borehole	299-W19-11		
Coordinates	37,860 N 74,210 W	Feet	(Plant 200 W)
Elevation	695.7 feet	Top of Casing	(Plant 200 W)

Borehole Environment Information

Borehole Fluid Depth 230.0 (Feet) from Zero (0.0) Depth Reference of Log

Casing Size I.D. (inch)	Casing Thickness (inch)	Top Depth (feet)	Base Depth (feet)
6.0	0.3	0.0	250.0
4.0	0.2	0.0	225.0

RLS Passive Spectral Gamma Survey Information

Logging Engineers R. V. Cram S. E. Kos
Log Depth Reference at Zero (0.0) depth is Ground Level

Log Date	Archive File Names	Log Mode[1], Speed	Depth Interval (feet) Top	Base	Incr
Jan 22, 92	H2W1911\A121	FIXED 0.6 fps	0.	120.	0.5

[1]FIXED: Fixed velocity of Cable Speed: fps: Feet per second

Calibration and Analysis Information

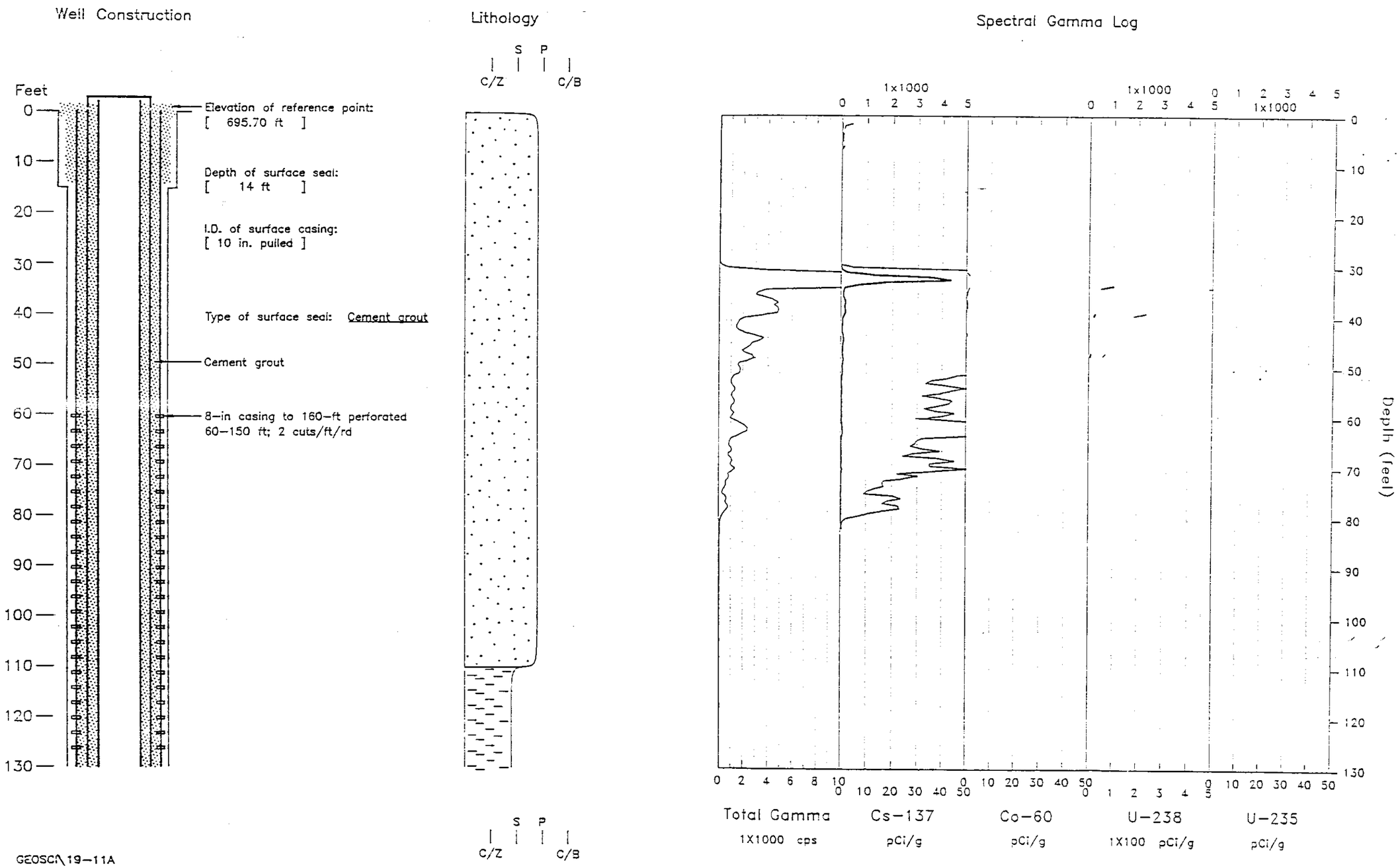
RLS Calibration Date: Nov 21, 1991
Calibration Report: WHC-SD-EN-TRP-001

Analyst Names: R. K. Price
Analysis Date: July 23, 1992

Analysis Notes: No man-made radionuclides found below 55 feet
Radionuclides identified: Cs-137, Co-60, U-238, U-235(not confirmed)

RLS Spectral Gamma Ray Borehole Survey

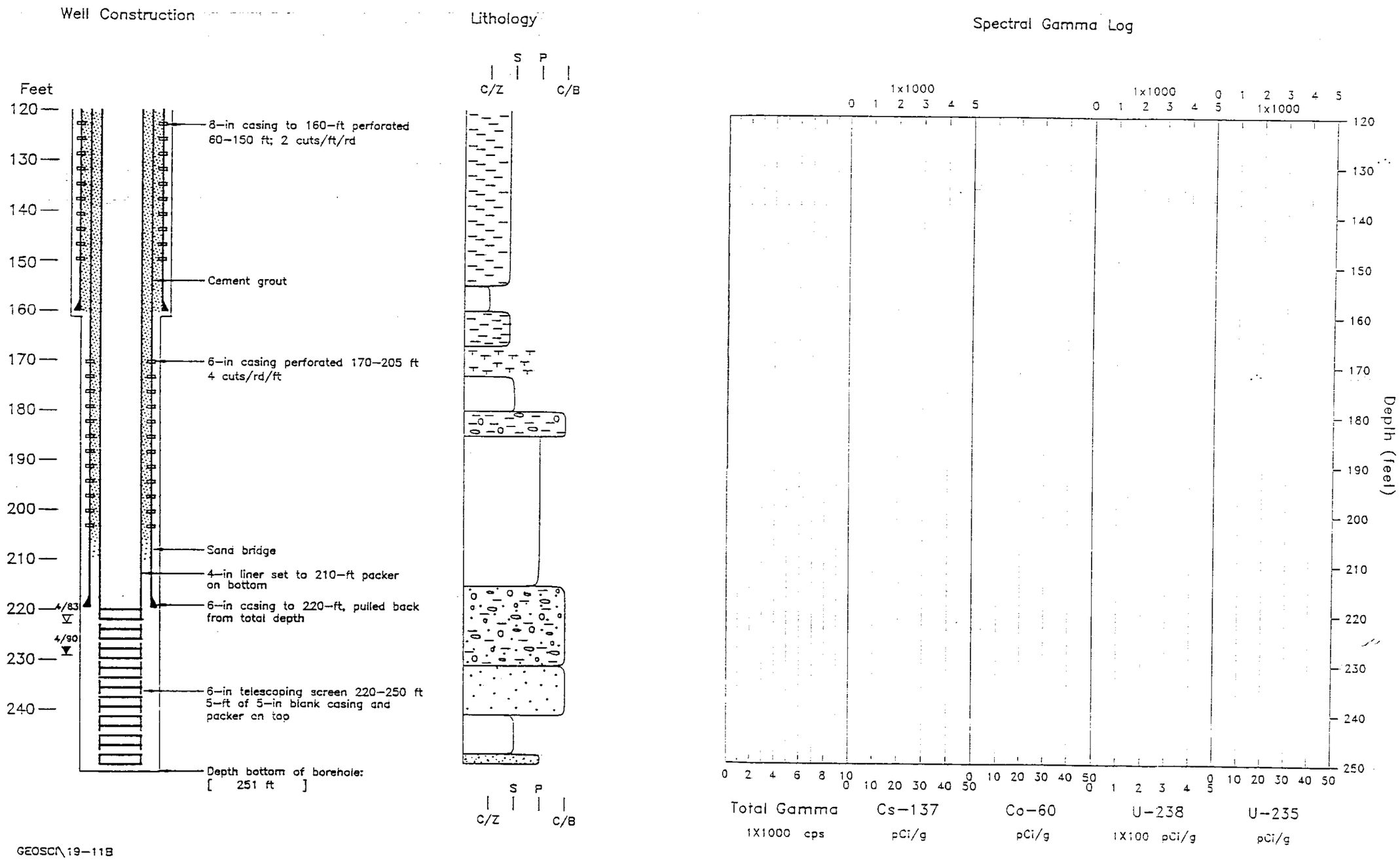
Well 299-W19-11 | Crib 216-U-1 | Log Date 1/22/92



GEOSC\19-11A

RLS Spectral Gamma Ray Borehole Survey (Page 2)

Well 299-W19-11 | Crib 216-U-1 | Log Date 1/22/92



299-W19-11 U-1 Crib

Casing	Depth: 250.0'	Size: 6"	Thickness:	0.3"
	Depth: 225.0'	Size: 4"	Thickness:	o.2"
Water	Depth: 230.0'			
Survey	Depth: 0 - 195'	Date: 1//22/92		

General Notes:
The data are plotted on two pages. The second plot page is blank since no man-made radionuclides were detected below 82 feet.

The data are plotted on two pages. The survey data from 120 feet to 130 feet are plotted on both pages.

The total gamma activity at 32 feet appeared to exceed 380,000 cps in the borehole survey.

The maximum calibrated casing correction of 0.40 inches was applied to the survey data. The computed activity for data recorded through multiple casing strings will be underestimated.

Man-made Radionuclides:
Cesium (Cs-137) was encountered in two zones, 1 foot to 9 feet with a maximum activity of 4 pCi/g and 30 feet to 82 feet with a maximum activity of 4300 pCi/g.

Cobalt (Co-60) was observed from 34 feet to 54 feet. The maximum activity encountered was 1 pCi/g at 34 feet.

Uranium-238 (U-238) was encountered in the borehole from 33 feet to 55 feet with a maximum activity of 900 pCi/g at 34 feet. The U-238 identified in this borehole must not be confused with naturally occuring uranium. Natural uranium (U-238) will be in secular equilibrium with all of its daughters. The U-238 radionuclide identified in borehole 299-W19-09 was not in secular equilibrium because the daughters below radium (Ra-226) were not identified on the gamma-ray spectra.

Uranium-235 (U-235) was not confirmed in the hole, presence of Cs-137 (662 keV) will mask gamma ray photo peak from U-235 (186 keV).

Westinghouse Hanford Company
RLS Spectral Gamma-Ray Borehole Survey Log Header

Project: 200 AAMS, U-2 Crib

Borehole	299-W19-09		
Coordinates	37,895 N 74,225 W	Feet	(Plant 200 W)
Elevation	693.8 feet	Top of Casing	(Plant 200 W)

Borehole Environment Information

Borehole Fluid Depth none (Feet) from Zero (0.0) Depth Reference of Log

Casing Size I.D. (inch)	Casing Thickness (inch)	Top Depth (feet)	Base Depth (feet)
12.0	0.40	0.0	45.0
10.0	0.38	0.0	211.0
8.0	0.33	0.0	262.0
6.0	0.313	0.0	302.0

RLS Passive Spectral Gamma Survey Information

Logging Engineers R. V. Cram S. E. Kos
Log Depth Reference at Zero (0.0) depth is Ground Level

Log Date	Archive File Names	Log Mode, Speed	Depth Interval (feet) Top	Base	Incr
Apr 27, 92	H2W1909\A173	FIXED 0.6 fps	0.	118.	0.5
Apr 28, 92	H2W1909\A174	FIXED 0.6 fps	115.	276.	0.5

[1] FIXED: Fixed velocity of Cable Speed: fps: Feet per second

Calibration and Analysis Information

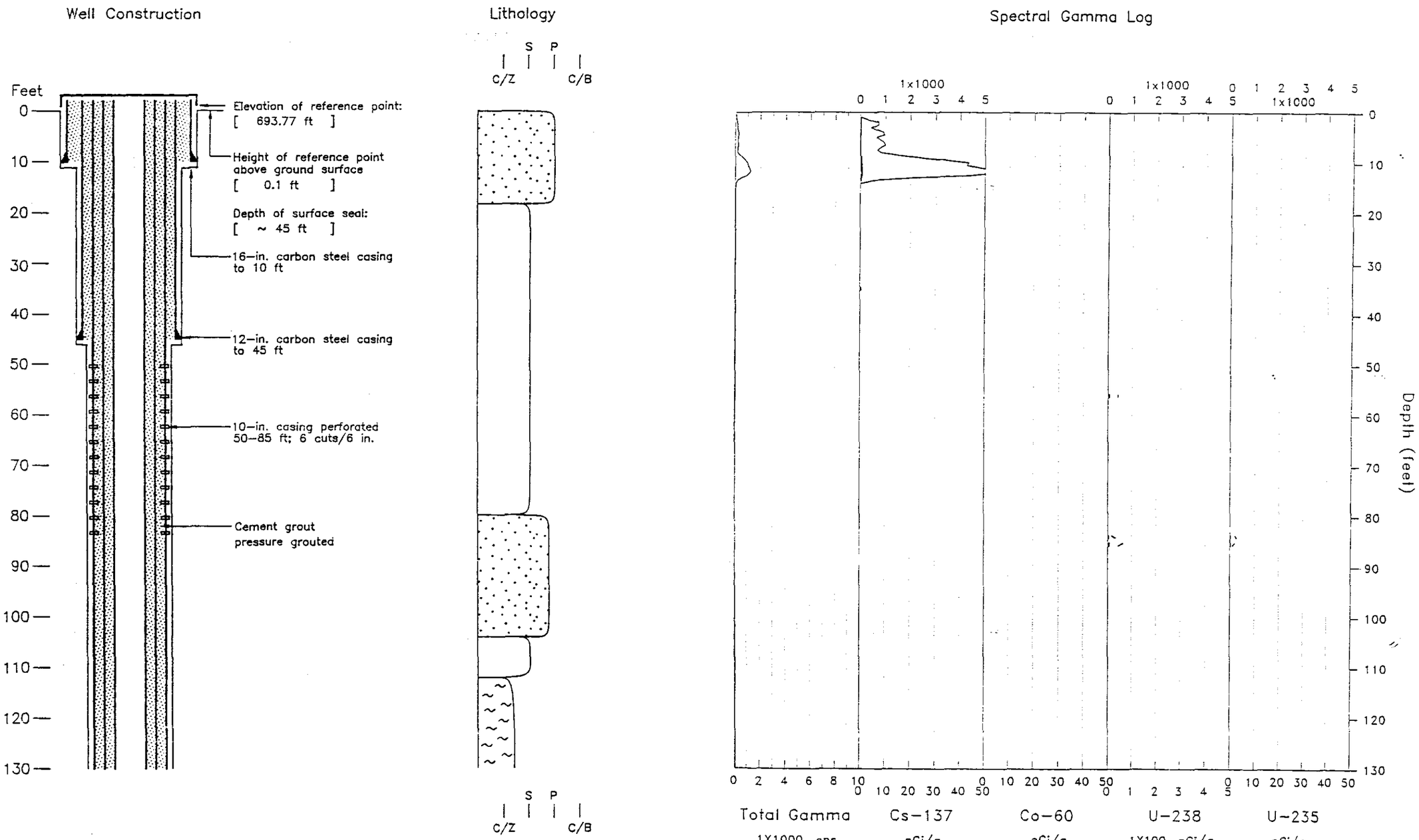
RLS Calibration Date: Nov 21, 1991
Calibration Report: WHC-SD-EN-TRP-001

Analyst Names: J. Meisner R. K. Price
Analysis Date: July 06, 1992

Analysis Notes: Data plot overlap between pages is 10 feet
Radionuclides identified: Cs-137, U-238, U-235,

RLS Spectral Gamma Ray Borehole Survey

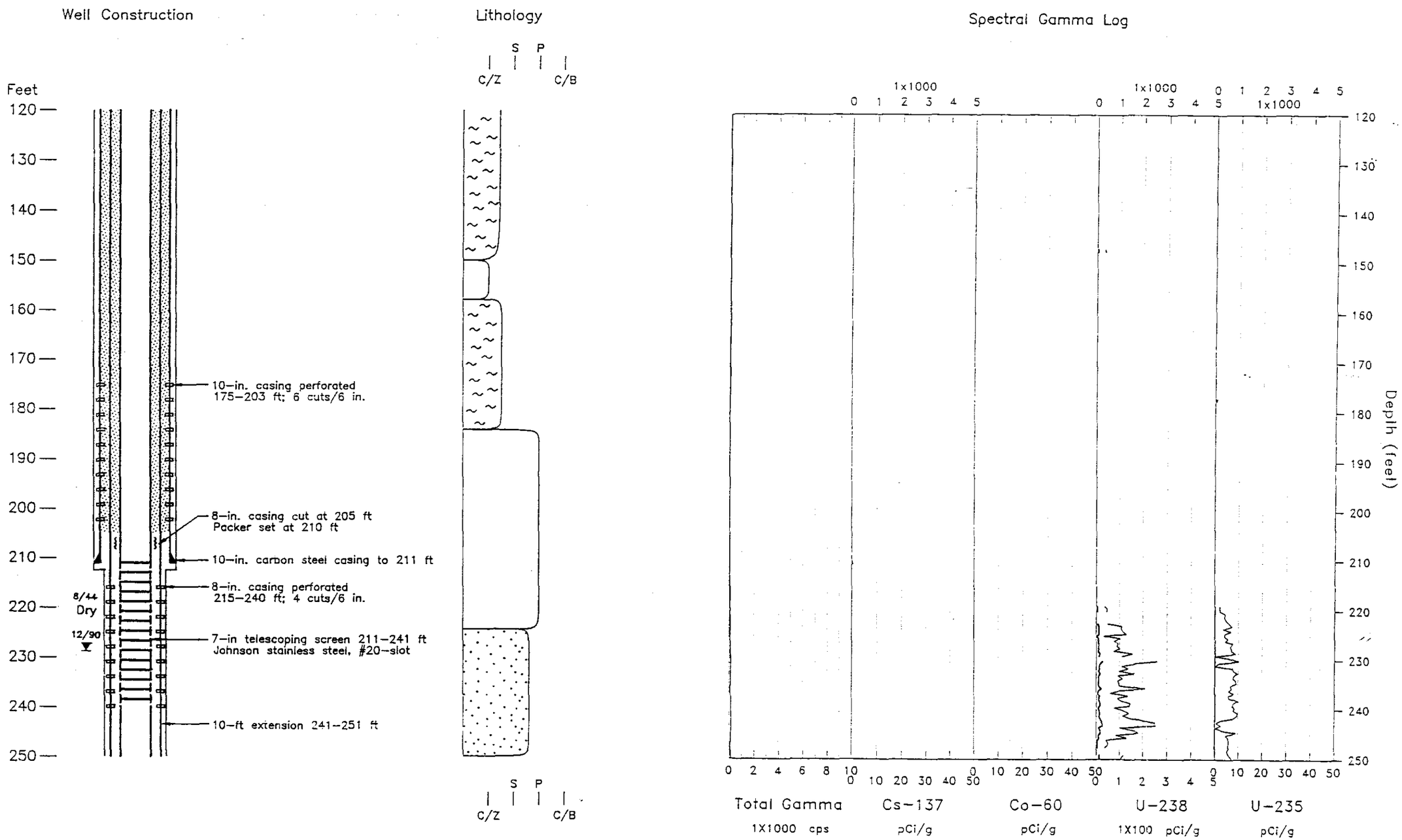
Well 299-W19-9 | Crib 216-U-2 | Log Date 4/27/92



GEOSCI\19-9A

RLS Spectral Gamma Ray Borehole Survey (Page 2)

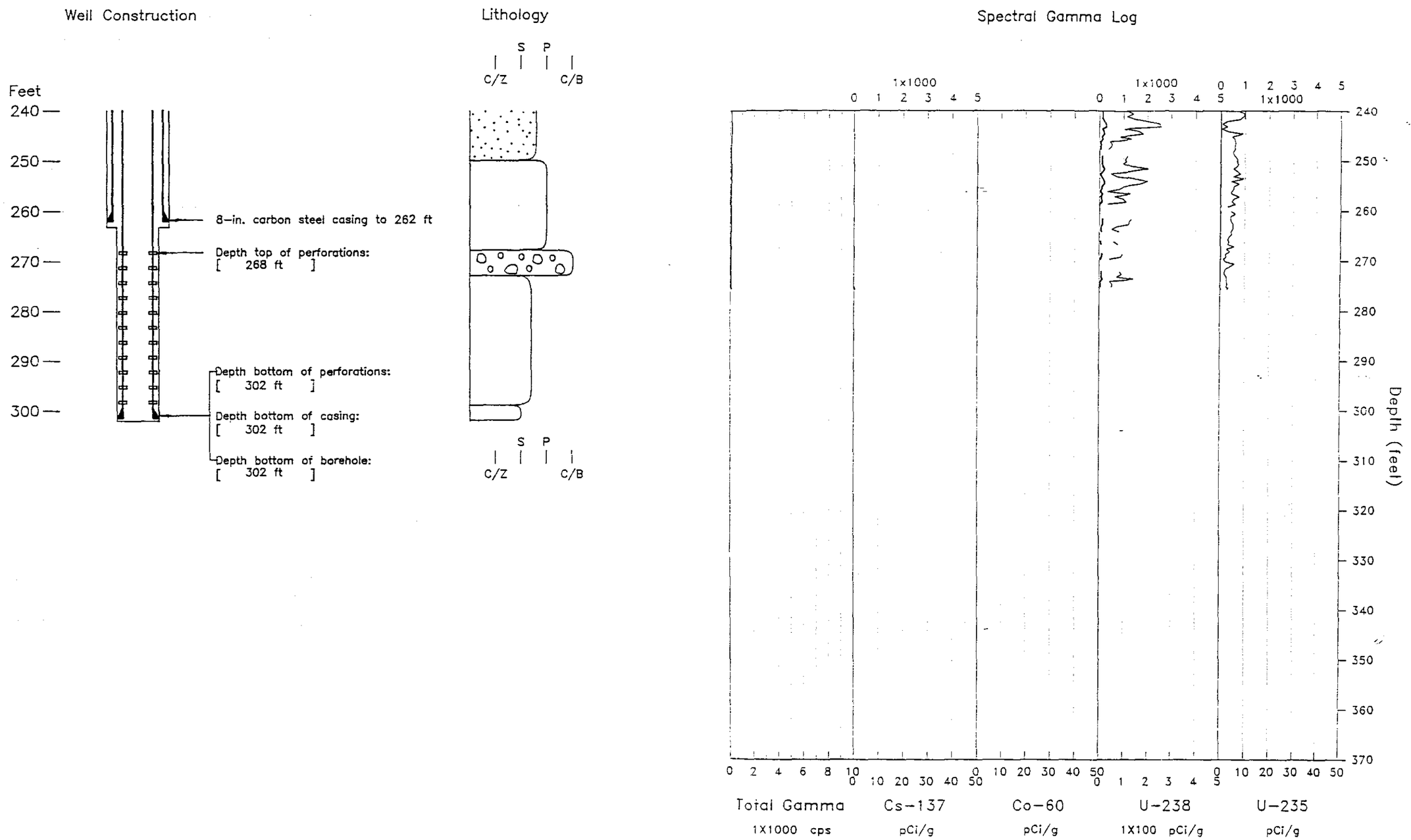
Well 299-W19-9 | Crib 216-U-2 | Log Date 4/27/92



GEOSCI\19-98

RLS Spectral Gamma Ray Borehole Survey (Page 3)

Well 299-W19-9 | Crib 216-U-2 | Log Date 4/27/92



GEOSCI\19-9C

299-W19-09 U-2 Crib

Casing	Depth: 45.0'	Size: 12"	Thickness: 0.40"
	Depth: 211.0'	Size: 10"	Thickness: 0.38"
	Depth: 262.0'	Size: 8"	Thickness: 0.33"
	Depth: 302.0'	Size: 6"	Thickness: 0.313"
Water Survey	Depth: none		
	Depth: 0 - 118'	Date: 4/27/92	
	Depth: 115 - 176'	4/28/92	

General Notes:
The data are plotted on two pages. The survey data from 120 feet to 130 feet are plotted on both pages.

The total gamma activity did not exceed 1,200 cps in the borehole survey.

The maximum calibrated casing correction of 0.40 inches was applied to the survey data. The computed activity for data recorded through multiple casing strings will be underestimated.

Man-made Radionuclides:
Cesium (Cs-137) was encountered from 1 feet to 14 feet. The maximum activity encountered was 55 pCi/g at 12 feet.

Uranium-238 (U-238) was encountered in the borehole from 83 feet to 94 feet with a maximum activity of 60 pCi/g and from 219 feet to 275 feet with a maximum of 250 pCi/g. The U-238 identified in this borehole must not be confused with naturally occuring uranium. Natural uranium (U-238) will be in secular equilibrium with all of its daughters. The U-238 radionuclide identified in borehole 299-W19-09 was not in secular equilibrium because the daughters below radium (Ra-226) were not identified on the gamma-ray spectra.

Uranium-235 (U-235) was encountered in the borehole from 82 feet to 90 feet with a miximum activity of 2 pCi/g and from 219 feet to 275 feet with a maximum of 15 pCu/g. The computed activity is not considered accurate. The identifying gamma-ray at 185.7 keV is at the lower energy range of the valid calibration data.

Crib Designation: 216-U-12 crib

Type of Facility: 100 ft x 10 ft gravel crib with a 12" perforated PVC pipe along the center

Location: N 36350, W 73100, Midway between U plant and S plant

Service Dates: 4/60 to 1/88

Description of Waste: 150 x 10^6 liters of the following waste: stack drainage from 291-U-1, 244-WR vault waste, 224-U process condensate waste via C-5 tank, Contaminated water from 244-WR vault, process condensate from 224-U building (pH less than 1), other miscellaneous wastes

Radionuclide Release Summary:

Radionuclide	Quantity
Pu	1 g
Am-241	0.0645 Ci
Cs-137	0.056 Ci
Ru-106	2.18 x 10^-6 Ci
Sr-90	55.9 Ci

Summary of Past Logging:

Boreholes	Date	Reference
299-W22-22	1976	Fecht, et al., 1977
	1982	Geophysics files
299-W22-23	1976	Fecht, et al., 1977
	1982	Geophysics files
299-W22-73	1982	"
299-W22-75	1982	"

Review of Current Logging:

Borehole: 299-W22-75

This borehole has been logged with the PNL gross gamma and the RLS spectral gamma logging system. The spectral gamma log showed a thick zone of Cs-137 deposition from 20 feet to about 75 feet. This borehole is right next to the crib and the cesium clearly has been release at the crib. This quantity of cesium in the unsaturated zone is not consistent with the discharge records, clearly showing those records to be inaccurate.

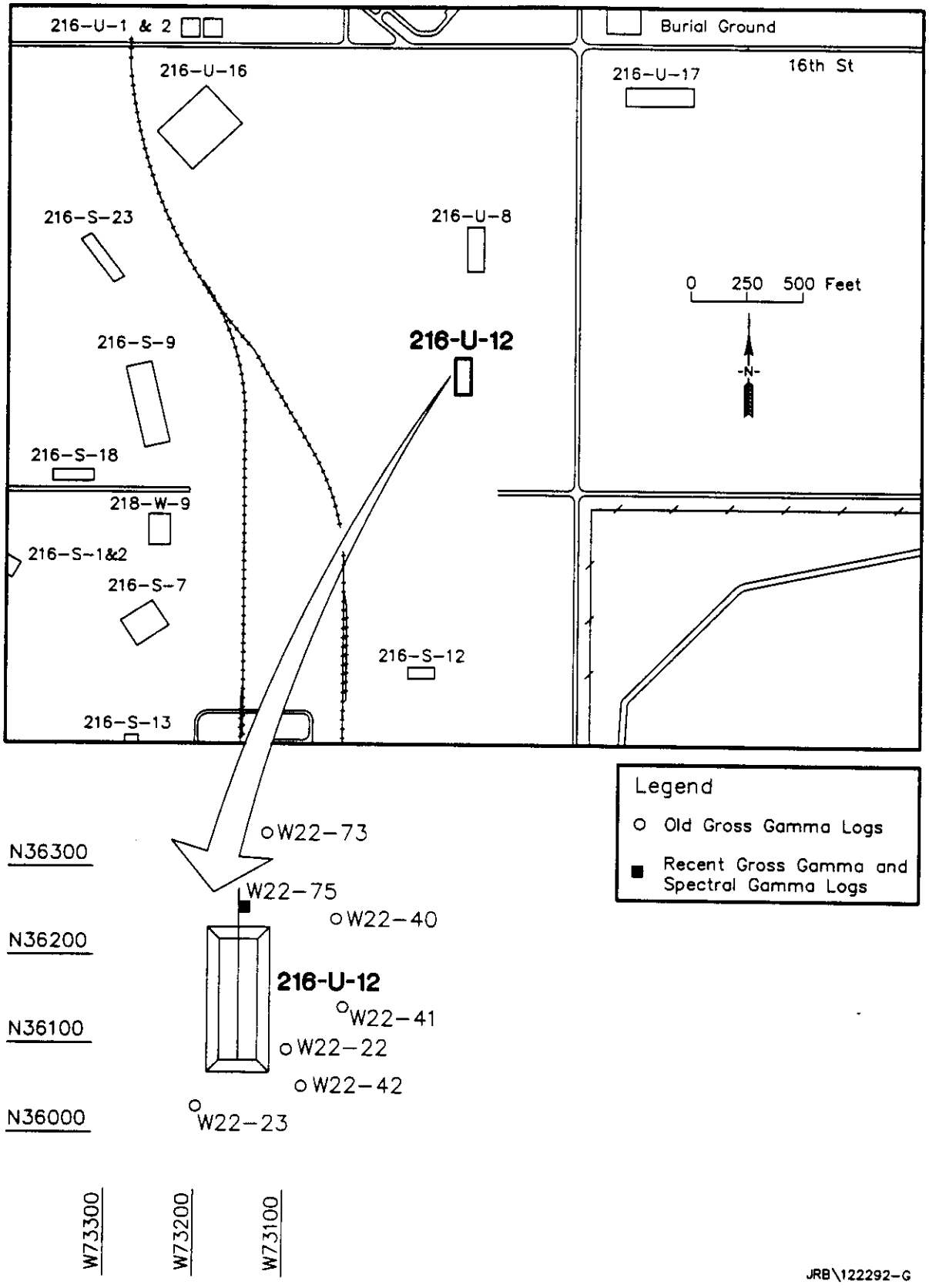
Processed uranium 235 and 238 were found further down in the borehole to about 82 feet. This is consistent with the higher mobility of the uranium relative to the cesium.

The gross gamma log shows some elevated activity deeper in the borehole from about 105 feet to 150 feet. The spectral gamma-ray log show this to be due to naturally high uranium. This is known to be naturally occurring because the gamma-rays are from the Bi-214 and Pb-214 which are at the bottom of the decay chain and require thousands of years to be generated. This natural activity zone coincides with the caliche layer that is known to exist in the west area even though it is not shown on

the lithology log.

No lithology control over the deposition is evident from the data.

It does not appear that contamination released at this site has migrated to the groundwater.


216-U-1 & 2
Burial Ground
216-U-16
216-U-17
16th St
216-S-23
216-U-8
0 250 500 Feet
N
216-S-9
216-U-12
216-S-18
218-W-9
216-S-1&2
216-S-7
216-S-12
216-S-13
Legend
Old Gross Gamma Logs
Recent Gross Gamma and Spectral Gamma Logs
W22-73
N36300
W22-75
W22-40
N36200
216-U-12
W22-41
N36100
W22-22
W22-42
N36000
W22-23
W73300
W73200
W73100
JRB\122292-G

Westinghouse Hanford Company
RLS Spectral Gamma-Ray Borehole Survey Log Header

Project: 200 AAMS, U-12 Crib

Borehole	299-W22-75			
Coordinates	36,255 N	73,145 W	Feet	(Plant 200 W)
Elevation	. feet		Top of Casing	(Plant 200 W)

Borehole Environment Information

Borehole Fluid Depth none (Feet) from Zero (0.0) Depth Reference of Log

Casing Size I.D. (inch)	Casing Thickness (inch)	Top Depth (feet)	Base Depth (feet)
8.0	0.312	0.0	175.0
6.0	0.281	0.0	175.0

RLS Passive Spectral Gamma Survey Information

Logging Engineers R. V. Cram S. E. Kos
Log Depth Reference at Zero (0.0) depth is Ground Level

Log Date	Archive File Names	Log Mode[1], Speed	Depth Interval (feet) Top	Base	Incr
Dec 05, 91	H2W2275\A101	FIXED 0.6 fps	0.	173.	0.5

[1]FIXED: Fixed velocity of Cable Speed: fps: Feet per second

Calibration and Analysis Information

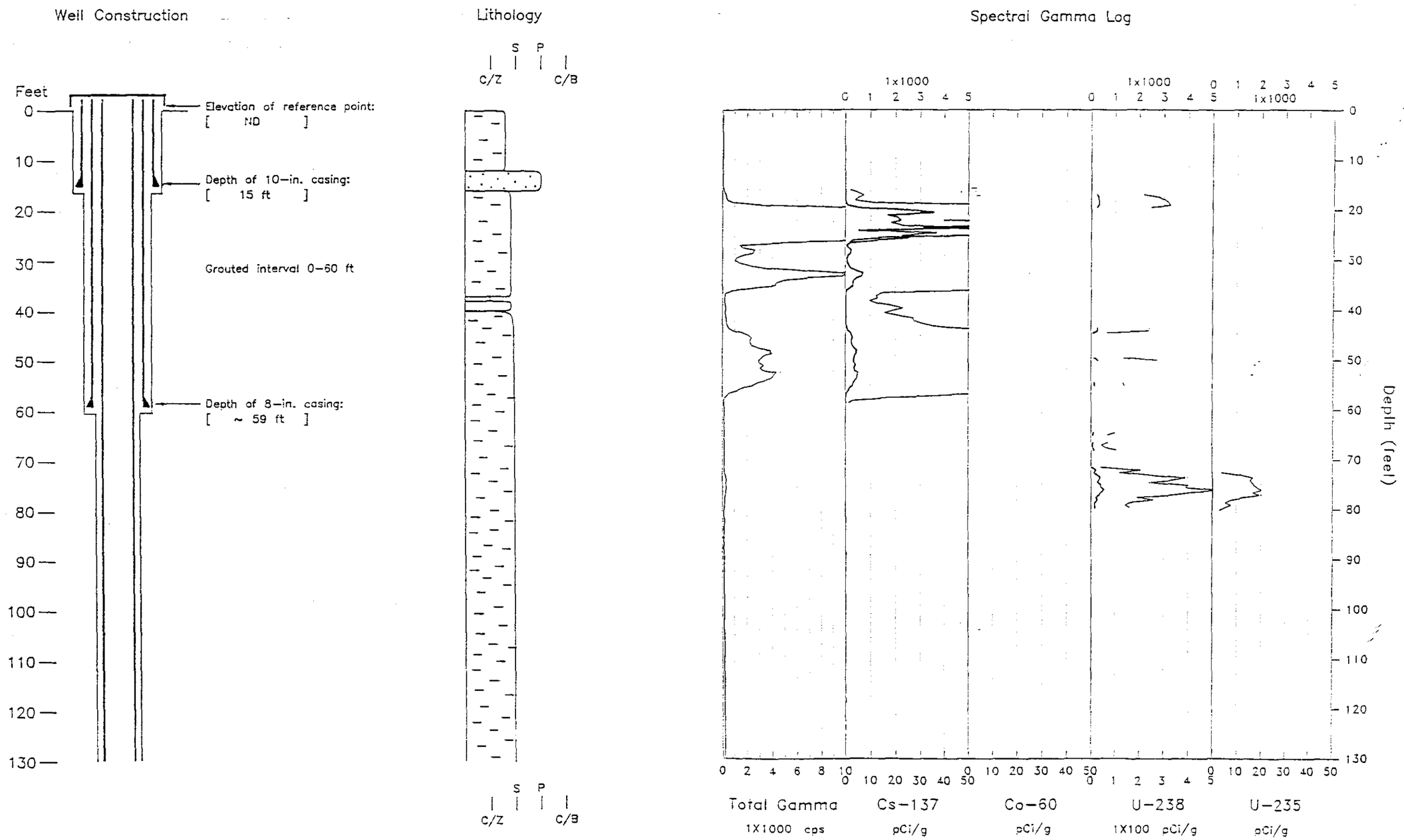
RLS Calibration Date: Nov 21, 1991
Calibration Report: WHC-SD-EN-TRP-001

Analyst Names: R. K. Price
Analysis Date: March 31, 1992

Analysis Notes: No man-made radionuclides found below 80 feet
Radionuclides identified: Cs-137, U-238, U-235

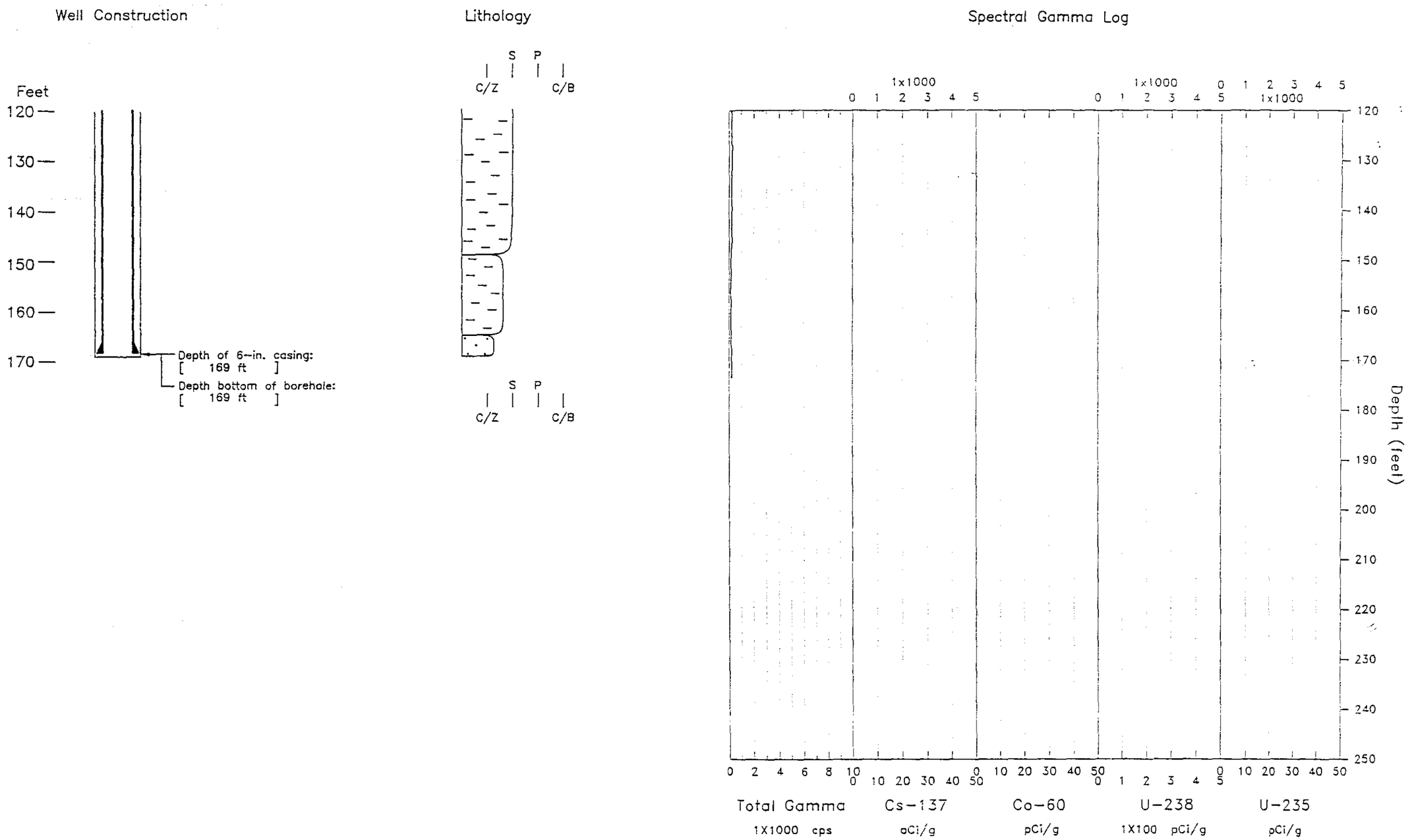
RLS Spectral Gamma Ray Borehole Survey

Well 299-W22-75 | Crib U-12 | Log Date 12/05/91



RLS Spectral Gamma Ray Borehole Survey (Page 2)

Well 299-W22-75 | Crib U-12 | Log Date 12/05/91



GEOSCI\22-75B

299-W22-75 U-12 Crib

Casing	Depth: 175'	Size: 8"	Thickness: 0.312"
	Depth: 175'	Size: 6"	Thickness: 0.281
Water	Depth: none		
Survey	Depth: 173 - 100'	Date: 12/05/91	
	100 - 48'		
	50 - 0'		
	22 - 27'	(Lead Shield)	

General Notes:
The survey is plotted on two pages. The second plot page is blank since no man-made radionuclides were detected below 80 feet.

The possibility of rain forced the borehole survey to be acquired with the detector moving up the borehole. The detector depth was checked at 100 feet and again at 50 feet with a tape measure. The depth error at 100 feet was 0.25 feet. The depth error at 50 feet was 0.1 feet.

The total gamma activity reached 340,000 cps at 23 feet in the borehole survey. The lead shield was installed and the high gamma activity zone was relogged. The total gamma activity reached 104,000 cps with the lead shield.

The maximum calibrated casing correction of 0.40 inches was applied to the survey data. The computed activity for data recorded through multiple casing strings will be underestimated.

Man-made Radionuclides:
Cesium (Cs-137) was encountered from 16 feet to 59 feet. The maximum activity encountered was 16,100 pCi/g at 23 feet.

No Cobalt (Co-60) was encountered in the borehole. The plot track is present only for uniformity of the displayed data.

Uranium-238 (U-238) was encountered in the borehole from 17 feet to 80 feet. The maximum activity was 500 pCi/g at 76 feet. The U-238 identified in this borehole must not be confused with naturally occuring uranium. Natural uranium (U-238) will be in secular equilibrium with all of its daughters. The U-238 radionuclide identified in borehole 299-W22-75 was not in secular equilibrium because the daughters below radium (Ra-226) were not identified on the gamma-ray spectra.

Uranium-235 (U-235) was encountered in the borehole from 73 feet to 80 feet. The computed activity is not considered accurate. The identifying gamma-ray at 185.7 keV is at the lower energy range of the valid calibration data. The maximum activity computed from the calibration algorithm was 20 pCi/g.

299-W22-75

Westinghouse Hanford Company — LOG HEADER — Page 1 of 2

Well No. 299-W22-75	Area 200W Date 5/12/92
Log Run #1	Log Type Gross Gamma
Elevation Datum	Elevation
Survey Coordinates N 36255	W 75145
Log Measured From Ground Surface	
Location Description U-12 Crib	
Ground Surface Elevation	
Surface Temperature N/A	Weather Clear - Warm

BOREHOLE INFORMATION

Driller	
Drill Rig Type	Bit Type/Diameter
Borehole Diameter(s)/Depth 8"/8 ?	6"/121'
Depth Driller ~71'	Depth Logger ~75.6'
Liquid Level N/A	Liquid Density N/A
Temperature N/A	

CASING RECORD

Type 8" Carbon Steel	Sch. 40	Interval +0.3' - ?
Type 6" Carbon Steel	Sch. 40	Interval +1.2' - ?
Type		Interval
Type		Interval

Well Screen Interval N/A

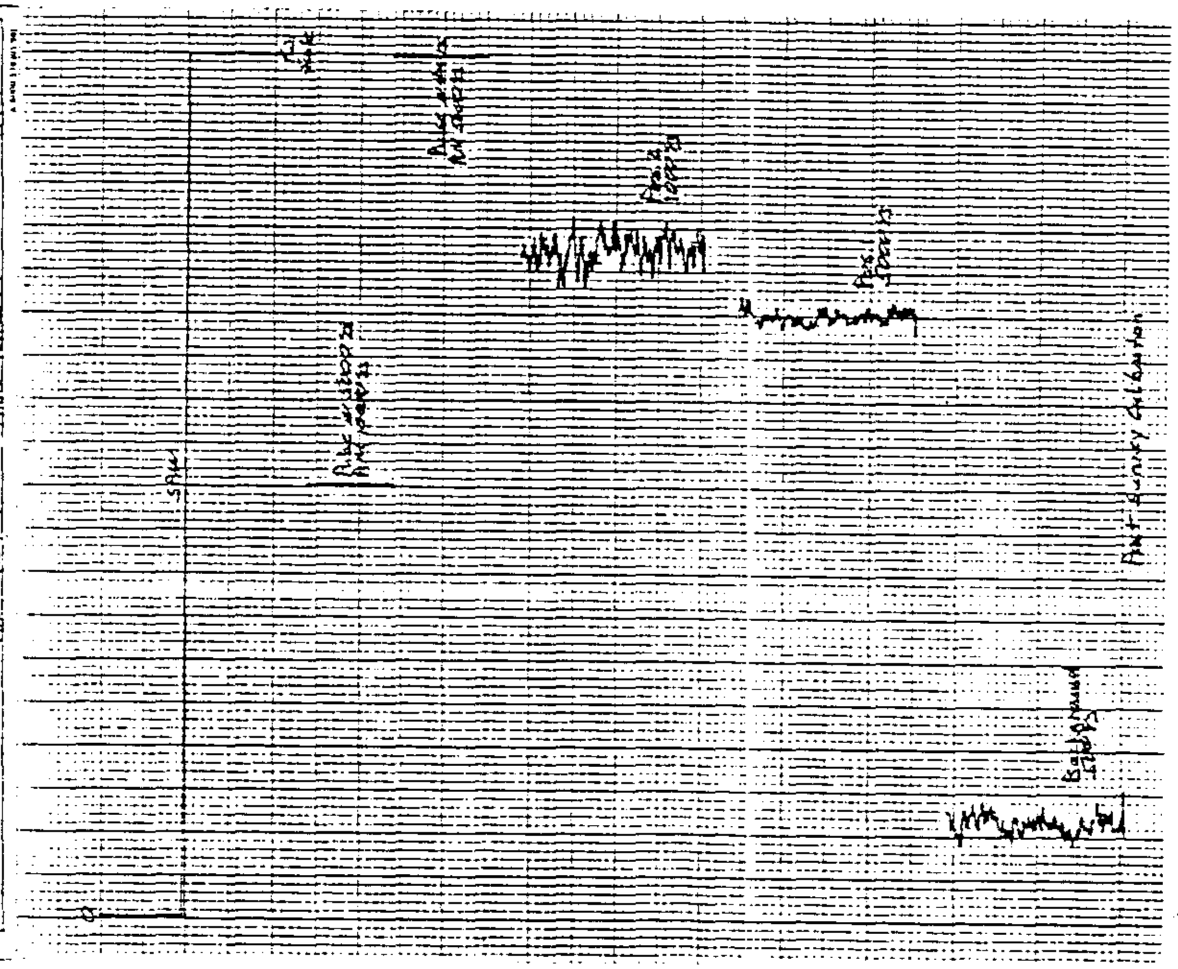
Comments: Riser Frame +0.2' high
Centralizer used

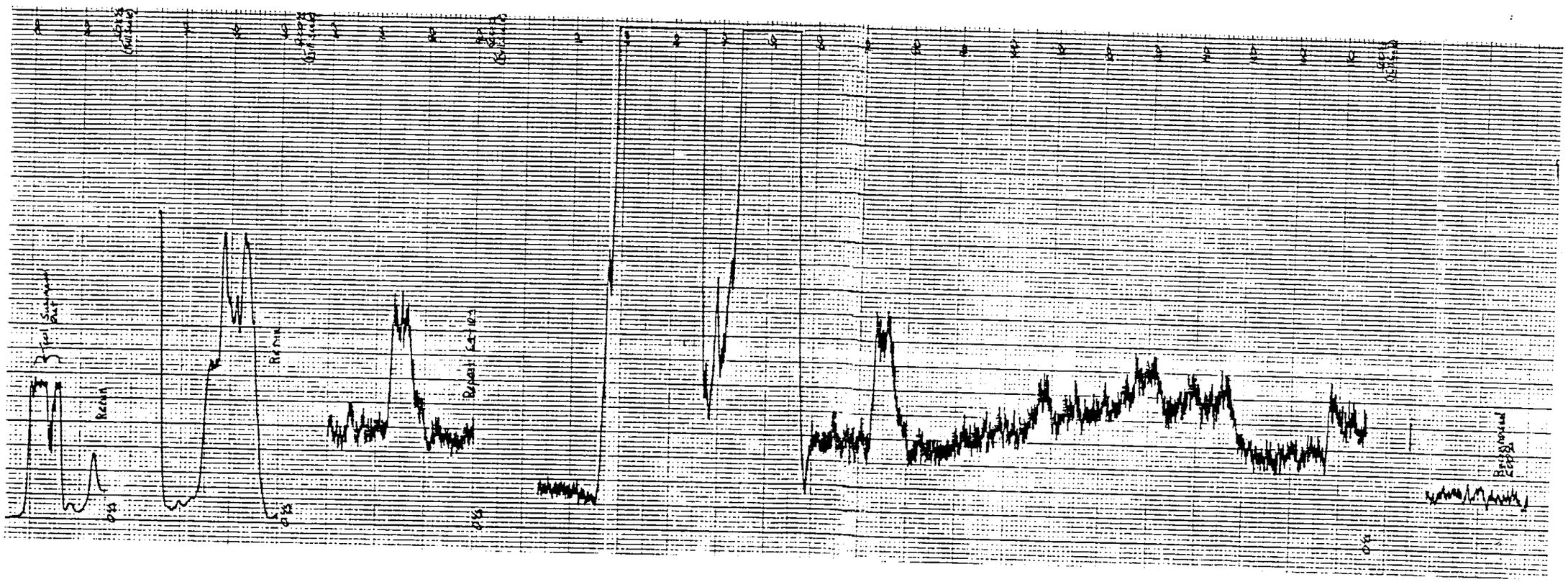
LOG HEADER — EQUIPMENT DATA — Page 1 of 1

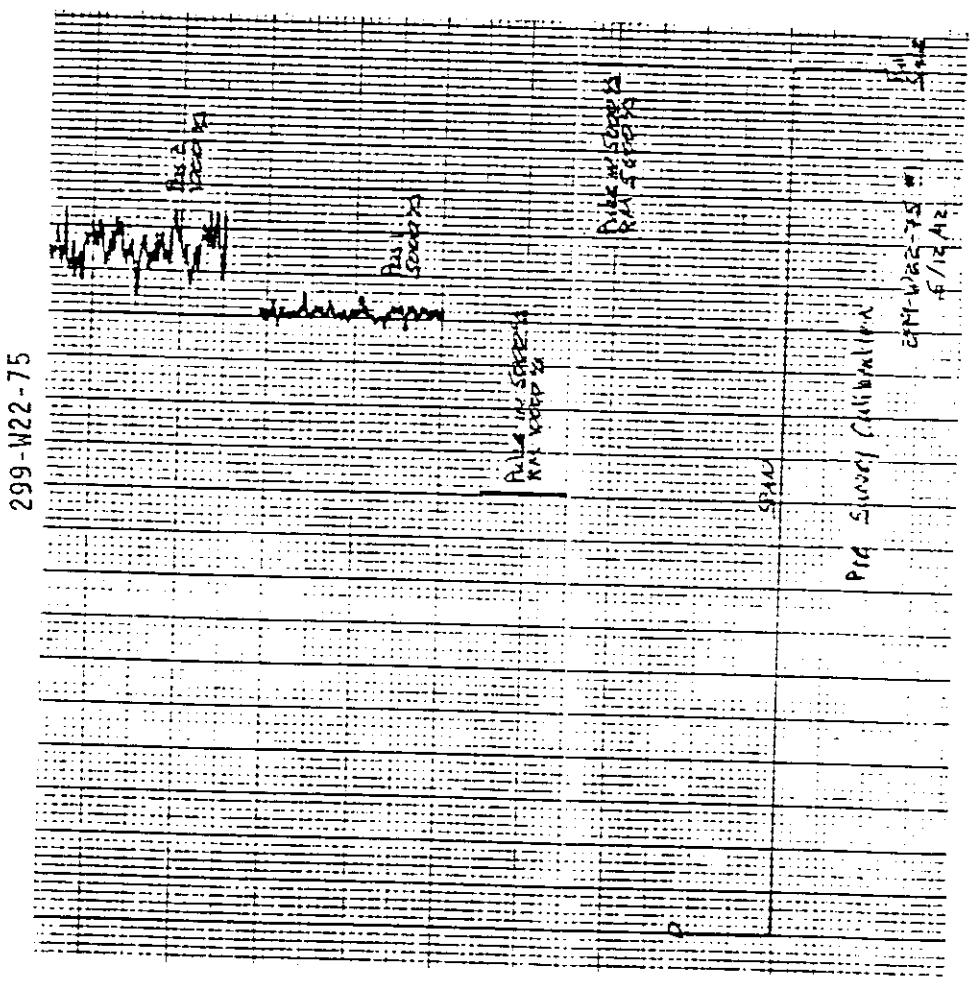
Logging Company: PNL
Operator(s): Alan Pearson
Equipment Brand: MIS — Equipment Type: Analog
Tool Type: Gamma Bat — Serial No.: CG22017
Base Calibration Date: 5/4/1 — Calibration Reference: PNL-7985 HC-606
Calibration/Probe Factor: B.B+... Position 1: 611.1 ell — Position 2: 611.3 ell
Dead Time: 11.8 μsec — Warm-Up Time: 215 min

LOGGING INFORMATION

Log Interval From: 175.6' To: 3.6'
Interval(s): 400' to 100 @ 40 sec; 600' to 350' @ 55 sec; 350 to 150 @ 26 sec
Pre Survey Verification: Position 1: 306.5 ell — Position 2: 634 ell — Background: 58 1/3
Base Calibration Difference: Position 1: 9.1 ell — Position 2: 0.9 ell
Logging Speed: 5 ft/min — Return Scale, CPS/in: 50 c/s/in
Start Time: 0945 — Completion Time: 1200
Chart Speed(s): 10 ft/in — Time Constant(s): TC-1
Chart Recorder Horizontal Scale, CPS/in: 50 c/s/in
Post Survey Verification: Position 1: 304.3 ell — Position 2: 63.4 ell — Background: 58 1/3
Percent Change: Position 1: 0.7% — Position 2: 0.0%
Comments: Probe Centered +0.2' high, Centralizer used
Witnessed and Verified by: (sign and print name) Alan Pearson Alan Pearson — Date: 5/12/92




299-W22-75


299-W22-75

Crib Designation: 216-Z-5 Crib

Type of Facility: Two wooden box cribs, each 12 ft x 12 ft x 4 ft high, boxes are 65 feet apart

Location: N 40912 to N 40992, W 76600, 150 ft east of 231-Z building, 600 ft north of 2704-Z building

Service Dates: 6/45 to 2/47

Description of Waste: 3.1 x 10^6 liters of process waste from 231-Z building via the 231-W-151 sump tank, Waste contained sludge which decreased the permeability of the underlying sediment, resulting in closure of the site

Radionuclide Release Summary:

Radionuclide	Quantity
Pu	340 g
Sr-90	5.0 Ci
Ru-106	100 Ci
Cs-137	10 Ci
Co-60	0.50 Ci
U	<0.05 g

Summary of Past Logging:

Boreholes	Date	Reference
299-W15-1	1976	Fecht, et al., 1977
299-W15-63	1986	Geophysics files

Review of Current Logging:

Borehole: 299-W15-63

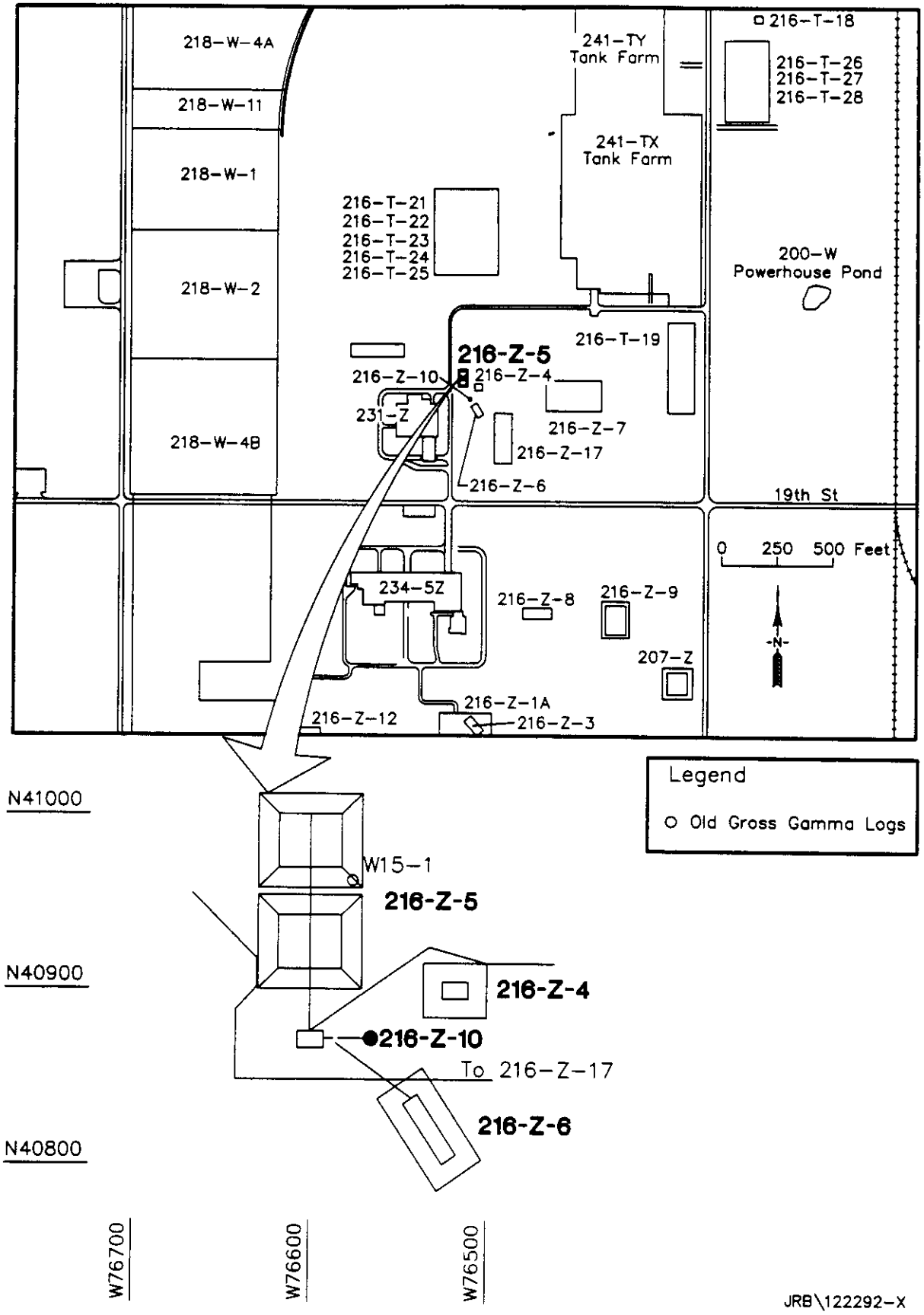
This borehole was logged with the PNL gross gamma and the RLS spectral gamma logging systems. High gamma activity was found near the bottom of the borehole from 90 feet to 145 feet. The last few feet of the borehole shows background count rates on the gross gamma log.

The spectral gamma log shows the high activity to be due to the presence of Co-60 and Eu-154. Both of these radionuclides are fairly mobile in the unsaturated zone and the source of the nuclides is probably this crib as opposed to another. However, the records only report cobalt, not europium, and only a small amount of cobalt is shown to be released at this site. This is not consistent with the cobalt concentrations found at this site. The records are therefore suspect.

This borehole does not extend all the way to the groundwater and no measurements of man-made nuclide concentrations are available for the lower portions of the unsaturated zone. However, considering the mobility of europium and cobalt and the concentration profiles in the upper portions of the unsaturated zone, it is likely that these nuclides have migrated to the groundwater.

There is no lithology information for this borehole, thus no

assessment can be made of the relationship between the deposition of the contamination and the lithology.


218-W-4A
218-W-11
218-W-1
218-W-2
218-W-4B
241-TY
Tank Farm
241-TX
Tank Farm
216-T-18
216-T-26
216-T-27
216-T-28
216-T-21
216-T-22
216-T-23
216-T-24
216-T-25
200-W
Powerhouse Pond
216-T-19
216-Z-5
216-Z-10
216-Z-4
231-Z
216-Z-7
216-Z-17
216-Z-6
19th St
0 250 500 Feet
234-5Z
216-Z-8
216-Z-9
207-Z
-N-
216-Z-1A
216-Z-12
216-Z-3
Legend
Old Gross Gamma Logs
N41000
W15-1
216-Z-5
N40900
216-Z-4
216-Z-10
To 216-Z-17
216-Z-6
N40800
W76700
W76600
W76500
JRB\122292-X

Westinghouse Hanford Company
RLS Spectral Gamma-Ray Borehole Survey Log Header

Project: 200 AAMS, Z-5 Crib

Borehole	299-W15-63			
Coordinates	40,975 N	76,100 W	Feet	(Plant 200 W)
Elevation	664.8 feet		Top of Casing	(Plant 200 W)

Borehole Environment Information

Borehole Fluid Depth none (Feet) from Zero (0.0) Depth Reference of Log

Casing Size I.D. (inch)	Casing Thickness (inch)	Top Depth (feet)	Base Depth (feet)
8.0	0.375	0.0	149.0

RLS Passive Spectral Gamma Survey Information

Logging Engineers R. V. Cram S. E. Kos
Log Depth Reference at Zero (0.0) depth is Ground Level

Log Date	Archive File Names	Log Mode, Speed	Depth Interval (feet) Top	Base	Incr
Mar 17, 92	H2W1563\A156	FIXED 0.6 fps	0.	146.6	0.5

[1]FIXED: Fixed velocity of Cable Speed: fps: Feet per second

Calibration and Analysis Information

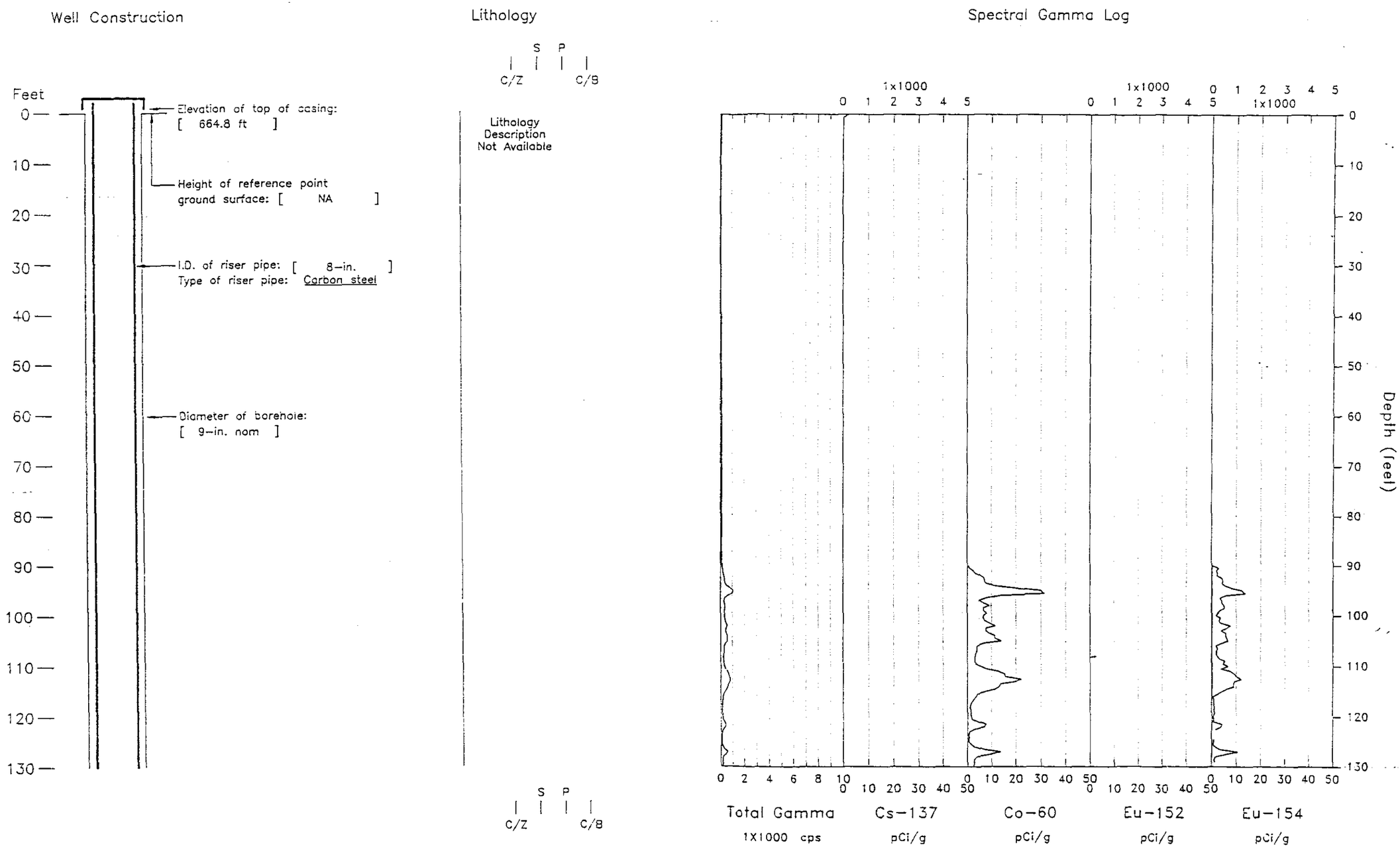
RLS Calibration Date: Nov 21, 1991
Calibration Report: WHC-SD-EN-TRP-001

Analyst Names: W. F. Nicaise R. K. Price
Analysis Date: June 25, 1992

Analysis Notes: Cs-137 only found at the surface
Radionuclides identified: Cs-137, Co-60, Eu-154, No Eu-152

RLS Spectral Gamma Ray Borehole Survey

Well 299-W15-63 | Crib 216-Z-5 | Log Date 3/17/92

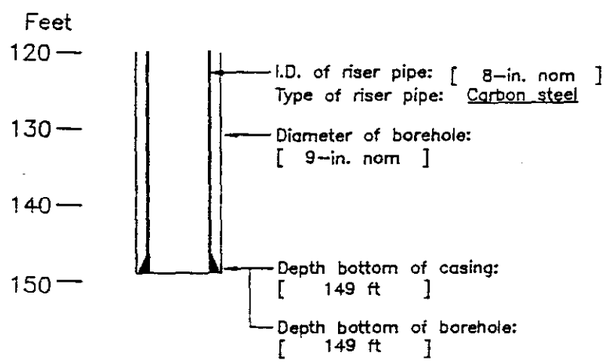


WELLS\W15-63A

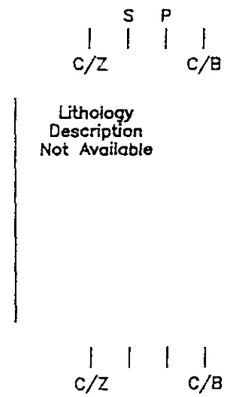
RLS Spectral Gamma Ray Borehole Survey (Page 2)

Well 299-W15-63 | Crib 216-Z-5 | Log Date 3/17/92

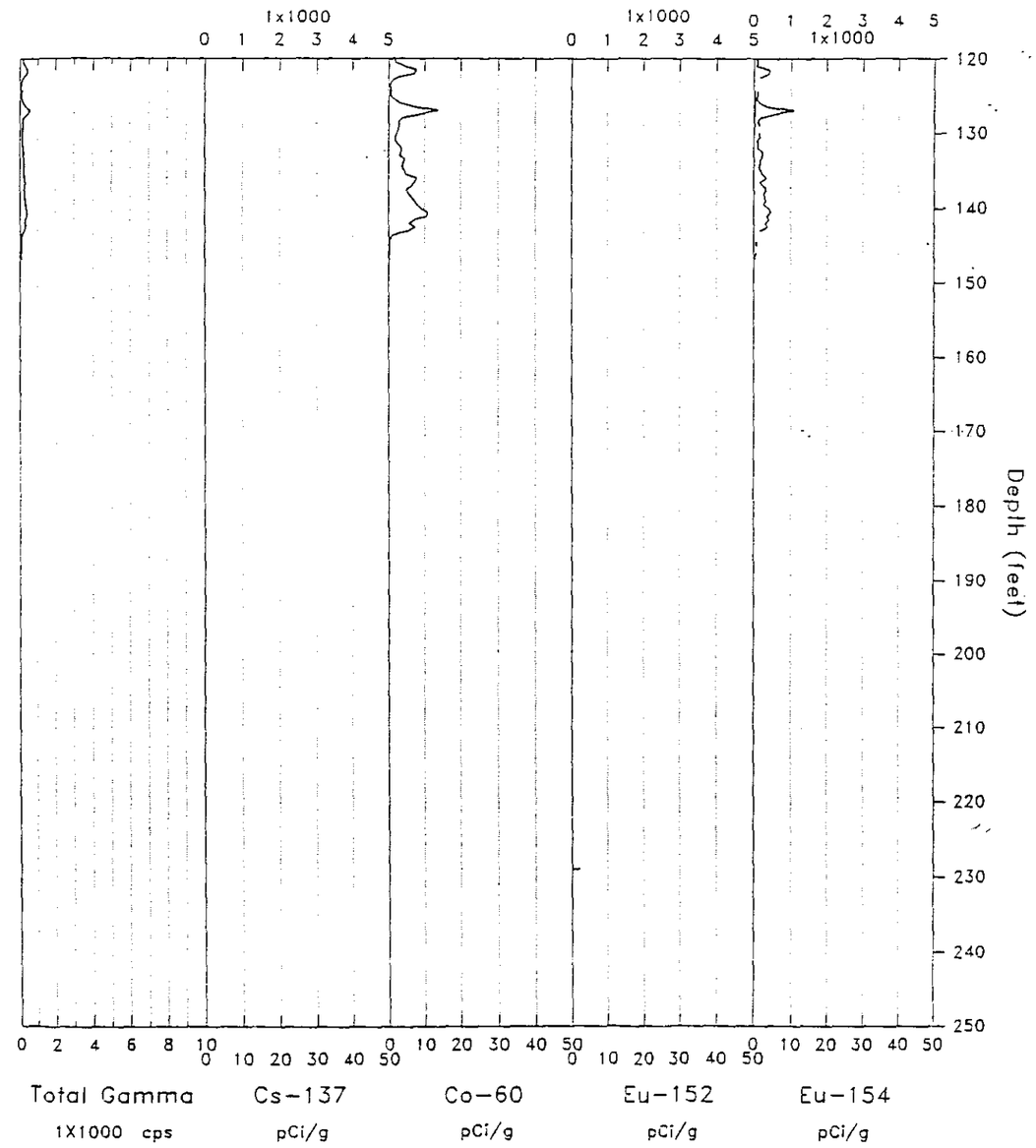
Well Construction



Lithology



Spectral Gamma Log



WELLS\W15-63B

299-W15-63 Z-5 Crib

Casing	Depth: 149'	Size: 8"	Thickness: 0.375"
Water	Depth: none		
Survey	Depth: 0 - 146.6'	Date: 3/17/92	

General Notes:
The survey is plotted on two pages. The survey data between depths 120 feet and 130 feet are plotted on each page.

The total gamma activity did not exceed 1000 cps in the borehole survey. The ratios between Total Gamma, Cobalt and Europium appear to be nearly constant.

Man-made Radionuclides:
Cesium (Cs-137) was encountered only at the surface around the borehole. The surface activity was highest and decreased with depth to a nondetectable amount below 0.5 feet.

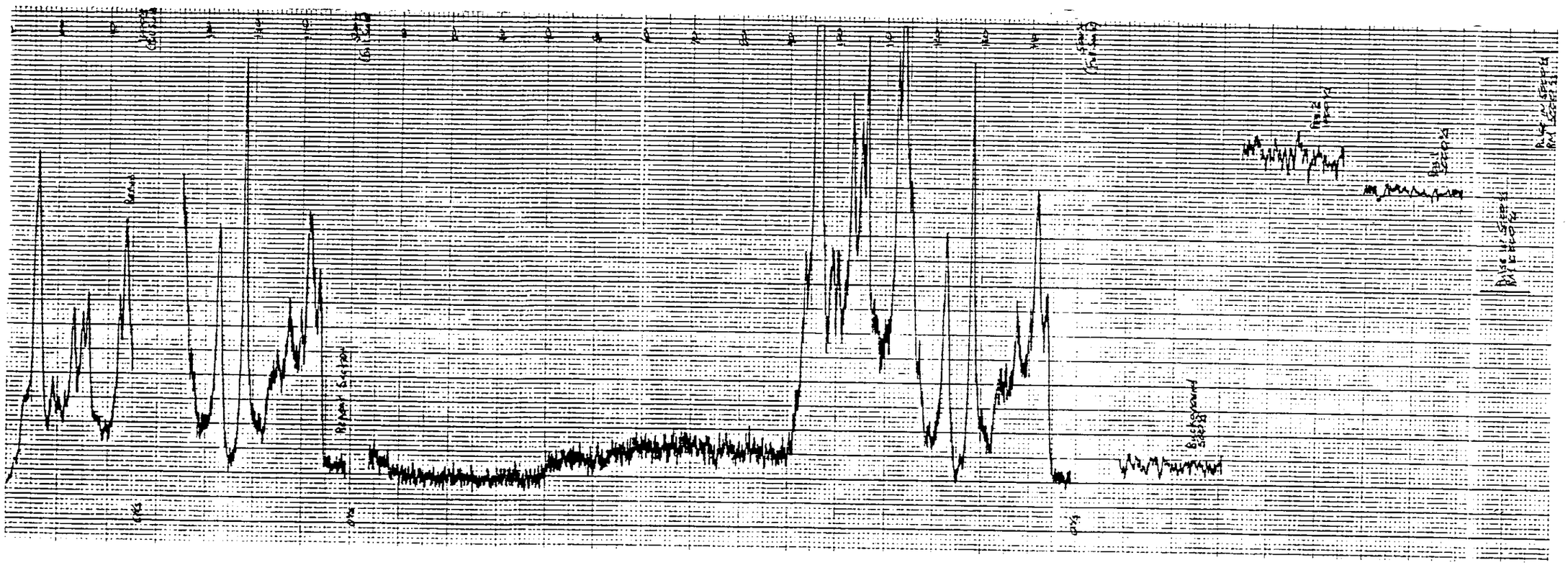
Cobalt (Co-60) was observed continuously along the borehole from 90 feet to the bottom (146 feet). The maximum activity encountered was 30 pCi/g at 95 feet. Other zones where elevated activity was recorded are: 112 and 127 feet.

Europium-152 (Eu-152) was not encountered in the borehole and the plot track is presented only for uniformity of the displayed data.

Europium-154 (Eu-154) was observed almost continuously along the borehole from 90 feet to the bottom (146 feet). The maximum activity encountered was about 13 pCi/g at 95 feet. Other zones where elevated activity was recorded are: 112 and 127 feet.

299-W15-63

299-W15-63



Crib Designation: 216-Z-7 crib

Type of Facility: Two wooden cribs in a 5 ft x 140 ft trench

Location: N 40888 to N 40912, W 76055 to W 76195

Service Dates: 2/47 to 2/67

Description of Waste: 79.9 x 10^6 liters of process waste and laboratories in the 231-Z building

Radionuclide Release Summary:

Radionuclide	Quantity
Pu	2000 g
Sr-90	370 Ci
Ru-106	100 Ci
Cs-137	360 Ci
Co-60	1 Ci
U	4.5 kg

Summary of Past Logging:

Boreholes	Date	Reference
299-W15-7	1976	Fecht, et al., 1977
299-W15-62	1976	"
	1984	Geophysics files
	1986	"
299-W15-63	1976	Fecht, et al., 1977
	1986	Geophysics files
299-W15-64	1976	Fecht, et al., 1977
	1984	Geophysics files
	1986	"
299-W15-76	1976	Fecht, et al., 1977
	1986	Geophysics files
299-W15-77	1976	Fecht, et al., 1977
	1986	Geophysics files
299-W15-78	1976	Fecht, et al., 1977
	1986	Geophysics files

Note: The 1976 gross gamma-ray logs from boreholes 299-W15-62, 299-W15-63, 299-W15-76, all have zones of high gamma activity that still exist in the gross gamma logs from the late 1980's indicating that the source nuclide is a long lived nuclide. Additionally, the shapes of the profiles are similar indicating little redistribution of the contaminants.

Review of Current Logging:

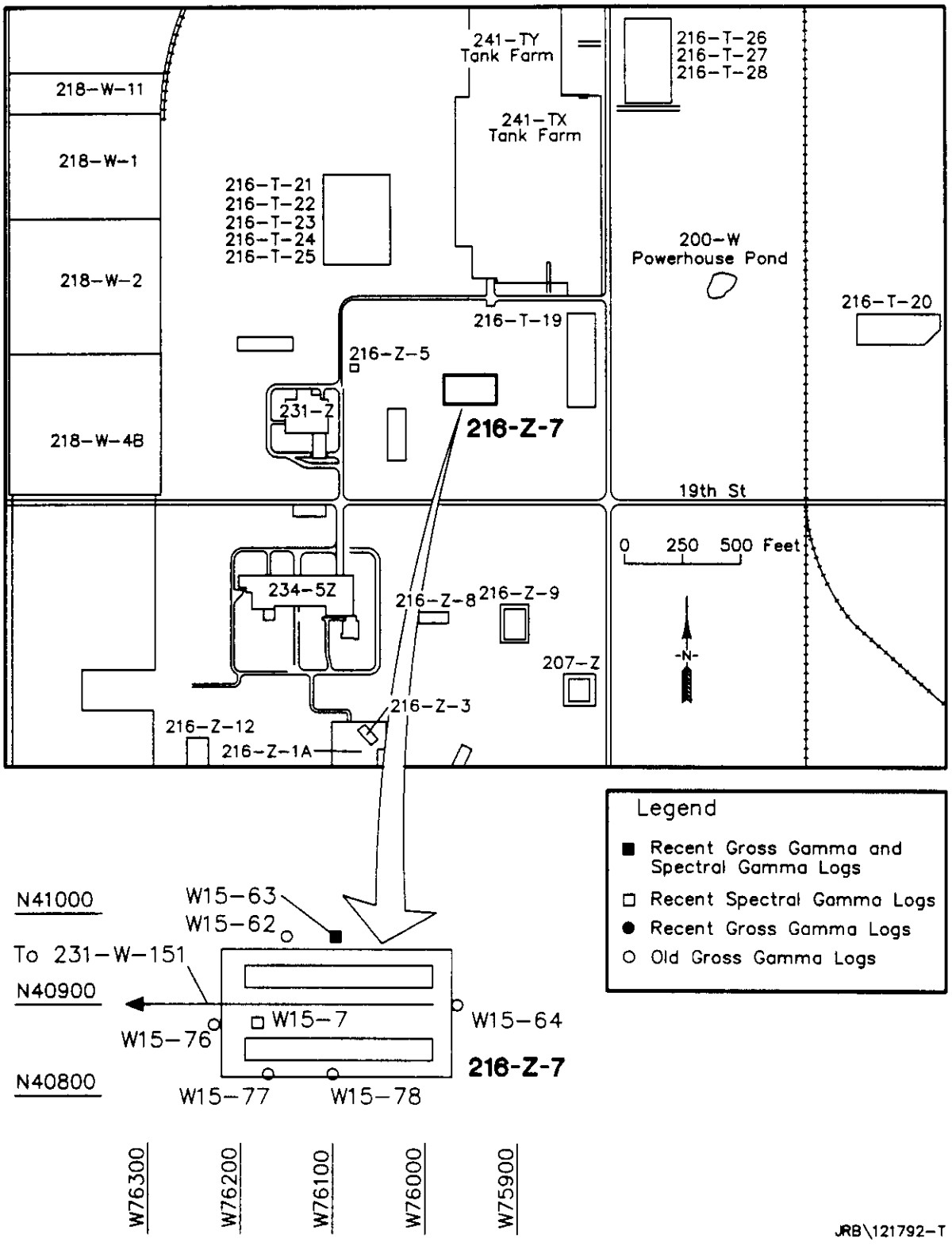
Boreholes: 299-W15-7, 299-W15-63

Borehole 299-W15-63 was logged with the PNL gross gamma system. There is a high activity zone from 90 feet to 145 feet that has not changed in shape since the last log run in 1986 indicating that the nuclides deposited in this zone are long lived and currently immobile. The 1986 log shows possible

slightly elevated activity from 20 feet to 90 feet suggesting the presence of man-made gamma-emitting nuclides. This is not present in the current log, indicating that either the nuclide was short lived or that there never was any present in the first place and the activity was due to data acquisition mistakes.

Borehole 299-W15-7 was logged with the RLS spectral gamma system. This log run produced a gross profile shape that was similar to the gross gamma profile obtained in 1976 and 1986. Co-60 and Eu-154 are basically present throughout the borehole borehole, indicating that the contamination has spread throughout the unsaturated zone and into the groundwater.

Little correlation can be established between the deposition pattern and the lithology.


241-TY
Tank Farm
216-T-26
216-T-27
216-T-28
218-W-11
241-TX
Tank Farm
218-W-1
216-T-21
216-T-22
216-T-23
216-T-24
216-T-25
200-W
Powerhouse Pond
218-W-2
216-T-20
216-T-19
216-Z-5
231-Z
216-Z-7
218-W-4B
19th St
0 250 500 Feet
234-5Z
216-Z-8
216-Z-9
N
207-Z
216-Z-3
216-Z-12
216-Z-1A
Legend
Recent Gross Gamma and Spectral Gamma Logs
Recent Spectral Gamma Logs
Recent Gross Gamma Logs
Old Gross Gamma Logs
N41000
W15-63
W15-62
To 231-W-151
N40900
W15-7
W15-64
W15-76
216-Z-7
N40800
W15-77
W15-78
W76300
W76200
W76100
W76000
W75900
JRB\121792-T

Westinghouse Hanford Company
RLS Spectral Gamma-Ray Borehole Survey Log Header

Project: 200 AAMS, Z-7 Crib

Borehole	299-W15-7			
Coordinates	40,880 N	76,180 W	Feet	(Plant 200 W)
Elevation	664. feet		Top of Casing	(Plant 200 W)

Borehole Environment Information

Borehole Fluid Depth 196.3 (Feet) from Zero (0.0) Depth Reference of Log

Casing Size I.D. (inch)	Casing Thickness (inch)	Top Depth (feet)	Base Depth (feet)
8.0	0.33	0.0	312.0

RLS Passive Spectral Gamma Survey Information

Logging Engineers R. V. Cram S. E. Kos
Log Depth Reference at Zero (0.0) depth is Ground Level

Log Date	Archive File Names	Log Mode[1], Speed	Depth Interval (feet) Top	Base	Incr
Apr 03, 92	H2W1507\A163	FIXED 0.6 fps	0.	195.	0.5
Apr 06, 92	H2W1507\A164	FIXED 0.6 fps	193.	308.	0.5

[1]FIXED: Fixed velocity of Cable Speed: fps: Feet per second

Calibration and Analysis Information

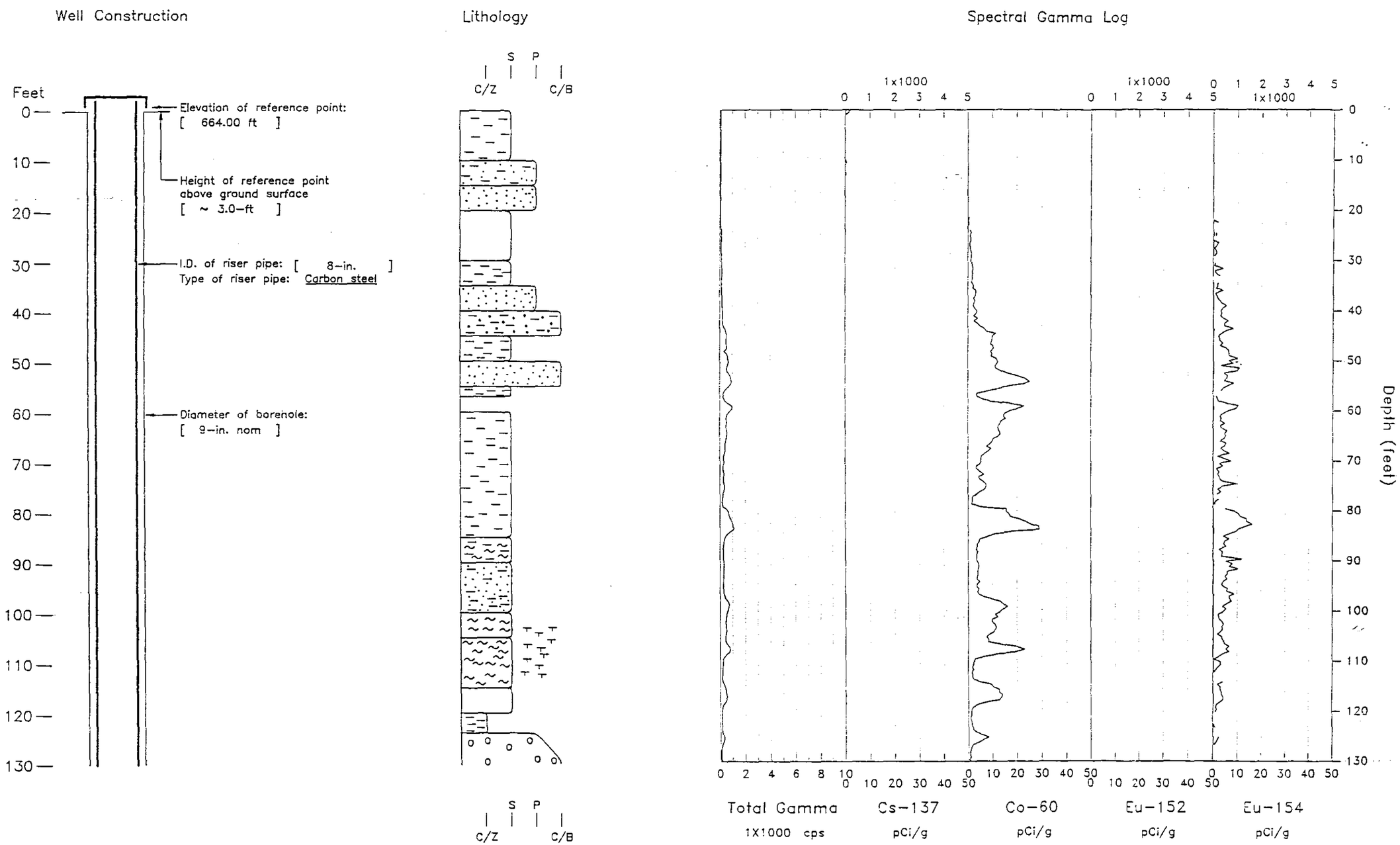
RLS Calibration Date: Nov 21, 1991
Calibration Report: WHC-SD-EN-TRP-001

Analyst Names: R. K. Price
Analysis Date: July 22, 1992

Analysis Notes: No water correction applied; Rad activity underestimated
Radionuclides identified: Cs-137, Co-60, Eu-154, NO Eu-152

RLS Spectral Gamma Ray Borehole Survey

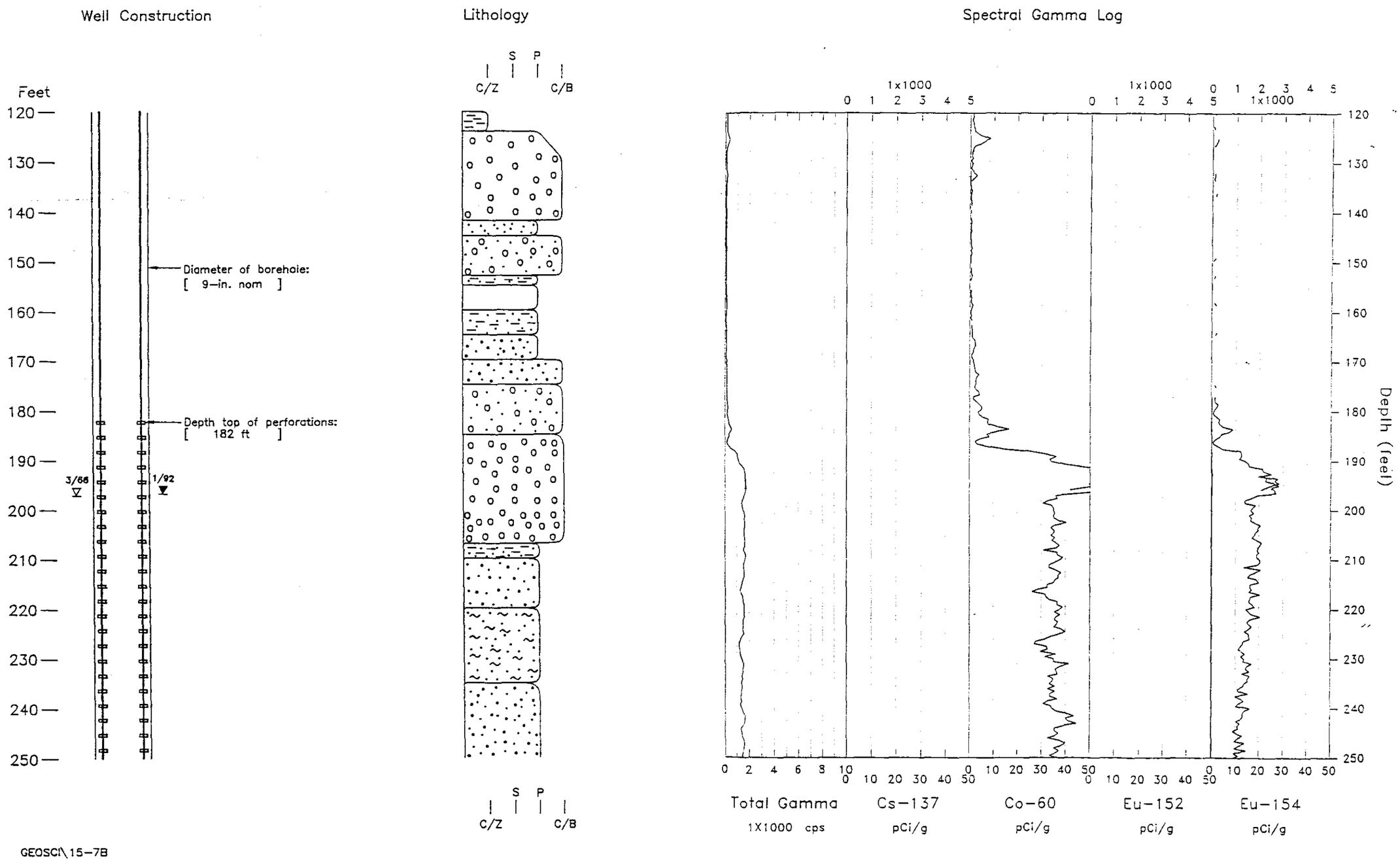
Well 299-W15-7 | Crib 216-Z-7 | Log Date 4/3,6/92



GEOSCI\15-7A

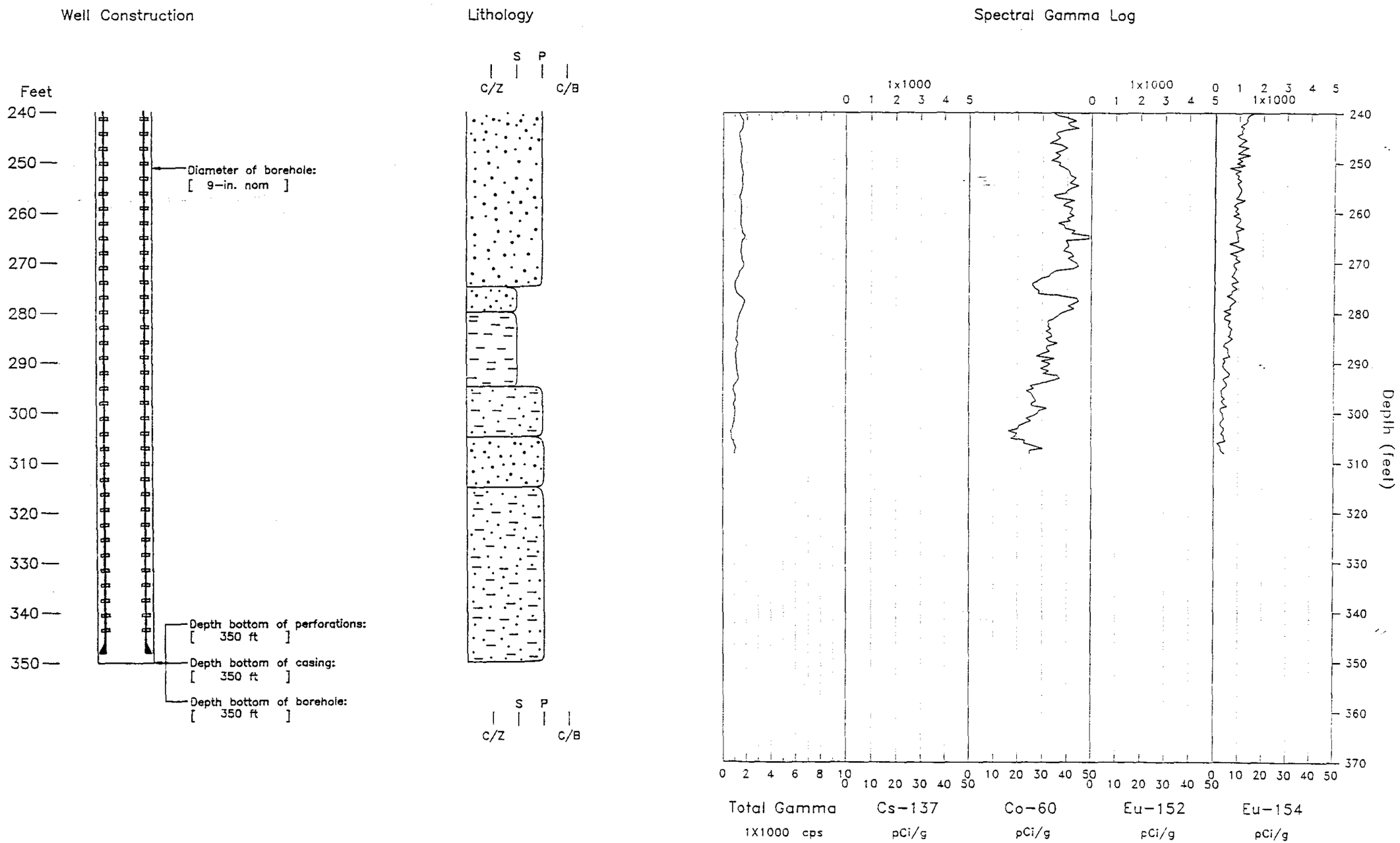
RLS Spectral Gamma Ray Borehole Survey (Page 2)

Well 299-W15-7 | Crib 216-Z-7 | Log Date 4/3, 6/92



RLS Spectral Gamma Ray Borehole Survey (Page 3)

Well 299-W15-7 | Crib Z16-Z-7 | Log Date 4/3, 6/92



GEOSCI\15-7C

299-W15-7 Z-7 Crib

Casing	Depth: 312.'	Size: 8"	Thickness: 0.33"
Water	Depth: 196.8'		
Survey	Depth: 0 - 195.7'	Date: 4/03/92	
	Depth: 193 - 308'	Date: 4/06/92	

General Notes:
The survey is plotted on three pages. The highest radionuclide activity occured below water table depth. No water correction has been applied to the computed data, therefore the reported results between 197 and 308 feet are underestimated.

The total gamma activity did not exceed 1800 cps in the borehole survey.

The borehole survey required two days to complete. Two observations are noted with the 2.5 feet overlap of measured log data between 193 and 195.7 feet. First, the measured depth between the two log runs may be off by about 1 foot. Second, the repeatability of measured radionuclide activities is good.

Man-made Radionuclides:
Cesium (Cs-137) was encountered at only two locations in the borehole. The surface activity was highest and decreased with depth to a nondetectable amount below 1.0 feet. Cesium was encountered in the borehole between 10 and 13 feet, the activity was less than one 1 pCi/g.

Cobalt (Co-60) was observed almost continuously along the borehole from 21 feet to the bottom (308 feet). The maximum activity encountered was 60 pCi/g at 193 feet. Other zones where elevated activity was recorded are: 54, 59, 82, 107, 116, and 188 thru 308 feet.

Europium-152 (Eu-152) was not encountered in the borehole and the plot trail is presented only for uniformity of the displayed data.

Europium-154 (Eu-154) was observed almost continuously along the borehole from 22 feet to 120 feet and from 177 feet to the bottom (308 feet). Detection of Eu-154 between 120 and 177 feet was discontinuous with activities generally less than 2 pCi/g. The maximum activity encountered was about 30 pCi/g at 194 feet. Other zones where elevated activity was recorded are: 50, 59, 82, and 188 thru 260 feet.

Crib Designation: 216-Z-9 Trench

Type of Facility: Concrete covered trench with a bottom surface of 30 ft x 60 ft

Location: N 39830 to N 39890, W 75910

Service Dates: 7/55 to 6/62

Description of Waste: 4.06 x 10^6 liters of: Received acidic recuplex CAW and aqueous and organic waste from the 234-5 building; Waste composition similar to 236-Z/242-Z waste except for higher HNO3 and Al(NO3)2 concentrations in recuplex CAW

Additionally, this trench received about 83 x 10^3 liters of carbon tetrachloride.

Radionuclide Release Summary:

Radionuclide	Quantity
Pu	38,000 g
Sr-90	<0.1 Ci
Ru-106	20 Ci
Cs-137	<0.1 Ci
Co-60	<0.1 Ci
U	<50 g

Summary of Past Logging:

Boreholes	Date	Reference
299-W15-6	1976	Fecht, et al., 1977
	1987	Geophysics files
299-W15-8	1976	Fecht, et al., 1977
	1987	Geophysics files
299-W15-9	1976	Fecht, et al., 1977
	1987	Geophysics files
299-W15-82	1976	Fecht, et al., 1977
	1987	Geophysics files
299-W15-84	1976	Fecht, et al., 1977
	1987	Geophysics files
299-W15-85	1976	Fecht, et al., 1977
	1987	Geophysics files
299-W15-86	1976	Fecht, et al., 1977
	1987	Geophysics files
299-W15-95	1976	Fecht, et al., 1977
	1987	Geophysics files

Review of Current Logging:

Boreholes: 299-W15-8, 299-W15-9, 299-W15-84, 299-W15-86

All of the boreholes listed immediately above were logged with the PNL gross gamma system. Borehole 299-W15-8 was logged with the spectral gamma system.

When comparing the gross gamma logs, a good correlation of the activity profiles can be seen between 299-W15-8 and 299-W15-86. From the W15-8 spectral gamma log, the gamma

activity at the 50 foot and 110 foot levels is primarily due to Pu-239. Detectable quantities of Cs-137 are also present but only at the zones with the highest Pu concentrations.

Detecting and quantifying the radionuclides surrounding this borehole is complicated by the grout surrounding the well casing. The concentration data reported is not accurate and the uncertainty of the measurements is very high.

The high activity zones in the borehole correlate very well with the changes in lithology. The lower activity zone (110 feet) is just above a 10 foot caliche layer which is found throughout much of the 200 West area. It appears that the contaminated liquids carried the nuclides down to this impermeable layer and transported and deposited them along the top of it.

Typically, plutonium is not very mobile in the unsaturated zone and to transport the plutonium deep into the unsaturated zone as is the case at this crib, it is necessary to either release a large quantity of water to act as a driving mechanism, or the chemical environment created from the combination of the soil geochemistry and the effluent chemistry must be ideal for plutonium transport. In the case of this trench, the carbon tetrachloride obviously played an important role in the migration of the plutonium.

Protactinium 233, a short lived daughter product of Neptunium 237, was also found in W15-8. It was distributed below the upper, high activity zone at 50 feet all the way down to the top of the caliche layer. This shows that the protactinium is chemically more mobile than the plutonium and the cesium and less readily adsorbed onto the sediment. The carbon tetrachloride may also have been an important factor in the transport of the protactinium.

The protactinium shows up in the gross gamma-ray log as slightly elevated activity between the upper and lower high activity plutonium peaks. This slightly elevated activity is also seen in the gross gamma log from W15-86.

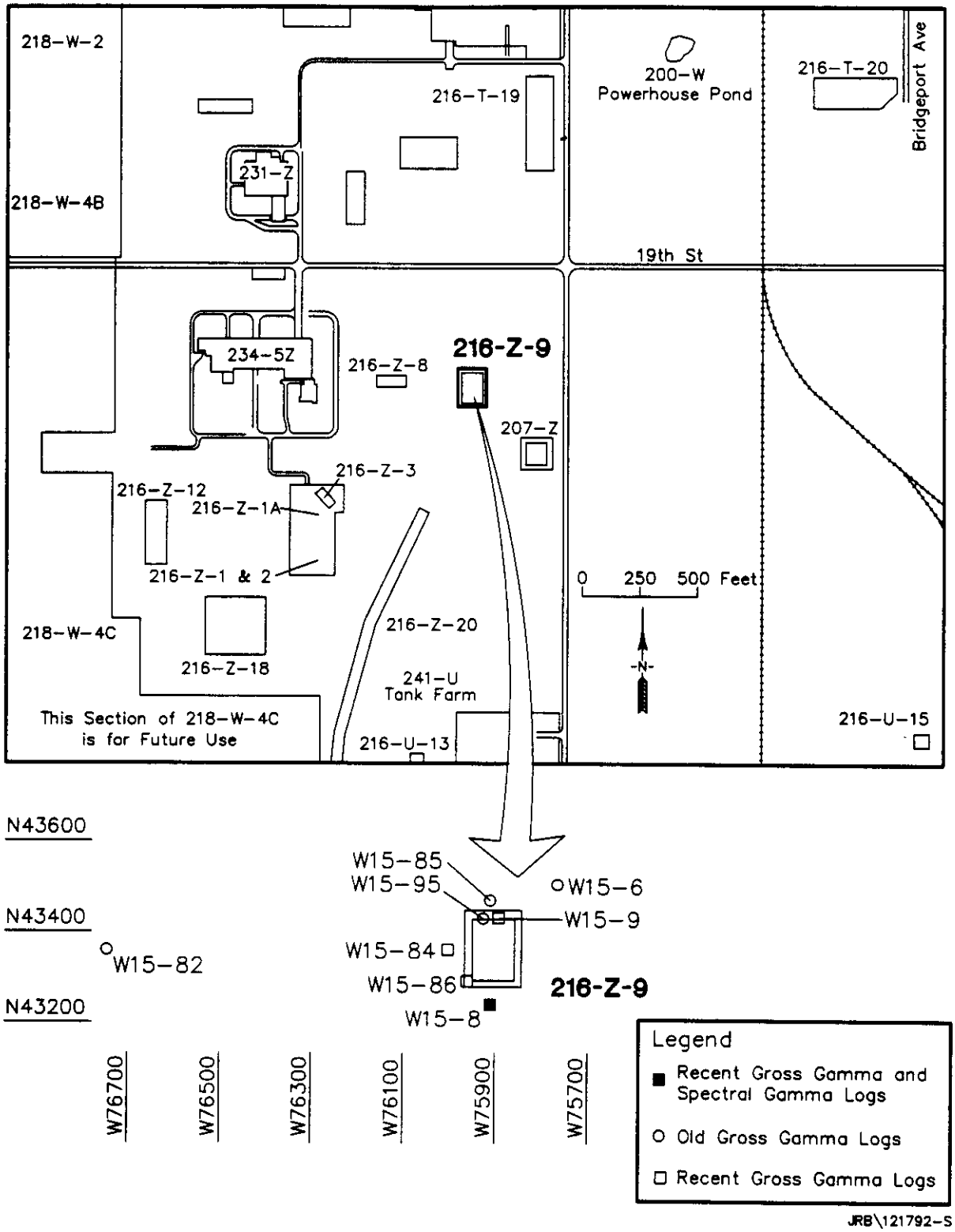
Cs-137 was detected in W15-8 at about 195 feet. It does not show up in the recent gross gamma log, but the 1987 log shows a small zone of slightly elevated activity that may be caused by the cesium.

Borehole 299-W15-84, which is close to W15-86, shows slightly elevated gross activity from about 50 feet to the bottom of the borehole. This is probably from Pa-233. The plutonium does not tend to migrate, or when it does it tends to concentrate in certain chemical environments creating zones of significant Pu concentrations. Therefore, is most likely that there is no plutonium in this area of the crib or it would show up as a high activity zone.

Borehole 299-W15-9 shows a small zone of elevated gross activity just above the caliche layer and another at 150 feet. These slight increases in activity may be due to Pa-233 or to naturally high concentrations of potassium in the clays found in the caliche. A spectral gamma-log of this borehole would provide information to resolve this question. There are considerable differences between the most recent gross gamma log and the previous ones. However, these differences are probably due to differing data acquisition methods and the old logs may not

properly represent the true gross gamma activity profile.

As a general summary of this crib, it is apparent that the bulk of the man-made nuclides released from this crib were deposited more toward the south end of the trench . The bulk of the contamination detected is plutonium and protactinium with barely detectable quantities of cesium. It is also apparent that the caliche zone acted as an impermeable barrier upon which the water traveled and the nuclides were deposited. Additional studies of the geochemistry of this site are recommended to try to understand the role of the site chemistry and the carbon tetrachloride on the deposition of the plutonium and protactinium (Np-237). It is also recommended that all of the boreholes be logged with the spectral gamma system and logs of the natural gamma emitters (K, U and Th) be run.


218-W-2
218-W-4B
231-Z
216-T-19
200-W
Powerhouse Pond
216-T-20
Bridgeport Ave
19th St
234-5Z
216-Z-8
216-Z-9
207-Z
216-Z-3
216-Z-12
216-Z-1A
216-Z-1 & 2
0 250 500 Feet
-N-
218-W-4C
216-Z-18
216-Z-20
241-U
Tank Farm
This Section of 218-W-4C
is for Future Use
216-U-13
216-U-15
N43600
N43400
N43200
W15-85
W15-95
W15-6
W15-9
W15-82
W15-84
W15-86
216-Z-9
W15-8
W76700
W76500
W76300
W76100
W75900
W75700
Legend
Recent Gross Gamma and Spectral Gamma Logs
Old Gross Gamma Logs
Recent Gross Gamma Logs
JRB\121792-S

Westinghouse Hanford Company
RLS Spectral Gamma-Ray Borehole Survey Log Header

Project: 200 AAMS, Z-9 Crib

Borehole	299-W15-8		
Coordinates	39,740 N 75,910 W	Feet	(Plant 200 W)
Elevation	667.8 feet	Top of Casing	(Plant 200 W)

Borehole Environment Information

Borehole Fluid Depth 198. (Feet) from Zero (0.0) Depth Reference of Log

Casing Size I.D. (inch)	Casing Thickness (inch)	Top Depth (feet)	Base Depth (feet)
8.0	0.33	0.0	106.5
6.0	0.25	0.0	206.
4.0	0.25	0.0	178.

RLS Passive Spectral Gamma Survey Information

Logging Engineers R. V. Cram S. E. Kos
Log Depth Reference at Zero (0.0) depth is Ground Level

Log Date	Archive File Names	Log Mode[1], Speed	Depth Interval (feet) Top	Base	Incr
Mar 03, 92	H2W1508\A146	FIXED 0.6 fps	0.	199.	0.5

[1]FIXED: Fixed velocity of Cable Speed: fps: Feet per second

Calibration and Analysis Information

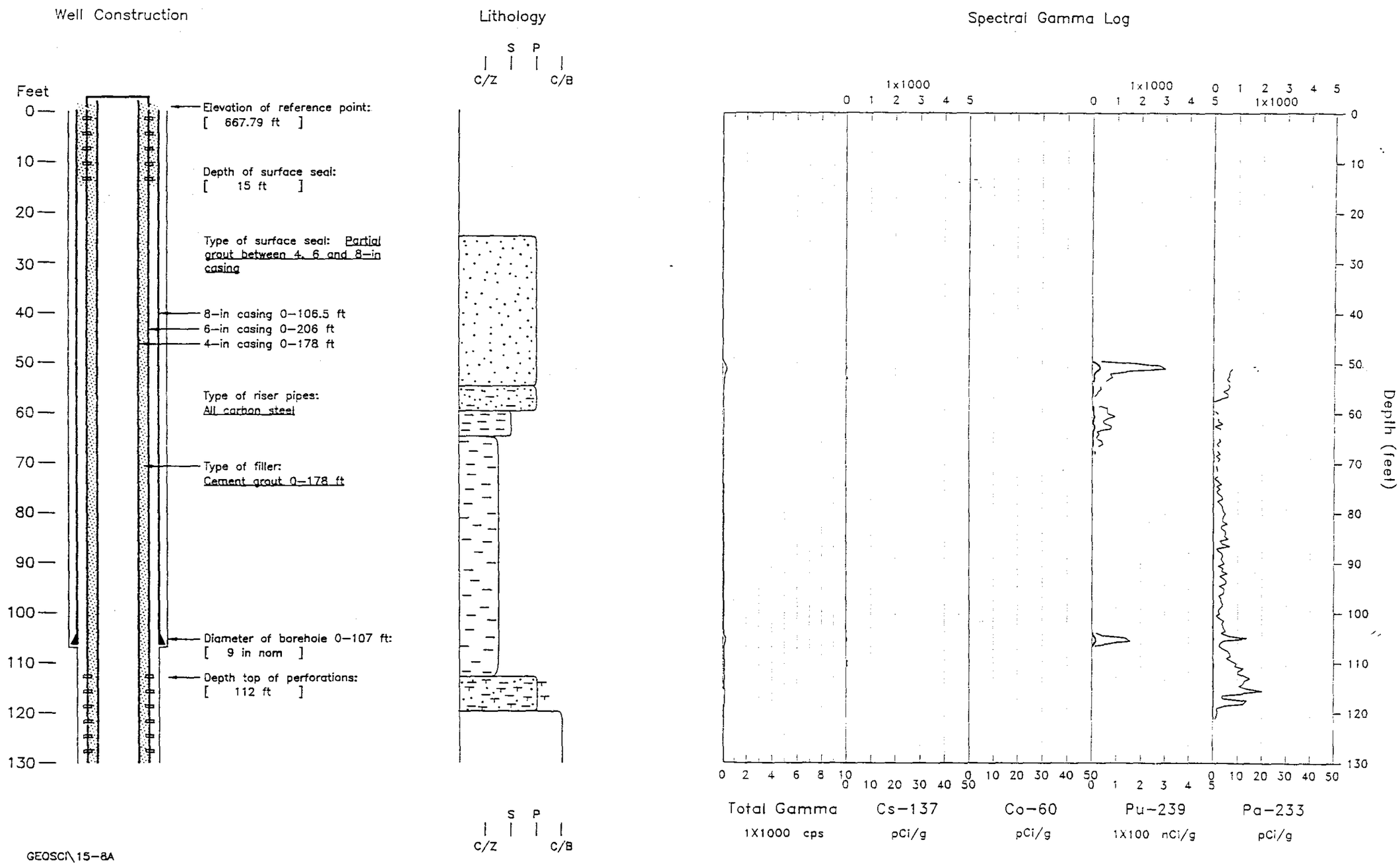
RLS Calibration Date: Nov 21, 1991
Calibration Report: WHC-SD-EN-TRP-001

Analyst Names: R. K. Price
Analysis Date: July 23, 1992

Analysis Notes: Maximum casing thickness correction 0.40 inch
Radionuclides identified: Cs-137, Pu-239, Pa-233(Np-237)

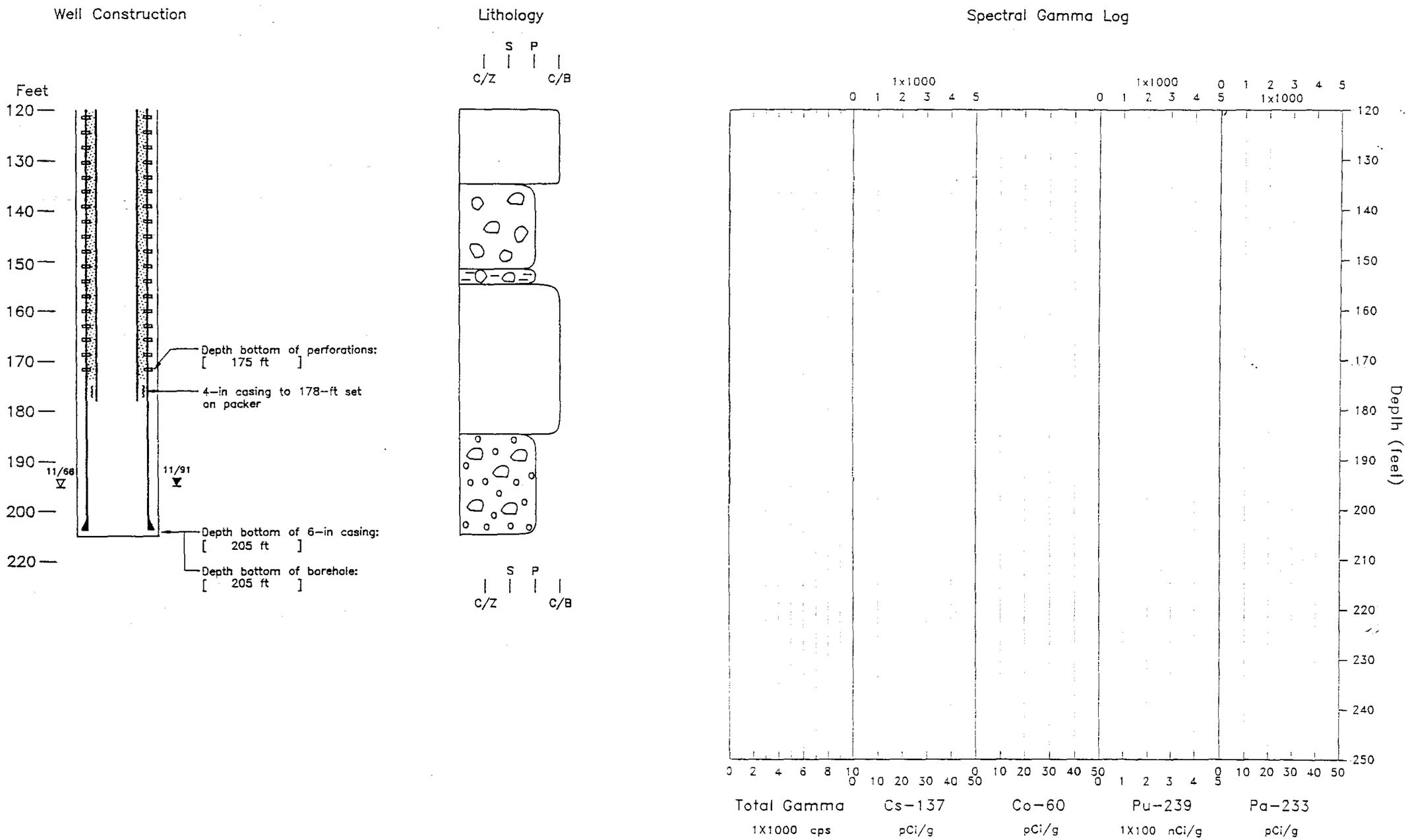
RLS Spectral Gamma Ray Borehole Survey

Well 299-W15-8 | Crib 216-Z-9 | Log Date 3/3/92



RLS Spectral Gamma Ray Borehole Survey (Page 2)

Well 299-W15-8 | Crib 216-Z-9 | Log Date 3/3/92



GEOSCI\15-88

299-W15-8 Z-9 Crib

Casing	Depth: 178.'	Size: 4"	Thickness: 0.25"
	Depth: 206.'	Size: 6"	Thickness: 0.25"
	Depth: 106.5'	Size: 8"	Thickness: 0.33"
Water	Depth: 198.'		
Survey	Depth: 0 - 199.'	Date: 3/03/92	

General Notes:
The survey is plotted on two pages. The second plot page is essentially blank since virtually no man-made radionuclides were observed below 120 feet.

The maximum calibrated casing correction of 0.40 inches was applied to the survey data. The computed activity for data recorded through multiple casing strings will be underestimated.

The total gamma activity did not exceed 400 cps in the borehole survey. The total gamma activity is not representative of the levels of radionuclide concentration computed in the borehole. The maximum decay activity of plutonium-239 (Pu-239) is about 300,000 pico-curies per gram (pCi/g) or 300 nano-curies per gram (nCi/g).

The complexity of the gamma-ray photo peaks for tranuranic radionuclides compromised analysis for the screening data acquired for the AAMS field investigation. Many of the gamma-ray photo peaks of Pu-239 occur below the calibrated energy range of 300 keV. And some gamma-ray photo peaks of Pu-239 and Pa-233 are so close in energies that they can not be efficiently separated due to the short counting time required for AAMS screening. Additional borehole surveys with longer counting times will be required if additional detail of the contaminents are needed.

Man-made Radionuclides:
Cesium (Cs-137) was encountered from 50 feet to 195 feet. The cesium activity never exceeded 1 pCi/g. The faster logging speed used for borehole screening of the AAMS field investigation may allow trace amounts of cesium to be undetected.

No Cobalt (Co-60) was encountered in the borehole. The plot track is present only for uniformity of the displayed data.

Plutonium-239 (Pu-239) was observed between the depth interval of 49.5 feet and 106 feet. The maximum activity encountered is 300 nCi/g at 51 feet. Other zones of identified activity were 51, 55 thru 68, and 105 feet.

Protactinium-233 (Pa-233), a daughter of Np-237, was observed between the depth interval of 51 feet and 121 feet. The maximum activity encountered was 20 pCi/g at 115 feet. Other zones of elevated activity were measured at 105 and 111 thru 118 feet.

299-W15-9

Westinghouse Hanford Company | LOG HEADER | Page 1 of 2

Well No. 299-W15-9 Area 200 West Date 8/9/92
Log Run 1 of 1 Log Type Gross Gamma
Elevation Datum Top of Casing Elevation 462.3
Survey Coordinates N 79970 W 75390
Log Measured From Ground Surface
Location Orientation North Side of 299 Crib
Ground Surface Elevation
Surface Temperature NA Weather Clear - Hot

BOREHOLE INFORMATION

Driller
Drill Rig Type Bit Type/Diameter
Borehole Diameter/Depth 6"/190 4"/179'
Depth Driller 190' (Horizontal Wells) Depth Logger 190.1'
Liquid Level NA (none) Liquid Density NA
Temperature NA

CASING RECORD

Type 8" Carbon Steel Sch 40 Interval +10' - 195'
Type 6" Carbon Steel Sch 40 Interval +17' - 195'
Type 4" Carbon Steel Sch 5 Interval +17' - 179
Type Interval
Well Screen Interval NA
Comments: Casing Errors +0.1' high
Centralizer used

Page 1 of 2

LOG HEADER

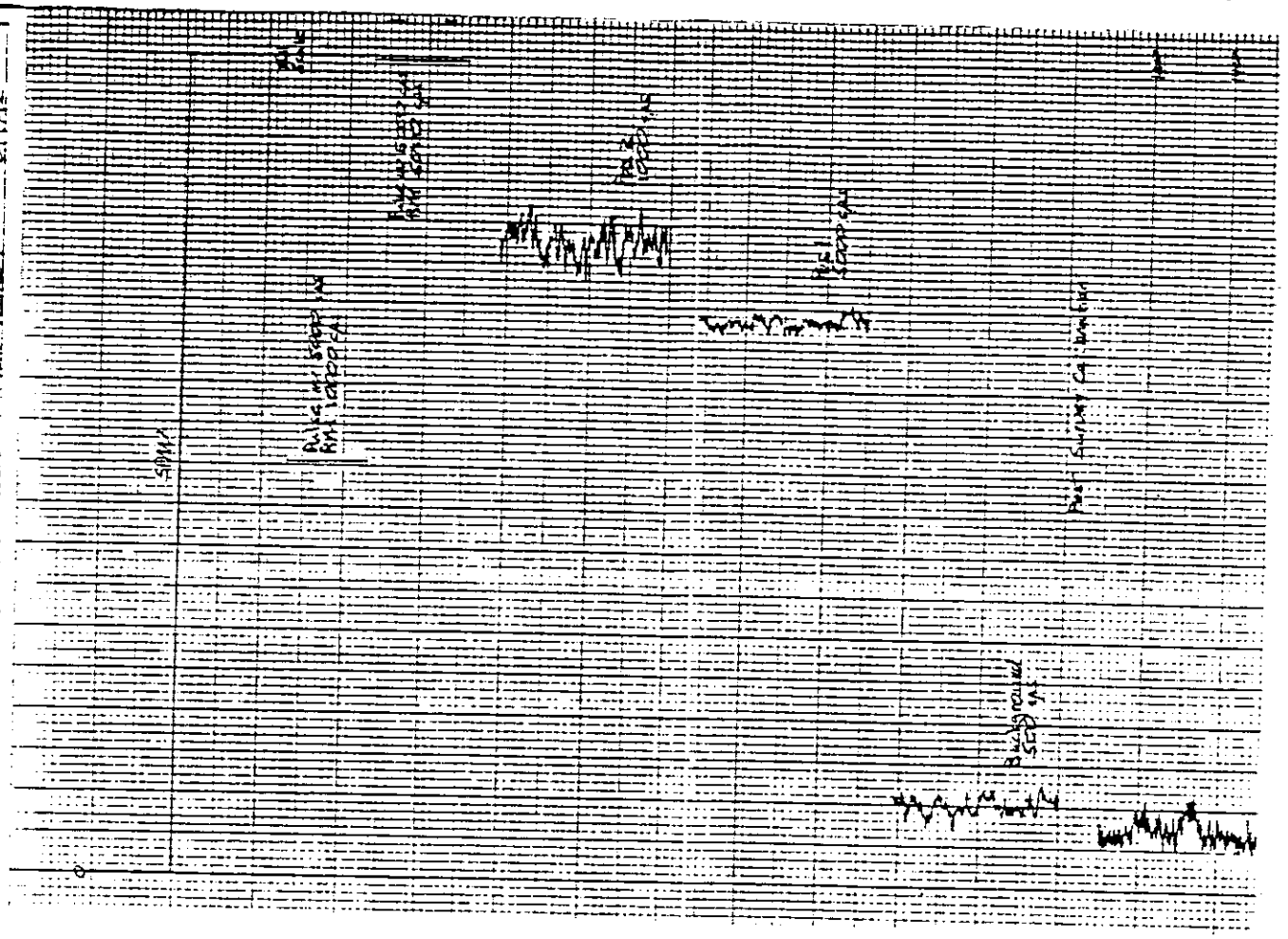
EQUIPMENT DATA

Logging Company PNL
Operator(s) Alan Pearson
Equipment Brand NIS
Equipment Type Analog
Tool Type Gamma Rat. Serial No. CGR7 MH1
Base Calibration Date 5/92 Calibration Reference PNL-8260 KC-1216
Calibration Product Factor 1 1.0 Calibration Datum (cps): Position 1 2161 cpm Position 2 651 cpm
Trend Line 12.3 cpm Warm Up Time 7:15 am

LOGGING INFORMATION

Log Interval From 190' to 3'
Recorded 190' to 1250 Position 1 209 cpm Position 2 613 cpm Background 52 cpm
Pre Survey Verification: Position 1 Position 2 Background
Base Calibration Difference: Position 1 5 Tech Position 2 0.8 cpm
Logging Speed 5 ft/min Recorded Scale, CPS/in 50 CPS/in.
Start Time 1215 Completion Time 1315
Chart Speed, Hor. 10 cm/in. Chart Recorded Horizontal Scale, CPS/in 50 CPS/in.
Chart Recorder Vertical Scale, CPS/in 50 CPS/in. Time Constant(s) 16-1
Post Survey Verification: Position 1 306.5 cpm Position 2 65.8 cpm Background 52 cpm
Percent Change: Position 1 0.9% Position 2 2.3%
Comments: Drum Errors +0.1' high
Centralizer used

Witnessed and Verified by (Sign and print name) Alan Pearson Date: 8/9/92



299-W15-86

Westinghouse Hanford Company | LOG HEADER | Page 1 of 2

Well No. 299-W15-86 Area 200 West Date 2/27/92
Log Run #1 Log Type Gross Gamma
Elevation Datum Top of Casing Elevation 461.27
Survey Coordinates N 79740 W 75954
Log Measured From Ground Surface
Location Orientation Se corner of 216-Z-9 Crib
Ground Surface Elevation
Surface Temperature NA Weather Clear - Warm

BOREHOLE INFORMATION

Driller
Drill Rig Type Bit Type/Diameter
Borehole Diameter/Depth 9"/? 6"/1389
Depth Driller 144' HW Depth Logger 138.9
Liquid Level NA Liquid Density NA
Temperature NA

CASING RECORD

Type 9" Carbon Steel Interval 4"-14'
Type 6" Carbon Steel Interval +30'
Type Interval
Type Interval
Well Screen Interval NA
Comments: Casing Errors +0.15' high
Centralizer used

Page 1 of 2

LOG HEADER

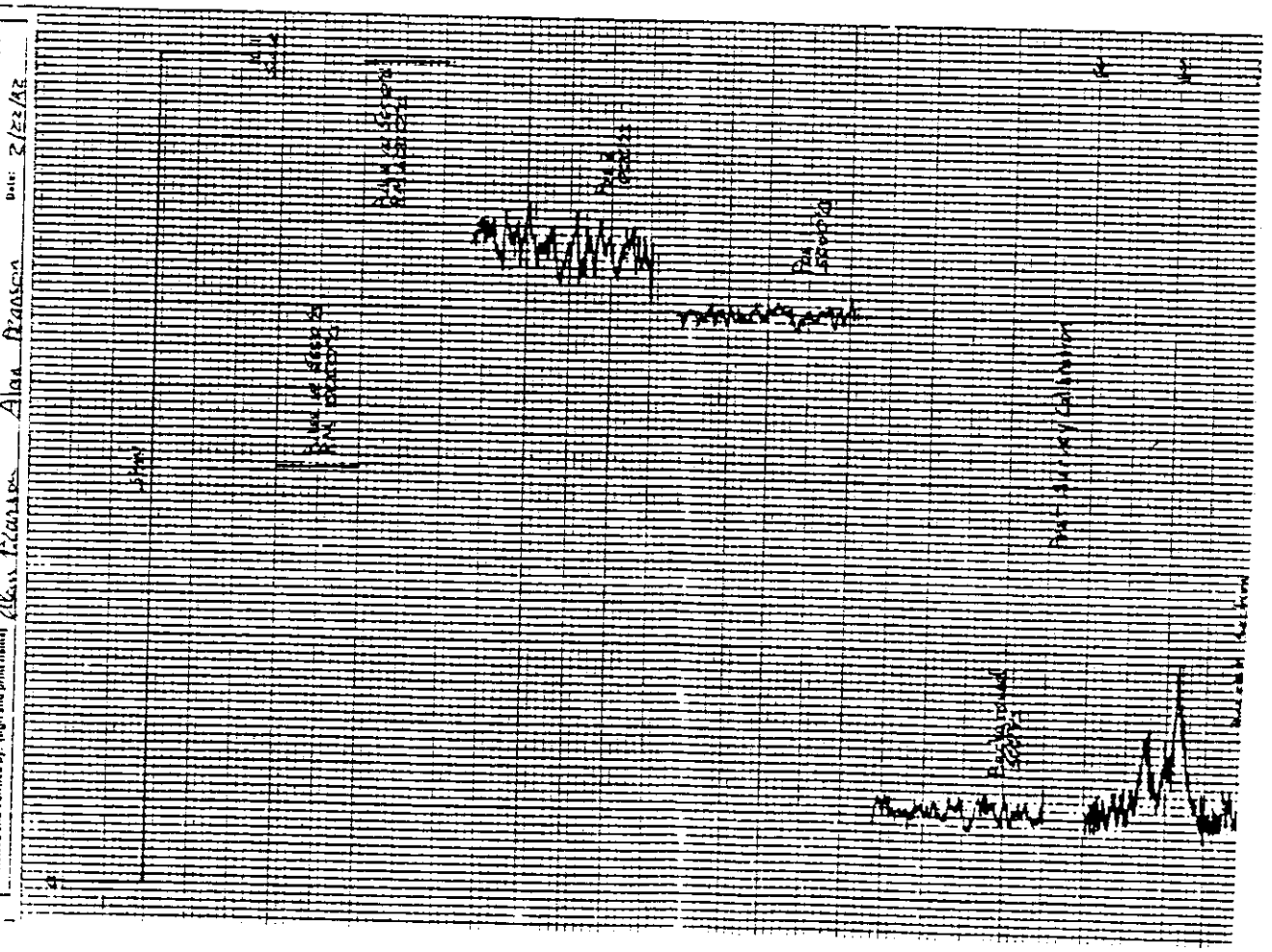
EQUIPMENT DATA

Logging Company PNL
Operator(s) Alan Pearson
Equipment Brand NIS
Equipment Type Analog
Tool Type Gamma Rat. Serial No. CGR7 MH1
Base Calibration Date 5/91 Calibration Reference PNL-7785 KC-606
Calibration Product Factor 1 0.8 Calibration Datum (cps): Position 1 261.1 cpm Position 2 41.3 cpm
Trend Line 11.0 cpm Warm Up Time 7:15 am

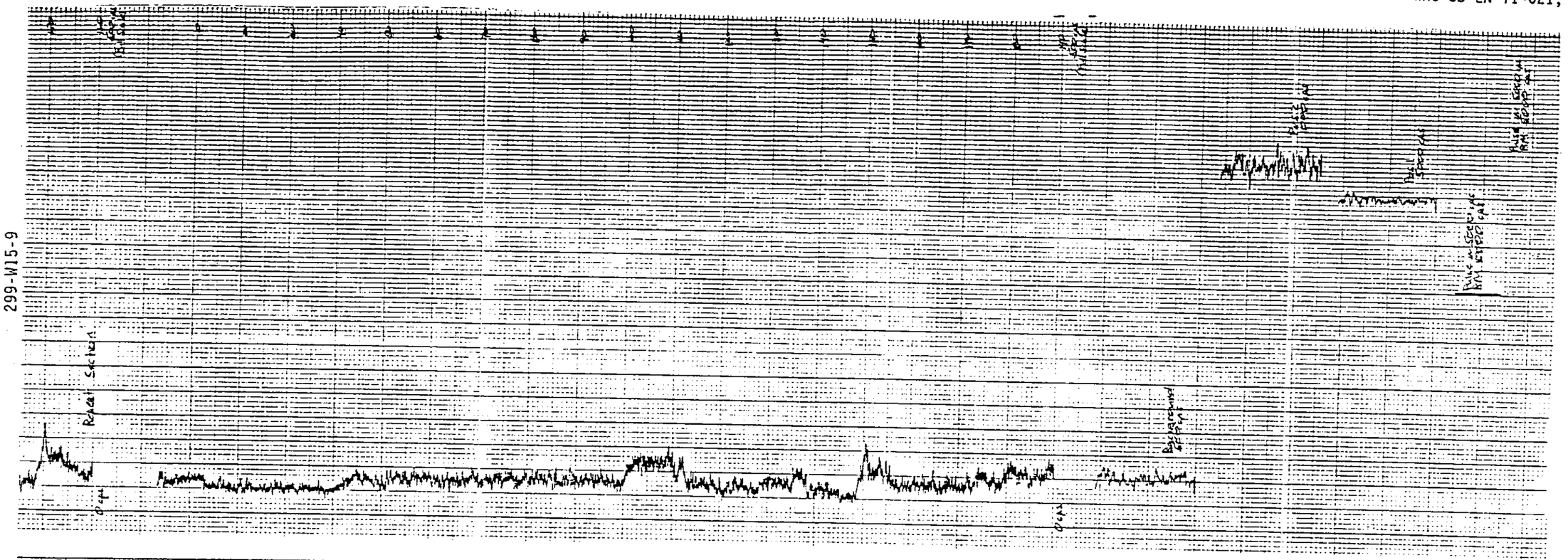
LOGGING INFORMATION

Log Interval From 138.9' to 2'
Recorded 138.9' to 1025' Position 1 302.2 cpm Position 2 63.6 cpm Background 55 cpm
Pre Survey Verification: Position 1 Position 2 Background
Base Calibration Difference: Position 1 11.9 cpm Position 2 0.7 cpm
Logging Speed 5 ft/min Recorded Scale, CPS/in 50 CPS/in.
Start Time 1125 Completion Time 1250
Chart Speed, Hor. 10 cm/in. Chart Recorded Horizontal Scale, CPS/in 50 CPS/in.
Chart Recorder Vertical Scale, CPS/in 50 CPS/in. Time Constant(s) 16-1
Post Survey Verification: Position 1 304.8 cpm Position 2 63.9 cpm Background 52 cpm
Percent Change: Position 1 0.8% Position 2 0.5%
Comments: Drum Errors +0.15' high
Centralizer used

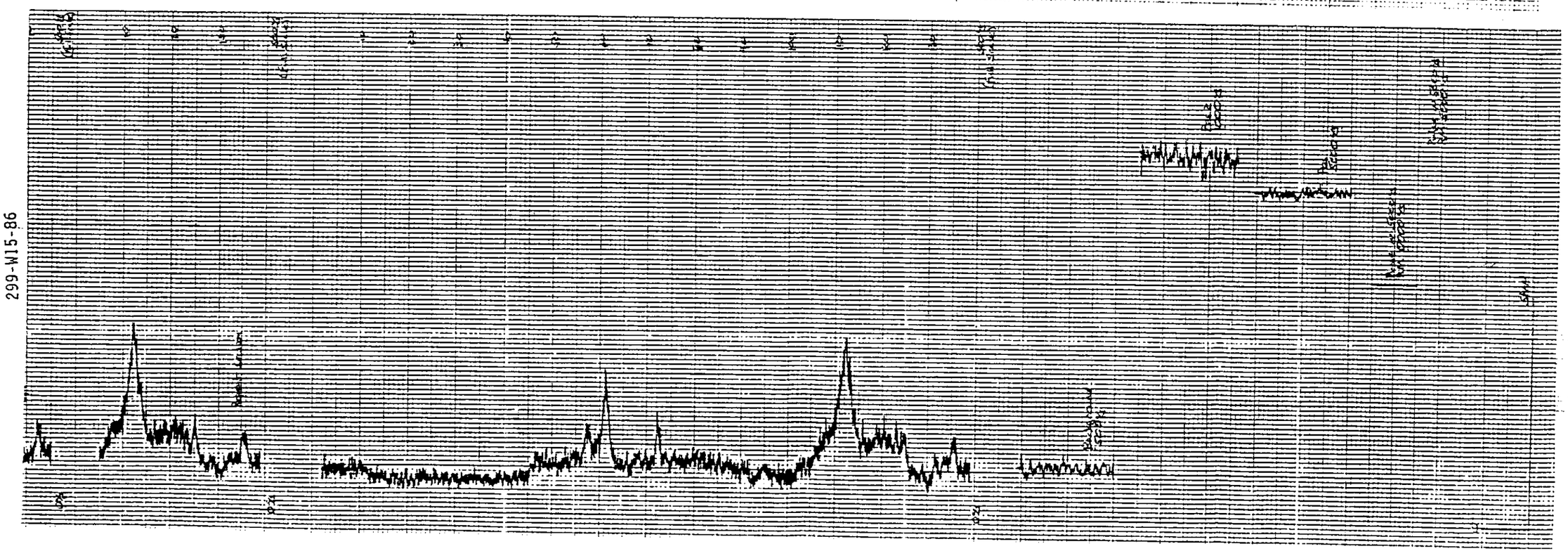
Witnessed and Verified by (Sign and print name) Alan Pearson Date: 2/27/92

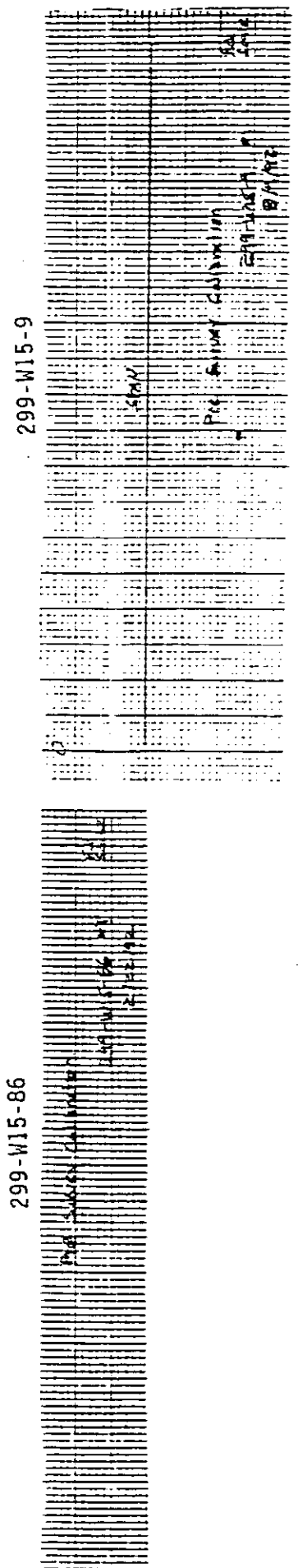


299-W15-9



299-W15-86




299-W15-9
299-W15-86

299-W15-84

Westinghouse Hanford Company | LOG HEADER | Page 1 of 2

Well No. 299-W15-84 Area 200W Date 3/10/82
Log Run #1 Log Type Gross Gamma
Elevation Datum Top of Casing Elevation 669.82
Survey Coordinates 39860 N 74000 W
Log Measured From Ground Surface
Location Description ~30 ft West of 2-0-A crib
Ground Surface Elevation
Surface Temperature NA Weather Clear - Warm

BOREHOLE INFORMATION
Driller
Drill Rig Type Bit Type/Diameter
Borehole Diameter(s)/Depth 8"/110'
Depth Driller 110' Depth Logger 105.6'
Liquid Level NA (none) Liquid Density NA
Temperature NA

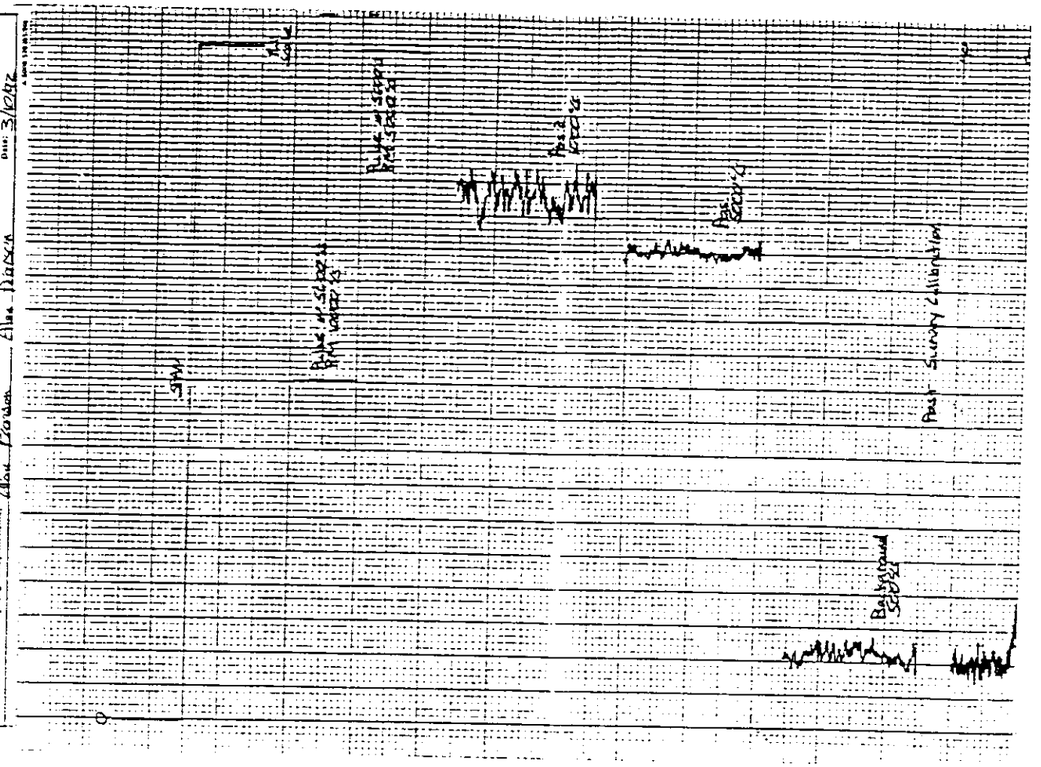
CASING RECORD
Type 8" Carbon Steel Sch 40 Interval +1.5 - 110'
Type Interval
Type Interval
Type Interval
Well Screen Interval NA
Comments: Casing Flange "0.2' high
Centralizer used

LOG HEADER — Page 2 of 2

EQUIPMENT DATA
Logging Company PNL
Operator(s) Alan Pearson
Equipment Brand AMS
Equipment Type Ana-log
Tool Type Gamma Ray Serial No. GR27871
Base Calibration Date 5/81 Calibration Reference PNL-7985 HC-6626
Calibration/Probe Factor 8.0 Calibration Datum (ft) Position 1 297.1 ±1 Position 2 61.3 ±1
Head Time 11.8 sec Warm Up Time 7.5 sec

LOGGING INFORMATION
Log Interval From 105.6' To 3.6'
Record(s) 750' to 1100'
Pre Survey Verification: Position 1 336.7 ±1 Position 2 64.5 ±1 Background 55½
Base Calibration Difference: Position 1 9.3 ±1 Position 2 0.2 ±1
Logging Speed 5 ft/min Recorder Scale CPS/in 50 cps/in
Start Time 1320 Completion Time 1500
Chart Speed(s), Min 10 cm/in
Chart Recorder Horizontal Scale CPS/in 50 cps/in Time Constant(s) TC-1
Post Survey Verification: Position 1 301.5 ±1 Position 2 61.5 ±1 Background 55½
Percent Change: Position 1 0.7% Position 2 0.0%
Comments: Return since 102' high
Centralizer used

Witnessed and Verified by (sign and print name) Alan Pearson Date 3/10/82



299-W15-8

Westinghouse Hanford Company | LOG HEADER | Page 1 of 2

Well No. 299-W15-8 Area 200-W Date 3/4/82
Log Run #1 Log Type Gross Gamma
Elevation Datum Top of Casing Elevation ~~669.79~~ 667.79
Survey Coordinates 39740 N 75910 W
Log Measured From Ground Surface
Location Description South End of 2-9 Crib
Ground Surface Elevation
Surface Temperature NA Weather Overcast - Cool

BOREHOLE INFORMATION
Driller
Drill Rig Type Bit Type/Diameter
Borehole Diameter(s)/Depth 8"/~~205~~ 6"/206' 4"/~~180~~
Depth Driller 203' Depth Logger 201.6'
Liquid Level 195' Liquid Density Clear
Temperature NA

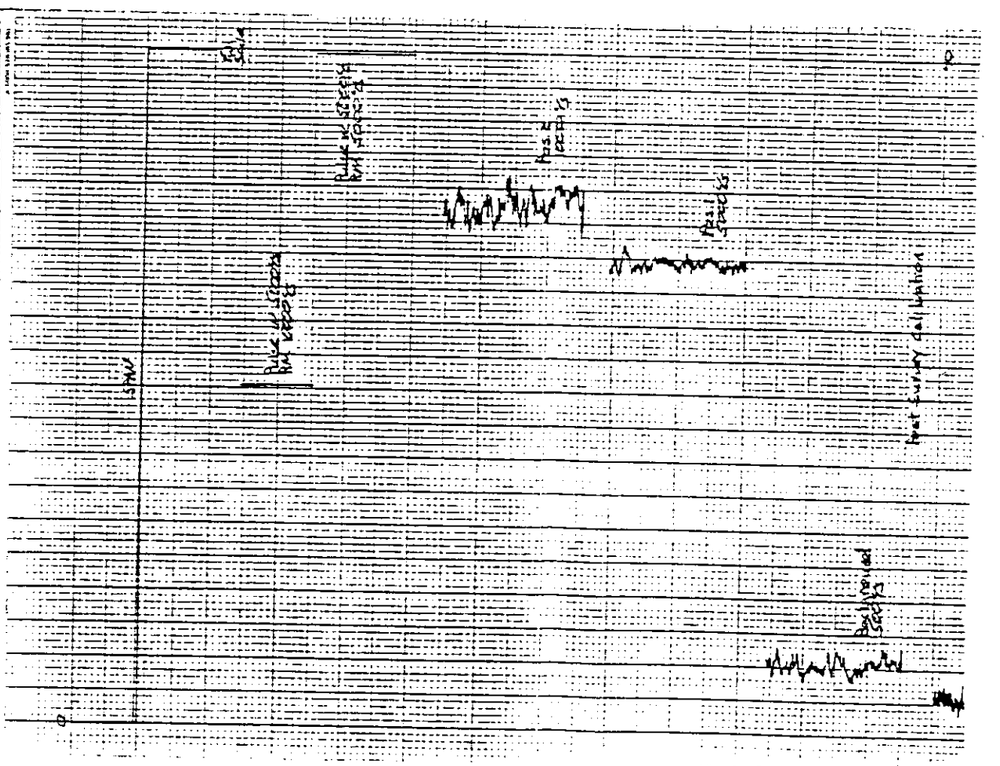
CASING RECORD
Type 8" Carbon Steel ~~3'~~ Interval +1.8' - ~~203'~~ 0.7'
Type 6" Carbon Steel Interval +2' - 206'
Type 4" Carbon Steel Interval +2' - ~~180~~ 178.0
Type Interval
Well Screen Interval NA
Comments: Casing Flange 0.0'
Centralizer used.

LOG HEADER — Page 2 of 2

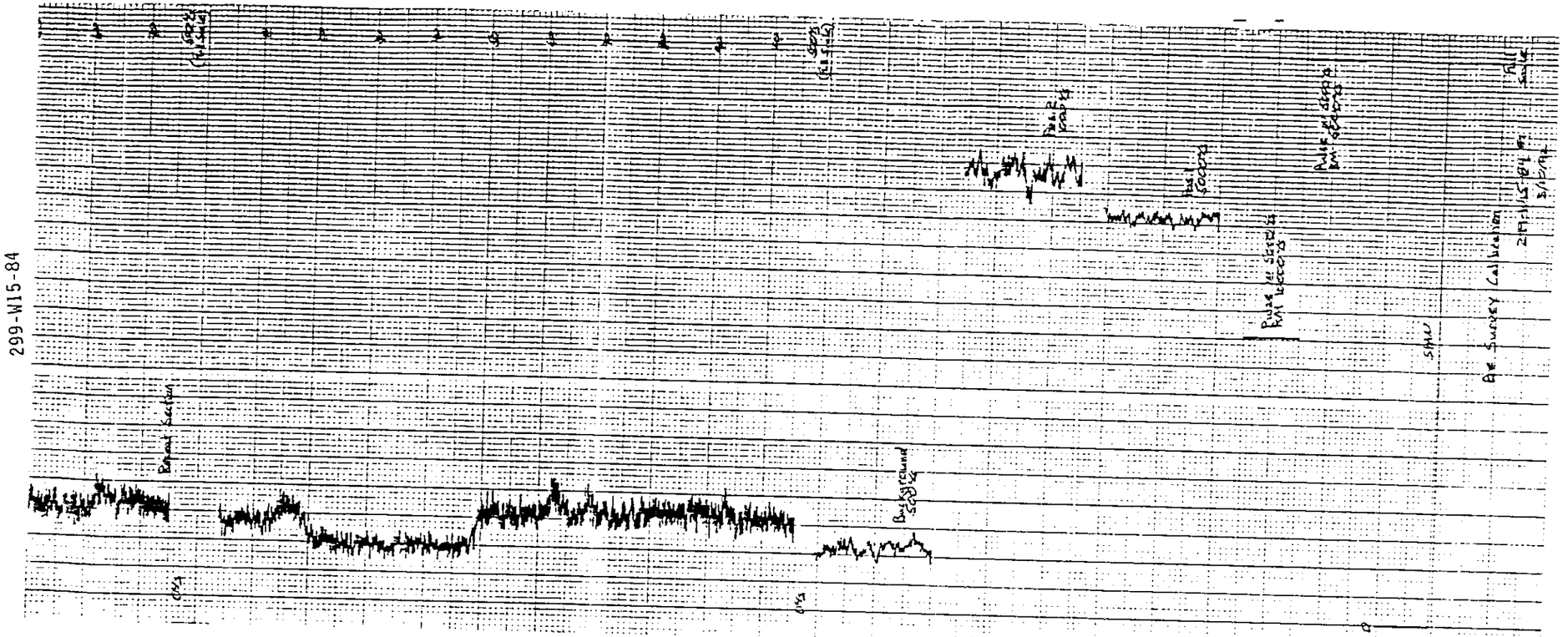
EQUIPMENT DATA
Logging Company PNL
Operator(s) Alan Pearson
Equipment Brand AMS
Equipment Type Ana-log
Tool Type Gamma Ray Serial No. GR27871
Base Calibration Date 5/81 Calibration Reference PNL-7985 HC-6626
Calibration/Probe Factor 8.0 Calibration Datum (ft) Position 1 297.1 ±1 Position 2 61.3 ±1
Head Time 11.8 sec Warm Up Time 7.5 sec

LOGGING INFORMATION
Log Interval From 201.6' To 3.6'
Record(s) 700' to 1000'
Pre Survey Verification: Position 1 302.3 ±1 Position 2 61.5 ±1 Background 55½
Base Calibration Difference: Position 1 4.9 ±1 Position 2 0.2 ±1
Logging Speed 5 ft/min Recorder Scale CPS/in 50 cps/in
Start Time 0830 Completion Time 1000
Chart Speed(s), Min 10 cm/in
Chart Recorder Horizontal Scale CPS/in 50 cps/in Time Constant(s) TC-1
Post Survey Verification: Position 1 302.6 ±1 Position 2 63.9 ±1 Background 55½
Percent Change: Position 1 0.1% Position 2 0.9%
Comments: Return since 0.0'
Centralized used

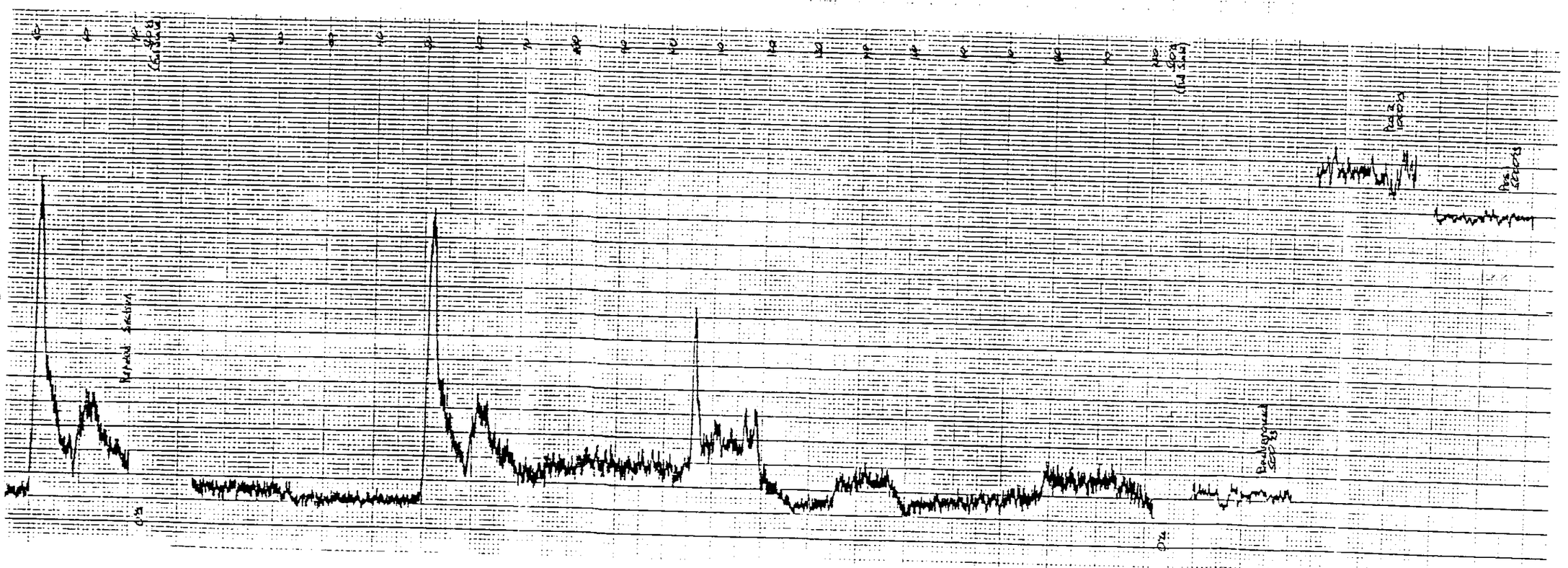
Witnessed and Verified by (sign and print name) Alan Pearson Date 3/4/82



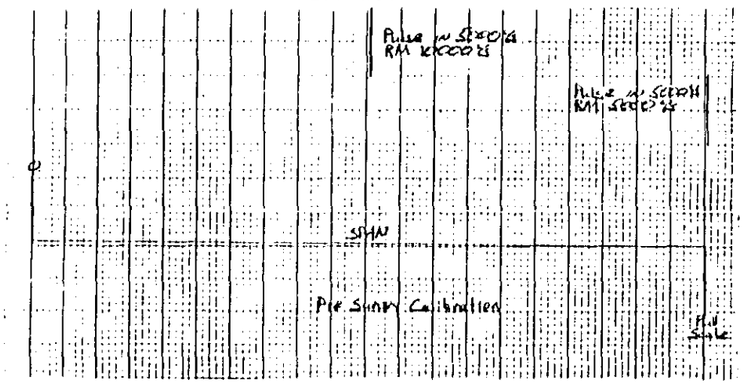
299-W15-84



299-W15-8



299-W15-8



Crib Designation: 216-Z-12

Type of Facility: 300 ft. x 20 ft. gravel filled crib

Location: N 39400 to N 39480, W 77200 to W 77209, Just southwest of the 234-5 building.

Service Dates: 3/59 to 5/73

Description of Waste: 281 x 10^6 liters of neutral to basic process waste, analytical laboratory and developmental laboratory waste from the 234-5 Z building via the 241-Z settling tank.

Radionuclide Release Summary:

Radionuclide	Quantity
Pu	25.1 x 10^3 g
Sr-90	<0.10 Ci
Ru-106	100 Ci
Cs-137	<0.10 Ci
Co-60	<0.10 Ci
U	<0.05 kg

Summary of Past Logging:

Boreholes	Date	Reference
299-W18-2	1976	Fecht, et al., 1977
	1987	Geophysics files
299-W18-5	1973	Fecht, et al., 1977
299-W18-8	1976	"
299-W18-69	1968	"
299-W18-71	1973	"
	1987	Geophysics files
299-W18-73	1973	Fecht, et al., 1977
	1987	Geophysics files
299-W18-74	1973	Fecht, et al., 1977
	1987	Geophysics files

Review of Current Logging:

Borehole: 299-W18-5

This borehole was logged with the PNL gross gamma and the RLS spectral gamma logging systems. A zone of elevated activity was found at 25 feet. This high activity is due to Pa-233, the first daughter product from alpha decay of Np-237. Pa-233 was also detected at various depths in the borehole, but it was at such a low concentration that it could not be quantified.

As a standard procedure, the neptunium was not separated out from the process streams and was typically released with the effluent wastes. It was separated in a Purex run for a short time as a part of a special project but the bulk of process effluent releases would not remove the neptunium.

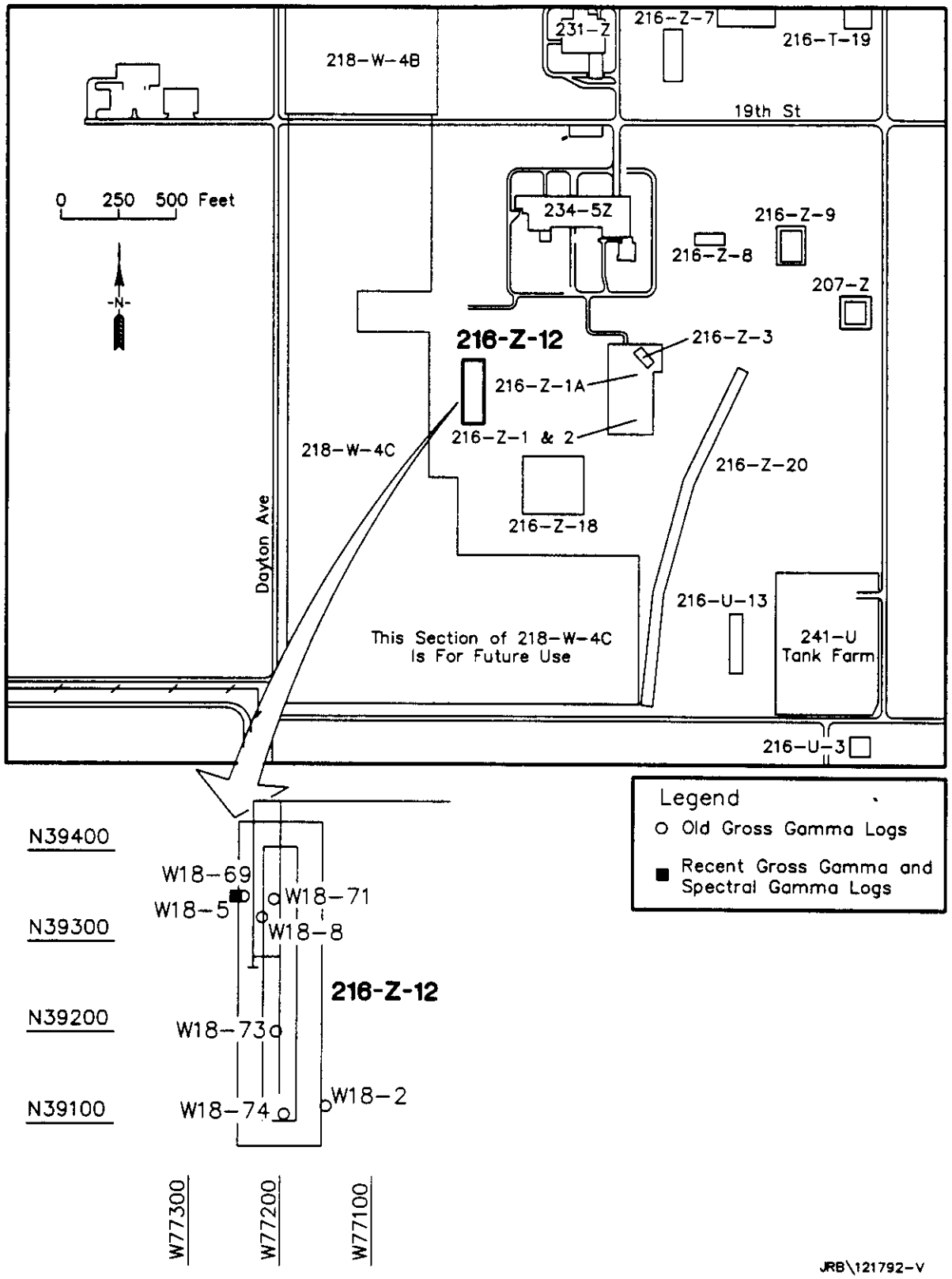
Np-237 has a long half life (2.14 x 10^6 years whereas Pa-233 has a very short half life (27 days). Therefore, at an inactive site such as this which is not subjected to a flux of

water through the unsaturated zone, the Pa-233 concentration profile represents the Np-237 deposition profile. It is apparent that the bulk of the neptunium was deposited near the release point at the 25 foot depth but some of it did migrate with the water to deeper locations.

No other nuclides were detected at this crib. Considering the high volume of plutonium released at this crib, it is somewhat of a mystery why Pu was not detected in the sediment. This must be investigated.

The gross gamma profile shows some variability between 80 feet and 140 feet but this is probably due to variations in the lithology. The caliche zone at about 130 feet shows up as a higher gross gamma activity zone.

Because all of the detected radionuclides were found high up in the unsaturated zone, it is unlikely that this site produced any groundwater contamination.


231-Z
216-Z-7
216-T-19
218-W-4B
19th St
0 250 500 Feet
-N-
234-5Z
216-Z-9
216-Z-8
207-Z
216-Z-12
216-Z-3
216-Z-1A
216-Z-1 & 2
218-W-4C
216-Z-20
216-Z-18
Dayton Ave
216-U-13
This Section of 218-W-4C
Is For Future Use
241-U
Tank Farm
216-U-3
Legend
Old Gross Gamma Logs
Recent Gross Gamma and
Spectral Gamma Logs
N39400
N39300
N39200
N39100
W18-69
W18-5
W18-71
W18-8
216-Z-12
W18-73
W18-74
W18-2
W77300
W77200
W77100
JRB\121792-V

Westinghouse Hanford Company
RLS Spectral Gamma-Ray Borehole Survey Log Header

Project: 200 AAMS, Z-12 Crib

Borehole	299-W18-5			
Coordinates	39,350 N	77,250 W	Feet	(Plant 200 W)
Elevation	683. feet		Top of Casing	(Plant 200 W)

Borehole Environment Information

Borehole Fluid Depth 215.6 (Feet) from Zero (0.0) Depth Reference of Log

Casing Size I.D. (inch)	Casing Thickness (inch)	Top Depth (feet)	Base Depth (feet)
8.0	0.288	0.0	271.5

RLS Passive Spectral Gamma Survey Information

Logging Engineers R. V. Cram S. E. Kos
Log Depth Reference at Zero (0.0) depth is Ground Level

Log Date	Archive File Names	Log Mode[1], Speed	Depth Interval (feet) Top	Base	Incr
May 04, 92	H2W1805\A176	FIXED 0.6 fps	0.	219.	0.5
May 05, 92	H2W1805\A177	FIXED 0.6 fps	215.	268.5	0.5

[1]FIXED: Fixed velocity of Cable Speed; fps: Feet per second

Calibration and Analysis Information

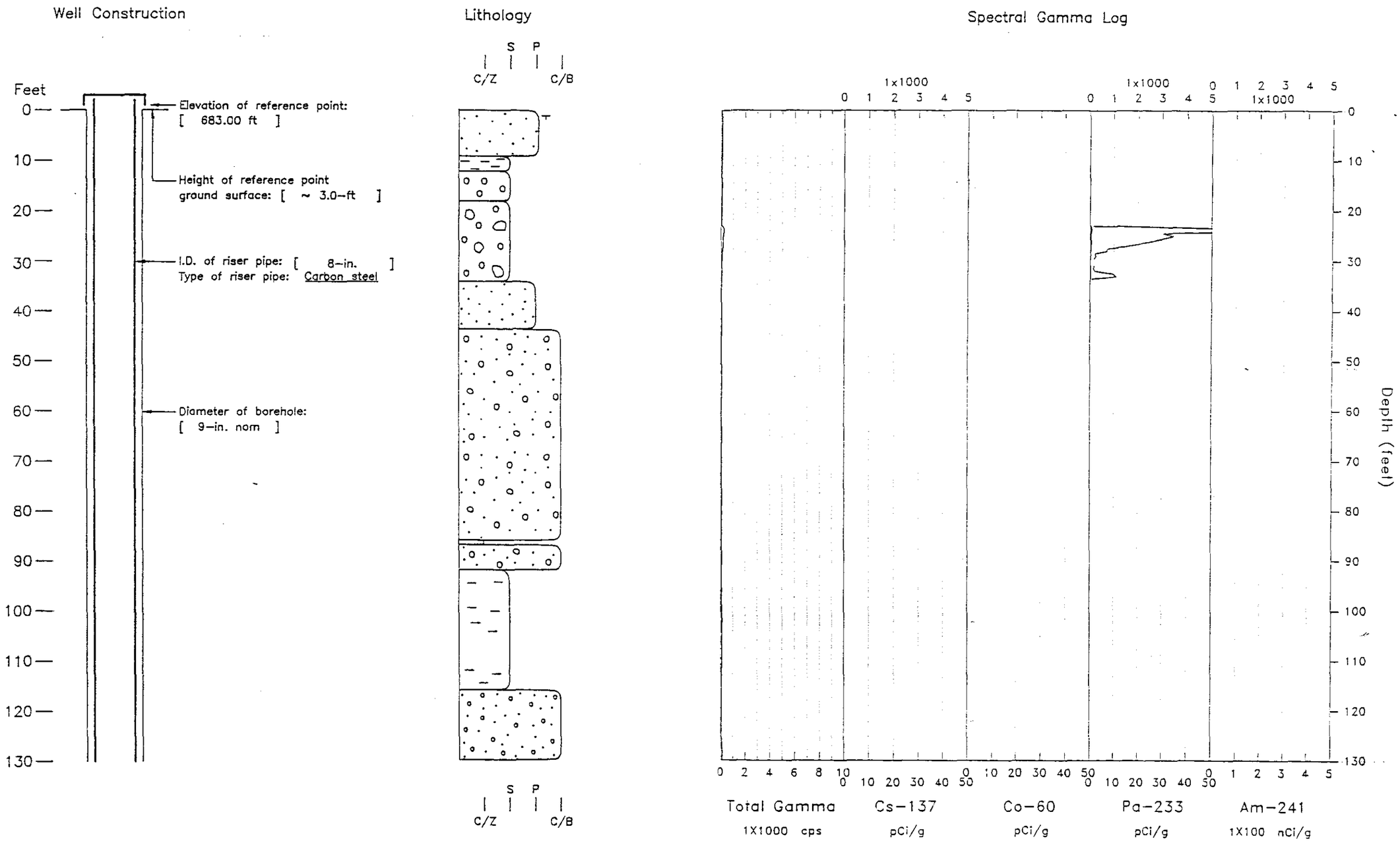
RLS Calibration Date: Nov 21, 1991
Calibration Report: WHC-SD-EN-TRP-001

Analyst Names: J. E. Meisner R. K. Price
Analysis Date: July 14, 1992

Analysis Notes: No man-made radionuclides plotted on Pg 2&3 of data plot
Radionuclides identified: Pa-233 (Np-237)

RLS Spectral Gamma Ray Borehole Survey

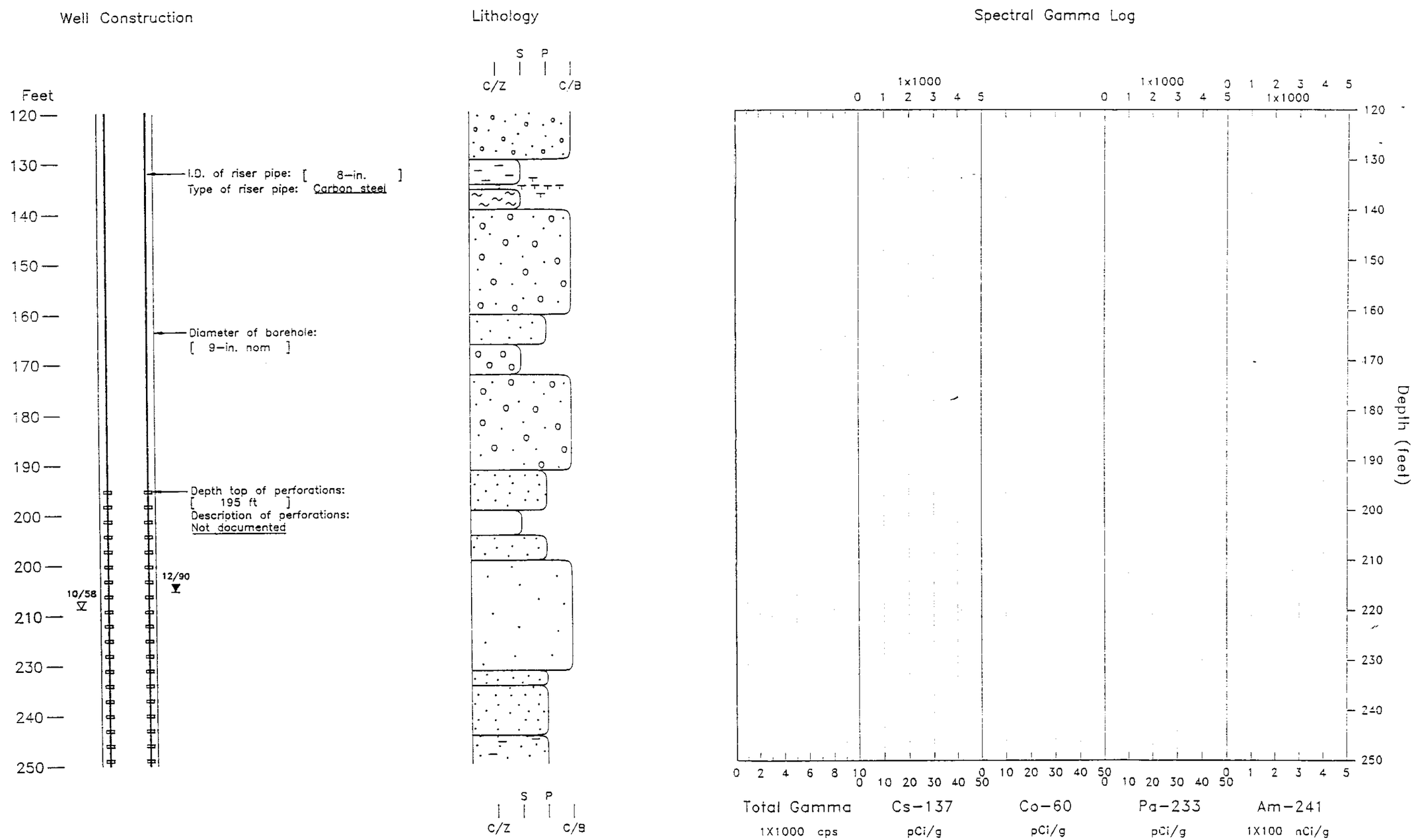
Well 299-W18-5 | Crib 216-Z-12 | Log Date 5/4/92



GEOSCI\18-5A

RLS Spectral Gamma Ray Borehole Survey (Page 2)

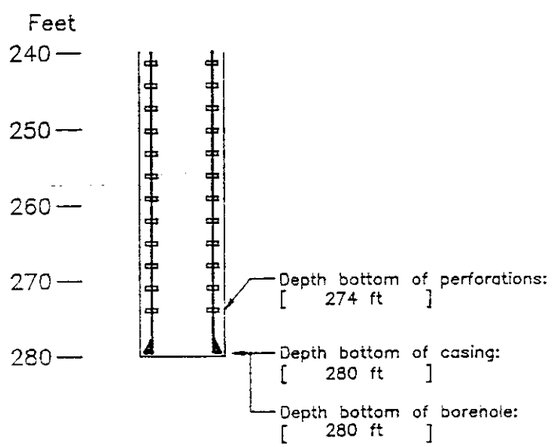
Well 299-W18-5 | Crib Z16-Z-12 | Log Date 5/4/92



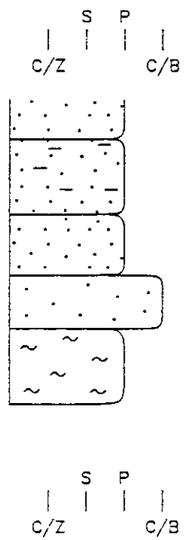
RLS Spectral Gamma Ray Borehole Survey (Page 3)

Well 299-W18-5 | Crib 216-Z-12 | Log Date 5/4/92

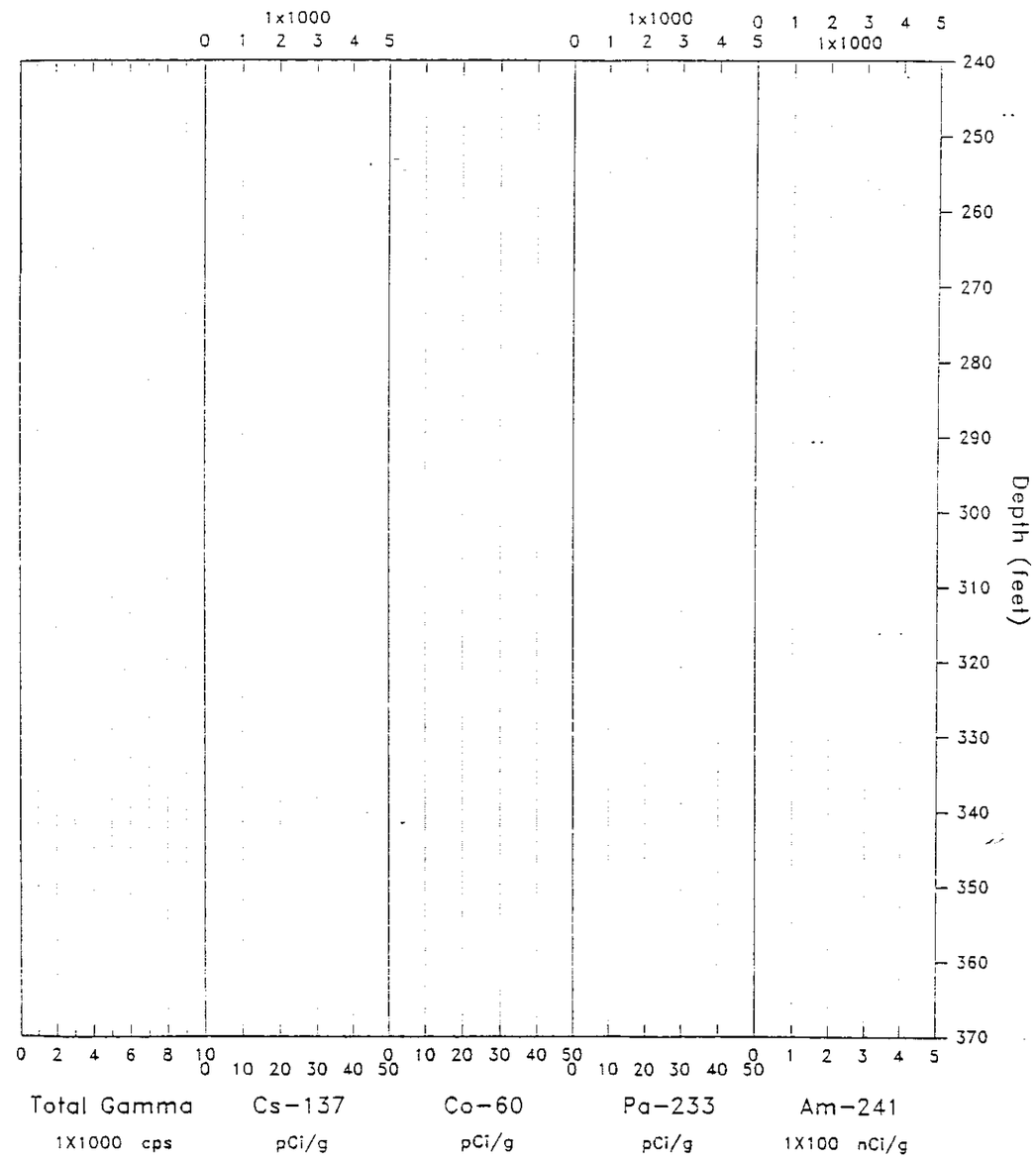
Well Construction



Lithology



Spectral Gamma Log



GEOSCI\18-5C

299-W18-5 Z-12 Crib

Casing	Depth: 271.5'	Size: 8"	Thickness: 0.288"
Water	Depth: 215.6'		
Survey	Depth: 0 - 219.'	Date: 5/04/92	
	Depth: 215 - 268.5'	Date: 5/05/92	

General Notes:
The survey is plotted on three pages. The second and third plot pages are blank since no continuous zones of man-made radionuclides were observed below 33 feet.

The total gamma activity did not exceed 300 cps in the borehole survey.

Man-made Radionuclides:
No Cesium (Cs-137) was detected in the borehole survey. The plot track is present only for uniformity of the displayed data.

No Cobalt (Co-60) was detected in the borehole survey. The plot track is present only for uniformity of the displayed data.

Protactinium-233 (Pa-233), a daughter of Neptunium-237 (Np-237), was observed between the depth interval of 23 feet and 258 feet. The maximum activity encountered was 60 pCi/g at 24 feet. Only one interval, from 23 feet to 33 feet, of continuous gamma-ray activity was encountered. Other depth locations where the primary gamma-ray from Pa-233 were encountered had no continuous depth measurements and all computed activities were less than 1.5 pCi/g. There were 15 spectra of the 470 spectra acquired below 33 feet where the 312 keV gamma-ray of Pa-233 was identified.

No Americium (Am-241) was detected in the borehole survey. The plot track is present only for uniformity of the displayed data.

299-W18-5

Westinghouse Hanford Company — LOG HEADER — Page 1 of 2

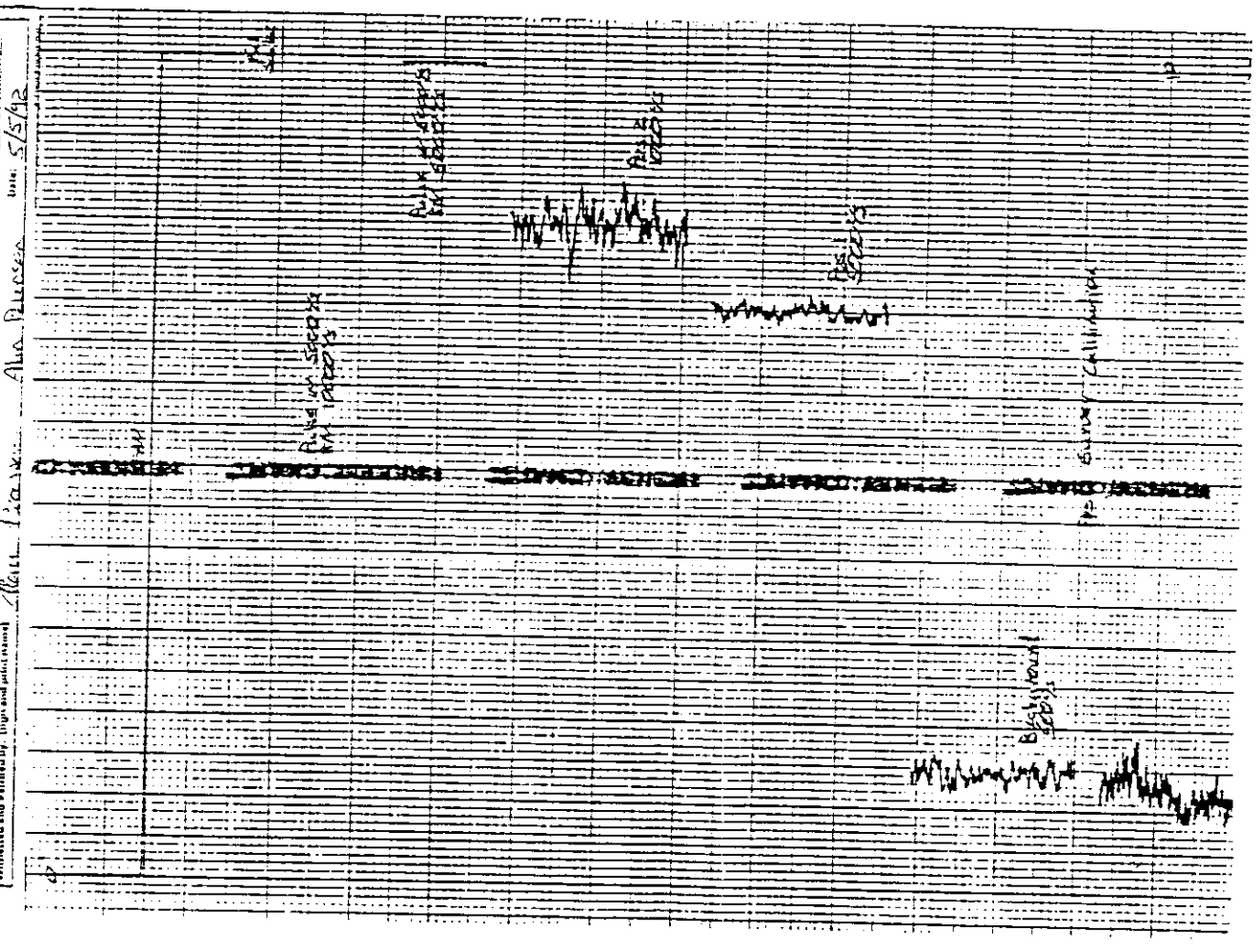
Well No. 299-W18-5 — Area 200 West Area — 5/5/92
Log Run #1 — Log Type Gamma Gamma
Elevation Datum Top of casing — Elevation 693 ft
Survey Coordinates N 39350' — W 77250
Log Measured From Ground Surface
Location Description ~500 ft SW of 2-Plant
Ground Surface Elevation
Surface Temperature N/A — Weather Clear - Hot

BOREHOLE INFORMATION
Driller
Drill Rig Type — Bit Type/Diameter
Borehole Diameter/Depth 8 1/2 / 215
Depth Driller 271.5 — Depth Logger 272
Fluid Level 215.6 — Fluid Density Water / Mud
Temperature

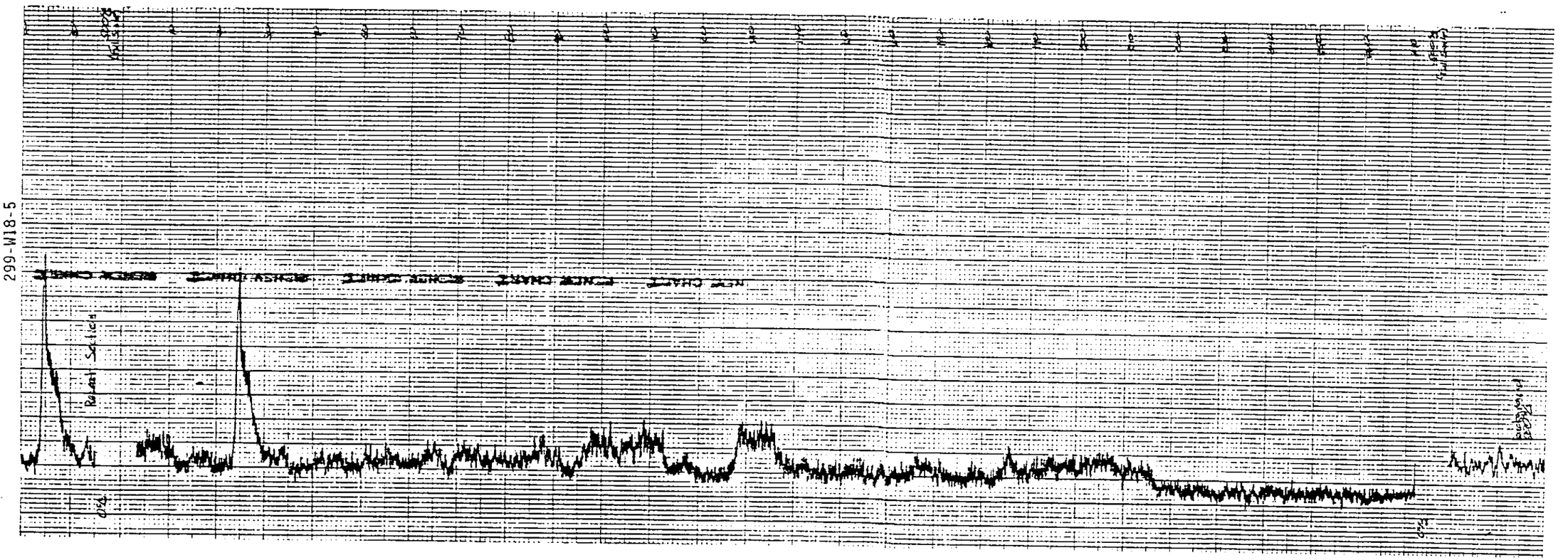
CASING RECORD
Size 8" Carbon Steel Sch 40 — Interval 1.6
Size — Interval
Size — Interval
Size — Interval
Well Screen Interval
Comments Casing Fence 403' high
Gamma used

LOG HEADER — Page 2 of 2

EQUIPMENT DATA
Logging Company PNL
Operator(s) Alan Watson
Equipment Brand AMS
Equipment Type Analog
Sonde Type Gamma Gamma
Sonde Id No. GG2-0011
Base Calibration Date 5/91
Calibration reference DOH-7485 HC-666
Calibration Factor B. Dazzell DAZZ
Calibration Date (all) Position 1 271.1 ft Position 2 61.3 ft
Dead Time 11.8 nsec
Wave Up Time 715 cps
LOGGING INFORMATION
Logging Interval From 272.1' to 3.5'
Record(s)
Pre Survey Verification: Position 1 305.4 ft Position 2 63.2 ft
Main Calibration Difference: Position 1 6.0 ft Position 2 1.1 ft
Logging Speed 50 ft/min — Background 70%
Start Time 1600
Chart Speed(s) 10 cm/m — Chart Sensitivity 50 cps/in
Chart Recorder: Horizontal Scale, CPS/in 50 cps/in — Short Count Time 12-1
Post Survey Verification: Position 1 303.0 ft Position 2 61.1 ft — Background 72%
Position 3 DEAD Position 4 1.9%
Percent Change
Comments Sales Fence 403' high
Gamma used
Witnessed and Verified by: Dept and print name Alan Pleasen — Date 5/5/92



299-W18-5



299-W18-5

A-386

Crib Designation: 216-Z-18 crib

Type of Facility: Five gravel filled cribs laid side-by-side, each 200 feet long by 10 feet wide

Location: N 38670 to N 38930, W 76800 to W 76930

Service Dates: 4/69 to 5/73 for the eastern three, 6/72 to 5/73 for the western two

Description of Waste: 3.86 x 10^6 liters of high salt, acidic, organic waste with phosphate, 75% carbon tetrachloride from 236-Z and 241-Z buildings

Radionuclide Release Summary:

Radionuclide	Quantity
Pu	22.9 x 10^3 g

No other radionuclide release data

Summary of Past Logging:

Boreholes	Date	Reference
299-W18-9	1976	Fecht, et al., 1977
	1986	Geophysics files
	1987	"
299-W18-10	1976	Fecht, et al., 1977
299-W18-11	1976	"
	1986	Geophysics files
	1987	"
299-W18-12	1976	Fecht, et al., 1977
299-W18-93	1976	"
	1986	Geophysics files
	1987	"
299-W18-94	1976	Fecht, et al., 1977
	1986	Geophysics files
	1987	"
299-W18-95	1976	Fecht, et al., 1977
	1986	Geophysics files
	1987	"
299-W18-96	1976	Fecht, et al., 1977
	1986	Geophysics files
	1987	"
299-W18-97	1976	Fecht, et al., 1977
	1986	Geophysics files
	1987	"
299-W18-98	1976	Fecht, et al., 1977
	1986	Geophysics files
	1987	"
299-W18-99	1976	Fecht, et al., 1977
	1987	Geophysics files

Review of Current Logging:

Boreholes: 299-W18-9, 299-W18-10, 299-W18-11, 299-W18-94, 299-W18-96, 299-W18-98

All of the boreholes listed immediately above were logged with the PNL gross gamma-ray logging system. An RLS spectral gamma-ray log was run in borehole 299-W18-10. This log shows Cs-137, Pa-233 and Am-241 from about 24 feet to about 50 feet. All three nuclides are only found in the same zone in the borehole.

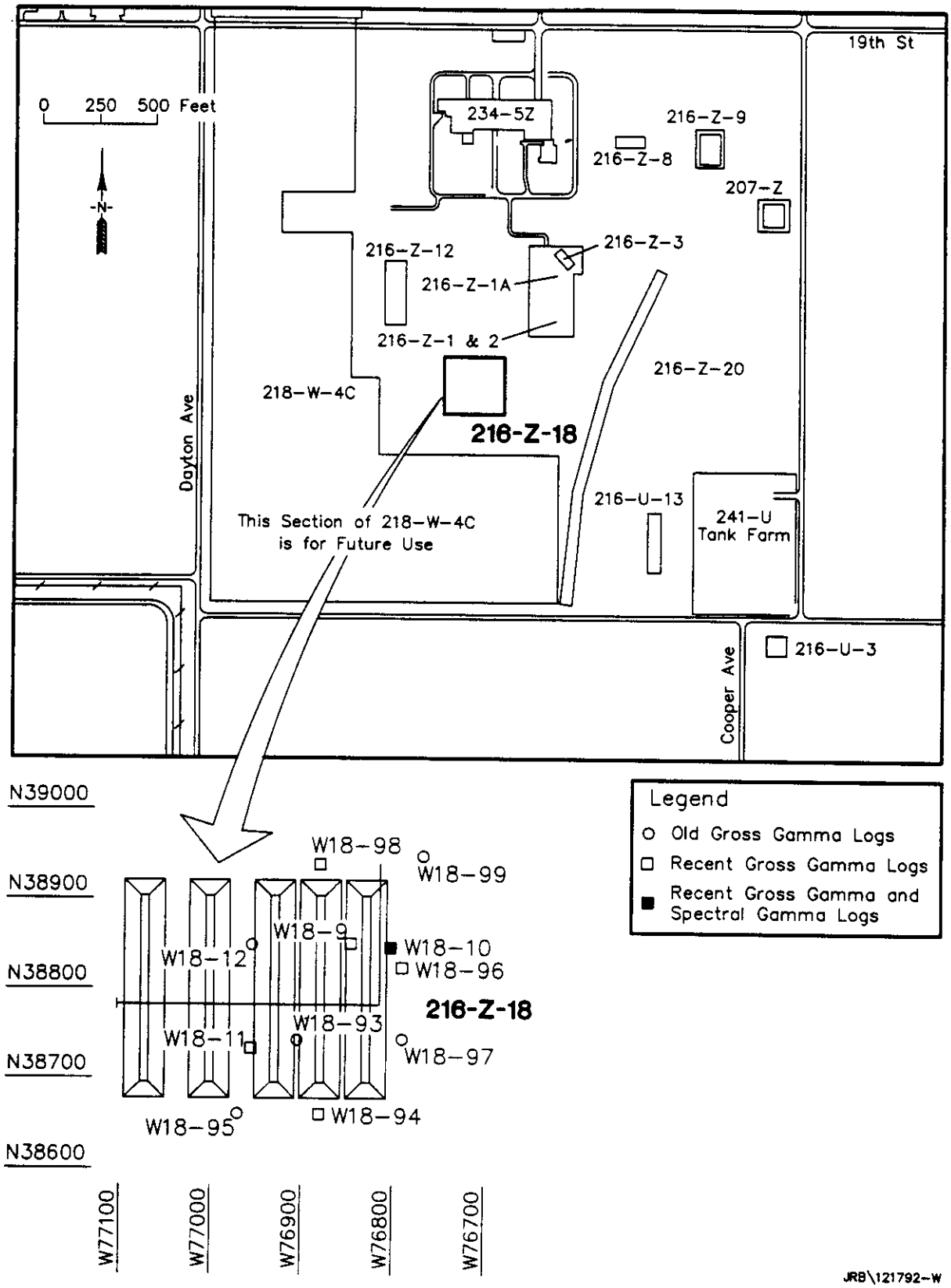
Pa-233 (27 day half life) is the daughter product of Np-237 (2.1x10^6 year half life) which in turn is the daughter of Am-241. The presence of Pa-233 indicates the presence of Np-237. Np-237 had to have been released at this site along with the Am-241. Although Np-237 is the daughter of Am-241, it did not evolve after the nuclides were deposited because Am-241 has a very long half life and it would take a few hundred years to build up enough Np to be detectable. We can therefore conclude that both neptunium and americium were in the effluent released at this site. Not all of the crib sites have both neptunium and americium.

The gross gamma log from borehole W18-10 shows the upper contamination zone and it shows the characteristic signature of the impermeable caliche zone found beneath much of the 200 West area. This caliche zone gamma profile is easily correlated between all of the gross gamma logs that are deep enough to penetrate it. At this site only boreholes W18-9, W18-10 and W18-11 are so deep.

Borehole W18-9 shows an upper contamination zone, gross activity very similar to that of W18-10. However, in W18-11, the upper contamination is reduced to a single spatial peak. It would be very useful to log this borehole and some of the other boreholes at this site with the spectral gamma-ray logging system to determine the species of the upper contamination peaks. It has been suggested that neptunium is chemically more mobile than the americium. W18-10 is right next to the solution release point where the americium comes out of solution and is deposited in the sediment. It would be useful to know if the gamma activity further from the release point is caused by Pa-233 (Np-237) or if it also contains Am-241.

In the old gross gamma logs, it is difficult to distinguish the lower level man-made nuclide activity from the variation of the background activity. These logs have a very limited utility and these boreholes should all be relogged using the current data acquisition methods.

The data from the spectral log of borehole 299-W18-10 and the recent gross gamma logs all confirm that the contamination released at this site is held up high in the unsaturated zone and has not spread an appreciable distance. We can assume that there has been no groundwater contamination at this site.


0 250 500 Feet
-N-
19th St
234-5Z
216-Z-9
216-Z-8
207-Z
216-Z-3
216-Z-12
216-Z-1A
216-Z-1 & 2
216-Z-20
218-W-4C
216-Z-18
Dayton Ave
This Section of 218-W-4C is for Future Use
216-U-13
241-U Tank Farm
216-U-3
Cooper Ave
Legend
Old Gross Gamma Logs
Recent Gross Gamma Logs
Recent Gross Gamma and Spectral Gamma Logs
N39000
N38900
N38800
N38700
N38600
W18-98
W18-99
W18-9
W18-10
W18-96
W18-12
216-Z-18
W18-93
W18-11
W18-97
W18-95
W18-94
W77100
W77000
W76900
W76800
W76700
JRB\121792-W

Westinghouse Hanford Company
RLS Spectral Gamma-Ray Borehole Survey Log Header

Project: 200 AAMS, Z-18 Crib

Borehole	299-W18-10			
Coordinates	38,847 N	76,803 W	Feet	(Plant 200 W)
Elevation	682.6 feet		Top of Casing	(Plant 200 W)

Borehole Environment Information

Borehole Fluid Depth none (Feet) from Zero (0.0) Depth Reference of Log

Casing Size I.D. (inch)	Casing Thickness (inch)	Top Depth (feet)	Base Depth (feet)
6.0	0.25	0.0	214.0

RLS Passive Spectral Gamma Survey Information

Logging Engineers R. V. Cram S. E. Kos
Log Depth Reference at Zero (0.0) depth is Ground Level

Log Date	Archive File Names	Log Mode, Speed	Depth Interval (feet) Top	Base	Incr
Mar 04, 92	H2W1810\A147	FIXED 0.6 fps	0.	210.	0.5

[1]FIXED: Fixed velocity of Cable Speed: fps: Feet per second

Calibration and Analysis Information

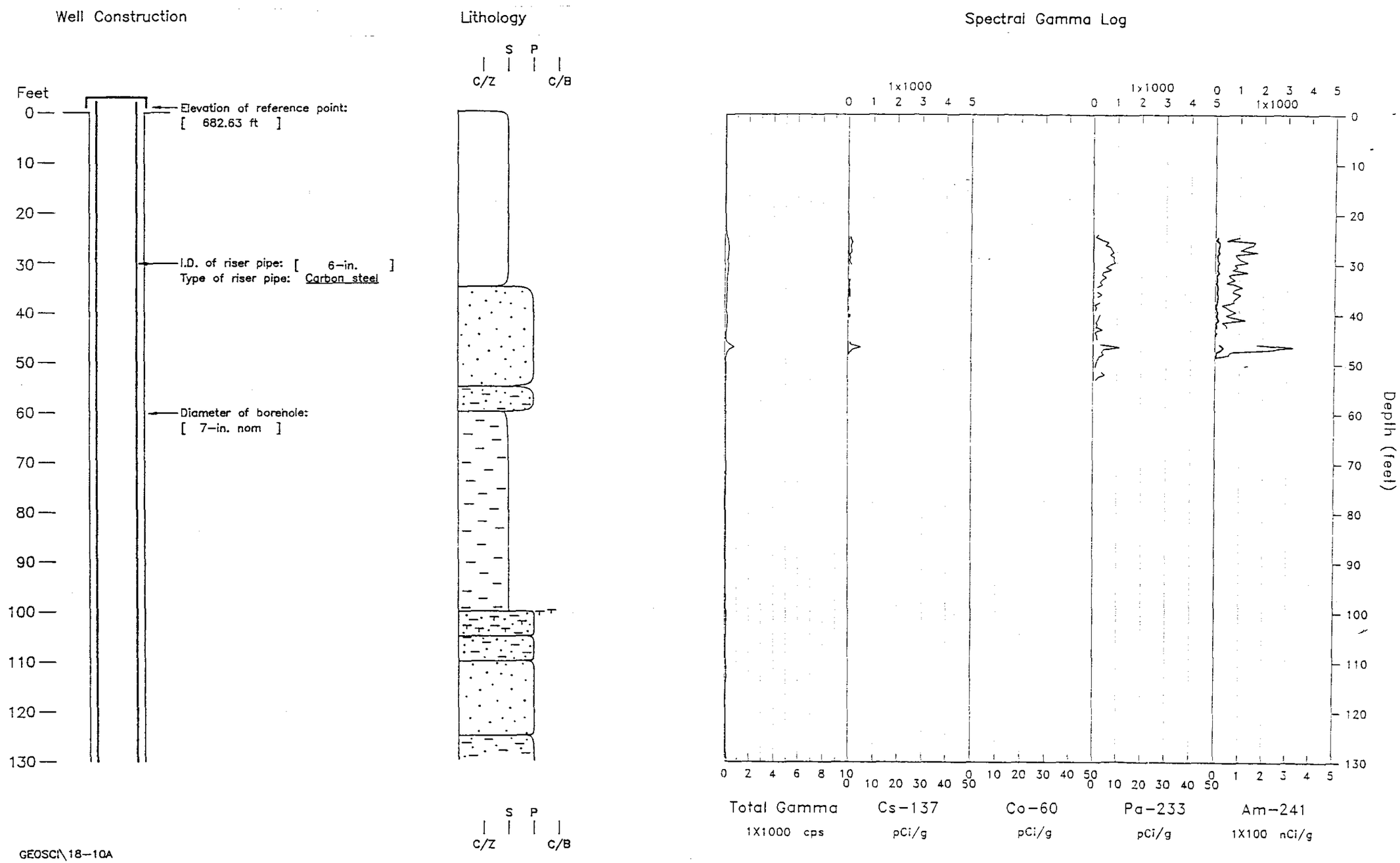
RLS Calibration Date: Nov 21, 1991
Calibration Report: WHC-SD-EN-TRP-001

Analyst Names: G. K. Jaeger R. K. Price
Analysis Date: July 23, 1992

Analysis Notes: No man-made radionuclides plotted on Pg 2 of data plot
Radionuclides identified: Cs-137, Pa-133 (Np-237), Am-241

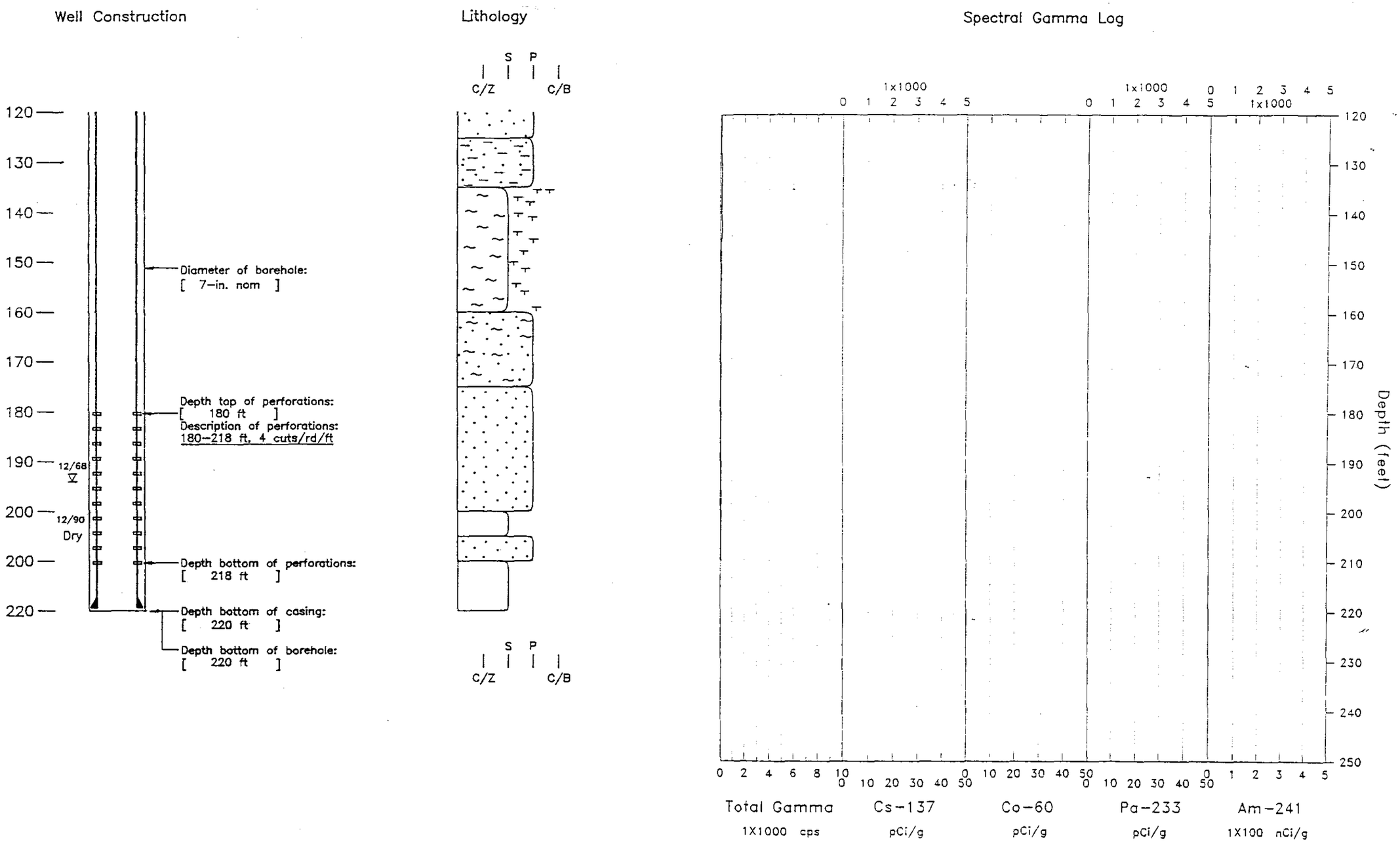
RLS Spectral Gamma Ray Borehole Survey

Well 299-W18-10 | Crib 216-Z-18 | Log Date 3/4/92



RLS Spectral Gamma Ray Borehole Survey (Page 2)

Well 299-W18-10 | Crib Z16-Z-18 | Log Date 3/4/92



GEOSCI\18-10B

299-W18-10 Z-18 Crib

Casing	Depth: 214.'	Size: 6"	Thickness: 0.25"
Water	Depth: none		
Survey	Depth: 0 - 210.'	Date: 3/04/92	

General Notes:
The survey is plotted on two pages. The second plot page is blank since no continuous zones of man-made radionuclides were observed below 54 feet.

The total gamma activity did not exceed 800 cps in the borehole survey. The total gamma activity is not representative of the levels of radionuclide concentration computed in the borehole. The maximum decay activity of Americium-241 (Am-241) is about 320,000 pico-curies per gram (pCi/g) or 320 nano-curies per gram (nCi/g).

The complexity of the gamma-ray photo peaks for tranuranic radionuclides compromised analysis for the screening data acquired for the AAMS field investigation. Many of the gamma-ray photo peaks of Am-241 and Pa-233 occur below the calibrated energy range of 300 keV. And some gamma-ray photo peaks of Am-241 and Pa-233 are so close in energies that they can not be efficiently separated due to the short counting time required for AAMS screening. Additional borehole surveys with longer counting times will be required if additional detail of the contaminents are needed.

Man-made Radionuclides:
Cesium (Cs-137) was encountered from 24 feet to 48 feet. The maximum cesium activity is 10 pCi/g at 46 feet. The faster logging speed used for borehole screening of the AAMS field investigation may allow trace amounts of cesium to be undetected.

No Cobalt (Co-60) was encountered in the borehole. The plot track is present only for uniformity of the displayed data.

Protactinium-233 (Pa-233), a daughter of Neptunium-237 (Np-237), was observed between the depth interval of 24 feet and 54 feet. The maximum activity encountered was 10 pCi/g at 46 feet.

Americium (Am-241) was detected from 24 feet to 48 feet. The maximum americium activity is 320 nCi/g at 47 feet. The maximum activity between 24 feet and 42 feet is 160 nCi/g.

299-W18-98

Washington Hanford Company	LOG HEADER	Page 1 of 2

Well No. 299-W18-98 Area 200 West Date 8/8/92
Log Run #1 Log Type Gamma Gamma
Elevation Datum Top of Casing Elevation 1655
Survey Coordinates N 324445 W 762420
Log Measured From Ground Surface
Location Description Center of 2-Mile
Ground Surface Elevation
Surface Temperature N/A Weather Clear - Hot

SCREENOUT INFORMATION

Driller
Drill Rig Type Bit Type/Diameter
Borehole Diameter/Thickness 6"/7.98"
Depth Driller 75' (Ground level) Depth Logger 71.8'
Casing Shoe N/A (same) Casing Density N/A
Temperature N/A

CASING RECORD

Type 6" Carbon Steel Sch 40 Interval +29' - 750'
Type Interval
Type Interval
Type Interval
Well Screen Interval N/A
Comments Open in Fines 702' high
Centralizer used

LOG HEADER

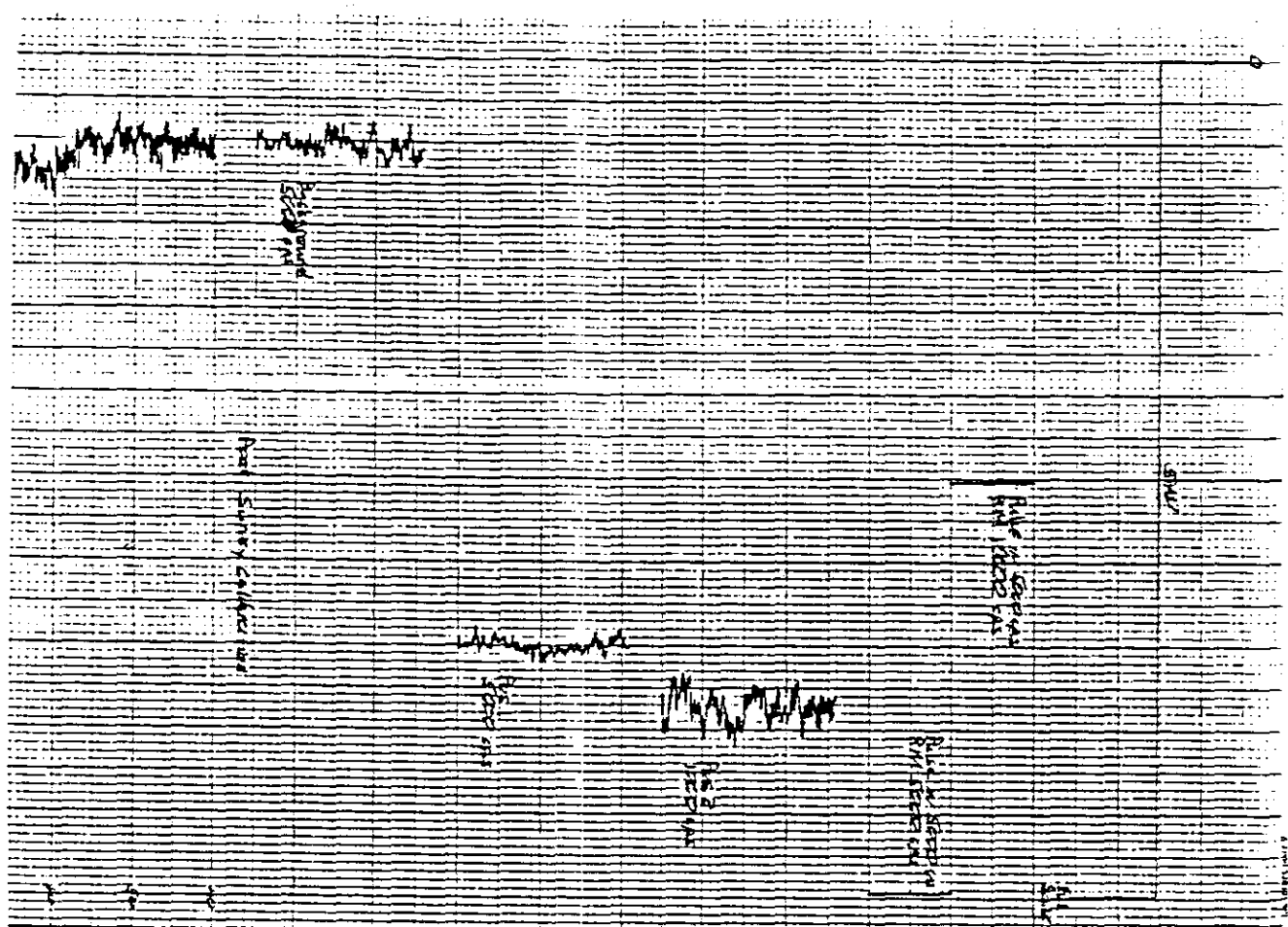
Page 1 of 1

Logging Company PNL
Operator(s) Alan Bacon
Equipment Brand AMS Equipment Type Analog
Tool Type Gamma Ray Serial No. CG27AM1
Base Calibration Date 5/92 Calibration Reference PNL-BRCO HC-0026
Calibration/Probe Factor 8.82 Calibration Datum (ft) Position 1 2551 ft
Tool Zero 1.3 Position 2 Water Up Line 7.15 psi

LOGGING INFORMATION

Log Interval From 2.2 To 400'
Recorded 71.8' Position 1 400' Position 2 @ 100'/m
Pre Survey Verification: Position 1 31.3 cpm Position 2 65.8 cpm Background 50 cpm
Base Calibration Difference: Position 1 1.8% Position 2 0.7% Background
Logging Speed 54'/min Recorded Static CPMs 50 cps/min
Start Time 1115 Completion Time 12:20
Chart Speed(s) Used 10cm/min Chart Sensitivity 12-1
Chart Recorded Horizontal Scale CPMs 50 cps/in Base Constant
Post Survey Verification: Position 1 31.3 cpm Position 2 65.8 cpm Background 50 cps
Percent Change: Position 1 0.1% Position 2 0.3%
Comments: Pipe Since 702' high
Centralizer used

Witnessed and Verified by: (sign and print name) Alan Bacon Date: 8/8/92



299-W18-96

Washington Hanford Company	LOG HEADER	Page 1 of 2

Well No. 299-W18-96 Area 200W Date 4/7/92
Log Run #1 Log Type Gamma Gamma
Elevation Datum Top of Casing Elevation 1655.6
Survey Coordinates N 324475 W 762420
Log Measured From Ground Surface
Location Description 2-18 Crib
Ground Surface Elevation
Surface Temperature N/A Weather Overcast - Cool

SCREENOUT INFORMATION

Driller
Drill Rig Type Bit Type/Diameter
Borehole Diameter/Thickness 6"/7.98"
Depth Driller 72.4' Depth Logger 72.4'
Casing Shoe N/A Casing Density N/A
Temperature N/A

CASING RECORD

Type 6" Carbon Steel Sch 40 Interval +29 -
Type Interval
Type Interval
Type Interval
Well Screen Interval N/A
Comments Open in Fines 702' high
Centralizer used

LOG HEADER

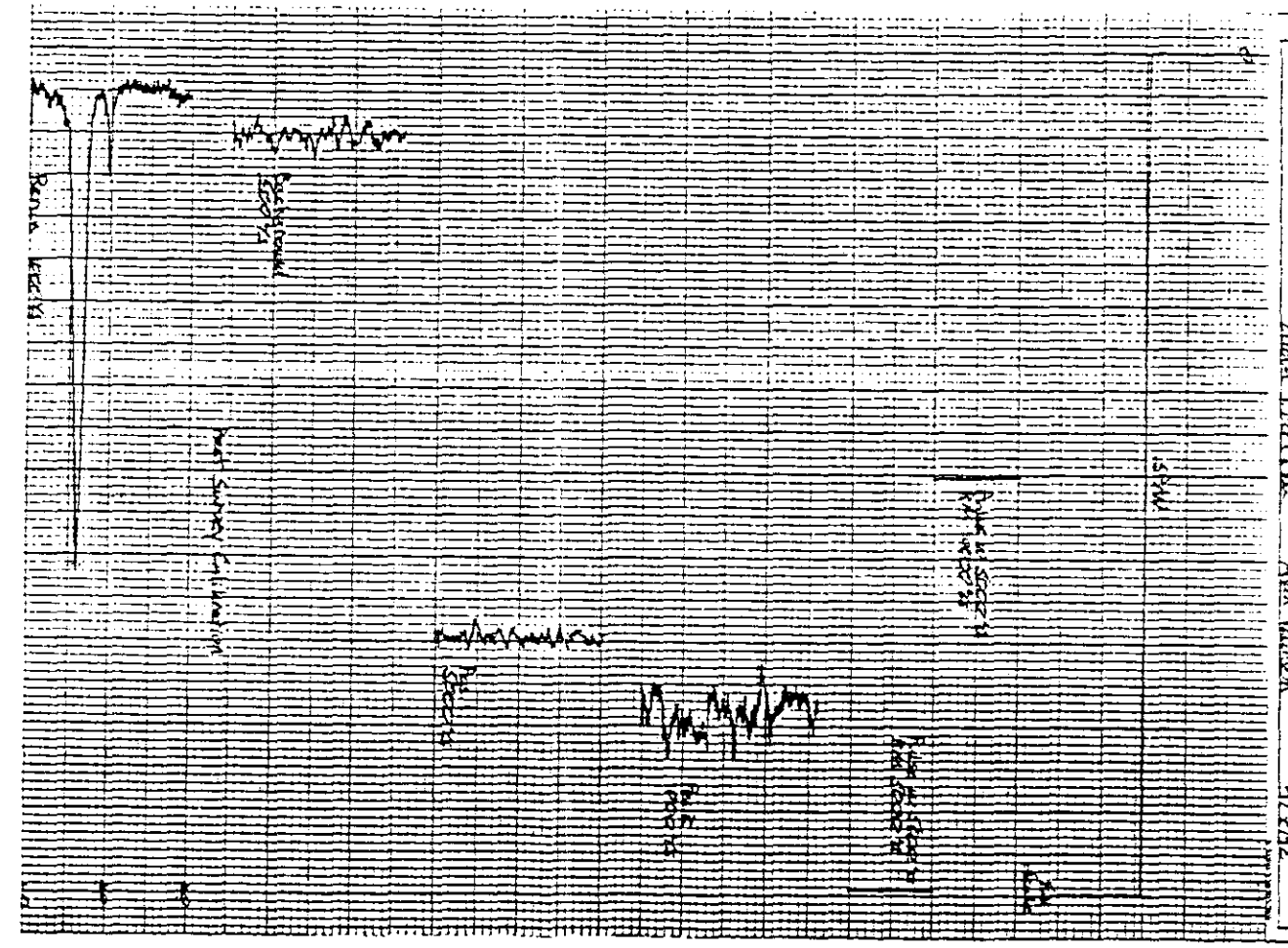
Page 1 of 1

Logging Company PNL
Operator(s) Alan Bacon
Equipment Brand AMS Equipment Type Analog
Tool Type Gamma Ray Serial No. CG27AM1
Base Calibration Date 5/92 Calibration Reference PNL-BRCO HC-0026
Calibration/Probe Factor 8.82 Calibration Datum (ft) Position 1 2551.4 ft
Tool Zero 1.3 Position 2 Water Up Line 7.15 psi

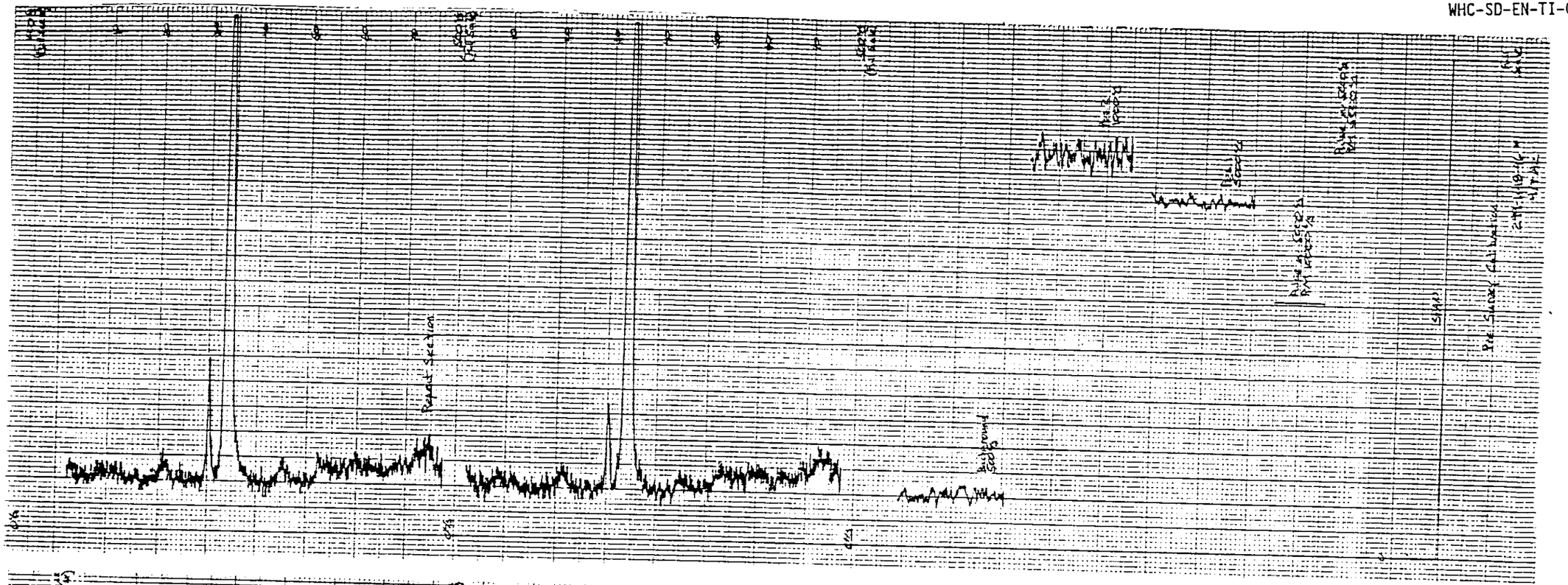
LOGGING INFORMATION

Log Interval From 2.2 To 400' @ 100'/m
Recorded 72.4 to 22.2 @ 50'/m Position 1 400' to 22.2 Position 2 Background
Pre Survey Verification: Position 1 31.3 cpm Position 2 65.8 cpm Background 50 cps
Base Calibration Difference: Position 1 1.4% Position 2 0.9% Background
Logging Speed 54'/min Recorded Static CPMs 50 cps/min
Start Time 1330 Completion Time 1350
Chart Speed(s) Used 10cm/min Chart Sensitivity 12-1
Chart Recorded Horizontal Scale CPMs 50 cps/in Base Constant
Post Survey Verification: Position 1 31.3 cpm Position 2 65.8 cpm Background 50 cps
Percent Change: Position 1 0.2% Position 2 0.3%
Comments: Pipe Since 702' high
Centralizer used

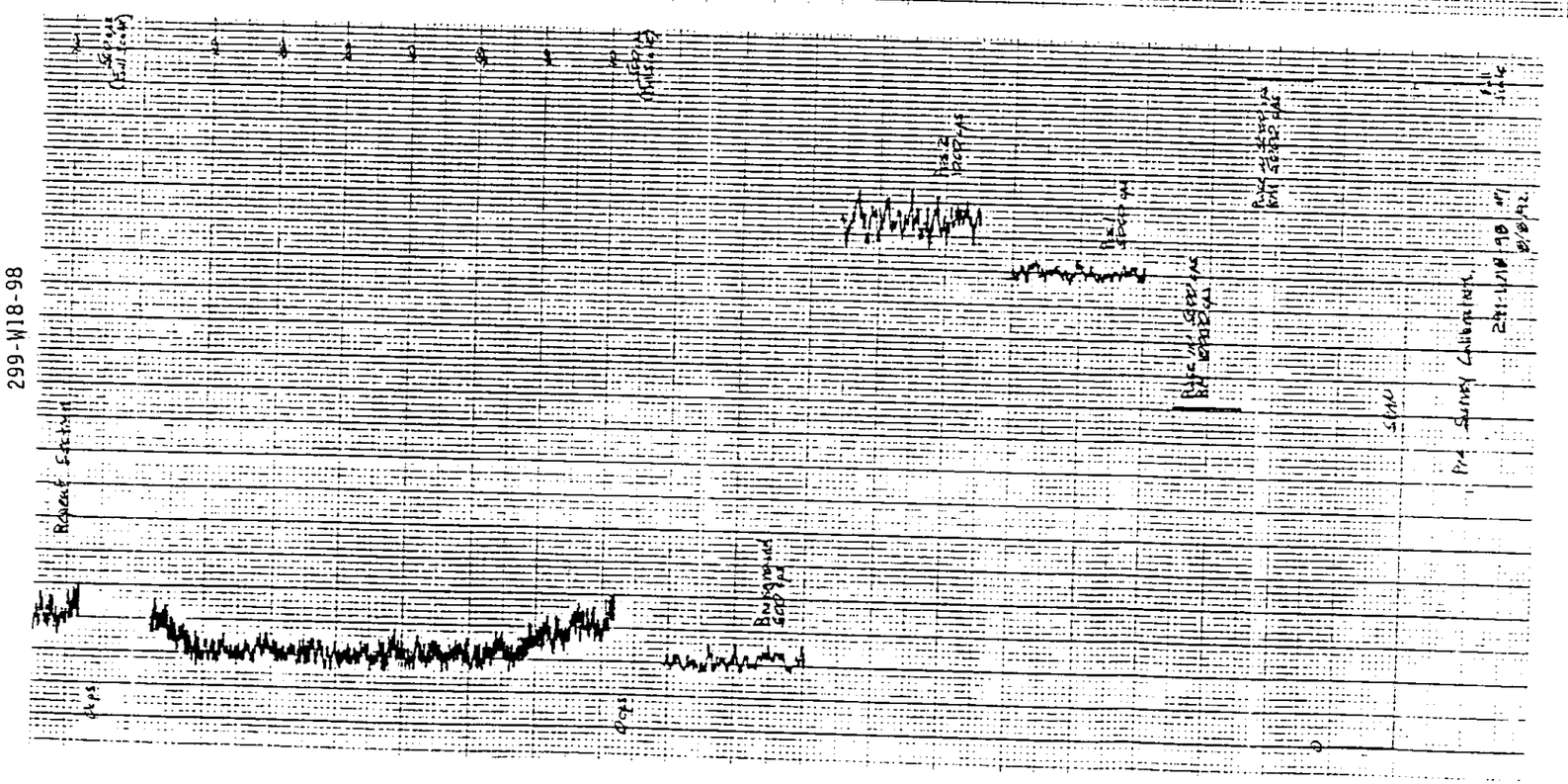
Witnessed and Verified by: (sign and print name) Alan Bacon Date: 4/7/92



299-W18-96



299-W18-98



299-W18-11

Westinghouse Hanford Company | LOG HEADER | Page 1 of 2

Well No. 299-W18-11 Area 200 West Date 8/8/82
Log Run #1 Log Type Gross Gamma
Elevation Datum Top of Casing Elevation 623
Survey Coordinates N 39735 W 71955
Log Measured From Ground Surface
Location Description South of Z-Plant
Ground Surface Elevation
Surface Temperature N/A Weather Clear-Warm

SOREHOLE INFORMATION

Driller
Drill Rig Type | Bit Type/Diameter
Borehole Diameter/Depth 6" 190'
Depth Driller 189' (Thermal Well) Depth Logger 194.6'
Liquid Level N/A (Dry) Liquid Density N/A
Temperature N/A

CASING RECORD

Type 6" Carbon Steel Sch 40 | Interval +23' - 220'
Type | Interval
Type | Interval
Type | Interval
Well Screen Interval Open Borehole 190-219'
Comments: Casing Stick-Up = +0.3' high
Centralizer used

LOG HEADER | Page 2 of 2

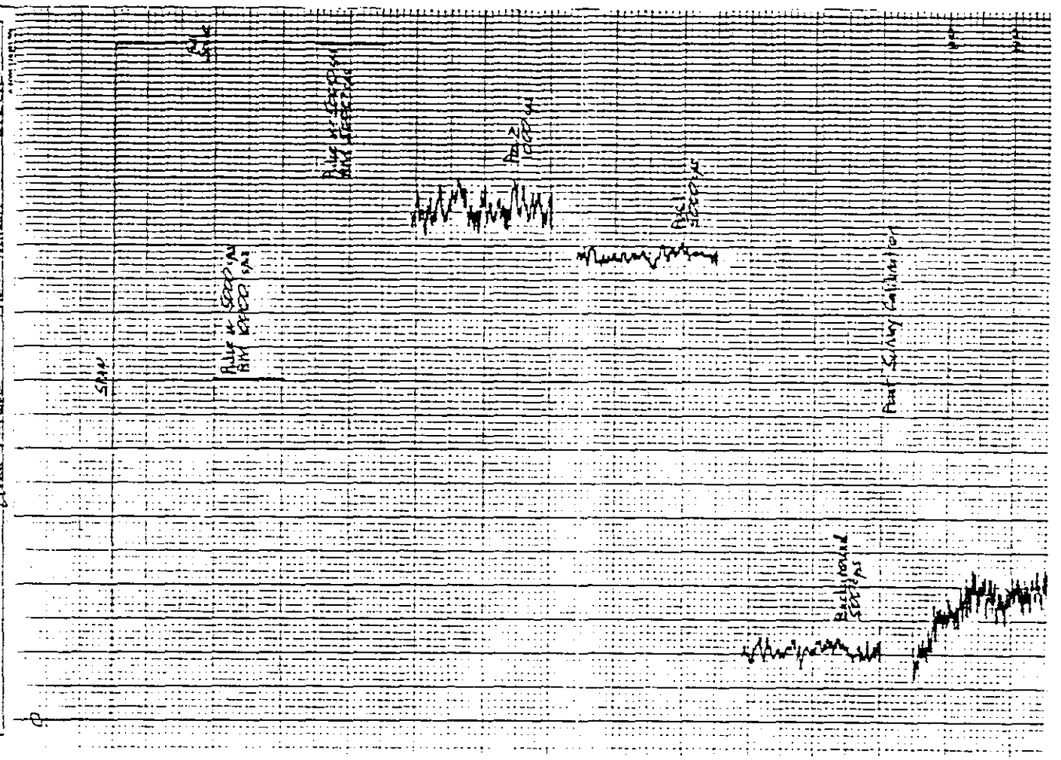
EQUIPMENT DATA

Logging Company PNL
Operator(s) Alan Pearson
Equipment Board NIS Equipment Type Analog
Tool Type Gamma Ray Serial No. CG21811
Base Calibration Date 5/82 Calibration Reference PNL-8250 WC-6026
Calibration/Production Factor 0.0140 Calibration Datum (cps) Position 1 3161 cps Position 2 651 cps
Speed Time 12.3 sec Warm Up Time 7.15 min

LOGGING INFORMATION

Log Interval From 189.6' To 19'
Recorded 150' Position 1 12.2'
Pre Survey Verification Position 1 312.8 cps Position 2 65.4 cps Background 55 cps
Base Calibration Difference Position 1 2.3 cps Position 2 0 cps
Logging Speed 5'/min Return Water (Plus) 50 GPM
Start Time 0715 Completion Time 0732
Chart Speed (Min) 10'/in Time Constant (s) 1.2-1
Chart Recorder Horizontal Scale (Plus) 50 CPS/in
Post Survey Verification: Position 1 302.3 cps Position 2 61.3 cps Background 52 cps
Percent Change: Position 1 2.1% Position 2 1.7%
Comments: Casing Stick-Up = +0.3' high
Centralizer used

Witnessed and Verified by (sign and print name) Alan Pearson Date 8/8/82



299-W18-94

Westinghouse Hanford Company | LOG HEADER | Page 1 of 2

Well No. 299-W18-94 Area 200 West Date 3/25/82
Log Run #1 Log Type Gross Gamma
Elevation Datum Top of Casing Elevation 665
Survey Coordinates N 39662 W 71940
Log Measured From Ground Surface
Location Description South of Z-Plant
Ground Surface Elevation
Surface Temperature N/A Weather Overcast-Cool

SOREHOLE INFORMATION

Driller
Drill Rig Type | Bit Type/Diameter
Borehole Diameter/Depth 6"/830
Depth Driller 830 Depth Logger 832
Liquid Level N/A (Dry) Liquid Density N/A
Temperature N/A

CASING RECORD

Type 6" Carbon Steel | Interval +23' - 830' ?
Type | Interval
Type | Interval
Type | Interval
Well Screen Interval N/A
Comments: Casing Stick-Up = +0.25' high
Centralizer used

LOG HEADER | Page 2 of 2

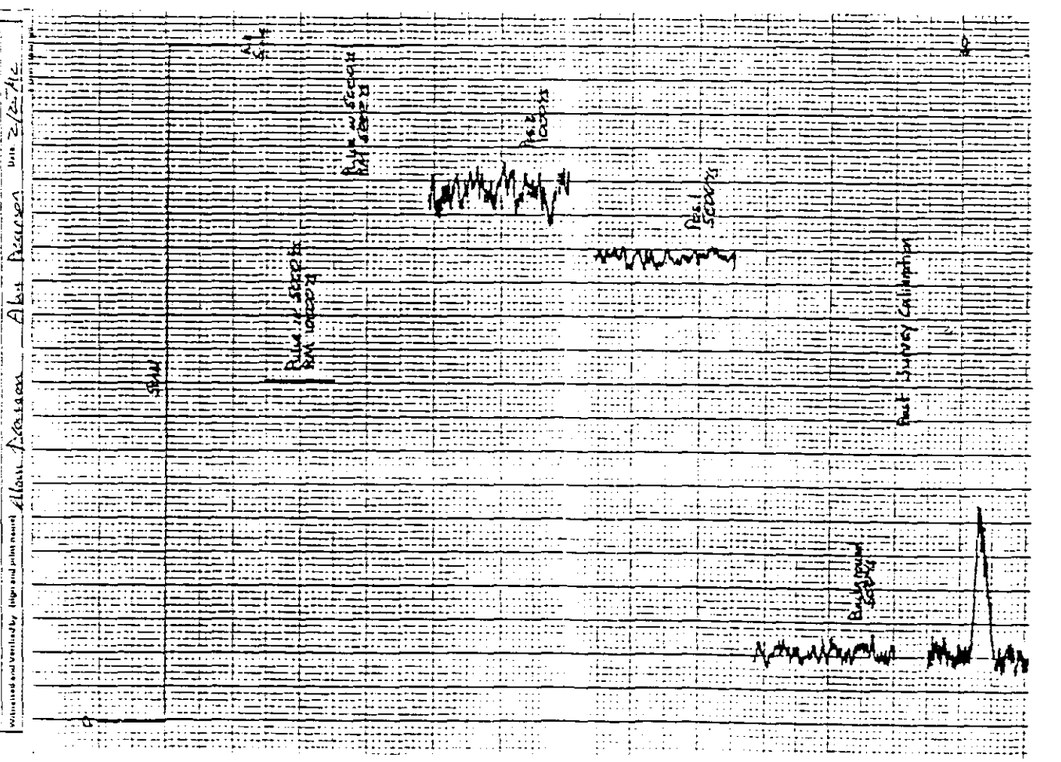
EQUIPMENT DATA

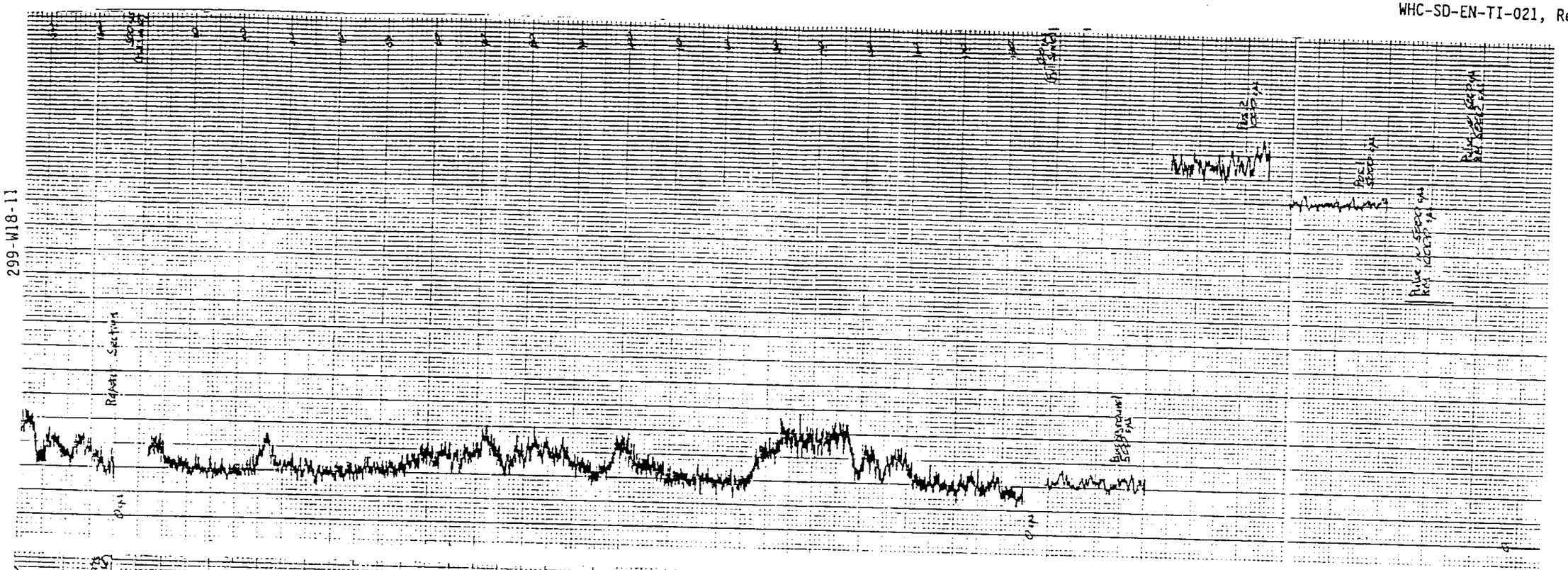
Logging Company PNL
Operator(s) Alan Pearson
Equipment Board NIS Equipment Type Analog
Tool Type Gamma Ray Serial No. CG21811
Base Calibration Date 5/82 Calibration Reference PNL-7985 WC-6026
Calibration/Production Factor 0.0140 Calibration Datum (cps) Position 1 2613.1 cps Position 2 611.3 cps
Speed Time 11.8 sec Warm Up Time 7.15 min

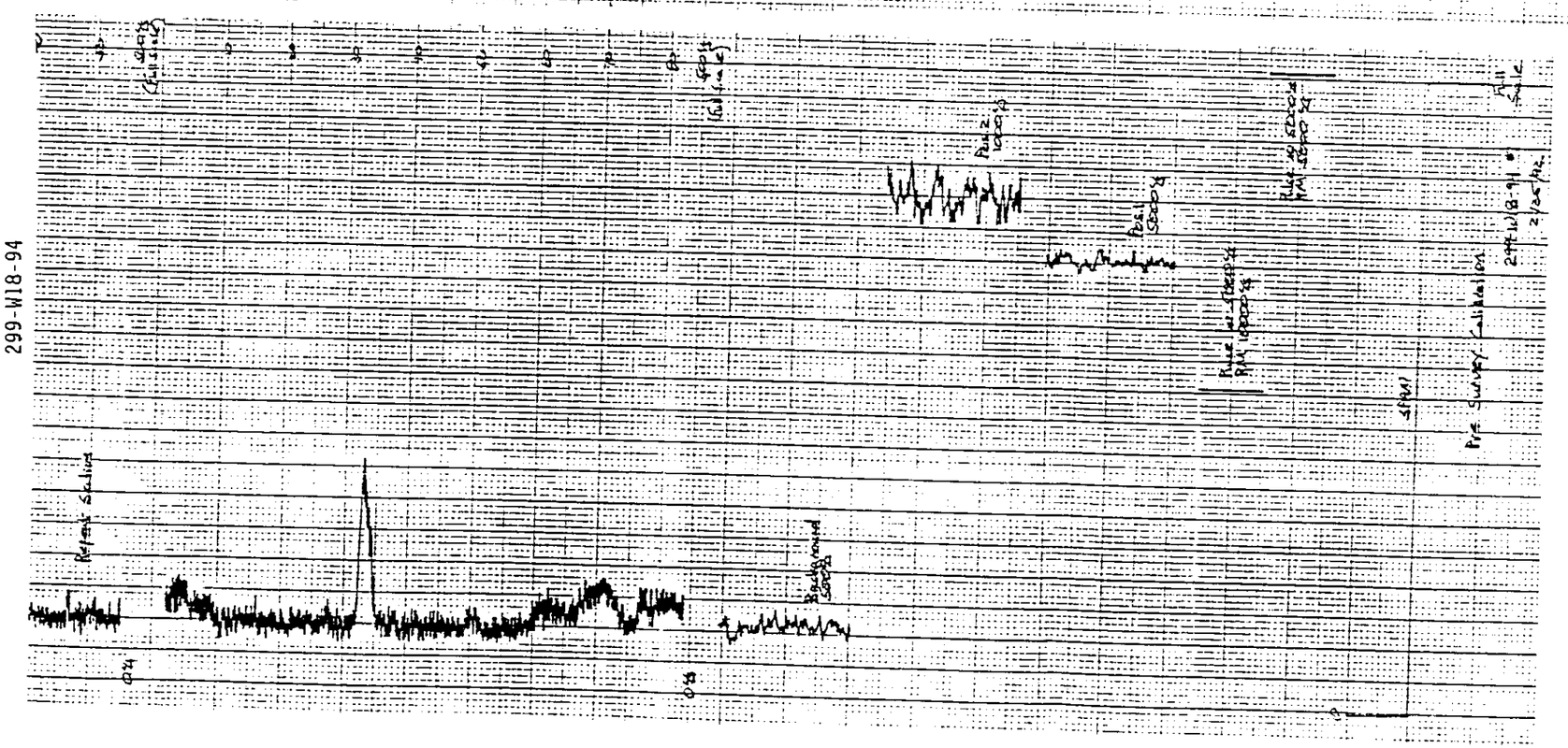
LOGGING INFORMATION

Log Interval From 83.7' To 19'
Recorded 560' To 25.0' Position 1 65.1 cps Position 2 55.1 cps Background 55 cps
Pre Survey Verification: Position 1 301.5 cps Position 2 1.6 cps
Base Calibration Difference: Position 1 7.1 cps Return Water (Plus) 60 GPM
Logging Speed 5'/min Completion Time 1215
Start Time 1215
Chart Speed (Min) 10'/in Time Constant (s) 1.2-1
Chart Recorder Horizontal Scale (Plus) 50 CPS/in
Post Survey Verification: Position 1 302.1 cps Position 2 65.0 cps Background 55 cps
Percent Change: Position 1 1.1% Position 2 1.1%
Comments: Casing Stick-Up = +0.25' high
Centralizer used

Witnessed and Verified by (sign and print name) Alan Pearson Date 3/25/82




299-W18-11
Repeat Sections
Background Scan
Pulse 2 Scan
Pulse 1 Scan
Pulse 2 Scan
Pulse 1 Scan
Pulse 1 Scan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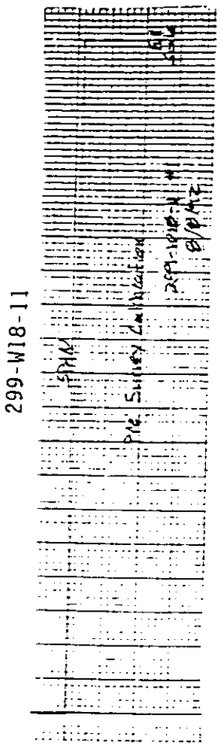
Repeat Section
Background Scan
Pulse 2 Scan
Pulse 1 Scan
Pulse 2 Scan
Pulse 1 Scan
Pre Survey Calibration
2-PT W/B-91 #
2/25/92
Full Scale


299-W18-11

299-W18-9

Westinghouse Hanford Company | LOG HEADER | Page 1 of 2

Well No. 299-W18-9 Area 200 West Date 3/6/92
Log Run #1 Log Type Gross Gamma
Elevation Datum Top of Casing Elevation 642.42
Survey Coordinates N 73457.2 W 76844
Log Measured from Ground Surface
Location Orientation South of Z-Plant
Ground Surface Elevation
Surface Temperature NA Weather Clear - Hot

BOREHOLE INFORMATION
Driller
Drill Rig Type | Bit Type/Diameter
Borehole Diameter(s)/Depth 6"/217'
Depth Driller 217' (Hanford Wells) | Depth Logger 215.2'
Liquid Level 208' (Hanford Wells) | Liquid Source Appearance Clear
Temperature NA

CASING RECORD
Type 6" Carbon Steel Sch.40 | Interval +2.9' - 220'
Type | Interval
Type | Interval
Type | Interval
Well Screen Interval Perforated 180' - 218'
Comments: Primary Casing = 0.2' high
Centralizer used

LOG HEADER | Page 1 of 2

EQUIPMENT DATA
Logging Company PNL
Operator(s) Alan Pearson
Equipment Brand AMS
Equipment Type Analog
Tool Type Gamma Ray
Serial No. CGZ7A17
Base Calibration Date 5/92
Calibration Reference PNL-8220 HC-6026
Calibration/Probe Factor and Date 0.84 cpm/pCi/g 1/1/92
Calibration Datum (cal) Position 1 2151 cpm Position 2 651 cpm
Time of Data 1823 Warm Up Time >15 min

LOGGING INFORMATION
Log Interval From 215.2' To 2.2'
Recorder(s) 700' to 200'
Pre Survey Verification: Position 1 313.2 cpm Position 2 447 cpm Background 50 cpm
Base Calibration Difference: Position 1 10 cpm Position 2 16 cpm
Logging Speed 5 ft/min Return Scaler, CPSm 50 cps/ft
Start Time 0930 Completion Time 1115
Chart Speed(s), ft/in. 100 ft/in. Time Constant(s) 16-1
Chart Recorder Horizontal Scale, CPSm 50 cpm/in.
Post Survey Verification: Position 1 311.2 cpm Position 2 645 cpm Background 50 cpm
Percent Change: Position 1 0.7% Position 2 1.9%
Comments: Casing Stick-up = 0.2' high
Centralizer used
Witnessed and Verified by (sign and print name) Alan Pearson Date 3/6/92

299-W18-10

Westinghouse Hanford Company | LOG HEADER | Page 1 of 2

Well No. 299-W18-10 Area 200W Date 3/6/92
Log Run #1 Log Type Gross Gamma
Elevation Datum Top of Casing Elevation 642.63
Survey Coordinates 38947 N 76872 W
Log Measured from Ground Surface
Location Orientation South of Z
Ground Surface Elevation
Surface Temperature NA Weather Partly Cloudy - Warm

BOREHOLE INFORMATION
Driller
Drill Rig Type | Bit Type/Diameter
Borehole Diameter(s)/Depth 6"/212'
Depth Driller 212' | Depth Logger 210.2'
Liquid Level 212' (Hanford Wells) | Liquid Source Appearance Clear
Temperature NA

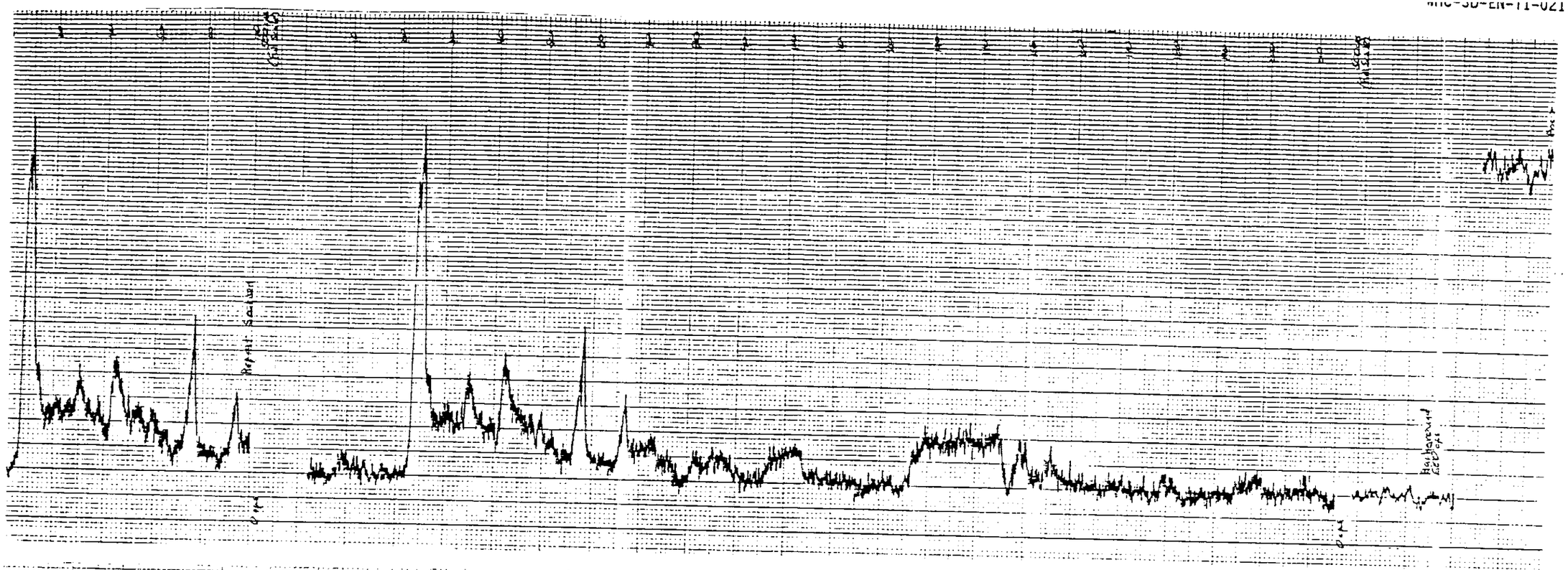
CASING RECORD
Type 6" Carbon Steel Sch. 40 | Interval +2.5' - 220'
Type | Interval
Type | Interval
Type | Interval
Well Screen Interval 180' - 218' Perforated
Comments: Casing Stick-up = 0.13' high
Centralizer used

LOG HEADER | Page 1 of 2

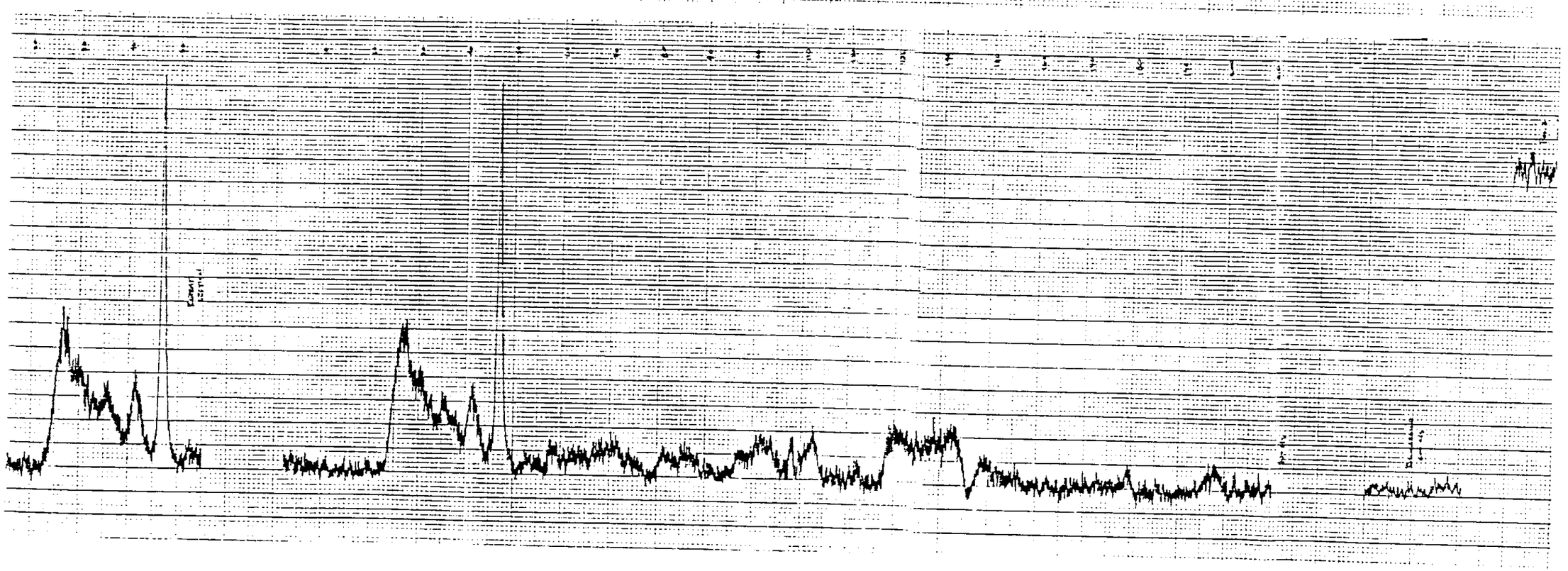
EQUIPMENT DATA
Logging Company PNL
Operator(s) Alan Pearson & Brad Gilmore
Equipment Brand AMS
Equipment Type Analog
Tool Type Gamma Ray
Serial No. CGZ7A17
Base Calibration Date 5/91
Calibration Reference PNL-7485 HC-6026
Calibration/Probe Factor and Date 0.84 cpm/pCi/g 1/1/92
Calibration Datum (cal) Position 1 297.4 cpm Position 2 61.3 cpm
Time of Data 1148 Warm Up Time >15 min

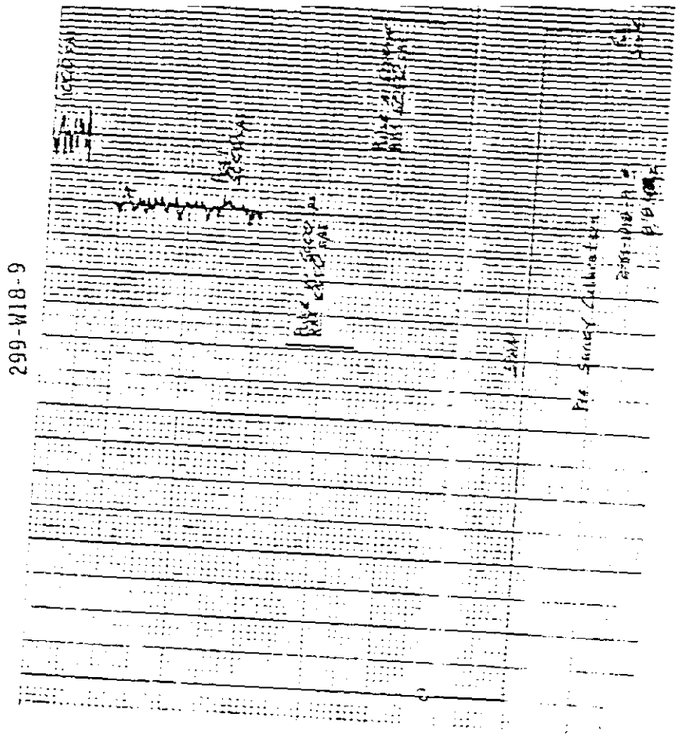
LOGGING INFORMATION
Log Interval From 210.2' To 2.2'
Recorder(s) 550' - 100'
Pre Survey Verification: Position 1 302.7 cpm Position 2 (4) 5 cpm Background 55 cpm
Base Calibration Difference: Position 1 9.3 cpm Position 2 0.2 cpm
Logging Speed 5 ft/min Return Scaler, CPSm 50 cps/ft
Start Time 1200 Completion Time 1215
Chart Speed(s), ft/in. 10 ft/in. Time Constant(s) 16-1
Chart Recorder Horizontal Scale, CPSm 50 cpm/in.
Post Survey Verification: Position 1 302.3 cpm Position 2 63.6 cpm Background 55 cpm
Percent Change: Position 1 1.1% Position 2 1.1%
Comments: Casing Stick-up = 0.13' high
Centralizer used
Witnessed and Verified by (sign and print name) Alan Pearson Date 3/6/92

299-W18-9

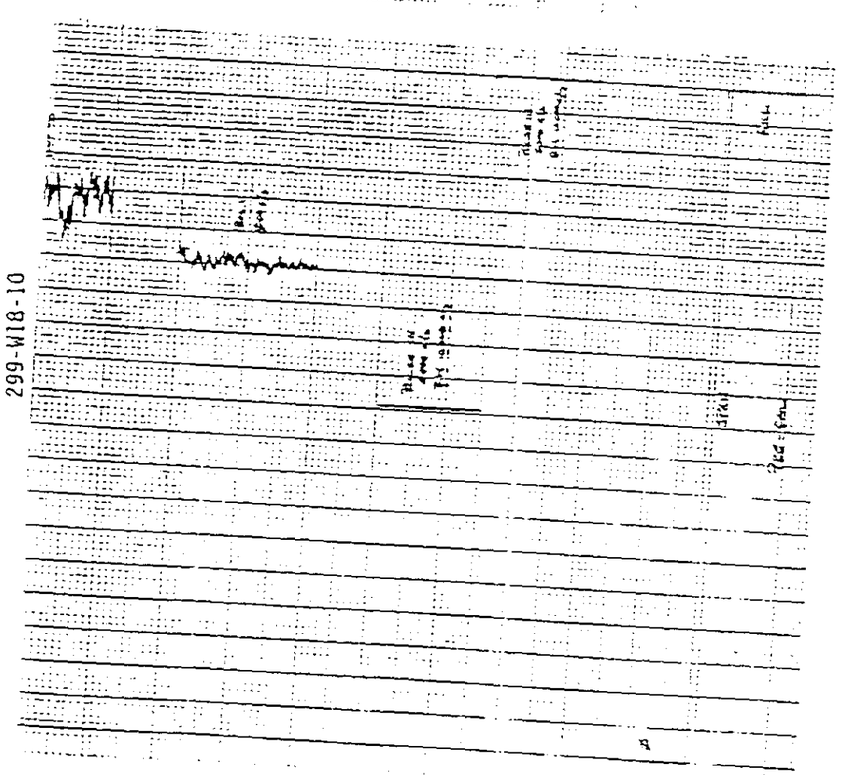


299-W18-10





299-W18-9



299-W18-10

APPENDIX B

200 AAMS: BOREHOLE GEOPHYSICS SAMPLING AND ANALYSIS PLAN

CONTENTS

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1.0 INTRODUCTION

1.1 PURPOSE

This sampling and analysis plan provides details for conducting borehole geophysical surveys with the RLS in support of the 200 AAMS program. Included within this pllan are the objectives of the field activity, data needs and data quality objectives, sampling and analysis task descriptions, analytical requirements, QA objectives and quality control methods.

1.2 BACKGROUND

Recent revisions to the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1989) require that an aggregate area approach be implemented in the 200 Areas based on the Hanford Past-Practice Investigation Strategy (HPPIS). The fundamental principal of the HPPIS is to streamline the existing RI/FS and RFI/CMS processes to provide a "bias for action" by maximizing the use of existing data, integrating past practice with RCRA treatment, storage, or disposal closure investigations, limiting and focusing the RI/FS process, and conducting expedited and interim actions where appropriate. The preferred path of the HPPIS is to achieve records of decisions through interim remedial actions for the initial stages of Hanford cleanup or closure of contaminated areas at the earliest possible date and in the most effective manner.

Borehole geophysics activities are focusing on the collection of data from existing boreholes and wells within each of the eight plant areas in the 200 AAMS. The data will be used to help define and understand the distribution, migration, and interaction of specific radiocontaminants emanating from source sites. The data will be integrated with other types of geohydrologic sites and with other types of geohydrologic and geochemical data to develop 200 AAMS conceptual models.

The specific objectives of the geophysical activities in the 200 AAMS are to log selected boreholes with the RLS. The RLS surveys will identify radionuclide species, the maximum depth of migration of each species and their relative decay activities.

2.0 SAMPLING AND ANALYSIS TASK DESCRIPTIONS

2.1 GENERAL APPROACH

The geophysical logging program has been structured into two principal tasks for the RLS surveys. The first task is to define the DQO for the logging, which are defined in Section 2.2. The other task is data evaluation and logging activities, which are described in Section 2.3. In addition, a summary of the activities for identifying boreholes to be logged in the RLS survey for each plant area are described in Section 4.0.

2.2 DATA QUALITY OBJECTIVES

The 200 AAMS geophysical logging program is a screening activity. The EPA does not specify DQO protocols for geophysical logging. Therefore, actual calibration, logging, and data handling will be in accordance with WHC requirements. Data quality objectives do not apply to the compilation and evaluation of existing data. Data objectives include logging in areas of maximum vertical extent of contaminant waste plumes to:

- Identify specific radioactive species (through defined energy levels) at waste management facilities
- Determine vertical distribution of radioactive species within the borehole to within about 1 ft at 1/2-ft intervals
- Log at facilities with high probability of the existence of a significant waste plume (i.e., exclude low activity sites such as french drains or storage sites such as catch tanks from logging).

2.3 TASK DESCRIPTIONS

2.3.1 Task 1 - Existing Data Compilation and Evaluation

The objective of this task is to assemble and evaluate existing geophysical data in each of the eight plant areas of the 200 AAMS to determine the waste storage and disposal sites that will be selected for RLS survey. Selected total gamma-ray logs for each plant area will be reviewed and about 10 wells will be selected from each plant area for RLS survey. In general, the most recent total gamma-ray log will be used. Total gamma-ray logs from well construction are preferred over bentonite-sealed well logs due to some interference from the bentonite seal. The review of total gamma-ray logs will include categorizing log response as natural or contamination. The results of this effort are documented in plant area specific tables in this appendix.

2.3.2 Task 2 - RLS Logging

The purpose of this task is to log wells selected in Task 1 with the RLS system. The system will be calibrated prior to logging. Secondary standards such as the calibration models at Grand Junction, Colorado; or Spokane, Washington, are acceptable for calibration since the geophysical logging program is a screening activity. (The Spokane calibration models are being stored for installation at the Hanford Site.) Calibration to the secondary standards will be in accordance with the American Petroleum Institute spectral gamma calibration procedure where appropriate. Field calibration checks will be performed during logging in accordance with WHC procedures. Also RLS well surveys will be conducted in accordance with WHC procedures and to the 200 AAMS schedule.

The survey will identify radionuclide species, define depth ranges of the radionuclides, and acquire data to compute relative concentrations along the length of each borehole. Data will be acquired at 0.5-ft intervals at a logging speed of 40 ft/hr.

Gamma-ray energy spectra will be recorded on a 4,000 channel analyzer. Each original and uncorrected spectra will be permanently recorded on optical disk.

2.3.3 Task 3 - Data Reduction

Radionuclide species will be identified by the presence of full energy gamma-ray photo peaks in the multi-channel analyzer spectra. The intensity of the gamma-ray peaks must agree with published gamma-ray energy values and gamma-ray yield intensity for positive radionuclide identification.

Maximum depth ranges will be determined by the presence of gamma-ray photo peaks. Radionuclides will not be reported if the gamma-ray photo peak is not above the Compton continum background.

Radionuclide concentrations will be computed from the net count rate observed in the full energy gamma-ray photo peaks. The net count rates will be corrected for borehole fluids and steel casing in accordance with WHC procedures. The RLS analysis tools are not currently able to correct for all borehole conditions, so the calculated concentration values will be conservative.

2.3.4 Task 4 - RLS Data Reporting

The purpose of this task is to compile and integrate the results of the RLS survey. A report will consist of a series of plots and associated explanatory text for each logged well including:

- The gamma-ray spectra for each logged interval
- Distribution of each detected contaminant radionuclide
- Relative concentration of each detected contaminant radionuclide.

3.0 QUALITY ASSURANCE

The DQO, which are the data quality and data quality levels required to support data interpretation requirements for this activity, are explained in Section 2.2. Logging is to be performed after the RLS is calibrated to at least secondary standards and will be supported by calibration check data. Calibration checks will be performed by approved WHC procedures. Logging will be conducted in accordance with internal WHC procedures. All calibration, logging, and data reduction will be performed by or under the direction of a qualified geophysist. The logging data will be stored on optical disk. Optical disks will be backed up to assure no data loss.

4.0 WELL SELECTION FOR RLS SURVEYS

The results of the borehole and facility evaluation that were used to select boreholes for RLS logging are presented by each of the eight plant areas. The order of the eight plant areas are:

- B1 U Plant
- B2 Z Plant
- B3 S Plant
- B4 T Plant
- B5 B Plant
- B6 PUREX Plant
- B7 Semiworks
- B8 200 North.

The facility data and total gamma-ray logs were reviewed by an environmental geologist and borehole geophysist. The outcome of the evaluation process was selection of wells for the RLS survey. Since the existing data was collected under differing quality requirements, the facility and well selection was based heavily on professional judgement.

Four tables are provided for each of the eight plant areas. The contents of each of the four tables follows.

Facilities disposal or storage data and well locations were reviewed to determine if contaminant plumes existed beneath a facility and should those plumes be logged. Two criteria were used: (1) the facility should have wells that are of sufficient depth (i.e., about 100 ft) to penetrate the waste plume, and (2) the facility should have a high activity inventory relative to other facilities in the plant area. The results of this screening are presented in Table 1 of each of the eight plant areas.

Total gamma-ray logs for boreholes and wells in the plant area were reviewed by a logging geophysist and radioactivity categorized into five types. The categories are: natural, probably natural, transfer line or surface (tank farms only), possible contamination and contamination. The categorization is tabulated in Table 2 of each of the eight plant areas.

Radioactive contaminated intervals were tabulated by facility and included depths to the top and bottom of the interval and the average gamma-ray activity. Results are in Table 3 of each of the eight plant areas.

The contaminated interval data and average gamma-ray activity (Table 3 of each plant area) and well construction data were used with the following criteria to select wells for RLS logging in each of the plant areas:

- Wells should be fully penetrating or a minimum depth of about 100 ft
- Wells selected should not have a bentonite seal (i.e., select wells drilled prior to 1986)
- Wells should be limited to one per facility or unit (i.e., trench, tank, etc.) for a total in the plant area of no more than 10
- Wells should be in close proximity to crib distribution system or storage tank.

Table 4 of each of the eight plant areas lists the wells selected for RLS logging to support the 200 AAMS.

APPENDIX B1
U PLANT TABLES

Table B1-1. U Plant Aggregate Area Disposal Facilities and RLS Logging Recommendations.

DISPOSAL FACILITY	LOG WITH RLS	COMMENTS
216-U-1 CRIB	YES	URANIUM ACTIVITY
216-U-2 CRIB	YES	URANIUM ACTIVITY
216-U-3 CRIB	NO	NO ACTIVITY
216-U-4 REVERSE WELL	NO	NO MONITORING WELLS
216-U-4A/B FRENCH DRAIN	NO	NO MONITORING WELLS
216-U-5 TRENCH	NO	NO MONITORING WELLS
216-U-6 TRENCH	NO	NO MONITORING WELLS
216-U-7 FRENCH DRAIN	NO	NO MONITORING WELLS
216-U-8 CRIB	YES	POTENTIAL URANIUM ACTIVITY
216-U-10 POND	NO	LOW ACTIVITY
216-U-11 TRENCH	NO	NO MONITORING WELLS
216-U-12 CRIB	YES	ACTIVITY
216-U-13 TRENCH	NO	NO MONITORING WELLS
216-U-14 DITCH	NO	LOW URANIUM ACTIVITY
216-U-15 TRENCH	NO	NO MONITORING WELLS
216-U-16 CRIB	NO	LOW ACTIVITY
216-U-17 CRIB	NO	LOW ACTIVITY
241-U TANK FARM	YES	CONTAMINATION ASSOCIATED WITH LEAKING TANKS/LINES
216-Z-1D DITCH	NO	NO MONITORING WELLS
216-Z-11 DITCH	NO	NO PREVIOUS LOGGING DATA
216-Z-19 DITCH	NO	NO PREVIOUS LOGGING DATA
216-Z-20 CRIB	NO	LOW ACTIVITY
216-S-21 CRIB	YES	ACTIVITY
216-S-4 FRENCH DRAIN	NO	LOW ACTIVITY

Table B1-2. U Plant Aggregate Area Radioactivity Categorized by Facility and Well. (sheet 1 of 5)

Well	Tankfarm	Facility	Log Date	Category	E	N
2-W21-51					-71500	36500
2-W21-52					-71486	36534
2-W21-53					-71474	36526
2-W21-54					-71466	36514
2-W21-55					-71463	36500
2-W21-56					-71466	36486
2-W21-57					-71474	36474
2-W21-58					-71486	36466
2-W21-59					-71500	36463
2-W21-60					-71514	36466
2-W21-61					-71526	36474
2-W21-62					-71534	36486
2-W21-63					-71537	36500
2-W21-64					-71534	36514
2-W21-65					-71526	36526
2-W21-66					-71514	36534
2-W21-67					-71500	36537
2-W21-68					-71462	36537
2-W21-69					-71552	36500
2-W21-70					-71470	36470
2-W21-71					-71500	36447
2-W21-72					-71530	36469
2-W21-73					-71548	36500
2-W21-74					-71538	36537
2-W21-75					-71500	36543
2-W21-76					-71434	36569
2-W21-77					-71406	36500
2-W21-78					-71434	36434
2-W21-79					-71500	36406
2-W21-80					-71566	36434
2-W21-81					-71594	36500
2-W21-82					-71569	36566
2-W21-83					-71500	36594
2-W23-013		S Tank farm	11/30/90	Natural	-76067	36040
2-W23-004		S-21 Crib	2/23/76	Contamination	-76335	35861
2-W23-063		S-21 Crib			-76400	35925
2-W23-071		S-21 Crib			-76300	35800
2-W19-07		S-23 Crib	5/13/76	Natural	-74125	37000
2-W19-10		S23:U16:Retn			-75000	37201
2-W19-91		U Basin:U-14			-75269	37617
2-W19-08		U Plant	4/05/85	Possible Contamination	-73268	38574
2-W19-28		U Plant	6/06/89	Natural	-73184	37823
2-W19-29		U Plant	6/08/89	Natural	-72940	37849
2-W19-51		U Plant			-73500	38160

Table B1-2. U Plant Aggregate Area Radioactivity Categorized by Facility and Well. (sheet 2 of 5)

Well	Tankfarm	Facility	Log Date	Category	E	N
2-W19-52		U Plant			-73285	38410
2-W19-55		U Plant			-73218	38210
2-W19-90		U Plant:U-8	2/05/87	Natural	-73341	37553
2-W18-015		U Pond	9/23/86	Possible Contamination	-77152	36990
2-W19-21		U Ret. Basin	7/08/86	Natural	-75273	37462
2-W19-22		U Ret. Basin	6/17/86	Probably Natural	-74796	37628
2-W19-27		U Ret. Basin	4/24/87	Natural	-75072	37629
2-W19-01		U TF : Basin	5/19/87	Probably Natural	-75491	37613
2-W19-12		U TF : Basin			-75456	38052
2-W19-31		U TF: Basin	12/06/90	Natural	-75457	38275
2-W19-32		U TF: Basin	10/17/90	Probably Natural	-75459	37887
2-W18-025		U Tank farm	11/29/90	Natural	-76034	37786
2-W18-051	60-00-06	U Tank farm	5/08/63	Probably Natural	-75700	37822
2-W18-052	60-00-11	U Tank farm	5/08/63	Probably Natural	-75837	38262
2-W18-053	60-00-10	U Tank farm	5/08/63	Probably Natural	-75908	38135
2-W18-054	60-08-10	U Tank farm	10/21/91	Natural	-75775	38035
2-W18-055	60-00-08	U Tank farm	5/08/63	Probably Natural	-75908	37935
2-W18-090	60-12-07	U Tank farm			-75860	37857
2-W18-091	60-12-10	U Tank farm			-75876	37920
2-W18-092	60-12-05	U Tank farm			-75820	37855
2-W18-100	60-10-01	U Tank farm	10/08/91	Natural	-75616	37942
2-W18-101	60-11-06	U Tank farm	10/21/91	Natural	-75737	37860
2-W18-102	60-11-03	U Tank farm	10/15/91	Transfer line	-75686	37901
2-W18-103	60-12-03	U Tank farm	10/21/91	Natural	-75786	37900
2-W18-104	60-10-05	U Tank farm	10/08/91	Natural	-75612	37857
2-W18-105	60-11-12	U Tank farm	10/15/91	Transfer line	-75737	37947
2-W18-109	60-11-05	U Tank farm	10/15/91	Natural	-75717	37857
2-W18-110	60-11-07	U Tank farm	10/15/91	Natural	-75763	37857
2-W18-113	60-12-01	U Tank farm	10/21/91	Contamination	-75817	37940
2-W18-114	60-07-01	U Tank farm	10/15/91	Contamination	-75617	38043
2-W18-115	60-08-04	U Tank farm	10/21/91	Transfer line	-75692	37976
2-W18-116	60-07-10	U Tank farm	10/15/91	Contamination	-75678	38017
2-W18-117	60-07-11	U Tank farm	10/15/91	Contamination	-75657	38043
2-W18-118	60-08-08	U Tank farm	10/15/91	Natural	-75787	37977
2-W18-119	60-08-09	U Tank farm	10/15/91	Natural	-75787	38017
2-W18-120	60-09-01	U Tank farm	10/15/91	Natural	-75818	38041
2-W18-121	60-09-07	U Tank farm	10/15/91	Natural	-75862	37956
2-W18-122	60-09-08	U Tank farm	10/21/91	Natural	-75887	37977
2-W18-123	60-09-10	U Tank farm	10/21/91	Natural	-75887	38017
2-W18-124	60-04-08	U Tank farm	10/08/91	Contamination	-75687	38077
2-W18-125	60-04-10	U Tank farm	10/15/91	Possible Contamination	-75687	38117

Table B1-2. U Plant Aggregate Area Radioactivity Categorized by Facility and Well. (sheet 3 of 5)

Well	Tankfarm	Facility	Log Date	Category	E	N
2-W18-126	60-04-12	U Tank farm			-75637	38143
2-W18-127	60-05-05	U Tank farm	10/21/91	Natural	-75722	38047
2-W18-128	60-05-07	U Tank farm	10/21/91	Natural	-75757	38047
2-W18-129	60-05-08	U Tank farm	10/21/91	Natural	-75787	38077
2-W18-130	60-05-10	U Tank farm	10/21/91	Natural	-75787	38117
2-W18-131	60-06-07	U Tank farm	10/15/91	Natural	-75857	38051
2-W18-132	60-06-08	U Tank farm	10/15/91	Transfer line	-75885	38077
2-W18-133	60-06-10	U Tank farm	10/15/91	Natural	-75885	38117
2-W18-134	60-06-11	U Tank farm	10/15/91	Natural	-75857	38141
2-W18-135	60-01-08	U Tank farm	10/15/91	Natural	-75690	38177
2-W18-136	60-01-10	U Tank farm	10/21/91	Natural	-75687	38217
2-W18-137	60-02-01	U Tank farm	10/21/91	Transfer line	-75717	38244
2-W18-138	60-02-05	U Tank farm	10/21/91	Natural	-75707	38164
2-W18-139	60-02-07	U Tank farm	10/21/91	Natural	-75757	38151
2-W18-140	60-02-08	U Tank farm	10/21/91	Natural	-75778	38186
2-W18-141	60-02-10	U Tank farm	10/15/91	Natural	-75787	38217
2-W18-142	60-02-11	U Tank farm	10/21/91	Natural	-75757	38244
2-W18-143	60-03-01	U Tank farm	10/15/91	Natural	-75817	38244
2-W18-144	60-03-05	U Tank farm	10/15/91	Natural	-75822	38151
2-W18-145	60-03-08	U Tank farm	10/15/91	Transfer line	-75885	38177
2-W18-146	60-03-10	U Tank farm	10/15/91	Natural	-75885	38217
2-W18-147	60-03-11	U Tank farm	10/15/91	Natural	-75857	38244
2-W18-148	60-10-07	U Tank farm	10/09/91	Contamination	-75657	37857
2-W19-53	60-00-05	U Tank farm	10/08/91	Natural	-75577	37898
2-W19-54	60-00-02	U Tank farm	5/08/63	Natural	-75577	38197
2-W19-74	60-07-02	U Tank farm	10/15/91	Probably Natural	-75594	38017
2-W19-75	60-10-02	U Tank farm	10/08/91	Natural	-75600	37920
2-W19-76	60-04-03	U Tank farm			-75593	38095
2-W18-176	60-05-04	U Tankfarm			-75698	38074
2-W19-03		U-1 Crib	4/18/85	Contamination	-74098	37819
2-W19-11		U-1 Crib	4/18/85	Contamination	-74210	37860
2-W19-16		U-1 Crib	6/12/85	Natural	-74230	37950
2-W19-17		U-1 Crib	12/10/85	Natural	-74175	37895
2-W19-18		U-1 Crib	11/27/85	Natural	-73936	37895
2-W22-28		U-12 : S-9	2/23/68	Contamination	-73770	36150
2-W22-22		U-12 Crib	9/29/82	Natural	-73098	36094
2-W22-23		U-12 Crib	8/25/82	Natural	-73198	36030
2-W22-24		U-12 Crib			-72998	35917
2-W22-24O		U-12 Crib			-72997	35917
2-W22-24P		U-12 Crib			-72997	35917
2-W22-24Q		U-12 Crib			-72997	35917
2-W22-24R		U-12 Crib			-72997	35917
2-W22-24S		U-12 Crib			-72997	35917
2-W22-24T		U-12 Crib			-72997	35917
2-W22-40		U-12 Crib	3/30/90	Natural	-73042	36242
2-W22-41		U-12 Crib	3/05/90	Natural	-73034	36142

Table B1-2. U Plant Aggregate Area Radioactivity Categorized by Facility and Well. (sheet 4 of 5)

Well	Tankfarm	Facility	Log Date	Category	E	N
2-W22-42		U-12 Crib	3/05/90	Natural	-73080	36053
2-W22-43		U-12 Crib	3/30/90	Natural	-73377	36339
2-W22-59		U-12 Crib			-73170	35955
2-W22-60		U-12 Crib	2/23/68	Natural	-73150	36125
2-W22-73		U-12 Crib	8/25/82	Contamination	-73120	36339
2-W22-75		U-12 Crib	8/25/82	Contamination	-73145	36255
2-W14-07		U-14 Ditch			-75002	40003
2-W14-63		U-14 Ditch			-74725	41090
2-W19-92		U-14 Ditch	4/07/87	Probably Natural	-75319	37492
2-W19-93		U-14 Ditch	5/19/87	Possible Contamination	-75431	37289
2-W23-210		U-14 Ditch			-76120	36322
2-W19-13		U-16 Crib	3/14/85	Natural	-74180	37510
2-W19-14		U-16 Crib	3/14/85	Natural	-74240	37300
2-W19-04		U-17 Crib	5/06/63	Natural	-71999	39000
2-W19-19		U-17 Crib	1/26/87	Probably Natural	-72406	37569
2-W19-20		U-17 Crib	6/02/86	Probably Natural	-72252	37525
2-W19-23		U-17 Crib	3/05/87	Natural	-72587	37499
2-W19-24		U-17 Crib	3/12/87	Natural	-72588	37613
2-W19-25		U-17 Crib	4/16/87	Natural	-72250	37575
2-W19-26		U-17 Crib	4/16/87	Possible Contamination	-72345	37504
2-W19-89		U-17 Crib	2/05/87	Natural	-72390	37520
2-W19-09		U-2 Crib	5/09/85	Contamination	-74225	37895
2-W19-15		U-2 Crib	5/24/85	Natural	-74285	37775
2-W19-72		U-2 Crib			-74247	37859
2-W19-73		U-2 Crib			-74322	37859
2-W18-177		U-3 Crib	9/16/87	Natural	-75500	37680
2-W19-02		U-8 Crib	5/13/76	Possible Contamination	-73000	36849
2-W19-69		U-8 Crib			-73100	36920
2-W19-70		U-8 Crib	12/03/76	Contamination	-73100	36860
2-W19-71		U-8 Crib	12/03/76	Contamination	-73100	36800
2-W19-30		U-8:U Plant	4/27/90	Natural	-72935	37603
6-35-78A		U-9 Ditch			-78190	35478
6-35-78B		U-9 Ditch			-78251	35498
2-W18-196		Z-1 Ditch			-77065	36880

Table B1-2. U Plant Aggregate Area Radioactivity Categorized by Facility and Well. (sheet 5 of 5)

Well	Tankfarm	Facility	Log Date	Category	E	N
2-W18-178		Z-11 Ditch			-76240	38610
2-W18-186		Z-11 Ditch			-76685	37270
2-W18-188		Z-11 Ditch			-76413	38065
2-W18-199		Z-11 Ditch			-76335	38366
2-W18-187		Z-19 Ditch			-76535	37425
2-W18-195		Z-19 Ditch			-76710	37275
2-W18-018		Z-20 Crib	6/27/91	Natural	-76270	38903
2-W18-019		Z-20 Crib	5/31/91	Natural	-76403	38503
2-W18-020		Z-20 Crib	5/29/91	Natural	-76477	38103
2-W18-207		Z-20 Crib			-76148	39145
2-W18-208		Z-20 Crib			-76207	39032
2-W18-209		Z-20 Crib			-76270	38898
2-W18-210		Z-20 Crib			-76319	38798
2-W18-211		Z-20 Crib			-76338	38715
2-W18-212		Z-20 Crib			-76355	38645
2-W18-213		Z-20 Crib			-76373	38564
2-W18-214		Z-20 Crib			-76395	38473
2-W18-215		Z-20 Crib			-76422	38370
2-W18-217		Z-20 Crib			-76459	38140
2-W18-218		Z-20 Crib			-76462	38058
2-W18-219		Z-20 Crib			-76470	37940
2-W18-220		Z-20 Crib			-76471	37840

Table B1-3. U Plant Contamination Intervals and Average Gamma Activity.

Well Site	Category	Top1	Base	Value1	Top2	Base	Value2	Top3	Base	Value3	Top4	Base	Value4	Top5	Base	Value5	Top6	Base	Value6
2-W23-004	S-21 Crib	Contamination	4	38	35	38	60	3200	60	170	45	170	257	25					
2-W19-08	U Plant	Possible Contamination	5	16	75	18	20	185	27	160	80	177	180	120	190	240	70	250	348 55
2-W18-015	U Pond	Possible Contamination	3	25	95	20	25	165	25	120	100	120	130	147	130	244	75		
2-W18-113	U Tank farm	Contamination	0	39	60	39	50	1000	50	70	21000	71	84	200	84	96	300	96	102 50
2-W18-114	U Tank farm	Contamination	3	47	19	47	58	60	58	97	34								
2-W18-116	U Tank farm	Contamination	3	54	19	53	67	300	67	97	31								
2-W18-117	U Tank farm	Contamination	3	52	23	52	75	200	75	122	38								
2-W18-124	U Tank farm	Contamination	2	53	19	53	66	200	66	117	29								
2-W18-125	U Tank farm	Possible contamination	3	7	38	7	49	22	49	57	48	57	115	32					
2-W18-148	U Tank farm	Contamination	2	18	50	18	48	5	48	61	20000	61	121	3					
2-W19-03	U-1 Crib	Contamination	2	9	430	10	72	35	73	80	145	80	92	95	94	101	220	102	240 55
2-W19-11	U-1 Crib	Contamination	4	30	30	30	80	20000	80		35		248	65	248	250	140		
2-W22-28	U-12 : S-9	Contamination	0	40	100	40	150	130	150	178	160	178	217	130	217	230	13000		
2-W22-73	U-12 Crib	Contamination	5	20	90	21	25	1800	26	59	95								
2-W22-75	U-12 Crib	Contamination	5	20	90	21	27	29000	29	38	3900	38	46	300	46	59	2650	59	95 85
2-W19-93	U-14 Ditch	Possible Contamination	2	12	75	12	39	150	39	112	90								
2-W19-26	U-17 Crib	Possible Contamination	2	18	90	18	30	295	30	99	195	99	130	250	130	213	195	215	248 120
2-W19-09	U-2 Crib	Contamination	5	8	175	11	13	1300	14	284	35								
2-W19-02	U-8 Crib	Possible Contamination		40	100	40	44	185	44		125		89	115	89	103	173	103	120
2-W19-70	U-8 Crib	Contamination	4	26	85	26	40	40000	40	52	10000	52	70	3000	70	82	2000		
2-W19-71	U-8 Crib	Contamination	5	30	75	30	42	40000	42	62	500	62	65	1000	65	82	250		

Table B1-4. Selected RLS Survey Wells for U Plant.

	Well	Tank farm Well	Disposal Site	Drill Date	Drill Depth
1	299-W23-004		S-21 Crib	6/30/57	253
2	299-W18-113	60-12-01	U Tank farm	7/31/74	124
3	299-W18-117	60-07-11	U Tank farm	5/31/74	122
4	299-W18-148	60-10-07	U Tank farm	2/28/74	121
5	299-W19-011		U-1 Crib	4/30/83	250
6	299-W22-075		U-12 Crib	4/30/82	171
7	299-W19-009		U-2 Crib	8/31/44	284
8	299-W19-070		U-8 Crib	1/31/51	105

APPENDIX B2

Z PLANT TABLES

Table B2-1. Z Plant Aggregate Area Disposal Facilities and RLS Logging Recommendations.

DISPOSAL FACILITY	LOG WITH RLS	COMMENTS
216-Z-1A TILE FIELD	YES	ACTIVITY
216-Z-1, -2 CRIBS	YES	ACTIVITY
216-Z-3 CRIB	NO	LOW ACTIVITY
216-Z-4 TRENCH	NO	NO MONITORING WELLS
216-Z-5 CRIB	YES	ACTIVITY
216-Z-6 CRIB	NO	NO MONITORING WELLS
216-Z-7 CRIB	YES	ACTIVITY
216-Z-8 FRENCH DRAIN	NO	NO MONITORING WELLS
216-Z-9 TRENCH	YES	ACTIVITY
216-Z-12 CRIB	YES	ACTIVITY
216-Z-13 FRENCH DRAIN	NO	NO MONITORING WELLS
216-Z-14 FRENCH DRAIN	NO	NO MONITORING WELLS
216-Z-15 FRENCH DRAIN	NO	NO MONITORING WELLS
216-Z-18 CRIB	YES	ACTIVITY

Table B2-2. Z Plant Aggregate Area Radioactivity Categorized by Facility and Well. (sheet 1 of 4)

Well	Facility	Log Date	Category	E	N
2-W15-212	T-25 Crib	6/24/86	Contamination	-76600	41190
2-W15-019	W-2 : W-4B	8/21/89	Natural	-77772	41041
2-W15-020	W-2 LLBG	8/12/89	Natural	-78120	41028
2-W10-179	W-3A LLBG			-77597	44420
2-W7-02	W-3A LLBG	7/10/87	Natural	-77385	46519
2-W7-03	W-3A LLBG	10/28/87	Natural	-77420	46520
2-W7-09	W-3A LLBG	11/10/89	Natural	-78889	46549
6-46-79	W-3A LLBG			-78900	45750
2-W6-2	W-3AE LLBG	10/29/87	Natural	-75302	45571
2-W7-04	W-3AE LLBG	11/05/87	Natural	-77040	45435
2-W7-05	W-3AE LLBG	11/14/87	Natural	-76816	46509
2-W7-06	W-3AE LLBG	10/09/87	Natural	-76219	46509
2-W7-07	W-3AE LLBG	11/17/89	Natural	-76519	46509
2-W7-08	W-3AE LLBG	11/17/89	Natural	-75880	46510
2-W7-10	W-3AE LLBG	1/25/90	Natural	-75564	45921
2-W15-002	W-4A LLBG	11/12/76	Probably Natural	-78082	42251
2-W15-207	W-4B Burial			-77736	40732
2-W15-015	W-4B LLBG	8/18/87	Natural	-78103	40330
2-W15-016	W-4B LLBG	8/18/87	Natural	-77387	40269
2-W15-017	W-4B LLBG	9/17/87	Natural	-77387	40221
2-W15-023	W-4B LLBG	1/16/90	Natural	-78119	40680
2-W15-014	W-4C LLBG			-78089	39990
2-W15-018	W-4C LLBG	7/08/87	Possible Contamination	-77383	39705
2-W15-024	W-4C LLBG	12/05/89	Probably Natural	-78096	39851
2-W18-003	W-4C LLBG	5/02/73	Natural	-77700	39600
2-W18-021	W-4C LLBG	7/08/87	Natural	-78080	37794
2-W18-022	W-4C LLBG	8/13/87	Natural	-78109	37831
2-W18-023	W-4C LLBG	6/15/87	Natural	-78120	38987
2-W18-024	W-4C LLBG	7/09/87	Natural	-77180	38998
2-W18-026	W-4C LLBG	9/27/89	Natural	-78097	39477
2-W18-084	W-4C LLBG	5/02/73	Natural	-77386	38249
2-W18-064	Z-1 Crib	9/22/67	Contamination	-76614	39373
2-W18-065	Z-1 Crib	7/22/86	Contamination	-76589	39373
2-W15-005	Z-1 Ditch	5/02/63	Natural	-75984	39537
2-W15-102	Z-1 Ditch	4/27/73	Probably Natural	-76180	39702
2-W15-053	Z-10			-76576	40878
2-W15-059	Z-10			-76522	40811

Table B2-2. Z Plant Aggregate Area Radioactivity Categorized by Facility and Well. (sheet 2 of 4)

Well	Facility	Log Date	Category	E	N
2-W18-001	Z-12 : Z-1A	4/27/73	Natural	-77013	39388
2-W18-002	Z-12 Crib	7/22/87	Natural	-77150	39120
2-W18-004	Z-12 Crib	7/22/87	Natural	-77375	39150
2-W18-005	Z-12 Crib	5/02/73	Contamination	-77250	39350
2-W18-008	Z-12 Crib	5/19/76	Contamination	-77221	39327
2-W18-013	Z-12 Crib			-77250	39370
2-W18-014	Z-12 Crib			-77210	39370
2-W18-069	Z-12 Crib	2/23/68	Contamination	-77241	39350
2-W18-070	Z-12 Crib			-77235	39395
2-W18-071	Z-12 Crib	8/20/87	Contamination	-77208	39347
2-W18-072	Z-12 Crib	8/20/87	Contamination	-77208	39298
2-W18-073	Z-12 Crib	8/20/87	Natural	-77205	39201
2-W18-074	Z-12 Crib	8/20/87	Natural	-77196	39111
2-W18-075	Z-12 Crib	7/08/86	Contamination	-77211	39371
2-W18-151	Z-12 Crib	7/15/86	Natural	-77194	39438
2-W18-152	Z-12 Crib	7/08/86	Contamination	-77247	39368
2-W18-153	Z-12 Crib	7/15/86	Contamination	-77154	39365
2-W18-154	Z-12 Crib	7/15/86	Contamination	-77184	39438
2-W18-155	Z-12 Crib	7/15/86	Natural	-77185	39458
2-W18-156	Z-12 Crib			-77216	39475
2-W18-157	Z-12 Crib	7/15/86	Natural	-77223	39070
2-W18-162	Z-12 Crib			-77202	39392
2-W18-179	Z-12 Crib			-77202	39432
2-W18-180	Z-12 Crib			-77225	39367
2-W18-181	Z-12 Crib			-77202	39367
2-W18-182	Z-12 Crib			-77202	39285
2-W18-183	Z-12 Crib			-77204	39190
2-W18-184	Z-12 Crib			-77213	39366
2-W18-185	Z-12 Crib			-77191	39367
2-W18-243	Z-12 Crib			-77212	39255
2-W15-010	Z-16 Crib	5/07/76	Natural	-76920	41080
2-W15-011	Z-16 Crib	5/07/76	Probably Natural	-77040	41145
2-W15-204	Z-17			-76373	40673
2-W18-009	Z-18 Crib	7/23/87	Contamination	-76846	38852
2-W18-010	Z-18 Crib	5/13/76	Contamination	-76803	38847
2-W18-011	Z-18 Crib	7/23/87	Natural	-76955	38735
2-W18-012	Z-18 Crib	5/13/76	Natural	-76955	38850
2-W18-082	Z-18 Crib	7/23/87	Natural	-77101	38570
2-W18-083	Z-18 Crib	7/23/87	Natural	-77240	38409
2-W18-093	Z-18 Crib	7/23/87	Possible Contamination	-76905	38744
2-W18-094	Z-18 Crib	7/23/87	Contamination	-76880	38662
2-W18-095	Z-18 Crib	7/23/87	Natural	-76970	38665
2-W18-096	Z-18 Crib	7/23/87	Contamination	-76790	38825
2-W18-097	Z-18 Crib	7/23/87	Natural	-76790	38745
2-W18-098	Z-18 Crib	7/22/87	Natural	-76880	38940

Table B2-2. Z Plant Aggregate Area Radioactivity Categorized by Facility and Well. (sheet 3 of 4)

Well	Facility	Log Date	Category	E	N
2-W18-099	Z-18 Crib	7/22/87	Natural	-76768	38949
2-W18-006	Z-1A Crib	2/12/87	Natural	-76706	39212
2-W18-007	Z-1A Crib	7/21/87	Natural	-76491	39204
2-W18-056	Z-1A Crib	5/01/73	Contamination	-76615	39301
2-W18-057	Z-1A Crib	1/31/66	Contamination	-76587	39309
2-W18-058	Z-1A Crib	9/15/67	Contamination	-76651	39161
2-W18-059	Z-1A Crib	5/01/73	Natural	-76552	39161
2-W18-066	Z-1A Crib	7/21/86	Contamination	-76601	39063
2-W18-076	Z-1A Crib	5/01/73	Natural	-76610	39318
2-W18-078	Z-1A Crib	5/01/73	Natural	-76600	39308
2-W18-081	Z-1A Crib	5/01/73	Contamination	-76605	39283
2-W18-085	Z-1A Crib	7/22/87	Natural	-76717	38989
2-W18-086	Z-1A Crib	7/22/87	Natural	-76742	
2-W18-087	Z-1A Crib	7/23/87	Natural	-76604	38980
2-W18-089	Z-1A Crib	7/22/87	Natural	-76752	39360
2-W18-150	Z-1A Crib	7/21/86	Contamination	-76601	39075
2-W18-158	Z-1A Crib	7/21/86	Possible Contamination	-76650	39266
2-W18-159	Z-1A Crib	7/21/86	Contamination	-76602	39228
2-W18-163	Z-1A Crib	7/21/86	Contamination	-76552	39284
2-W18-164	Z-1A Crib		Possible Contamination	-76602	39040
2-W18-165	Z-1A Crib	7/21/86	Contamination	-76650	39180
2-W18-166	Z-1A Crib	7/21/86	Possible Contamination	-76650	39108
2-W18-167	Z-1A Crib	7/22/86	Contamination	-76552	39214
2-W18-168	Z-1A Crib	7/22/86	Contamination	-76552	39043
2-W18-169	Z-1A Crib	7/21/86	Natural	-76552	39073
2-W18-170	Z-1A Crib	7/21/86	Contamination	-76602	39154
2-W18-171	Z-1A Crib	7/23/86	Natural	-76604	39010
2-W18-172	Z-1A Crib	7/22/86	Natural	-76595	39435
2-W18-173	Z-1A Crib	7/21/86	Possible Contamination	-76574	39307
2-W18-174	Z-1A Crib	7/21/86	Contamination	-76565	39296
2-W18-175	Z-1A Crib	7/21/86	Contamination	-76600	39117
2-W18-067	Z-1A Tile			-76534	39399
2-W18-077	Z-1A Tile			-76608	39273
2-W18-079	Z-1A Tile			-76594	39274
2-W18-080	Z-1A Tile			-76596	39246
2-W18-149	Z-1A Tile			-76602	39329
2-W18-061	Z-2 Crib	7/22/86	Possible Contamination	-76589	39424
2-W18-062	Z-2 Crib	7/22/86	Natural	-76614	39398
2-W18-063	Z-2 Crib	7/22/86	Contamination	-76589	39398
2-W18-068	Z-3 Crib			-76506	39371
2-W18-088	Z-3 Crib	9/23/86	Natural	-76432	39298
2-W15-055	Z-4			-76591	40904
2-W15-057	Z-4			-76591	40936
2-W15-061	Z-4			-76548	40811
2-W15-001	Z-5 : Z-4	5/03/63	Probably Natural	-76576	40962

Table B2-2. Z Plant Aggregate Area Radioactivity Categorized by Facility and Well. (sheet 4 of 4)

Well	Facility	Log Date	Category	E	N
2-W15-052	Z-5 Crib			-76648	40920
2-W15-054	Z-5 Crib			-76628	40920
2-W15-056	Z-5 Crib			-76618	40920
2-W15-058	Z-5 Crib			-76678	40920
2-W15-062	Z-5 Crib	7/03/86	Contamination	-76150	40975
2-W15-063	Z-5 Crib	7/08/86	Contamination	-76100	40975
2-W15-064	Z-5 Crib	7/03/86	Natural	-75965	40900
2-W15-051	Z-6			-76535	40804
2-W15-060	Z-6			-76535	40788
2-W15-007	Z-7 Crib	5/12/76	Contamination	-76180	40880
2-W15-076	Z-7 Crib	7/08/86	Contamination	-76229	40878
2-W15-077	Z-7 Crib	7/08/86	Contamination	-76170	40824
2-W15-078	Z-7 Crib	7/08/86	Contamination	-76100	40824
2-W15-198	Z-8			-76333	39995
2-W15-199	Z-8			-76315	39991
2-W15-200	Z-8			-76300	39991
2-W15-201	Z-8			-76282	39995
2-W15-202	Z-8			-76250	39995
2-W15-203	Z-8			-76100	39873
2-W15-205	Z-8			-76388	40180
2-W15-213	Z-8			-76250	39999
2-W15-214	Z-8			-76252	40000
2-W15-215	Z-8			-76254	39996
2-W15-005O	Z-9 Crib			-75984	39537
2-W15-005P	Z-9 Crib			-75984	39537
2-W15-005Q	Z-9 Crib			-75984	39537
2-W15-005R	Z-9 Crib			-75984	39537
2-W15-005S	Z-9 Crib			-75984	39537
2-W15-006	Z-9 Crib	3/23/87	Possible Contamination	-75765	40005
2-W15-008	Z-9 Crib	3/23/87	Contamination	-75910	39740
2-W15-009	Z-9 Crib	3/23/87	Probably Natural	-75890	39930
2-W15-082	Z-9 Crib	2/26/87	Natural	-75810	39860
2-W15-084	Z-9 Crib	3/05/87	Probably Natural	-76000	39860
2-W15-085	Z-9 Crib	2/26/87	Probably Natural	-75910	39970
2-W15-086	Z-9 Crib	3/23/87	Contamination	-75958	39790
2-W15-094	Z-9 Crib	5/03/63	Natural	-75890	39930
2-W15-095	Z-9 Crib	2/26/87	Natural	-75925	39930
2-W15-101	Z-9 Crib	4/30/73	Natural	-75860	39890
2-W15-206	Z-9 Ditch			-76104	39873
2-W15-208	Z-9 Ditch			-75650	39600
2-W18-017	Z-9 Ditch			-76091	39256
2-W18-205	Z-9 Ditch			-76051	39348
2-W18-206	Z-9 Ditch			-76096	39256

Table B2-3. Z Plant Contamination Intervals and Average Gamma Activity. (sheet 1 of 2)

Well	Site	Category	Top1	Base	Value1	Top2	Base	Value2	Top3	Base	Value3	Top4	Base	Value4	Top5	Base	Value5	Top6	Base	Value6
2-W15-212	T-25 Crib	Contamination	2	26	105	26	30	20000	30	72	5000	72	97	100						
2-W15-018	W-4C LLBG	Possible Contamination	3	63	45	63	181	65	181	189	115	190	242	70						
2-W18-064	Z-1 Crib	Contamination	0	18	110	19	34	3500	34	36	380	36	64	150						
2-W18-065	Z-1 Crib	Contamination	3	22	125	22	50	3300	50	61	450	61	139	145						
2-W18-005	Z-12 Crib	Contamination	0	23	240	23	30	1800	30	274	250									
2-W18-008	Z-12 Crib	Contamination	4	24	75	24	30	135	30	76	75									
2-W18-069	Z-12 Crib	Contamination	0	21	80	21	29	220	29	47	70									
2-W18-071	Z-12 Crib	Contamination	4	17	65	17	20	8000												
2-W18-072	Z-12 Crib	Contamination	2	17	60	17	20	1500												
2-W18-075	Z-12 Crib	Contamination	4	16	95	16	24	5700	24	39	125									
2-W18-152	Z-12 Crib	Contamination	1	22	110	22	26	200	26	113	130									
2-W18-153	Z-12 Crib	Contamination	2	22	100	22	25	220	25	104	125									
2-W18-154	Z-12 Crib	Contamination	3	14	90	14	18	1600												
2-W18-009	Z-18 Crib	Contamination	2	21	70	21	27	380	27	67	130	67	212	80						
2-W18-010	Z-18 Crib	Contamination	2	36	80	27	47	160	48	52	400	52	214	90						
2-W18-093	Z-18 Crib	Possible Contamination	2	25	75	25	37	160	37	56	145	56	123	95	123	141	115			
2-W18-094	Z-18 Crib	Contamination	3	32	70	32	36	170	36	83	75									
2-W18-096	Z-18 Crib	Contamination	2	32	65	32	36	700	36	77	80									
2-W18-056	Z-1A Crib	Contamination	0	41	160	41	49	1800	49	69	800	69	94	300	94	149	240			
2-W18-057	Z-1A Crib	Contamination	0	20	110	20	44	18000	44	54	2000	54	123	120						
2-W18-058	Z-1A Crib	Contamination	0	43	120	44	58	20000	58	70	340	70	99	1400						
2-W18-066	Z-1A Crib	Contamination	5	17	100	17	52	1000	52	82	350	82	149	155						
2-W18-081	Z-1A Crib	Contamination	0	15	200	15	32	600	32	38	340									
2-W18-150	Z-1A Crib	Contamination	3	8	85	8	15	2300	15	31	1000	31	53	150	53	78	310	78	117	150
2-W18-158	Z-1A Crib	Possible Contamination	1	48	80	48	58	140	58	107	100									
2-W18-159	Z-1A Crib	Contamination	4	12	21000	12	58	1500	58	119	110									
2-W18-163	Z-1A Crib	Contamination	2	41	95	41	45	240	45	127	145									
2-W18-164	Z-1A Crib	Possible Contamination	1	79	95	79	98	190	98	109	90									
2-W18-165	Z-1A Crib	Contamination	1	89	90	89	93	180	93	111	90									
2-W18-166	Z-1A Crib	Possible Contamination	1	88	80	88	91	145	91	112	80									
2-W18-167	Z-1A Crib	Contamination	1	52	100	52	56	280	56	124	145									
2-W18-168	Z-1A Crib	Contamination	1	45	105	45	61	240	61	223	150									
2-W18-170	Z-1A Crib	Contamination	1	22	6000															
2-W18-173	Z-1A Crib	Possible Contamination	2	10	120	10	16	190	16	26	110	26	36	180						
2-W18-174	Z-1A Crib	Contamination	2	13	125	13	18	165	18	32	120	32	42	300						
2-W18-175	Z-1A Crib	Contamination	3	22	9000	22	96	500	96	120	160									
2-W18-061	Z-2 Crib	Possible Contamination	2	22	105	22	69	250	69	110	105	110	130	150	130	147	100			
2-W18-063	Z-2 Crib	Contamination	4	23	110	24	54	430	54	111	110	111	134	165						

Table B2-3. Z Plant Contamination Intervals and Average Gamma Activity. (sheet 2 of 2)

Well	Site	Category	Top1	Base	Value1	Top2	Base	Value2	Top3	Base	Value3	Top4	Base	Value4	Top5	Base	Value5	Top6	Base	Value6
2-W15-062	Z-5 Crib	Contamination	1	96	95	96	108	700	108	139	190	139	151	700	151	190	105			
2-W15-063	Z-5 Crib	Contamination	3	39	100	39	90	145	90	143	1700	143	147	125						
2-W15-007	Z-7 Crib	Contamination	4	23	105	23	32	400	32	45	800	45	64	4000	64	82	1000	82	130	4500
2-W15-076	Z-7 Crib	Contamination	2	10	120	10	42	95	42	64	220	64	73	700	73	98	150	98	101	650
2-W15-077	Z-7 Crib	Contamination	2	8	120	8	41	100	41	66	145	66	68	265						
2-W15-078	Z-7 Crib	Contamination	2	39	95	40	61	950	61	69	360									
2-W15-006	Z-9 Crib	Possible Contamination	0	47	60	47	110	70	110	151	50	151	160	110	160	172	70	172	185	105
2-W15-008	Z-9 Crib	Contamination	3	48	55	48	56	450	56	70	180	70	104	120	104	120	290	120	136	65
2-W15-086	Z-9 Crib	Contamination	1	48	65	48	61	145	61	104	85	104	112	260	112	136	95			

Table B2-4. Selected RLS Survey Wells for Z Plant.

	Well	Disposal Site	Drill Date	Drill Depth
1	299-W15-212	T-25 Crib	10/31/82	97
2	299-W18-065	Z-1 Ditch	4/30/49	140
3	299-W18-005	Z-12 Crib	11/30/58	272
4	299-W18-010	Z-18 Crib	12/31/68	212
5	299-W18-150	Z-1A Crib	6/30/73	128
6	299-W15-063	Z-5 Crib	10/31/47	200
7	299-W15-007	Z-7 Crib	3/31/66	325
8	299-W15-008	Z-9 Crib	11/30/66	203

APPENDIX B3

S PLANT TABLES

Table B3-1. S Plant Aggregate Area Disposal Facilities and RLS Logging Recommendations.

DISPOSAL FACILITY	LOG WITH RLS	COMMENTS
216-S-1 & S-2 CRIB	YES	ACTIVITY
216-S-3 FRENCH DRAIN	NO	LOW ACTIVITY
216-S-5 CRIB	YES	ACTIVITY
216-S-6 CRIB	YES	ACTIVITY
216-S-7 CRIB	YES	ACTIVITY
216-S-8 TRENCH	NO	LOW ACTIVITY
216-S-9 CRIB	YES	ACTIVITY
216-S-10D DITCH	NO	LOW ACTIVITY
216-S-10P POND	NO	LOW ACTIVITY
216-S-11 POND	NO	NO MONITORING WELLS
216-S-12 TRENCH	NO	NO LOGGING DATA
216-S-13 CRIB	YES	ACTIVITY
216-S-14 TRENCH	NO	NO MONITORING WELLS
216-S-15 POND	NO	NO MONITORINT WELLS
216-S-16D DITCH	NO	LOW ACTIVITY
216-S-16P POND	NO	NO MONITORING WELLS
216-S-17 POND	NO	NO PREVIOUS LOGGING DATA
216-S-19 POND	NO	NO PREVIOUS LOGGING DATA
216-S-23 CRIB	NO	LOW ACTIVITY
216-S-20 CRIB	YES	ACTIVITY
216-S-22 CRIB	NO	LOW ACTIVITY
216-S-25 CRIB	NO	LOW ACTIVITY
216-S-26 CRIB	NO	NO LOGGING DATA
241-S TANK FARM	YES	ACTIVITY
241-SX TANK FARM	YES	ACTIVITY

Table B3-2. S Plant Aggregate Area Radioactivity Categorized by Facility and Well. (sheet 1 of 6)

Well	Tankfarm	Facility	Log Date	Category	E	N
2-W22-52		202-S Bldg.			-73950	34480
2-W22-57		S Bldg.			-73750	34475
2-W23-001	40-00-04	S Tank Farm	6/07/90	Transfer Line	-75615	35970
2-W23-012	40-10-01	S Tank Farm	10/22/91	Natural	-75625	35969
2-W23-051	40-00-02	S Tank Farm	10/11/91	Natural	-75615	36175
2-W23-052	40-02-04	S Tank Farm	10/22/91	Transfer Line	-75722	36186
2-W23-053	40-03-05	S Tank Farm	10/22/91	Natural	-75827	36186
2-W23-054	40-05-05	S Tank Farm	10/07/91	Natural	-75722	36082
2-W23-055	40-06-05	S Tank Farm	6/07/90	Natural	-75827	36082
2-W23-056	40-00-06	S Tank Farm	10/22/91	Natural	-75722	35875
2-W23-057	40-09-05	S Tank Farm	10/23/91	Natural	-75827	35980
2-W23-122	40-04-07	S Tank Farm	10/07/91	Natural	-75694	36087
2-W23-123	40-04-01	S Tank Farm	10/07/91	Natural	-75636	36161
2-W23-124	40-04-05	S Tank Farm	10/09/91	Contamination	-75631	36090
2-W23-145	40-01-01	S Tank Farm	11/12/91	Natural	-75642	36266
2-W23-146	40-01-06	S Tank Farm	11/12/91	Natural	-75665	36180
2-W23-147	40-01-08	S Tank Farm	11/12/91	Transfer line	-75707	36207
2-W23-148	40-02-01	S Tank Farm	11/12/91	Natural	-75744	36266
2-W23-149	40-02-07	S Tank Farm	11/12/91	Natural	-75783	36183
2-W23-150	40-02-10	S Tank Farm	11/12/91	Natural	-75810	36242
2-W23-151	40-03-01	S Tank Farm	11/12/91	Natural	-75846	36266
2-W23-152	40-03-06	S Tank Farm	11/12/91	Natural	-75885	36183
2-W23-153	40-03-09	S Tank Farm	11/12/91	Natural	-75912	36242
2-W23-154	40-05-03	S Tank Farm	10/07/91	Possible Contamination	-75724	36140
2-W23-155	40-05-07	S Tank Farm	11/12/91	Natural	-75783	36081
2-W23-156	40-05-10	S Tank Farm	11/12/91	Natural	-75810	36140
2-W23-157	40-06-02	S Tank Farm	11/12/91	Natural	-75837	36156
2-W23-158	40-06-06	S Tank Farm	11/12/91	Natural	-75885	36081
2-W23-159	40-06-09	S Tank Farm	11/12/91	Natural	-75912	36140
2-W23-160	40-07-01	S Tank Farm	11/12/91	Natural	-75642	36062
2-W23-161	40-07-06	S Tank Farm	11/12/91	Natural	-75663	35972
2-W23-162	40-07-10	S Tank Farm	11/12/91	Natural	-75705	36045
2-W23-163	40-08-06	S Tank Farm	11/13/91	Natural	-75767	35979
2-W23-164	40-08-09	S Tank Farm	11/12/91	Natural	-75813	36026
2-W23-165	40-09-02	S Tank Farm	11/12/91	Natural	-75837	36054
2-W23-166	40-09-06	S Tank Farm	11/12/91	Natural	-75877	35977
2-W23-167	40-09-09	S Tank Farm	11/12/91	Natural	-75912	36038
2-W23-168	40-10-03	S Tank Farm	11/13/91	Natural	-75619	35924
2-W23-169	40-10-06	S Tank Farm	11/13/91	Natural	-75665	35874
2-W23-170	40-10-09	S Tank Farm	11/13/91	Natural	-75711	35924
2-W23-171	40-11-01	S Tank Farm	11/13/91	Natural	-75744	35960
2-W23-172	40-11-07	S Tank Farm	11/13/91	Natural	-75783	35877
2-W23-173	40-11-09	S Tank Farm	11/13/91	Natural	-75810	35936
2-W23-174	40-12-02	S Tank Farm	11/13/91	Natural	-75837	35952
2-W23-175	40-12-06	S Tank Farm	11/13/91	Natural	-75869	35874
2-W23-176	40-12-09	S Tank Farm	11/13/91	Natural	-75915	35924

Table B3-2. S Plant Aggregate Area Radioactivity Categorized by Facility and Well. (sheet 2 of 6)

Well	Tankfarm	Facility	Log Date	Category	E	N
2-W23-177	40-04-08	S Tank Farm	10/07/91	Transfer Line	-75698	36091
2-W23-178	40-08-01	S Tank Farm	11/12/91	Natural	-75747	36072
2-W23-179	40-01-04	S Tank Farm	11/12/91	Natural	-75620	36214
2-W23-180	40-01-10	S Tank Farm	11/12/91	Natural	-75695	36266
2-W23-181	40-02-05	S Tank Farm	11/12/91	Natural	-75753	36183
2-W23-182	40-02-11	S Tank Farm	11/12/91	Natural	-75786	36271
2-W23-183	40-03-08	S Tank Farm	11/12/91	Natural	-75910	36200
2-W23-184	40-03-11	S Tank Farm	11/12/91	Natural	-75885	36271
2-W23-185	40-07-04	S Tank Farm	11/12/91	Natural	-75620	36012
2-W23-186	40-07-08	S Tank Farm	11/12/91	Natural	-75709	36000
2-W23-187	40-07-11	S Tank Farm	11/12/91	Transfer Line	-75678	36068
2-W23-188	40-02-03	S Tank Farm	11/14/91	Contamination	-75726	36249
2-W23-189	40-02-08	S Tank Farm	10/22/91	Possible Contamination	-75815	36204
2-W23-199	40-05-08	S Tank Farm	11/12/91	Natural	-75819	36111
2-W23-200	40-09-01	S Tank Farm	11/12/91	Natural	-75859	36072
2-W23-201	40-06-08	S Tank Farm	11/12/91	Natural	-75910	36102
2-W23-202	40-08-08	S Tank Farm	11/12/91	Natural	-75799	35990
2-W23-203	40-09-08	S Tank Farm	11/12/91	Natural	-75907	35995
2-W23-204	40-10-05	S Tank Farm	11/13/91	Natural	-75632	35880
2-W23-205	40-10-08	S Tank Farm	11/13/91	Natural	-75687	35882
2-W23-206	40-11-05	S Tank Farm	11/13/91	Natural	-75747	35875
2-W23-207	40-11-08	S Tank Farm	11/13/91	Natural	-75815	35900
2-W23-208	40-12-07	S Tank Farm	11/13/91	Natural	-75901	35885
2-W23-212	40-03-03	S Tank Farm	11/12/91	Natural	-75823	36228
2-W23-213	40-06-04	S Tank Farm	11/12/91	Natural	-75829	36101
2-W23-216	40-08-12	S Tank Farm	11/12/91	Natural	-75767	36070
2-W23-218	40-10-13	S Tank Farm	11/13/91	Natural	-75642	35959
2-W23-220	40-12-04	S Tank Farm	11/13/91	Natural	-75829	35897
2-W22-01		S-1 : S-2	7/09/79	Contamination	-75208	35455
2-W22-02		S-1 : S-2	7/09/79	Contamination	-75221	35429
2-W22-03		S-1 : S-2			-75158	35412
2-W22-11		S-1 : S-2	2/25/86	Contamination	-75277	35450
2-W22-64		S-1 : S-2			-75100	35429
2-W22-05		S-1 Crib	2/25/86	Natural	-75034	35411
2-W22-06		S-1 Crib	2/25/86	Contamination	-73380	35412
2-W22-10		S-1 Crib	3/23/87	Natural	-75115	35314
2-W22-15		S-1 Crib	8/20/87	Contamination	-75182	35507
2-W22-16		S-1 Crib	8/20/87	Natural	-75209	35335
2-W22-17		S-1 Crib	8/20/87	Natural	-75082	35534
2-W22-18		S-1 Crib	2/25/86	Contamination	-75094	35429
2-W22-29		S-1 Crib	2/04/86	Contamination	-75195	35428
2-W22-30		S-1 Crib	6/03/80	Contamination	-75165	35411
2-W22-31		S-1 Crib	2/14/86	Contamination	-75198	35446
2-W22-36		S-1 Crib	2/04/86	Contamination	-75221	35455
2-W22-67		S-1 Crib	8/20/87	Contamination	-75200	35400

Table B3-2. S Plant Aggregate Area Radioactivity Categorized by Facility and Well. (sheet 3 of 6)

Well	Tankfarm	Facility	Log Date	Category	E	N
2-W26-11		S-10 Ditch	4/13/90	Natural	-75493	33527
2-W26-09		S-10 Pond	4/13/90	Natural	-76801	32049
6-32-77		S-10 Pond			-77032	31812
2-W22-07		S-12 : U-12			-73630	35337
2-W22-51		S-12 Crib			-74150	34480
2-W22-56		S-12 Crib			-74330	34330
2-W22-21		S-13 Crib	2/23/76	Contamination	-74600	34600
2-W22-54		S-15			-75625	35600
2-W22-04		S-2 : W-9			-74853	35408
2-W22-20		S-20 Crib	5/13/76	Natural	-73182	34175
2-W22-61		S-20 Crib			-73300	34296
2-W22-63		S-20 Crib			-73260	34296
2-W22-74		S-20 Crib	2/12/87	Contamination	-73330	34330
2-W27-01		S-20 Crib			-73242	33752
2-W22-08		S-22 : U-12			-72710	35409
2-W22-09		S-22 : U-12			-72710	35200
2-W22-19		S-22 Crib	3/14/84	Natural	-73099	34508
2-W19-05		S-23 Crib	5/13/76	Natural	-74685	36850
2-W19-06		S-23 Crib	5/13/76	Probably Natural	-74710	36850
2-W22-37		S-23 Crib	5/13/76	Natural	-74845	36800
2-W22-38		S-23 Crib	5/13/76	Natural	-74670	36700
2-W23-009		S-25 Crib	2/23/76	Surface	-76300	35480
2-W23-010		S-25 Crib	5/18/76	Natural	-76535	35420
2-W23-011		S-25 Crib	5/18/76	Natural	-76725	35560
2-W22-55		S-401 Bldg.			-75625	35075
2-W26-08		S-5 : S-6	5/29/90	Natural	-76293	33474
2-W18-216		S-5 Crib			-76440	33235
2-W26-01		S-5 Crib	5/18/76	Contamination	-77493	33211
2-W26-03		S-5 Crib	5/18/76	Natural	-77269	33006
2-W26-04		S-5 Crib	5/18/76	Natural	-77201	32945
2-W26-05		S-5 Crib	5/18/76	Natural	-77223	32964
2-W26-06		S-5 Crib			-76895	32635
2-W26-02		S-6 Crib	5/18/76	Natural	-77500	33300
2-W26-51		S-6 Crib	8/20/87	Contamination	-77710	33240

Table B3-2. S Plant Aggregate Area Radioactivity Categorized by Facility and Well. (sheet 4 of 6)

Well	Tankfarm	Facility	Log Date	Category	E	N
2-W22-12		S-7 Crib	2/23/76	Contamination	-74499	35180
2-W22-13		S-7 Crib	8/20/87	Contamination	-74671	35140
2-W22-14		S-7 Crib	2/12/87	Contamination	-74513	35120
2-W22-32		S-7 Crib	5/03/79	Contamination	-74540	35151
2-W22-33		S-7 Crib	8/20/87	Contamination	-74600	35135
2-W22-25		S-9 Crib	8/19/87	Contamination	-74504	35901
2-W22-26		S-9 Crib	5/14/76	Contamination	-74450	36100
2-W22-27		S-9 Crib			-74627	36203
2-W22-27O		S-9 Crib			-74627	36203
2-W22-27P		S-9 Crib			-74627	36203
2-W22-27Q		S-9 Crib			-74627	36203
2-W22-27R		S-9 Crib			-74627	36203
2-W22-27S		S-9 Crib			-74627	36203
2-W22-34		S-9 Crib	8/19/87	Contamination	-74465	36105
2-W22-35		S-9 Crib	8/19/87	Natural	-74610	36200
2-W22-58		SL Bldg.			-73500	34450
2-W22-39		SX Tank Farm	2/14/91	Natural	-75442	35276
2-W23-002	41-00-03	SX Tank Farm	10/07/91	Natural	-75604	35425
2-W23-003	41-00-05	SX Tank Farm	6/19/91	Natural	-75614	35110
2-W23-005	41-00-04	SX Tank Farm	6/19/91	Natural	-75550	35200
2-W23-008		SX Tank Farm	5/18/76	Surface	-76100	35520
2-W23-014		SX Tank Farm	1/21/91	Natural	-76082	35529
2-W23-058	41-06-11	SX Tank Farm	10/21/91	Natural	-75900	35501
2-W23-059	41-02-07	SX Tank Farm	11/11/91	Natural	-75808	35520
2-W23-060	41-01-07	SX Tank Farm	10/21/91	Possible Contamination	-75665	35520
2-W23-061	41-00-02	SX Tank Farm	10/07/91	Natural	-75600	35520
2-W23-062	41-04-07	SX Tank Farm	11/11/91	Natural	-75695	35405
2-W23-064	41-11-10	SX Tank Farm	6/20/91	Contamination	-75810	35287
2-W23-065	41-00-08	SX Tank Farm	10/21/91	Contamination	-75923	35297
2-W23-066	41-10-02	SX Tank Farm	6/19/91	Natural	-75614	35271
2-W23-067	41-10-10	SX Tank Farm	6/19/91	Natural	-75710	35273
2-W23-068	41-12-04	SX Tank Farm	6/19/91	Natural	-75829	35206
2-W23-069	41-14-04	SX Tank Farm	6/19/91	Natural	-75737	35102
2-W23-070	41-15-07	SX Tank Farm	6/19/91	Contamination	-75894	35099
2-W23-072	41-13-10	SX Tank Farm	6/19/91	Natural	-75705	35177
2-W23-073	41-07-12	SX Tank Farm	11/11/91	Natural	-75668	35397
2-W23-074	41-07-02	SX Tank Farm	10/14/91	Natural	-75631	35383
2-W23-075	41-07-03	SX Tank Farm	6/19/91	Possible Contamination	-75617	35344
2-W23-076	41-07-05	SX Tank Farm	6/20/91	Contamination	-75639	35308
2-W23-077	41-07-07	SX Tank Farm	6/20/91	Contamination	-75681	35302
2-W23-078	41-07-08	SX Tank Farm	6/19/91	Contamination	-75711	35332
2-W23-079	41-07-10	SX Tank Farm	6/19/91	Natural	-75706	35374
2-W23-080	41-10-01	SX Tank Farm	6/19/91	Possible Contamination	-75645	35290
2-W23-081	41-10-03	SX Tank Farm	6/19/91	Possible Contamination	-75617	35242
2-W23-082	41-10-05	SX Tank Farm	6/19/91	Natural	-75638	35206

Table B3-2. S Plant Aggregate Area Radioactivity Categorized by Facility and Well. (sheet 5 of 6)

Well	Tankfarm	Facility	Log Date	Category	E	N
2-W23-083	41-10-06	SX Tank Farm	6/19/91	Natural	-75675	35199
2-W23-084	41-10-08	SX Tank Farm	6/19/91	Natural	-75709	35227
2-W23-085	41-10-11	SX Tank Farm	6/19/91	Natural	-75690	35287
2-W23-086	41-14-03	SX Tank Farm	6/19/91	Natural	-75720	35131
2-W23-087	41-14-06	SX Tank Farm	6/19/91	Natural	-75773	35096
2-W23-088	41-14-08	SX Tank Farm	6/19/91	Natural	-75803	35112
2-W23-089	41-14-09	SX Tank Farm	6/19/91	Contamination	-75815	35151
2-W23-090	41-14-11	SX Tank Farm	6/19/91	Natural	-75796	35182
2-W23-091	41-14-02	SX Tank Farm	6/19/91	Natural	-75730	35175
2-W23-092	41-11-05	SX Tank Farm	6/19/91	Natural	-75736	35209
2-W23-093	41-11-06	SX Tank Farm	6/19/91	Natural	-75767	35194
2-W23-094	41-11-08	SX Tank Farm	6/19/91	Natural	-75805	35217
2-W23-095	41-11-09	SX Tank Farm	6/19/91	Natural	-75814	35253
2-W23-096	41-11-02	SX Tank Farm	6/19/91	Natural	-75741	35286
2-W23-097	41-11-03	SX Tank Farm	6/19/91	Natural	-75719	35253
2-W23-098	41-08-04	SX Tank Farm	6/19/91	Contamination	-75731	35316
2-W23-099	41-08-06	SX Tank Farm	6/19/91	Natural	-75767	35300
2-W23-100	41-08-07	SX Tank Farm	6/20/91	Contamination	-75804	35318
2-W23-101	41-08-11	SX Tank Farm	6/20/91	Contamination	-75789	35391
2-W23-102	41-08-02	SX Tank Farm	6/19/91	Contamination	-75744	35390
2-W23-103	41-08-03	SX Tank Farm	6/19/91	Natural	-75719	35355
2-W23-104	41-09-03	SX Tank Farm	6/20/91	Contamination	-75812	35356
2-W23-105	41-09-04	SX Tank Farm	5/02/78	Contamination	-75833	35317
2-W23-106	41-09-06	SX Tank Farm	6/19/91	Transfer Line	-75872	35297
2-W23-107	41-09-07	SX Tank Farm	6/20/91	Contamination	-75907	35319
2-W23-108	41-09-09	SX Tank Farm	10/21/91	Contamination	-75915	35360
2-W23-109	41-09-11	SX Tank Farm	6/19/91	Natural	-75889	35392
2-W23-110	41-09-02	SX Tank Farm	6/19/91	Transfer Line	-75847	35391
2-W23-111	41-12-02	SX Tank Farm	6/20/91	Contamination	-75832	35277
2-W23-112	41-12-03	SX Tank Farm	6/21/91	Contamination	-75824	35229
2-W23-113	41-12-06	SX Tank Farm	6/19/91	Natural	-75865	35195
2-W23-114	41-12-07	SX Tank Farm	6/19/91	Natural	-75895	35206
2-W23-115	41-12-09	SX Tank Farm	6/19/91	Transfer Line	-75915	35234
2-W23-116	41-12-10	SX Tank Farm	6/19/91	Natural	-75909	35272
2-W23-117	41-15-02	SX Tank Farm	6/19/91	Natural	-75827	35168
2-W23-118	41-15-03	SX Tank Farm	6/19/91	Natural	-75824	35126
2-W23-119	41-15-05	SX Tank Farm	6/19/91	Natural	-75854	35098
2-W23-120	41-15-09	SX Tank Farm	6/21/91	Natural	-75916	35134
2-W23-121	41-15-10	SX Tank Farm	6/21/91	Natural	-75904	35177
2-W23-125	41-05-05	SX Tank Farm	11/11/91	Natural	-75750	35405
2-W23-126	41-05-07	SX Tank Farm	11/11/91	Natural	-75792	35410
2-W23-127	41-05-08	SX Tank Farm	11/11/91	Possible Contamination	-75817	35444
2-W23-128	41-05-10	SX Tank Farm	11/11/91	Possible Contamination	-75809	35475
2-W23-129	41-05-12	SX Tank Farm	11/11/91	Possible Contamination	-75760	35498
2-W23-130	41-05-02	SX Tank Farm	11/11/91	Possible Contamination	-75726	35475
2-W23-131	41-05-03	SX Tank Farm	11/11/91	Possible Contamination	-75720	35440
2-W23-132	41-01-01	SX Tank Farm	11/11/91	Possible Contamination	-75643	35590
2-W23-133	41-01-06	SX Tank Farm	11/11/91	Contamination	-75665	35508

Table B3-2. S Plant Aggregate Area Radioactivity Categorized by Facility and Well. (sheet 6 of 6)

Well	Tankfarm	Facility	Log Date	Category	E	N
2-W23-134	41-01-08	SX Tank Farm	11/11/91	Possible Contamination	-75705	35534
2-W23-135	41-02-02	SX Tank Farm	11/11/91	Contamination	-75745	35590
2-W23-136	41-02-08	SX Tank Farm	11/11/91	Possible Contamination	-75811	35548
2-W23-137	41-03-12	SX Tank Farm	11/11/91	Possible Contamination	-75869	35596
2-W23-138	41-03-06	SX Tank Farm	11/11/91	Natural	-75869	35508
2-W23-139	41-03-09	SX Tank Farm	11/11/91	Natural	-75913	35548
2-W23-140	41-04-01	SX Tank Farm	11/11/91	Natural	-75641	35488
2-W23-141	41-04-11	SX Tank Farm	11/11/91	Possible Contamination	-75689	35483
2-W23-142	41-06-02	SX Tank Farm	11/11/91	Possible Contamination	-75847	35488
2-W23-143	41-06-05	SX Tank Farm	11/11/91	Possible Contamination	-75838	35419
2-W23-144	41-06-09	SX Tank Farm	11/11/91	Natural	-75913	35446
2-W23-190	41-01-04	SX Tank Farm	11/11/91	Natural	-75628	35527
2-W23-191	41-01-10	SX Tank Farm	11/11/91	Possible Contamination	-75711	35567
2-W23-192	41-01-11	SX Tank Farm	11/11/91	Natural	-75680	35592
2-W23-193	41-02-11	SX Tank Farm	11/11/91	Possible Contamination	-75795	35590
2-W23-194	41-03-02	SX Tank Farm	11/11/91	Possible Contamination	-75832	35578
2-W23-195	41-03-05	SX Tank Farm	11/11/91	Possible Contamination	-75833	35520
2-W23-196	41-03-10	SX Tank Farm	11/11/91	Possible Contamination	-75900	35582
2-W23-197	41-04-03	SX Tank Farm	11/11/91	Contamination	-75616	35452
2-W23-198	41-04-05	SX Tank Farm	11/11/91	Natural	-75639	35412
2-W23-223	41-02-05	SX Tank Farm	11/11/91	Possible Contamination	-75747	35509
2-W23-225	41-04-08	SX Tank Farm	11/11/91	Natural	-75704	35427
2-W23-226	41-06-06	SX Tank Farm	11/11/91	Possible Contamination	-75869	35404
2-W23-227	41-06-23	SX Tank Farm	11/11/91	Natural	-75891	35489
2-W23-006		SX-151 Bldg.			-75550	35010
2-W23-007		SX-151 Bldg.			-75550	35700
2-W23-229		SX-151 Bldg.			-75620	35665
2-W22-53		SX-401 Bldg.			-75955	35350

Table B3-3. S Plant Contamination Intervals and Average Gamma Activity. (sheet 1 of 2)

Well	Site	Category	Top1	Base	Value1	Top2	Base	Value2	Top3	Base	Value3	Top4	Base	Value4	Top5	Base	Value5	Top6	Base	Value6
2-W23-124	S Tank Farm	Contamination	2	37	2	37	49	17000	49	63	60	63	132	2						
2-W23-154	S Tank Farm	Possible Contamination	2	5	65	5	34	24	34	41	40	41	48	19	48	99	28			
2-W23-188	S Tank Farm	Contamination	0	18	5	18	38	24000	38	95	3									
2-W23-189	S Tank Farm	Possible Contamination	2	7	90	7	52	28	52	56	60	56	76	19	76	99	29			
2-W22-01	S-1 : S-2	Contamination	3	24	150	24	40	99999	40	80	45000	80	184	7500	184	191	40000	191	228	450
2-W22-02	S-1 : S-2	Contamination	3	24	150	24	36	99999	36	60	42000	60	186	6000	186	200	43000	200	285	70
2-W22-11	S-1 : S-2	Contamination	2	41	90	41	46	3000	46	80	170	80	142	115	142	303	80			
2-W22-06	S-1 Crib	Contamination	1	45	85	45	48	270	48	195	105									
2-W22-15	S-1 Crib	Contamination	3	45	50	45	70	9000	70	210	65									
2-W22-18	S-1 Crib	Contamination	3	44	90	44	70	8000	70	272	100									
2-W22-29	S-1 Crib	Contamination	2	27	15000	27	44	99999	44	84	25000	84	117	1000	117	160	12000			
2-W22-30	S-1 Crib	Contamination	3	30	30000	30	72	99999	72	172	30000	72	200	10000						
2-W22-31	S-1 Crib	Contamination	3	30	6000	30	63	99999	63	138	25000	138	214	9000	224	230	4000	230	249	400
2-W22-36	S-1 Crib	Contamination	3	23	700	23	53	99999	53	96	22000	96	122	9000	122	179	3000	179	204	400
2-W22-67	S-1 Crib	Contamination	4	38	95	38	52	4500	52	107	115									
2-W22-21	S-13 Crib	Contamination	3	33	50	33	40	330	40	144	95	144	201	60	201	216	120			
2-W22-74	S-20 Crib	Contamination	6	36	140	36	40	300	40	173	85									
2-W26-01	S-5 Crib	Contamination	3	61	42000	61	55	90												
2-W26-51	S-6 Crib	Contamination	1	22	30000	22	29	1200	29	51	25000	51	81	170	81	98	90			
2-W22-12	S-7 Crib	Contamination	4	18	45	18	50	6000	50	120	2500	120	155	400	155	194	70	194	203	200
2-W22-13	S-7 Crib	Contamination	3	16	50	16	41	1100	41	78	140	78	213	70						
2-W22-14	S-7 Crib	Contamination	5	22	70	22	42	5000	42	128	70	128	132	170	132	247	60			
2-W22-32	S-7 Crib	Contamination	2	14	300	14	59	45000	59	114	500	114	192	350	192	208	70			
2-W22-33	S-7 Crib	Contamination	2	14	150	14	49	30000	49	81	800	81	140	110	140	205	60			
2-W22-25	S-9 Crib	Contamination	2	25	55	25	64	35000	64	242	70									
2-W22-26	S-9 Crib	Contamination	5	40	85	40	78	30000	78	134	250	134	152	3000	152	204	150	204	286	1100
2-W22-34	S-9 Crib	Contamination	4	24	60	24	31	25000	31	41	2000	41	68	130	68	211	80			
2-W23-060	SX Tank Farm	Possible Contamination	2	9	280	9	99	26												
2-W23-064	SX Tank Farm	Contamination	0	60	2	60	75	15000	75	78	6	78	86	80	86	124	2			
2-W23-065	SX Tank Farm	Contamination	2	64	25	64	71	170	71	77	30	77	82	360	82	123	32			
2-W23-070	SX Tank Farm	Contamination	2	55	21	55	62	300	62	123	24									
2-W23-075	SX Tank Farm	Possible Contamination	2	6	29	6	11	70	11	51	25	51	64	22	64	74	32			
2-W23-076	SX Tank Farm	Contamination	0	54	0	54	61	4000	61	73	0									
2-W23-077	SX Tank Farm	Contamination	0	56	0	56	70	9000	70	73	0									
2-W23-078	SX Tank Farm	Contamination	2	54	22	54	64	20000	64	75	25									
2-W23-080	SX Tank Farm	Possible Contamination	2	64	21	64	69	70	69	133	31									
2-W23-081	SX Tank Farm	Possible Contamination	2	9	38	9	62	23	62	74	32									
2-W23-089	SX Tank Farm	Contamination	2	62	24	62	67	75	67	74	26									
2-W23-098	SX Tank Farm	Contamination	2	20	22	20	25	100	25	75	23									

Table B3-3. S Plant Contamination Intervals and Average Gamma Activity. (sheet 2 of 2)

Well	Site	Category	Top1	Base	Value1	Top2	Base	Value2	Top3	Base	Value3	Top4	Base	Value4	Top5	Base	Value5	Top6	Base	Value6
2-W23-100	SX Tank Farm	Contamination	0	62	0	62	72	5000												
2-W23-101	SX Tank Farm	Contamination	0	50	0	50	63	6000	63	73	0									
2-W23-102	SX Tank Farm	Contamination	2	51	4	51	61	11000	61	73	5									
2-W23-104	SX Tank Farm	Contamination	0	61	0	61	72	5000												
2-W23-105	SX Tank Farm	Contamination	0	18	0	18	20	2	20	57	0	57	72	100	72	89	20000	89	105	25
2-W23-107	SX Tank Farm	Contamination	0	58	2	58	73	20000												
2-W23-108	SX Tank Farm	Contamination	2	63	21	63	80	55000	80	127	29									
2-W23-111	SX Tank Farm	Contamination	1	69	0	69	94	1000	94	100	3	100	107	30	107	120	1	120	123	35
2-W23-112	SX Tank Farm	Contamination	2	60	4	60	73	20000	73	74	4									
2-W23-127	SX Tank Farm	Possible Contamination	2	15	60000	15	83	22	83	123	28									
2-W23-128	SX Tank Farm	Possible Contamination	2	7	70	7	76	23	76	123	28									
2-W23-129	SX Tank Farm	Possible Contamination	2	7	90	7	123	28												
2-W23-130	SX Tank Farm	Possible Contamination	2	17	65	17	124	30												
2-W23-131	SX Tank Farm	Possible Contamination	2	12	100	12	21	40	21	66	24	66	122	30						
2-W23-132	SX Tank Farm	Possible Contamination	2	14	53	14	17	120	17	60	24	60	137	32						
2-W23-133	SX Tank Farm	Contamination	2	18	5500	18	31	32	31	37	50	37	95	28						
2-W23-134	SX Tank Farm	Possible Contamination	2	7	70	7	66	24	66	97	33									
2-W23-135	SX Tank Farm	Contamination	2	22	350	22	45	30	45	55	130	55	137	30						
2-W23-136	SX Tank Farm	Possible Contamination	2	21	65	21	46	22	46	52	50	52	73	22	73	97	28			
2-W23-137	SX Tank Farm	Possible Contamination	2	11	120	11	74	23	74	137	31									
2-W23-141	SX Tank Farm	Possible Contamination	2	8	400	8	67	23	67	100	32									
2-W23-142	SX Tank Farm	Possible Contamination	2	6	40	6	12	280	12	32	30	32	96	22						
2-W23-143	SX Tank Farm	Possible Contamination	2	5	60	5	84	20	84	138	26									
2-W23-191	SX Tank Farm	Possible Contamination	2	4	60	4	64	25	64	98	28									
2-W23-193	SX Tank Farm	Possible Contamination	2	16	140	16	31	44	31	67	23	67	97	28						
2-W23-194	SX Tank Farm	Possible Contamination	2	8	3500	8	18	54	18	60	31	60	97	24						
2-W23-195	SX Tank Farm	Possible Contamination	2	24	60	24	77	23	77	98	28									
2-W23-196	SX Tank Farm	Possible Contamination	2	14	110	14	82	21	82	96	27									
2-W23-197	SX Tank Farm	Contamination	2	18	25	18	25	550	25	58	24	58	99	31						
2-W23-223	SX Tank Farm	Possible Contamination	2	23	190	23	77	23	77	123	30									
2-W23-226	SX Tank Farm	Possible Contamination	2	11	70	11	84	20	84	122	28									

Table B3-4. Selected RLS Survey Wells for S Plant.

Well	Tank farm Well	Disposal Site	Drill Date	Drill Depth
299-W22-021		S-13 Crib	9/30/57	218
299-W22-026		S-9 Crib	12/31/63	282
299-W22-031		S-1 & 2 Crib	4/30/66	250
299-W22-032		S-7 Crib	5/31/66	210
299-W22-074		S-20 Crib	12/31/82	173
299-W23-111	41-12-02	SX Tank farm	3/31/62	123
299-W23-124	40-04-05	S Tank farm	5/31/70	135
299-W23-135	41-02-02	SX Tank farm	1/31/72	140
299-W26-001		S-5 Crib	6/30/54	54
299-W26-051		S-6 Crib	4/30/83	98

APPENDIX B4

T PLANT TABLES

Table B4-1. T Plant Aggregate Area Disposal Facilities and RLS Logging Recommendations.

DISPOSAL FACILITY	LOG WITH RLS	COMMENTS
216-T-1 DITCH	NO	NO MONITORING WELLS
216-T-2 REVERSE WELL	NO	NO MONITORING WELLS
216-T-3 CRIB	YES	ACTIVITY
216-T-4 DITCH	NO	NO MONITORING WELLS
216-T-5 TRENCH	NO	LOW ACTIVITY
216-T-6 CRIB	YES	ACTIVITY
216-T-7 CRIB & TILE FIELD	YES	ACTIVITY
216-T-8 CRIB	NO	NO MONITORING WELLS
216-T-9 TO 216-T-11 TRENCHES	NO	NO MONITORING WELLS
216-T-12 TRENCH	NO	LOW ACTIVITY
216-T-13 TRENCH	NO	NO MONITORING WELLS
216-T-14 TO 216-T-17 CRIBS	YES	ACTIVITY
216-T-18 CRIB	YES	ACTIVITY
216-T-19 CRIB & TILE FIELD	YES	ACTIVITY
216-T-20 TRENCH	NO	NO MONITORING WELLS
216-T-21 TO 216-T-24 CRIBS	YES	ACTIVITY
216-T-25 TRENCH	NO	NO MONITORING WELLS
216-T-26 TO 216-T-28 CRIBS	YES	ACTIVITY
216-T-29 CRIB	NO	NO MONITORING WELLS
216-T-31 FRENCH DRAIN	NO	INSIDE TX TANK FARM FENCE
216-T-32 CRIB	NO	LOW ACTIVITY
216-T-33 CRIB	NO	NO LOGGING DATA
216-T-34 CRIB	NO	NO LOGGING DATA
216-T-35 CRIB	YES	ACTIVITY
216-T-36 CRIB	NO	NO LOGGING DATA
216-W-LWC CRIB (LAUNDRY)	NO	LOW ACTIVITY
241-T TANK FARM	YES	ACTIVITY
241-TX TANK FARM	YES	ACTIVITY
241-TY TANK FARM	YES	ACTIVITY

Table B4-2. T Plant Aggregate Area Radioactivity Categorized by Facility and Well. (sheet 1 of 8)

Well	Tankfarm	Facility	Log Date	Category	E	N
2-W14-56					-73400	40000
2-W14-57					-73500	40000
2-W14-58					-73660	40000
2-W19-77					-71789	40105
2-W11-02		221T Bldg.			-73772	43335
2-W11-02O		221T Bldg.			-73772	43335
2-W11-02P		221T Bldg.			-73772	43335
2-W11-02Q		221T Bldg.			-73772	43335
2-W11-02R		221T Bldg.			-73772	43335
2-W11-02S		221T Bldg.			-73772	43335
2-W11-02T		221T Bldg.			-73772	43335
2-W14-08		2704W Bldg.	8/10/81	Natural	-71795	40098
2-W14-08A		2704W Bldg.			-71788	40105
2-W14-10		2704W Bldg.	8/10/81	Natural	-71905	40810
2-W14-55		2704W Bldg.			-72100	40740
2-W14-54		2719W Bldg.			-72310	40755
2-W15-080		2721 Bldg.	6/24/86	Contamination	-71570	41495
2-W07-51		3AE Burial			-76700	45525
2-W07-52		3AE Burial			-76825	45530
2-W07-53		3AE Burial			-76865	45475
2-W15-194		Abandoned			-75958	41709
2-W11-04		T Plant			-73904	43060
2-W11-05		T Plant			-73650	43075
2-W11-06		T Plant			-73525	42750
2-W11-08		T Plant			-72992	42759
2-W11-09		T Plant			-72542	43319
2-W11-10		T Plant			-71500	43150
2-W10-008	50-00-01	T Tankfarm			-75600	43799
2-W10-009		T Tankfarm			-75930	43760
2-W10-010		T Tankfarm			-75920	43783
2-W10-011		T Tankfarm			-75908	43771
2-W10-012		T Tankfarm			-75906	43755
2-W10-015		T Tankfarm			-75858	43791
2-W10-051	50-08-11	T Tankfarm	8/27/91	Contamination	-75774	43484
2-W10-052	50-00-08	T Tankfarm	10/07/91	Natural	-75908	43385
2-W10-053	50-00-12	T Tankfarm	6/20/91	Natural	-75774	43711
2-W10-054	50-00-10	T Tankfarm	6/20/91	Natural	-75907	43584
2-W10-101	50-01-02	T Tankfarm	10/07/91	Natural	-75597	43671
2-W10-102	50-01-04	T Tankfarm	10/09/91	Contamination	-75595	43632
2-W10-103	50-01-06	T Tankfarm	11/18/91	Contamination	-75637	43593
2-W10-104	50-01-09	T Tankfarm	10/07/91	Contamination	-75680	43685
2-W10-105	50-01-12	T Tankfarm	10/07/91	Natural	-75637	43692

Table B4-2. T Plant Aggregate Area Radioactivity Categorized by Facility and Well. (sheet 2 of 8)

Well	Tankfarm	Facility	Log Date	Category	E	N
2-W10-106	50-06-06	T Tankfarm	6/20/91	Contamination	-75837	43502
2-W10-107	50-06-03	T Tankfarm	10/07/91	Contamination	-75792	43535
2-W10-108	50-06-02	T Tankfarm	6/17/91	Contamination	-75805	43580
2-W10-109	50-06-08	T Tankfarm	6/21/91	Contamination	-75869	43514
2-W10-110	50-06-04	T Tankfarm	6/21/91	Contamination	-75780	43531
2-W10-111	50-06-05	T Tankfarm	6/21/91	Contamination	-75809	43511
2-W10-112	50-08-09	T Tankfarm	10/07/91	Contamination	-75787	43452
2-W10-113	50-05-06	T Tankfarm	10/07/91	Transfer Line	-75742	43502
2-W10-114	50-09-10	T Tankfarm	6/20/91	Contamination	-75870	43480
2-W10-115	50-06-11	T Tankfarm	6/20/91	Natural	-75870	43580
2-W10-116	50-02-08	T Tankfarm			-75787	43627
2-W10-117	50-03-05	T Tankfarm	6/17/91	Contamination	-75796	43604
2-W10-118	50-03-04	T Tankfarm	6/17/91	Contamination	-75796	43630
2-W10-119	50-02-09	T Tankfarm	6/17/91	Possible Contamination	-75780	43630
2-W10-120	50-09-09	T Tankfarm	6/20/91	Natural	-75882	43447
2-W10-121	50-05-11	T Tankfarm	10/07/91	Natural	-75761	43592
2-W10-122	50-02-02	T Tankfarm	6/17/91	Natural	-75702	43680
2-W10-123	50-02-05	T Tankfarm	10/07/91	Contamination	-75723	43596
2-W10-124	50-02-10	T Tankfarm	6/17/91	Natural	-75786	43668
2-W10-125	50-02-12	T Tankfarm	6/17/91	Natural	-75744	43693
2-W10-126	50-03-01	T Tankfarm	6/17/91	Natural	-75818	43693
2-W10-127	50-03-08	T Tankfarm	6/17/91	Natural	-75800	43634
2-W10-128	50-03-10	T Tankfarm	6/17/91	Natural	-75870	43678
2-W10-129	50-04-05	T Tankfarm	11/18/91	Natural	-75620	43500
2-W10-130	50-04-10	T Tankfarm	11/13/91	Possible Contamination	-75687	43567
2-W10-133	50-08-07	T Tankfarm	6/17/91	Natural	-75761	43397
2-W10-134	50-09-05	T Tankfarm	6/20/91	Natural	-75812	43397
2-W10-135	50-10-05	T Tankfarm	11/20/91	Natural	-75618	43305
2-W10-136	50-10-07	T Tankfarm	11/20/91	Natural	-75657	43305
2-W10-137	50-10-10	T Tankfarm	11/18/91	Natural	-75684	43367
2-W10-138	50-11-05	T Tankfarm	11/18/91	Natural	-75717	43305
2-W10-139	50-11-08	T Tankfarm	11/18/91	Natural	-75790	43327
2-W10-140	50-12-07	T Tankfarm	6/17/91	Natural	-75855	43305
2-W10-141	50-12-10	T Tankfarm	6/17/91	Natural	-75888	43360
2-W10-142	50-07-07	T Tankfarm	10/07/91	Possible Contamination	-75650	43397
2-W10-143	50-08-05	T Tankfarm	11/18/91	Natural	-75716	43400
2-W10-144	50-09-07	T Tankfarm	6/20/91	Natural	-75857	43397
2-W10-145	50-03-06	T Tankfarm	6/17/91	Possible Contamination	-75847	43603
2-W10-146	50-04-03	T Tankfarm	11/18/91	Tansfer Line	-75592	43552
2-W10-147	50-04-07	T Tankfarm	11/18/91	Surface	-75657	43501
2-W10-148	50-04-08	T Tankfarm	11/18/91	Natural	-75685	43527
2-W10-149	50-07-03	T Tankfarm	10/07/91	Natural	-75594	43447
2-W10-150	50-07-08	T Tankfarm	10/07/91	Natural	-75685	43427
2-W10-151	50-10-08	T Tankfarm	11/18/91	Natural	-75684	43327
2-W10-152	50-11-07	T Tankfarm	11/18/91	Natural	-75757	43305
2-W10-153	50-11-10	T Tankfarm	11/18/91	Natural	-75789	43369
2-W10-154	50-12-05	T Tankfarm	11/20/91	Natural	-75817	43305
2-W10-162	50-06-17	T Tankfarm	6/21/91	Contamination	-75820	43504
2-W10-164	50-09-01	T Tankfarm	10/07/91	Contamination	-75785	43493

Table B4-2. T Plant Aggregate Area Radioactivity Categorized by Facility and Well. (sheet 3 of 8)

Well	Tankfarm	Facility	Log Date	Category	E	N
2-W10-165	50-05-07	T Tankfarm	10/07/91	Contamination	-75762	43510
2-W10-166	50-09-02	T Tankfarm	10/07/91	Contamination	-75789	43461
2-W10-167	50-06-16	T Tankfarm	6/20/91	Contamination	-75799	43520
2-W10-168	50-00-09	T Tankfarm	6/20/91	Contamination	-75908	43519
2-W10-176		T Tankfarm			-75777	43432
2-W10-176	50-08-08	T Tankfarm	6/20/91	Natural		
2-W10-177	50-11-11	T Tankfarm	11/18/91	Natural	-75759	43387
2-W10-178	50-08-19	T Tankfarm	6/17/91	Contamination	-75759	43408
2-W11-51	50-00-03	T Tankfarm	10/07/91	Natural	-75577	43648
2-W11-53	50-00-05	T Tankfarm	11/20/91	Natural	-75577	43348
2-W15-196		T-10			-75817	41899
2-W15-197		T-10			-75831	41895
2-W11-26		T-12 : T-6	8/11/81	Natural	-74959	42986
2-W10-016		T-13 Crib			-75825	43130
2-W11-68		T-14 Crib	7/21/87	Possible Contamination	-75335	43380
2-W11-69		T-14 Crib	7/21/87	Natural	-75200	43705
2-W11-80		T-14 Crib	6/24/86	Natural	-75115	43998
2-W11-81		T-14 Crib	6/24/86	Contamination	-75025	43768
2-W11-23	50-00-02	T-14 Trench			-75416	43766
2-W11-12		T-152			-75340	43098
2-W11-24		T-152			-75416	43716
2-W11-11		T-18 Crib	2/23/76	Contamination	-75274	42632
2-W14-51		T-19 Crib	7/03/86	Possible Contamination	-75587	41144
2-W14-52		T-19 Crib	7/03/86	Natural	-75587	40934
2-W14-59		T-19 Crib			-75300	41046
2-W14-60		T-19 Crib			-75400	41046
2-W14-61		T-19 Crib			-75400	40946
2-W15-004		T-19 Crib	2/23/76	Contamination	-75700	41200
2-W15-065		T-19 Crib	7/03/86	Natural	-75629	41144
2-W15-066		T-19 Crib	7/03/86	Natural	-75629	40934
2-W15-081		T-21 Crib	12/02/76	Natural	-76745	41640
2-W15-209		T-21 Crib	6/24/86	Contamination	-76600	41600
2-W15-210		T-21 Crib	6/24/86	Contamination	-76590	41730
2-W15-211		T-21 Crib	6/24/86	Contamination	-76475	41820
2-W11-52		T-224 Bldg.			-73173	43172
2-W11-70		T-26 Crib	8/14/87	Contamination	-75330	42425
2-W14-03P		T-26 Crib			-75305	42265

Table B4-2. T Plant Aggregate Area Radioactivity Categorized by Facility and Well. (sheet 4 of 8)

Well	Tankfarm	Facility	Log Date	Category	E	N
2-W11-13		T-28 Crib			-74781	42529
2-W11-13O		T-28 Crib			-74781	42529
2-W11-13P		T-28 Crib			-74781	42529
2-W11-13Q		T-28 Crib			-74781	42529
2-W11-82		T-28 Crib	8/14/87	Contamination	-75325	42475
2-W14-01		T-28 Crib	7/21/87	Natural	-75262	42159
2-W14-02		T-28 Crib	2/23/76	Contamination	-75330	42255
2-W14-03		T-28 Crib	8/19/87	Contamination	-75304	42263
2-W14-04		T-28 Crib	8/14/87	Contamination	-75369	42283
2-W14-53		T-28 Crib	8/14/87	Contamination	-75330	42340
2-W14-62		T-28 Crib	8/14/87	Contamination	-75300	42365
2-W11-07		T-3 Crib	8/12/87	Contamination	-74251	43350
2-W14-05		T-31			-75440	41160
2-W14-06		T-31			-75440	41360
2-W10-056		T-32 Crib	5/07/76	Natural	-76023	43434
2-W10-057		T-32 Crib	6/07/76	Natural	-75994	43449
2-W10-058		T-32 Crib	5/07/76	Possible Contaminaiton	-75994	43418
2-W10-064		T-32 Crib	5/07/76	Possible Contamination	-75991	43410
2-W10-065		T-32 Crib	5/07/76	Natural	-75980	43392
2-W10-073		T-32 Crib	5/07/76	Contamination	-76082	43364
2-W10-075		T-32 Crib	5/07/76	Natural	-75980	43431
2-W11-14		T-33 Crib	7/21/87	Natural	-73000	44000
2-W11-15		T-34 Crib	5/07/76	Natural	-74200	44849
2-W11-16		T-34 Crib	7/21/87	Natural	-74310	44720
2-W11-17		T-35 Crib	7/21/87	Natural	-74535	44655
2-W11-18		T-35 Crib	2/23/76	Contamination	-74505	44950
2-W11-19		T-35 Crib	7/21/87	Natural	-74400	44870
2-W11-20		T-35 Crib	7/21/87	Natural	-74500	44850
2-W11-21		T-35 Crib	7/21/87	Possible Contamination	-74500	44850
2-W6-1		T-35 Crib	4/25/63	Probably Natural	-74396	46090
2-W10-002		T-36 Crib	7/21/87	Natural	-76183	43154
2-W10-004		T-36 Crib	5/07/76	Natural	-75977	43033
2-W10-001		T-5 Crib	8/13/87	Natural	-76210	43550
2-W10-076		T-5 Crib			-76120	43405
2-W10-189		T-5 Crib			-76186	43537
2-W10-190		T-5 Crib			-76186	43526
2-W10-191		T-5 Crib			-76185	43547
2-W11-01		T-6 Crib	7/21/87	Contamination	-74378	43274
2-W11-54		T-6 Crib	5/06/76	Contamination	-74466	43307
2-W11-55		T-6 Crib	5/06/76	Contamination	-74450	43333
2-W11-56		T-6 Crib	5/06/76	Contamination	-74434	43307
2-W11-57		T-6 Crib	7/22/87	Natural	-74450	43343

Table B4-2. T Plant Aggregate Area Radioactivity Categorized by Facility and Well. (sheet 5 of 8)

Well	Tankfarm	Facility	Log Date	Category	E	N
2-W11-58		T-6 Crib	5/06/76	Contamination	-74474	43301
2-W11-59		T-6 Crib	7/22/87	Contamination	-74408	43291
2-W11-60		T-6 Crib	5/06/76	Contamination	-74543	43315
2-W11-61		T-6 Crib	5/06/76	Contamination	-74483	43296
2-W11-62		T-6 Crib	5/06/76	Contamination	-74426	43301
2-W11-63		T-6 Crib	7/22/87	Contamination	-74450	43277
2-W11-64		T-6 Crib	5/06/76	Natural	-74436	43339
2-W11-65		T-6 Crib	7/22/87	Natural	-74450	43244
2-W11-66		T-6 Crib	7/22/87	Natural	-74506	43282
2-W11-67		T-6 Crib	7/21/87	Natural	-74374	43244
2-W10-003		T-7 : T-32	7/03/86	Contamination	-75980	43348
2-W10-059		T-7 Crib	12/06/76	Contamination	-76012	43298
2-W10-060		T-7 Crib	12/06/76	Contamination	-75998	43298
2-W10-061		T-7 Crib	12/06/76	Contamination	-76012	43272
2-W10-062		T-7 Crib	12/06/76	Contamination	-76020	43305
2-W10-063		T-7 Crib	12/06/76	Contamination	-75980	43265
2-W10-066		T-7 Crib	12/06/76	Contamination	-75988	43272
2-W10-067		T-7 Crib	12/06/76	Contamination	-75980	43305
2-W10-068		T-7 Crib	12/06/76	Contamination	-76020	43265
2-W10-069		T-7 Crib	8/13/87	Possible Contamination	-76110	43320
2-W10-070		T-7 Crib	8/13/87	Natural	-76272	43342
2-W10-071		T-7 Crib	8/13/87	Natural	-76317	43285
2-W10-072		T-7 Crib	8/14/87	Contamination	-76160	43270
2-W10-074		T-7 Crib	12/06/76	Contamination	-76000	43285
2-W10-077		T-7 Crib	8/13/87	Natural	-76111	43315
2-W10-078		T-7 Crib	8/14/87	Natural	-76236	43270
2-W10-079		T-7 Crib	8/13/87	Natural	-76251	43315
2-W10-080		T-7 Crib	5/07/76	Contamination	-76078	43220
2-W10-081		T-7 Crib	8/14/87	Natural	-76096	43270
2-W11-79		T-7 Crib	8/13/87	Contamination	-74225	43323
2-W15-022		TX Tankfarm	12/17/90	Natural	-76150	41504
2-W15-067	51-00-03	TX Tankfarm	6/20/91	Natural	-75690	41803
2-W15-068	51-17-03	TX Tankfarm	6/18/91	Transfer Line	-75801	42098
2-W15-069	51-00-06	TX Tankfarm	6/20/91	Natural	-75903	41590
2-W15-070	51-00-05	TX Tankfarm			-75700	41590
2-W15-071	51-03-02	TX Tankfarm			-75903	41690
2-W15-072	51-11-02	TX Tankfarm	6/18/91	Natural	-75903	41894
2-W15-073	51-00-07	TX Tankfarm	6/18/91	Natural	-76106	41590
2-W15-074	51-00-09	TX Tankfarm	6/18/91	Natural	-76126	41803
2-W15-075	51-00-10	TX Tankfarm	6/20/91	Natural	-76056	42007
2-W15-103	51-10-04	TX Tankfarm	6/20/91	Transfer Line	-75810	41844
2-W15-104	51-10-08	TX Tankfarm	6/21/91	Natural	-75886	41820
2-W15-105	51-10-12	TX Tankfarm	6/18/91	Natural	-75863	41898
2-W15-106	51-11-03	TX Tankfarm	6/18/91	Natural	-75908	41866
2-W15-107	51-11-07	TX Tankfarm	6/18/91	Natural	-75978	41813
2-W15-108	51-11-10	TX Tankfarm	6/18/91	Natural	-75989	41889

Table B4-2. T Plant Aggregate Area Radioactivity Categorized by Facility and Well. (sheet 6 of 8)

Well	Tankfarm	Facility	Log Date	Category	E	N
2-W15-109	51-12-04	TX Tankfarm	6/18/91	Natural	-76010	41842
2-W15-110	51-12-07	TX Tankfarm	6/18/91	Natural	-76080	41813
2-W15-111	51-12-11	TX Tankfarm	6/20/91	Transfer Line	-76080	41900
2-W15-112	51-13-05	TX Tankfarm	6/17/91	Natural	-75716	41922
2-W15-113	51-13-08	TX Tankfarm	6/17/91	Natural	-75781	41925
2-W15-114	51-13-12	TX Tankfarm	6/17/91	Transfer Line	-75750	42004
2-W15-115	51-14-04	TX Tankfarm	6/18/91	Contamination	-75809	41950
2-W15-116	51-14-08	TX Tankfarm	6/18/91	Contamination	-75886	41922
2-W15-117	51-14-11	TX Tankfarm	6/18/91	Contamination	-75863	41999
2-W15-118	51-15-04	TX Tankfarm	6/18/91	Transfer Line	-75912	41949
2-W15-119	51-15-07	TX Tankfarm	6/18/91	Natural	-75982	41923
2-W15-120	51-15-11	TX Tankfarm	6/18/91	Transfer Line	-75969	41996
2-W15-121	51-17-02	TX Tankfarm	6/17/91	Natural	-75818	42094
2-W15-122	51-17-10	TX Tankfarm	6/17/91	Contamination	-75894	42082
2-W15-123	51-18-03	TX Tankfarm	6/17/91	Contamination	-75908	42070
2-W15-124	51-18-07	TX Tankfarm	6/18/91	Natural	-75976	42020
2-W15-125	51-18-10	TX Tankfarm	6/17/91	Natural	-75989	42093
2-W15-126	51-03-12	TX Tankfarm	6/18/91	Contamination	-75954	41698
2-W15-127	51-03-06	TX Tankfarm	6/20/91	Natural	-75954	41602
2-W15-128	51-03-09	TX Tankfarm	6/18/91	Contamination	-76002	41654
2-W15-129	51-04-12	TX Tankfarm	6/18/91	Transfer Line	-76056	41698
2-W15-130	51-04-05	TX Tankfarm	6/18/91	Contamination	-76022	41616
2-W15-131	51-04-08	TX Tankfarm	6/18/91	Natural	-76096	41626
2-W15-132	51-07-11	TX Tankfarm	6/28/91	Natural	-75978	41794
2-W15-133	51-07-04	TX Tankfarm	6/18/91	Natural	-75917	41721
2-W15-134	51-07-09	TX Tankfarm	6/18/91	Transfer Line	-76066	41760
2-W15-135	51-08-11	TX Tankfarm	6/18/91	Natural	-76080	41794
2-W15-136	51-08-05	TX Tankfarm	6/18/91	Transfer Line	-76022	41718
2-W15-137	51-08-09	TX Tankfarm	6/18/91	Natural	-76104	41748
2-W15-138	51-09-12	TX Tankfarm	6/17/91	Transfer Line	-75750	41902
2-W15-139	51-09-03	TX Tankfarm	6/17/91	Natural	-75705	41870
2-W15-140	51-09-08	TX Tankfarm	6/17/91	Natural	-75784	41820
2-W15-141	51-02-12	TX Tankfarm	6/18/91	Natural	-75852	41696
2-W15-142	51-02-09	TX Tankfarm	6/20/91	Transfer Line	-75896	41646
2-W15-143	51-02-05	TX Tankfarm	6/20/91	Natural	-75819	41617
2-W15-144	51-05-10	TX Tankfarm	6/17/91	Natural	-75783	41785
2-W15-145	51-05-05	TX Tankfarm	6/20/91	Possible Contamination	-75717	41719
2-W15-146	51-05-08	TX Tankfarm	6/20/91	Natural	-75790	41729
2-W15-147	51-06-10	TX Tankfarm	6/18/91	Natural	-75885	41785
2-W15-148	51-06-02	TX Tankfarm	6/20/91	Natural	-75819	41785
2-W15-149	51-06-04	TX Tankfarm	6/20/91	Natural	-75814	41726
2-W15-153	51-04-02	TX Tankfarm	6/18/91	Possible Contamination	-76022	41682
2-W15-154	51-04-06	TX Tankfarm	6/18/91	Natural	-76058	41608
2-W15-155	51-01-09	TX Tankfarm	6/20/91	Probably Natural	-75800	41655
2-W15-156	51-04-10	TX Tankfarm	6/18/91	Transfer Line	-76092	41682
2-W15-158	51-06-12	TX Tankfarm	6/20/91	Natural	-75850	41804
2-W15-159	51-12-01	TX Tankfarm	6/20/91	Natural	-76030	41899
2-W15-160	51-15-09	TX Tankfarm	6/18/91	Natural	-75999	41960
2-W15-161	51-16-04	TX Tankfarm	6/17/91	Contamination	-75704	42048
2-W15-162	51-16-11	TX Tankfarm	6/17/91	Natural	-75765	42106

Table B4-2. T Plant Aggregate Area Radioactivity Categorized by Facility and Well. (sheet 7 of 8)

Well	Tankfarm	Facility	Log Date	Category	E	N
2-W15-163	51-16-07	TX Tankfarm	6/17/91	Natural	-75788	42021
2-W15-164	51-17-11	TX Tankfarm	6/17/91	Transfer Line	-75856	42106
2-W15-165	51-18-11	TX Tankfarm	6/18/91	Transfer Line	-75960	42106
2-W15-166	51-01-02	TX Tankfarm	6/20/91	Transfer Line	-75710	41680
2-W15-167	51-01-04	TX Tankfarm	6/21/91	Natural	-75708	41630
2-W15-168	51-01-06	TX Tankfarm	6/20/91	Natural	-75750	41603
2-W15-169	51-01-08	TX Tankfarm	6/20/91	Natural	-75780	41615
2-W15-170	51-02-02	TX Tankfarm	6/20/91	Natural	-75820	41688
2-W15-171	51-05-07	TX Tankfarm	6/20/91	Possible Contamination	-75763	41708
2-W15-172	51-02-07	TX Tankfarm	6/20/91	Natural	-75863	41603
2-W15-173	51-05-01	TX Tankfarm	6/17/91	Possible Contamination	-75724	41787
2-W15-174	51-05-03	TX Tankfarm	6/20/91	Possible Contamination	-75702	41757
2-W15-175	51-06-08	TX Tankfarm	6/18/91	Transfer Line	-75892	41730
2-W15-176	51-10-01	TX Tankfarm	6/20/91	Natural	-75819	41889
2-W15-177	51-11-01	TX Tankfarm	6/18/91	Natural	-75934	41898
2-W15-178	51-07-01	TX Tankfarm	6/20/91	Transfer Line	-75932	41799
2-W15-179	51-12-05	TX Tankfarm	6/18/91	Natural	-76036	41800
2-W15-180	51-12-10	TX Tankfarm	6/20/91	Natural	-76098	41868
2-W15-181	51-18-01	TX Tankfarm	6/17/91	Transfer Line	-75934	42103
2-W15-182	51-18-05	TX Tankfarm	6/18/91	Transfer Line	-75922	42024
2-W15-183	51-18-09	TX Tankfarm	6/20/91	Natural	-76001	42054
2-W15-187	51-07-03	TX Tankfarm	6/18/91	Natural	-75903	41768
2-W15-188	51-09-04	TX Tankfarm	6/20/91	Contamination	-75714	41830
2-W15-189	51-09-10	TX Tankfarm	6/17/91	Natural	-75793	41871
2-W15-190	51-07-07	TX Tankfarm	8/28/91	Contamination	-75975	41714
2-W15-191	51-03-11	TX Tankfarm	6/18/91	Contamination	-75965	41692
2-W15-192	51-03-01	TX Tankfarm	6/18/91	Contamination	-75945	41692
2-W15-193	51-07-06	TX Tankfarm			-75954	41708
2-W15-195	51-07-18	TX Tankfarm	6/18/91	Contamination	-75956	41708
2-W10-005		TY Tankfarm			-76489	42669
2-W10-006		TY Tankfarm			-76095	42670
2-W10-007		TY Tankfarm			-75615	42670
2-W10-017		TY Tankfarm			-75844	42751
2-W10-018		TY Tankfarm			-75610	42439
2-W10-055	50-00-06	TY Tankfarm			-75700	43271
2-W10-082	52-04-10	TY Tankfarm	6/17/91	Natural	-75997	42549
2-W10-083	52-04-03	TY Tankfarm	6/17/91	Transfer Line	-75912	42544
2-W10-088	52-01-01	TY Tankfarm	6/17/91	Natural	-75836	42649
2-W10-089	52-01-05	TY Tankfarm	6/17/91	Natural	-75836	42570
2-W10-090	52-01-09	TY Tankfarm	6/17/91	Natural	-75900	42600
2-W10-091	52-02-01	TY Tankfarm	6/17/91	Natural	-75920	42649
2-W10-092	52-02-05	TY Tankfarm	6/17/91	Natural	-75920	42570
2-W10-093	52-02-09	TY Tankfarm	6/17/91	Natural	-76002	42600
2-W10-094	52-03-12	TY Tankfarm	6/17/91	Natural	-75852	42550
2-W10-095	52-03-03	TY Tankfarm	6/21/91	Contamination	-75804	42498
2-W10-096	52-03-06	TY Tankfarm	6/17/91	Contamination	-75852	42452
2-W10-097	52-04-02	TY Tankfarm	6/17/91	Natural	-75920	42536
2-W10-098	52-04-06	TY Tankfarm	6/17/91	Natural	-75954	42452
2-W10-099	52-04-09	TY Tankfarm	6/17/91	Natural	-76002	42506

Table B4-2. T Plant Aggregate Area Radioactivity Categorized by Facility and Well. (sheet 8 of 8)

Well	Tankfarm	Facility	Log Date	Category	E	N
2-W10-100	52-06-02	TY Tankfarm	6/17/91	Natural	-75928	42443
2-W10-161	52-02-11	TY Tankfarm	6/17/91	Contamination	-75980	42638
2-W15-003	52-06-07	TY Tankfarm	6/17/91	Natural	-75996	42355
2-W15-012		TY Tankfarm			-76095	42350
2-W15-079	52-06-05	TY Tankfarm	6/17/91	Natural	-75912	42358
2-W15-096		TY Tankfarm			-75933	42446
2-W15-097		TY Tankfarm			-75936	42355
2-W15-098	52-04-06	TY Tankfarm			-75905	42395
2-W15-099		TY Tankfarm			-75922	42364
2-W15-100	52-06-02	TY Tankfarm			-75910	42377
2-W15-184	52-06-06	TY Tankfarm	6/17/91	Natural	-75938	42357
2-W15-185	52-06-04	TY Tankfarm	6/17/91	Natural	-75910	42385
2-W15-186	52-05-07	TY Tankfarm	6/17/91	Contamination	-75872	42357
2-W15-013		TY-153			-75615	42350
2-W11-03		W-8 Vault			-73001	43310

Table B4-3. T Plant Contamination Intervals and Average Gamma Activity. (sheet 1 of 2)

Well	Tank farm	Site	Category	Top1	Base	Value1	Top2	Base	Value2	Top3	Base	Value3	Top4	Base	Value4	Top5	Base	Value5	Top6	Base	Value6
2-W15-080		Laundry	Contamination	1	34	80	34	38	3000	38	114	70	114	162	105						
2-W10-051	50-08-11	T Tankfarm	Contamination	2	64	4	64	86	450	86	135	4									
2-W10-102	50-01-04	T Tankfarm	Contamination	0	20	0	20	30	3000	30	70	90	70	110	0	110	122	4			
2-W10-103	50-01-06	T Tankfarm	Contamination	2	6	40	6	52	16	52	86	160									
2-W10-104	50-01-09	T Tankfarm	Contamination	2	17	22	17	27	3500	27	36	17	36	48	34	48	91	18			
2-W10-106	50-06-06	T Tankfarm	Contamination	2	33	5	33	46	50000	46	64	3000	64	80	700	80	105	240	105	119	50
2-W10-107	50-06-03	T Tankfarm	Contamination	2	35	4	35	44	35	44	52	1500	52	78	110	78	119	300			
2-W10-108	50-06-02	T Tankfarm	Contamination	2	45	17	45	94	2000	94	111	75	111	121	35						
2-W10-109	50-06-08	T Tankfarm	Contamination	5	30	2	30	44	20000	40	64	400	64	110	140	110	119	19			
2-W10-110	50-06-04	T Tankfarm	Contamination	0	34	0	34	42	400	42	59	4	59	86	0	86	88	2	88	91	0
2-W10-111	50-06-05	T Tankfarm	Contamination	0	33	0	33	50	5000	50	62	13	62	90	100	90	107	7	107	118	20
2-W10-112	50-08-09	T Tankfarm	Contamination	2	64	16	64	78	250	78	86	70	86	118	19						
2-W10-114	50-09-10	T Tankfarm	Contamination	2	39	14	39	50	190	50	64	1200	64	84	120	84	111	420	111	118	30
2-W10-117	50-03-05	T Tankfarm	Contamination	2	42	17	42	52	280	52	122	20									
2-W10-118	50-03-04	T Tankfarm	Contamination	2	20	15	20	50	1000	50	121	20									
2-W10-123	50-02-05	T Tankfarm	Contamination	2	35	14	35	44	18000	44	59	21	59	67	75	67	85	19			
2-W10-162	50-06-17	T Tankfarm	Contamination	2	34	0	34	50	500	50	86	35									
2-W10-164	50-09-01	T Tankfarm	Contamination	2	5	30	5	49	3	49	58	60	58	63	7	63	77	400	77	81	1900
2-W10-165	50-05-07	T Tankfarm	Contamination	2	65	12	65	81	35	81	86	800									
2-W10-166	50-09-02	T Tankfarm	Contamination	2	11	24	11	64	14	64	85	9000									
2-W10-167	50-06-16	T Tankfarm	Contamination	2	14	19	14	20	300	20	33	20	33	43	26000	43	64	4000	64	85	90
2-W10-168	50-00-09	T Tankfarm	Contamination	2	46	12	46	59	800	59	76	25	76	82	100	82	118	28			
2-W10-178	50-08-19	T Tankfarm	Contamination	2	69	20	69	85	65												
2-W11-81		T-14 Crib	Contamination	1	10	400	10	19	30000	19	28	2200	28	44	160	44	48	500			
2-W11-11		T-18 Crib	Contamination	4	11	50	11	16	12000	16	20	3000	20	33	25000	33	80	450	80	240	40
2-W15-004		T-19 Crib	Contamination	3	32	40	32	56	23000	56	120	75	120	210	40						
2-W15-209		T-21 Crib	Contamination	2	4	1000	4	16	250	16	21	2200	21	26	250	26	46	25000			
2-W15-210		T-21 Crib	Contamination	3	22	130	22	33	30000	33	148	5000	48	71	20000	71	96	110			
2-W15-211		T-21 Crib	Contamination	2	26	125	26	37	30000	37	51	11000	57	97	110						
2-W11-70		T-26 Crib	Contamination	2	10	80	10	94	11000	94	107	220	107	143	105						
2-W11-82		T-28 Crib	Contamination	3	29	80	29	36	7000	36	40	250	40	50	7000	50	60	1000			
2-W14-02		T-28 Crib	Contamination	1	10	50	10	24	99999	24	105	24000	105	119	2000	119	205	50	205	219	400
2-W14-03		T-28 Crib	Contamination	1	6	2500	6	18	99999	18	24	12000	24	74	2000	74	84	13000	84	110	5000
2-W14-04		T-28 Crib	Contamination	2	21	80	21	28	4000	28	36	10000	36	86	1000	86	98	3400	98	116	250
2-W14-53		T-28 Crib	Contamination	5	12	200	12	16	12000	16	34	1200	34	48	11000	48	66	3500	66	143	130
2-W14-62		T-28 Crib	Contamination	3	22	65	22	26	3000	26	40	300	40	50	10000	50	62	3000			
2-W11-07		T-3 Crib	Contamination	9	21	12000	21	42	120	42	74	800	74	99	100	99	109	10000	109	305	80

Table B4-3. T Plant Contamination Intervals and Average Gamma Activity. (sheet 2 of 2)

Well	Tank farm	Site	Category	Top1	Base	Value1	Top2	Base	Value2	Top3	Base	Value3	Top4	Base	Value4	Top5	Base	Value5	Top6	Base	Value6
2-W10-073		T-32 Crib	Contamination	3	36	115	36	40	250	40	63	120									
2-W11-18		T-35 Crib	Contamination	3	19	45	19	28	15000	28	50	350	50	108	70	108	298	35			
2-W11-01		T-6 Crib	Contamination	3	20	70	20	24	220	24	270	80									
2-W11-54		T-6 Crib	Contamination	5	21	3000	21	48	40000	48	148	90									
2-W11-55		T-6 Crib	Contamination	4	23	65	23	30	6000	30	36	200	36	148	95						
2-W11-56		T-6 Crib	Contamination	5	16	60	16	50	40000	50	137	95									
2-W11-58		T-6 Crib	Contamination	4	21	80	21	41	40000	41	55	450	55	71	100						
2-W11-59		T-6 Crib	Contamination	5	19	80	19	34	9000	34	85	85									
2-W11-60		T-6 Crib	Contamination	5	26	70	26	32	450	32	149	95									
2-W11-61		T-6 Crib	Contamination	5	19	65	19	27	200	27	32	25000	32	48	5000	48	80	80			
2-W11-63		T-6 Crib	Contamination	4	36	70	36	44	370	44	153	90									
2-W10-003		T-7 : T-32	Contamination	5	40	100	40	52	7000	52	74	2500	74	79	150	79	90	700	90	134	180
2-W10-059		T-7 Crib	Contamination	5	22	70	22	84	35000	84	103	9000	103	135	95						
2-W10-060		T-7 Crib	Contamination	4	27	70	27	89	40000	89	122	10000	122	138	75						
2-W10-061		T-7 Crib	Contamination	4	14	95	14	42	37000	42	51	10000	51	88	45000	88	108	300	108	112	35000
2-W10-062		T-7 Crib	Contamination	4	24	70	24	37	40000	37	42	15000	42	82	37000	82	102	500	102	134	80
2-W10-063		T-7 Crib	Contamination	4	38	60	38	52	130	52	70	45000	70	92	700	92	139	85			
2-W10-066		T-7 Crib	Contamination	2	14	45	45	75	45000	75	94	900	94	101	230	101	103	350			
2-W10-067		T-7 Crib	Contamination	4	44	65	44	74	43000	74	94	20000	94	121	1200	121	144	130			
2-W10-068		T-7 Crib	Contamination	4	21	95	21	84	45000	84	110	600	110	133	130						
2-W10-072		T-7 Crib	Contamination	5	40	95	40	73	10000	73	82	150	82	133	12000						
2-W10-074		T-7 Crib	Contamination	5	14	100	14	40	37000	40	45	10000									
2-W10-080		T-7 Crib	Contamination	4	38	230	38	43	1500	43	58	400	58	103	30000						
2-W11-79		T-7 Crib	Contamination	2	27	11000	27	56	90	56	52	450	62	102	100	102	111	10000	111	142	160
2-W15-115	51-14-04	TX Tankfarm	Contamination	2	14	34	14	42	5	42	52	15000	52	97	6						
2-W15-116	51-14-08	TX Tankfarm	Contamination	2	12	32	12	43	22	43	48	100	48	97	26						
2-W15-117	51-14-11	TX Tankfarm	Contamination	2	14	100	14	41	24	41	48	600	48	98	24						
2-W15-122	51-17-10	TX Tankfarm	Contamination	2	18	3000	18	22	34	22	28	150	28	97	26						
2-W15-123	51-18-03	TX Tankfarm	Contamination	2	9	1400	9	13	60	13	28	600	28	77	35						
2-W15-126	51-03-12	TX Tankfarm	Contamination	2	50	21	50	69	2000	69	98	28									
2-W15-128	51-03-09	TX Tankfarm	Contamination	2	60	24	60	76	170	76	96	30									
2-W15-130	51-04-05	TX Tankfarm	Contamination	2	70	26	70	78	100	78	97	26									
2-W15-161	51-16-04	TX Tankfarm	Contamination	2	12	90	12	19	32	19	24	60	24	40	25	40	45	70	45	97	24
2-W15-188	51-09-04	TX Tankfarm	Contamination	2	24	20	24	30	2000	30	97	23									
2-W15-190	51-07-07	TX Tankfarm	Contamination	2	19	50	19	48	22	48	70	5000	70	97	26						
2-W15-191	51-03-11	TX Tankfarm	Contamination	2	49	21	49	71	3000	71	98	26									
2-W15-192	51-03-01	TX Tankfarm	Contamination	2	13	50	13	49	20	49	71	400	71	98	25						
2-W15-195	51-07-18	TX Tankfarm	Contamination	2	50	5	50	70	2500	70	96	6									
2-W10-095	52-03-03	TY Tankfarm	Contamination	2	38	3	38	55	16000	55	96	3									
2-W10-096	52-03-06	TY Tankfarm	Contamination	2	56	20	56	69	200	69	74	90	74	89	600	89	99	1100			
2-W10-161	52-02-11	TY Tankfarm	Contamination	2	41	16	41	49	140	49	89	25	89	97	36						
2-W15-186	52-05-07	TY Tankfarm	Contamination	2	50	20	50	72	120	72	96	60									

Table B4-4. Selected RLS Survey Wells for T Plant.

Well	Tank farm Well	Disposal Site	Drill Date	Drill Depth
299-W10-114	50-09-10	T Tank farm	7/31/73	93
299-W11-081		T-14:17 Cribs	10/31/82	50
299-W11-011		T-18 Crib	3/31/53	243
299-W15-004		T-19 Crib	1/31/56	212
299-W15-210		T-21:24 Cribs	10/31/82	100
299-W11-070		T-26 Crib	5/31/55	143
299-W14-004		T-28 Crib	7/31/66	198
299-W11-007		T-3 Crib	9/30/51	300
299-W11-018		T-35 Crib	3/31/67	300
299-W11-061		T-6 Crib	7/31/47	80
299-W10-061		T-7 Crib	7/31/47	150
299-W15-190	51-07-07	TX Tank farm	5/51/77	105
299-W10-096	52-03-06	TY Tank farm	12/31/71	100

APPENDIX B5

B PLANT TABLES

Table B5-1. B Plant Aggregate Area Disposal Facilities and RLS Logging Recommendations.

DISPOSAL FACILITY	LOG WITH RLS	COMMENTS
216-A-25 Gable Pond	NO	LOW ACTIVITY
216-B-1 Ditch	NO	NO LOGGING DATA
216-B-2 Ditch	NO	NO LOGGING DATA
216-B-3 Pond	NO	LOW ACTIVITY
216-B-5 Crib	YES	ACTIVITY
216-B-7A & B-7b Crib	YES	ACTIVITY
216-B-8 Crib	YES	ACTIVITY
216-B-8 Tile Field	YES	ACTIVITY
216-B-9 Crib	YES	ACTIVITY
216-B-10A & B-10B Crib	NO	LOW ACTIVITY
216-B-11 Crib	YES	ACTIVITY
216-B-12 Crib	YES	ACTIVITY
216-B-14 thru B-19 Cribs	YES	ACTIVITY
216-B-20 thru B-22 Cribs	NO	LOW ACTIVITY
216-B-23 thru B-28 Cribs	NO	LOW ACTIVITY
216-B-29 thru B-34 Cribs	NO	LOW ACTIVITY
216-B-35 thru B-41 Cribs	YES	ACTIVITY
216-B-43 thru B-50 Cribs	NO	LOGGED UNDER 200-BP-1
216-B-52 Trench	NO	NO LOGGING DATA
216-B-55 Crib	NO	LOW ACTIVITY
216-B-56 Crib	YES	ACTIVITY
216-B-57 Crib	YES	ACTIVITY
216-B-59 Crib	NO	LOW ACTIVITY
216-B-61 Crib	YES	ACTIVITY
216-B-62 Crib	YES	ACTIVITY
216-BC-Cribs	YES	ACTIVITY
216-E-1 thru E-10 Bruial Grnd	YES	ACTIVITY
216-N-8 Pond	NO	LOW ACTIVITY
241-B TANK FARM	YES	ACTIVITY
241-BX TANK FARM	YES	ACTIVITY
241-BY TANK FARM	YES	ACTIVITY

Table B5-2. B Plant Aggregate Area Radioactivity Categorized by Facility and Well. (sheet 1 of 11)

Well	Tankfarm	Facility	Log Date	Category	E	N
2-E18-1		2101M	7/12/88	Natural	-54458	38458
2-E18-2		2101M	6/23/88	Natural	-54143	38756
2-E18-3		2101M	7/22/88	Natural	-54023	38712
2-E18-4		2101M	6/15/88	Natural	-54024	38651
6-59-55		216-N-8 Pond	5/18/81	Natural	-55217	59276
2-E23-2		275E Bldg.			-53000	40000
2-E23-20		275E Bldg.			-53000	40000
2-E23-2P		275E Bldg.			-53000	40000
2-E23-2Q		275E Bldg.			-53000	40000
2-E13-13		Abandoned		Buried	-54100	34800
20-00-23	B Tank Farm		6/10/91	Natural		
2-E33-051	20-00-02	B Tank Farm	6/10/91	Natural	-52488	45374
2-E33-052	20-00-05	B Tank Farm	6/10/91	Contamination	-52552	45176
2-E33-053	20-00-01	B Tank Farm	6/10/91	Contamination	-52615	45508
2-E33-054	20-08-02	B Tank Farm	6/10/91	Natural	-52716	45375
2-E33-055	20-00-11	B Tank Farm	6/10/91	Natural	-52815	45508
2-E33-056	20-00-07	B Tank Farm	6/10/91	Natural	-52853	45177
2-E33-057	20-00-09	B Tank Farm	6/10/91	Natural	-52928	45300
2-E33-060		B Tank Farm	5/05/76	Contamination	-52777	45606
2-E33-147	20-07-11	B Tank Farm	6/10/91	Natural	-52770	45280
2-E33-148	20-07-08	B Tank Farm	6/10/91	Natural	-52795	45220
2-E33-149	20-07-05	B Tank Farm	6/10/91	Natural	-52734	45195
2-E33-179	20-02-03	B Tank Farm	6/10/91	Natural	-52508	45337
2-E33-180	20-02-05	B Tank Farm	6/10/91	Natural	-52543	45296
2-E33-181	20-02-07	B Tank Farm	6/10/91	Natural	-52575	45300
2-E33-182	20-02-09	B Tank Farm	6/10/91	Natural	-52598	45337
2-E33-183	20-02-11	B Tank Farm	6/10/91	Shallow	-52573	45378
2-E33-184	20-03-02	B Tank Farm	6/10/91	Natural	-52521	45469
2-E33-185	20-03-03	B Tank Farm	6/10/91	Natural	-52507	45430
2-E33-186	20-03-06	B Tank Farm	6/10/91	Shallow	-52557	45392
2-E33-187	20-03-09	B Tank Farm	6/10/91	Natural	-52596	45430
2-E33-188	20-03-11	B Tank Farm	6/10/91	Shallow	-52571	45478
2-E33-189	20-06-02	B Tank Farm	6/10/91	Shallow	-52621	45469
2-E33-190	20-06-03	B Tank Farm	6/10/91	Natural	-52609	45429
2-E33-191	20-06-06	B Tank Farm	6/10/91	Contamination	-52648	45393
2-E33-192	20-06-11	B Tank Farm	6/10/91	Natural	-52663	45491
2-E33-193	20-08-03	B Tank Farm	6/10/91	Shallow	-52707	45330
2-E33-194	20-08-05	B Tank Farm	6/10/91	Natural	-52737	45296
2-E33-195	20-08-07	B Tank Farm	6/10/91	Natural	-52784	45306
2-E33-196	20-08-09	B Tank Farm	6/10/91	Natural	-52798	45338
2-E33-197	20-09-02	B Tank Farm	6/10/91	Natural	-52719	45467
2-E33-198	20-09-06	B Tank Farm	6/10/91	Natural	-52748	45394

Table B5-2. B Plant Aggregate Area Radioactivity Categorized by Facility and Well. (sheet 2 of 11)

Well	Tankfarm	Facility	Log Date	Category	E	N
2-E33-199	20-12-03	B Tank Farm	6/10/91	Natural	-52800	45438
2-E33-200	20-09-11	B Tank Farm	6/10/91	Shallow	-52775	45472
2-E33-201	20-12-02	B Tank Farm	6/10/91	Natural	-52821	45469
2-E33-202	20-12-06	B Tank Farm	6/10/91	Probable Contamination	-52848	45398
2-E33-203	20-12-07	B Tank Farm	6/10/91	Natural	-52884	45401
2-E33-204	20-12-11	B Tank Farm	6/10/91	Natural	-52884	45469
2-E33-212	20-07-02	B Tank Farm	6/10/91	Contamination	-52715	45257
2-E33-213	20-10-02	B Tank Farm	8/20/91	Contamination	-52815	45257
2-E33-214	20-10-12	B Tank Farm	8/20/91	Contamination	-52855	45280
2-E33-215	20-10-09	B Tank Farm	8/20/91	Natural	-52895	45238
2-E33-216	20-10-07	B Tank Farm	8/20/91	Contamination	-52877	45200
2-E33-217	20-11-09	B Tank Farm	6/10/91	Possible Contamination	-52901	45337
2-E33-218	20-05-06	B Tank Farm	6/10/91	Contamination	-52655	45290
2-E33-219	20-04-03	B Tank Farm	6/10/91	Shallow	-52608	45237
2-E33-220	20-01-03	B Tank Farm	6/10/91	Natural	-52502	45237
2-E33-221	20-04-06	B Tank Farm	6/10/91	Shallow	-52652	45187
2-E33-261	20-01-01	B Tank Farm	6/10/91	Contamination	-52520	45270
2-E33-262	20-01-05	B Tank Farm	6/10/91	Natural	-52521	45195
2-E33-263	20-01-07	B Tank Farm	6/10/91	Natural	-52582	45195
2-E33-264	20-01-11	B Tank Farm	6/10/91	Shallow	-52582	45270
2-E33-273	20-10-24	B Tank Farm			-52855	45277
2-E33-274	20-01-06	B Tank Farm	6/10/91	Contamination	-53276	45559
2-E33-036		B-1 Ditch			-51906	45145
2-E33-037		B-1 Ditch			-51832	44965
2-E28-17		B-10 Crib	5/05/76	Natural	-53807	42169
2-E28-51		B-10 Crib			-53883	42403
2-E33-019		B-11 Crib	2/20/76	Contamination	-52629	45744
2-E33-020		B-11 Crib	2/20/76	Contamination	-52629	45664
2-E28-09		B-12 Crib	8/25/87	Natural	-55101	43044
2-E28-16		B-12 Crib	5/05/76	Contamination	-54975	42927
2-E28-63		B-12 Crib			-55000	43000
2-E28-64		B-12 Crib	5/05/76	Contamination	-55000	43000
2-E28-65		B-12 Crib	5/05/76	Contamination	-55000	43060
2-E28-66		B-12 Crib	5/05/76	Contamination	-55000	43120
2-E28-69		B-12 Crib			-55050	43000
2-E28-70		B-12 Crib			-55050	43050
2-E28-71		B-12 Crib			-55050	43100
2-E28-75		B-12 Crib			-55000	43600
2-E28-76		B-12 Crib	8/25/87	Contamination	-54965	43088
2-E28-06		B-154 Crib	7/15/87	Natural	-52855	42445
2-E28-22		B-154 Crib	8/13/81	Natural	-52006	42130

Table B5-2. B Plant Aggregate Area Radioactivity Categorized by Facility and Well. (sheet 3 of 11)

Well	Tankfarm	Facility	Log Date	Category	E	N
2-E26-08		B-2 Ditch			-47142	43317
2-E33-033		B-2 Ditch			-51868	45348
2-E34-8		B-2 Ditch			-51454	45175
2-E27-008		B-2-2 Ditch	8/14/87	Natural	-49642	44496
2-E27-011		B-2-2 Ditch			-49990	44558
2-E27-149		B-2-2 Ditch			-49706	44515
2-E27-150		B-2-2 Ditch			-49824	44631
2-E27-016		B-2-3 Ditch			-51544	44897
2-E27-151		B-2-3 Ditch			-49780	44527
2-E26-09		B-3 Ditch			-46960	44780
2-E26-10		B-3 Ditch			-46919	44420
2-E26-11		B-3 Ditch			-44979	44779
6-43-42		B-3 Pond	5/27/80	Natural	-41817	43116
6-43-42AP		B-3 Pond			-41813	43110
6-43-42BP		B-3 Pond			-41773	43118
6-43-42BQ		B-3 Pond			-41773	43118
6-43-42BR		B-3 Pond			-41773	43118
6-43-42CP		B-3 Pond			-41747	43125
6-43-42CQ		B-3 Pond			-41747	43125
6-43-42DP		B-3 Pond			-41726	43131
6-43-42DQ		B-3 Pond			-41726	43131
6-43-42DR		B-3 Pond			-41726	43131
6-43-42EP		B-3 Pond			-41705	42892
6-43-42EQ		B-3 Pond			-41705	42892
6-43-42ER		B-3 Pond			-41705	42892
6-43-42FP		B-3 Pond			-41667	42894
6-43-42FQ		B-3 Pond			-41667	42894
6-43-42GP		B-3 Pond			-41828	43362
6-43-42GQ		B-3 Pond			-41828	43362
6-43-42GR		B-3 Pond			-41828	43362
6-43-42HP		B-3 Pond			-41790	43368
6-43-42HQ		B-3 Pond			-41790	43368
6-43-42J		B-3 Pond	8/10/88	Natural	-42274	42532
6-43-42K		B-3 Pond	11/18/88	Natural	-42304	42509
6-43-43		B-3 Pond	9/01/88	Natural	-43184	42942
6-43-45		B-3 Pond	6/06/89	Natural	-44644	42977
6-44-42		B-3 Pond	9/19/88	Natural	-41965	43783
6-44-43B		B-3 Pond	5/18/89	Natural	-43363	43997
6-45-42		B-3 Pond	8/18/80	Natural	-42099	45274
6-46-46		B-3 Pond			-45600	46400
6-47-46B		B-3 Pond			-46200	46800
6-42-42A		B-3A Pond	7/02/80	Probably Natural	-42012	42004
6-42-42B		B-3A Pond	9/14/88	Natural	-42301	42473

Table B5-2. B Plant Aggregate Area Radioactivity Categorized by Facility and Well. (sheet 4 of 11)

Well	Tankfarm	Facility	Log Date	Category	E	N
6-42-40A		B-3B Pond			-40205	42420
6-42-40B		B-3B Pond			-40205	42420
6-42-40C		B-3B Pond	7/14/82	Probably Natural	-40181	42414
6-40-39		B-3C Pond	6/27/89	Natural	-39224	39878
6-41-40		B-3C Pond	6/08/89	Natural	-40285	41030
6-43-41CP		B-3C Pond			-41172	42677
6-43-41CQ		B-3C Pond			-41172	42677
6-43-41DP		B-3C Pond			-41172	42835
6-43-41E		B-3C Pond			-40723	42995
6-43-41F		B-3C Pond			-40721	42945
2-E28-07		B-5 Crib	7/15/89	Contamination	-52812	43437
2-E28-23		B-5 Crib			-52852	43477
2-E28-24		B-5 Crib	7/15/87	Contamination	-52841	43466
2-E28-25		B-5 Crib			-52869	43494
2-E28-73		B-5 Crib	8/12/87	Natural	-52890	43415
2-E28-74		B-5 Crib	8/12/87	Natural	-52890	43385
2-E29-1		B-52 Crib			-56000	42004
2-E28-11		B-55 Crib			-54420	42580
2-E28-12		B-55 Crib	3/20/84	Natural	-54885	42490
2-E28-13		B-55 Crib	9/28/82	Natural	-55145	42675
2-E28-15		B-55 Crib			-54420	42588
2-E33-014		B-56 Crib	5/05/76	Contamination	-52177	46223
2-E33-024		B-57 Crib	5/04/76	Contamination	-53790	46260
2-E28-03		B-59 Crib	1/28/87	Natural	-53093	43071
2-E28-04		B-59 Crib	1/28/87	Natural	-52148	42773
2-E28-14		B-59 Crib	2/05/87	Contamination	-52635	42885
2-E33-025		B-61 Crib	2/20/76	Contamination	-54210	46600
2-E33-026		B-61 Crib	5/04/76	Contamination	-54315	46600
2-E33-035		B-61 Crib			-54685	46351
2-E28-18		B-62 Crib	9/28/82	Contamination	-55105	43603
2-E28-19		B-62 Crib	3/20/84	Natural	-55205	43324
2-E28-20		B-62 Crib	3/20/84	Natural	-55188	43705
2-E28-21		B-62 Crib	9/29/82	Natural	-55290	43806
2-E28-84		B-62 Crib			-55031	43602
2-E28-86		B-62 Crib			-55340	43929
2-E28-87		B-62 Crib			-55269	43858
2-E28-88		B-62 Crib			-55198	43788
2-E28-89		B-62 Crib			-55128	43717
2-E28-91		B-62 Crib			-55312	43888

Table B5-2. B Plant Aggregate Area Radioactivity Categorized by Facility and Well. (sheet 5 of 11)

Well	Tankfarm	Facility	Log Date	Category	E	N
2-E33-018		B-7 Crib	5/05/76	Contamination	-52825	45624
2-E33-058		B-7 Crib	5/05/76	Contamination	-52761	45633
2-E33-059		B-7 Crib	5/05/76	Contamination	-52794	45633
2-E33-075		B-7B Crib	5/05/76	Contamination	-52798	45709
2-E33-015		B-8 Crib	5/05/76	Contamination	-52751	46066
2-E33-016		B-8 Crib	2/20/76	Contamination	-52815	45887
2-E33-017		B-8 Crib	5/05/76	Natural	-52529	45894
2-E33-066		B-8 Crib	5/05/76	Contamination	-52883	45885
2-E33-067		B-8 Crib	5/05/76	Contamination	-52857	45875
2-E33-068		B-8 Crib	5/05/76	Contamination	-52845	45897
2-E33-069		B-8 Crib	5/05/76	Contamination	-52833	45855
2-E33-070		B-8 Crib	5/05/76	Contamination	-52865	45873
2-E33-071		B-8 Crib	5/05/76	Contamination	-52847	45905
2-E33-072	20-00-12	B-8 Crib	5/05/76	Natural	-52819	45795
2-E33-011		B-8 Tile	5/05/76	Contamination	-52452	46444
2-E33-012		B-8 Tile	1/12/82	Contamination	-52850	46436
2-E33-039		B-8 Tile			-52641	46451
2-E33-073		B-8 Tile	5/05/76	Contamination	-52815	45993
2-E33-074		B-8 Tile	5/05/76	Natural	-52747	46011
2-E33-076		B-8 Tile	5/05/76	Natural	-52681	46155
2-E33-079		B-8 Tile			-52795	45943
2-E33-080		B-8 Tile			-52773	46624
2-E33-081		B-8 Tile			-52709	46078
2-E33-082		B-8 Tile			-52710	46118
2-E33-089		B-8 Tile	5/05/76	Contamination	-52835	45863
2-E28-01		B-9 Crib	5/04/76	Natural	-52355	43480
2-E28-02		B-9 Crib	1/28/87	Contamination	-53105	43913
2-E28-05		B-9 Crib	5/04/76	Contamination	-52024	43887
2-E28-10		B-9 Crib	1/05/87	Contamination	-53000	44000
2-E28-53		B-9 Crib	5/24/76	Contamination	-52593	43732
2-E28-54		B-9 Crib	5/04/76	Contamination	-52643	43732
2-E28-55		B-9 Crib	5/04/76	Contamination	-52643	43782
2-E28-56		B-9 Crib	5/04/76	Natural	-52578	43862
2-E28-57		B-9 Crib	5/04/76	Contamination	-52660	43862
2-E28-58		B-9 Crib	5/04/76	Natural	-52575	43916
2-E28-59		B-9 Crib	8/25/87	Natural	-52660	43916
2-E28-60		B-9 Crib	5/04/76	Natural	-52618	43977
2-E28-61		B-9 Crib	5/04/76	Contamination	-52593	43782
2-E28-62		B-9 Crib			-52635	43837
2-E28-67		B-9 Crib			-52635	43916
2-E28-68		B-9 Crib			-52600	43887

Table B5-2. B Plant Aggregate Area Radioactivity Categorized by Facility and Well. (sheet 6 of 11)

Well	Tankfarm	Facility	Log Date	Category	E	N
2-E33-028		B-Trench	10/15/87	Natural	-54668	45596
2-E33-029		B-Trench	9/14/87	Natural	-54665	45124
2-E33-030		B-Trench	9/15/87	Natural	-55660	45903
2-E33-290		B-Trench	7/15/87	Contamination	-53980	45520
2-E13-01		B14-19 Crib	7/13/87	Contamination	-53260	35800
2-E13-02		B14-19 Crib	7/13/87	Contamination	-53446	35564
2-E13-03		B14-19 Crib	7/10/87	Contamination	-53408	35734
2-E13-04		B14-19 Crib	7/13/87	Contamination	-53550	35809
2-E13-05		B14-19 Crib	4/18/85	Contamination	-53447	35565
2-E13-06		B14-19 Crib	7/10/87	Contamination	-53589	35641
2-E13-20		B14-19 Crib	7/10/87	Contamination	-53440	35543
2-E13-20Q		B14-19 Crib			-53440	35543
2-E13-20R		B14-19 Crib			-53440	35543
2-E13-21		B14-19 Crib	7/10/87	Contamination	-53420	35730
2-E33-008		B35-41 Crib	2/20/76	Contamination	-53851	45832
2-E33-010		B35-41 Crib	12/03/76	Contamination	-54566	45216
2-E33-021		B35-41 Crib	5/04/76	Contamination	-53855	45324
2-E33-286		B35-41 Crib	7/15/87	Contamination	-54017	45257
2-E33-287		B35-41 Crib	7/15/87	Contamination	-53980	45383
2-E33-288		B35-41 Crib	7/15/87	Contamination	-53980	45428
2-E33-289		B35-41 Crib	9/15/87	Contamination	-53980	45479
2-E33-001		B43-50 Crib	2/28/79	Contamination	-53335	46375
2-E33-002		B43-50 Crib	7/16/87	Contamination	-53384	46466
2-E33-003		B43-50 Crib	5/03/79	Contamination	-53331	46547
2-E33-004		B43-50 Crib	7/16/87	Contamination	-53384	46635
2-E33-005		B43-50 Crib	5/04/76	Contamination	-53523	46352
2-E33-006		B43-50 Crib	7/16/87	Contamination	-53524	46503
2-E33-007		B43-50 Crib	7/16/87	Contamination	-53520	46619
2-E33-013		B43-50 Crib	7/16/87	Contamination	-53093	46278
2-E33-022		B43-50 Crib	7/16/87	Contamination	-53300	46450
2-E33-023		B43-50 Crib	7/16/87	Contamination	-53350	46600
2-E33-038		B43-50 Crib			-53469	46312
2-E33-041		B43-50 Crib			-53091	45573
2-E33-090		B43-50 Crib			-53200	46500
2-E13-07		BC Cribs	7/08/87	Contamination	-54107	35631
2-E13-08		BC Cribs	7/09/87	Natural	-54323	35508
2-E13-09		BC Cribs	7/08/87	Natural	-54297	35900
2-E13-10		BC Cribs	7/09/87	Natural	-54798	35348
2-E13-11		BC Cribs	3/22/84	Natural	-54170	35199
2-E13-12		BC Cribs	7/09/87	Natural	-54820	35001

Table B5-2. B Plant Aggregate Area Radioactivity Categorized by Facility and Well. (sheet 7 of 11)

Well	Tankfarm	Facility	Log Date	Category	E	N
2-E13-14		BC Cribs	4/03/84	Natural	-55150	36080
2-E13-15		BC Cribs	7/09/87	Possible Contamination	-55470	35660
2-E13-16		BC Cribs	7/09/87	Natural	-54840	35660
2-E13-17		BC Cribs	7/09/87	Natural	-55250	35230
2-E13-18		BC Cribs	7/09/87	Possible Contamination	-55050	35230
2-E13-19		BC Cribs	7/10/87	Natural	-54530	34720
2-E13-51		BC Cribs	7/08/87	Contamination	-54200	35500
2-E13-52		BC Cribs			-55200	35700
2-E13-54		BC Cribs	7/13/87	Contamination	-54460	35445
2-E13-55		BC Cribs	7/09/87	Contamination	-54495	35320
2-E13-56		BC Cribs	7/09/87	Contamination	-54495	35120
2-E13-57		BC Cribs	7/09/87	Contamination	-54495	34920
2-E13-58		BC Cribs	7/09/87	Natural	-51550	35747
2-E13-59		BC Cribs	7/08/87	Contamination	-55150	35617
2-E13-60		BC Cribs	7/08/87	Contamination	-55150	35453
2-E13-61		BC Cribs	7/13/87	Contamination	-54720	35995
21-03-01		BX	6/06/90	Natural		
2-E33-027	21-02-04	BX Tank Farm	6/07/90	Contamination	-53220	45470
2-E33-061	21-27-11	BX Tank Farm	6/15/92	Contamination	-53145	45537
2-E33-062	21-00-05	BX Tank Farm	6/06/90	Natural	-53250	45339
2-E33-063	21-00-01	BX Tank Farm	6/06/90	Natural	-53312	45670
2-E33-064	21-08-02	BX Tank Farm	1/21/75	Natural	-53412	45537
2-E33-065	21-00-11	BX Tank Farm	5/19/92	Natural	-53512	45670
2-E33-077	21-00-07	BX Tank Farm	5/19/92	Natural	-53550	45339
2-E33-078	21-00-21	BX Tank Farm	6/12/90	Contamination	-53625	45462
2-E33-092	21-00-09	BX Tank Farm			-53623	45462
2-E33-092	21-00-09	BX Tank Farm	5/19/92	Natural	-53622	45462
2-E33-093	21-00-22	BX Tank Farm	6/12/90	Natural	-53651	45464
2-E33-129	21-02-01	BX Tank Farm	6/06/90	Shallow	-53220	45530
2-E33-130	21-02-07	BX Tank Farm	6/06/90	Natural	-53272	45463
2-E33-131	21-02-11	BX Tank Farm	6/06/90	Natural	-53272	45537
2-E33-132	21-27-10	BX Tank Farm	6/15/92	Shallow	-53183	45524
2-E33-133	21-27-09	BX Tank Farm	11/14/78	Contamination	-53160	45490
2-E33-134	21-27-07	BX Tank Farm	11/14/78	Contamination	-53160	45450
2-E33-135	21-01-02	BX Tank Farm	6/27/89	Contamination	-53185	45410
2-E33-136	21-02-04	BX Tank Farm			-53220	45490
2-E33-137	21-02-05	BX Tank Farm			-53240	45470
2-E33-138	21-27-02	BX Tank Farm	6/11/91	Natural	-53120	45510
2-E33-139	21-27-06	BX Tank Farm	1/28/75	Shallow	-53120	45470
2-E33-140	21-00-03	BX Tank Farm	1/20/75	Natural	-53140	45411
2-E33-141	21-27-01	BX Tank Farm	10/03/78	Contamination	-53120	45550
2-E33-142	21-00-02	BX Tank Farm	6/06/90	Natural	-53160	45570
2-E33-143	21-02-06	BX Tank Farm	6/07/90	Contamination	-53240	45450
2-E33-144	21-01-01	BX Tank Farm	6/06/90	Contamination	-53220	45430
2-E33-145	21-02-03	BX Tank Farm	6/28/89	Contamination	-53208	45500
2-E33-146	21-27-08	BX Tank Farm	6/06/90	Contamination	-53195	45470
2-E33-150	21-08-12	BX Tank Farm	5/19/92	Natural	-53454	45549

Table B5-2. B Plant Aggregate Area Radioactivity Categorized by Facility and Well. (sheet 8 of 11)

Well	Tankfarm	Facility	Log Date	Category	E	N
2-E33-151	21-08-06	BX Tank Farm	6/03/92	Natural	-53454	45456
2-E33-152	21-08-07	BX Tank Farm	11/15/78	Contamination	-53484	45478
2-E33-153	21-12-02	BX Tank Farm	5/19/92	Shallow	-53503	45616
2-E33-154	21-12-05	BX Tank Farm	5/19/92	Natural	-53528	45562
2-E33-155	21-12-07	BX Tank Farm	5/19/92	Natural	-53581	45569
2-E33-156	21-12-10	BX Tank Farm	5/19/92	Natural	-53581	45631
2-E33-157	21-05-12	BX Tank Farm	5/19/92	Natural	-53346	45547
2-E33-158	21-05-02	BX Tank Farm	6/06/90	Natural	-53319	45531
2-E33-159	21-05-03	BX Tank Farm	6/06/90	Natural	-53304	45500
2-E33-160	21-05-05	BX Tank Farm	6/06/90	Natural	-53319	45469
2-E33-161	21-05-06	BX Tank Farm	5/19/92	Natural	-53346	45453
2-E33-162	21-05-10	BX Tank Farm	8/16/89	Natural	-53386	45522
2-E33-163	21-06-01	BX Tank Farm	5/19/92	Natural	-53346	45644
2-E33-164	21-06-02	BX Tank Farm	5/19/92	Natural	-53319	45631
2-E33-165	21-06-05	BX Tank Farm	5/19/92	Contamination	-53319	45569
2-E33-166	21-06-10	BX Tank Farm	5/19/92	Natural	-53386	45622
2-E33-167	21-10-01	BX Tank Farm	5/19/92	Contamination	-53519	45432
2-E33-168	21-10-05	BX Tank Farm	5/20/92	Contamination	-53519	45369
2-E33-169	21-10-07	BX Tank Farm	5/18/92	Natural	-53581	45369
2-E33-170	21-10-11	BX Tank Farm	5/19/92	Natural	-53581	45431
2-E33-171	21-11-05	BX Tank Farm	5/13/92	Contamination	-53519	45469
2-E33-172	21-11-07	BX Tank Farm	5/13/92	Possible Contamination	-53572	45461
2-E33-173	21-11-04	BX Tank Farm	5/13/92	Contamination	-53512	45478
2-E33-174	21-11-10	BX Tank Farm	5/13/92	Natural	-53588	45522
2-E33-175	21-11-11	BX Tank Farm	5/13/92	Natural	-53581	45532
2-E33-222	21-07-06	BX Tank Farm	5/07/92	Contamination	-53450	45355
2-E33-223	21-10-03	BX Tank Farm	5/20/92	Contamination	-53503	45401
2-E33-224	21-04-06	BX Tank Farm	6/03/92	Contamination	-53350	45350
2-E33-225	21-07-03	BX Tank Farm	6/03/92	Natural	-53404	45398
2-E33-226	21-04-03	BX Tank Farm	2/15/91	Shallow	-53303	45398
2-E33-229	21-03-05	BX Tank Farm	6/06/90	Natural	-53230	45558
2-E33-231	21-09-12	BX Tank Farm	5/19/92	Natural	-53452	45645
2-E33-232	21-12-12	BX Tank Farm	5/19/92	Natural	-53552	45645
2-E33-233	21-09-04	BX Tank Farm	5/19/92	Xfer Line	-53413	45580
2-E33-234	21-08-04	BX Tank Farm	1/21/75	Shallow	-53404	45482
2-E33-235	21-08-05	BX Tank Farm	5/19/92	Natural	-53425	45459
2-E33-236	21-08-10	BX Tank Farm	1/21/75	Natural	-53485	45532
2-E33-237	21-11-03	BX Tank Farm	6/03/92	Contamination	-53502	45500
2-E33-238	21-03-12	BX Tank Farm	6/12/90	Contamination	-53252	45646
2-E33-239	21-03-03	BX Tank Farm	6/15/92	Natural	-53204	45600
2-E33-257	21-09-02	BX Tank Farm	5/19/92	Natural	-53417	45633
2-E33-258	21-09-08	BX Tank Farm	5/19/92	Natural	-53486	45572
2-E33-275	21-03-11	BX Tank Farm	5/19/92	Natural	-53202	45631
2-E33-277		BX Tank Farm			-53310	45370
2-E33-278	21-04-04	BX Tank Farm	5/13/92	Natural	-53320	45370
2-E33-282	21-03-07	BX Tank Farm	6/06/90	Shallow		

Table B5-2. B Plant Aggregate Area Radioactivity Categorized by Facility and Well. (sheet 9 of 11)

Well	Tankfarm	Facility	Log Date	Category	E	N
2-E33-009	22-02-07	BY Tank Farm	5/13/92	Shallow	-53285	45960
2-E33-031		BY Tank Farm			-53687	45975
2-E33-032		BY Tank Farm			-53689	45524
2-E33-083	22-00-05	BY Tank Farm		Not in use	-53298	45854
2-E33-084	22-00-03	BY Tank Farm	6/15/92	Contamination	-53198	46058
2-E33-085	22-00-01	BY Tank Farm	5/20/92	Possible Contamination	-53298	46141
2-E33-086	22-06-07	BY Tank Farm	5/13/92	Possible Contamination	-53390	46058
2-E33-087	22-08-07	BY Tank Farm	5/19/92	Shallow	-53492	45956
2-E33-088	22-00-10	BY Tank Farm	5/19/92	Natural	-53592	46051
2-E33-094	22-12-03	BY Tank Farm	5/05/92	Shallow	-53507	46104
2-E33-095	22-12-05	BY Tank Farm	5/20/92	Shallow	-53532	46061
2-E33-096	22-12-06	BY Tank Farm	5/20/92	Shallow	-53563	46058
2-E33-097	22-12-07	BY Tank Farm	5/19/92	Natural	-53588	46072
2-E33-098	22-12-09	BY Tank Farm	5/19/92	Natural	-53599	46101
2-E33-099	22-12-10	BY Tank Farm	5/20/92	Natural	-53591	46142
2-E33-100	22-12-01	BY Tank Farm	5/20/92	Natural	-53526	46138
2-E33-101	22-02-01	BY Tank Farm	5/13/92	Contamination	-53225	46038
2-E33-102	22-02-09	BY Tank Farm	5/13/92	Contamination	-53291	46005
2-E33-103	22-03-05	BY Tank Farm	5/20/92	Contamination	-53225	46064
2-E33-104	22-03-01	BY Tank Farm	5/20/92	Shallow	-53225	46140
2-E33-105	22-03-09	BY Tank Farm	5/13/92	Contamination	-53291	46102
2-E33-106	22-04-01	BY Tank Farm	5/20/92	Natural	-53327	45936
2-E33-107	22-04-05	BY Tank Farm	5/20/92	Natural	-53326	45859
2-E33-108	22-04-09	BY Tank Farm	5/20/92	Shallow	-53392	45907
2-E33-109	22-05-01	BY Tank Farm	5/20/92	Shallow	-53327	46038
2-E33-110	22-05-05	BY Tank Farm	5/20/92	Natural	-53327	45962
2-E33-111	22-05-09	BY Tank Farm	5/20/92	Natural	-53393	46000
2-E33-112	22-06-01	BY Tank Farm	5/20/92	Natural	-53327	46140
2-E33-113	22-06-05	BY Tank Farm	5/20/92	Contamination	-53327	46064
2-E33-114	22-06-09	BY Tank Farm	5/20/92	Natural	-53392	46102
2-E33-115	22-07-01	BY Tank Farm	6/15/92	Contamination	-53429	45936
2-E33-116	22-07-05	BY Tank Farm	5/19/92	Shallow	-53429	45860
2-E33-117	22-07-09	BY Tank Farm	5/20/92	Contamination	-53495	45898
2-E33-118	22-08-01	BY Tank Farm	5/19/92	Contamination	-53429	46038
2-E33-119	22-08-05	BY Tank Farm	5/19/92	Possible Contamination	-53429	45962
2-E33-120	22-08-09	BY Tank Farm	5/20/92	Shallow	-53495	46008
2-E33-121	22-09-08	BY Tank Farm	5/13/92	Contamination	-53491	46088
2-E33-122	22-09-05	BY Tank Farm	5/13/92	Natural	-53424	46069
2-E33-123	22-09-01	BY Tank Farm	5/20/92	Natural	-53446	46144
2-E33-124	22-10-05	BY Tank Farm	5/20/92	Natural	-53531	45860
2-E33-125	22-10-10	BY Tank Farm	5/19/92	Natural	-53590	45922
2-E33-126	22-11-01	BY Tank Farm	5/20/92	Contamination	-53531	46040
2-E33-127	22-11-05	BY Tank Farm	1/03/91	Shallow	-53542	45957
2-E33-128	22-11-09	BY Tank Farm	5/19/92	Shallow	-53595	46013
2-E33-176	22-01-01	BY Tank Farm	5/20/92	Shallow	-53218	45929
2-E33-177	22-01-04	BY Tank Farm	5/20/92	Contamination	-53225	45860
2-E33-178	22-01-07	BY Tank Farm	5/20/92	Shallow	-53278	45867
2-E33-206	22-07-02	BY Tank Farm	6/15/92	Possible Contamination	-53412	45920

Table B5-2. B Plant Aggregate Area Radioactivity Categorized by Facility and Well. (sheet 10 of 11)

Well	Tankfarm	Facility	Log Date	Category	E	N
2-E33-207	22-08-06	BY Tank Farm	5/19/92	Contamination	-53449	45954
2-E33-208	22-08-02	BY Tank Farm	5/19/92	Contamination	-53411	46022
2-E33-209	22-08-12	BY Tank Farm	5/20/92	Contamination	-53447	46049
2-E33-210	22-03-06	BY Tank Farm	5/05/92	Cosntamination	-53244	46056
2-E33-211	22-03-04	BY Tank Farm	5/20/92	Contamination	-53207	46081
2-E33-227	22-02-02	BY Tank Farm	5/13/92	Shallow	-53203	46015
2-E33-228	22-02-05	BY Tank Farm	5/13/92	Shallow	-53204	45605
2-E33-240	22-00-02	BY Tank Farm	6/15/92	Contamination	-53200	46072
2-E33-241	22-00-04	BY Tank Farm	6/15/92	Possible Contamination	-53202	46038
2-E33-242	22-03-10	BY Tank Farm	5/20/92	Shallow	-53265	46055
2-E33-243	22-03-08	BY Tank Farm	5/20/92	Shallow	-53289	46130
2-E33-244	22-01-03	BY Tank Farm	5/20/92	Natural	-53282	46070
2-E33-245	22-01-10	BY Tank Farm	5/20/92	Contamination	-53202	45900
2-E33-246	22-03-07	BY Tank Farm	5/05/92	Shallow	-53292	45911
2-E33-248	22-04-07	BY Tank Farm	5/20/92	Natural	-53379	45865
2-E33-249	22-04-11	BY Tank Farm	5/20/92	Possible Contamination	-53365	45940
2-E33-250	22-06-11	BY Tank Farm	5/13/92	Shallow	-53375	46140
2-E33-251	22-07-07	BY Tank Farm	6/15/92	Contamination	-53481	45860
2-E33-252	22-07-10	BY Tank Farm	5/20/92	Contamination	-53497	45932
2-E33-253	22-09-11	BY Tank Farm	5/13/92	Contamination	-53477	46137
2-E33-254	22-10-07	BY Tank Farm	5/19/92	Natural	-53577	45860
2-E33-255	22-10-09	BY Tank Farm	5/19/92	Shallow	-53604	45888
2-E33-256	22-11-08	BY Tank Farm	5/19/92	Natural	-53585	45970
2-E33-259	22-09-02	BY Tank Farm	5/05/92	Contamination	-53412	46128
2-E33-260	22-09-07	BY Tank Farm	5/05/92	Natural	-53466	46060
2-E24-07	West of	E-1 Burial			-50813	39631
2-E24-18		E-1 Burial	8/04/88	Natural	-50024	39331
2-E28-26		E-10 Burial	10/15/87	Natural	-55606	44446
2-E28-27		E-10 Burial	12/04/87	Contamination	-54670	44595
2-E28-28		E-10 Burial			-56056	44724
2-E32-1		E-10 Burial			-56684	46488
2-E32-2		E-10 Burial	8/28/87	Natural	-56565	45904
2-E32-3		E-10 Burial	8/28/87	Natural	******	45631
2-E32-4		E-10 Burial	9/14/87	Natural	-56713	44985
2-E32-5		E-10 Burial			-56725	45306
2-E19-1		E-3 Burial	10/29/81	Natural	-56023	38085
2-E28-08		E-9 Crib	2/05/87	Natural	-53124	44603
2-E33-034		GWMW			-55065	46796
2-E35-2		GWMW			-46959	45180
6-50-45		Gable Pond	5/16/80	Possible Contamination	-44992	50150
6-51-46		Gable Pond	4/18/80	Possible Contamination	-46414	50915
6-52-46A		Gable Pond	5/01/80	Natural	-45706	52196

Table B5-2. B Plant Aggregate Area Radioactivity Categorized by Facility and Well. (sheet 11 of 11)

Well	Tankfarm	Facility	Log Date	Category	E	N
6-52-48		Gable Pond	3/24/80	Natural	-48076	51556
6-53-47A		Gable Pond	2/02/84	Natural	-47463	52518
6-53-47B		Gable Pond			-47468	52505
6-53-48A		Gable Pond			-47721	52862
6-53-48B		Gable Pond			-47729	52868
6-53-50		Gable Pond	4/09/80	Contamination	-50196	53219
6-54-45A		Gable Pond	3/18/80	Possible Contamination	-44506	54203
6-54-45B		Gable Pond	7/19/82	Natural	-44510	54250
6-54-48		Gable Pond			-47656	53607
6-54-49		Gable Pond			-49100	53800
6-55-50A		Gable Pond			-49999	55006
6-55-50AO		Gable Pond			-49999	55006
6-55-50AP		Gable Pond			-49999	55006
6-55-50AQ		Gable Pond			-49999	55006
6-55-50C		Gable Pond			-49940	55000
6-55-50D		Gable Pond	3/10/80	Natural	-50150	55017
6-56-51		Gable Pond			-50500	56000
6-56-53		Gable Pond	7/19/82	Natural	-52779	56343
2-E13-20O		Plugged			-53440	35543
2-E13-20P		Plugged			-53440	35543
2-E23-1		Railroad			-52000	41131

Table B5-3. B Plant Contamination Intervals and Average Gamma Activity. (sheet 1 of 4)

Well	Site	Category	Top1	Base	Value1	Top2	Base	Value2	Top3	Base	Value3	Top4	Base	Value4	Top5	Base	Value5	Top6	Base	Value6
2-E33-052	B Tank Farm	Contamination	2	51	16	51	57	800	57	143	26									
2-E33-053	B Tank Farm	Contamination	2	5	44	5	51	20	51	56	34	34	42	1100	42	100	32			
2-E33-060	B Tank Farm	Contamination	5	28	30	28	74	35000	74	150	75									
2-E33-191	B Tank Farm	Contamination	2	16	120	16	46	25	46	59	50000	59	70	130	70	99	250			
2-E33-212	B Tank Farm	Contamination	2	34	22	34	61	6000	61	78	28	78	85	150	85	99	40			
2-E33-213	B Tank Farm	Contamination	2	68	24	64	85	1100	85	97	22									
2-E33-214	B Tank Farm	Contamination	0	25	0	25	41	1800	41	54	310	54	72	110	72	91	32	91	96	50
2-E33-216	B Tank Farm	Contamination	2	20	21	20	24	600	24	97	24									
2-E33-218	B Tank Farm	Contamination	2	43	24	43	53	100000	53	66	400	66	119	55						
2-E33-261	B Tank Farm	Contamination	2	38	26	38	44	1000	44	98	34									
2-E33-274	B Tank Farm	Contamination	2	5	50	5	23	25	23	38	200	38	51	22	51	59	60			
2-E33-019	B-11 Crib	Contamination	4	30	40	30	50	60	50	70	100	70	356	50						
2-E33-020	B-11 Crib	Contamination	2	78	45	78	84	500	84	232	50	232	244	500						
2-E28-16	B-12 Crib	Contamination	5	94	175	94	108	99999	108	316	150									
2-E28-64	B-12 Crib	Contamination	6	10	5000	10	15	700	15	32	99999									
2-E28-65	B-12 Crib	Contamination	4	8	75	8	14	250	14	20	100	20	76	45000						
2-E28-66	B-12 Crib	Contamination	5	24	90	24	36	900	36	80	40000									
2-E28-07	B-5 Crib	Contamination	2	220	55	220	306	125	306	330	15000									
2-E28-24	B-5 Crib	Contamination	3	52	40	52	94	80	94	265	75	265	300	99999	300	322	500			
2-E33-014	B-56 Crib	Contamination	4	18	60	18	206	90	206	227	1000									
2-E33-024	B-57 Crib	Contamination	5	28	75	28	64	40000	64	235	75	235	253	600						
2-E28-14	B-59 Crib	Contamination	2	335	125	335	340	350	340	352	80									
2-E33-025	B-61 Crib	Contamination	0	20	30	20	226	50	226	232	500									
2-E33-026	B-61 Crib	Contamination	5	10	100	10	228	90	228	240	500									
2-E28-18	B-62 Crib	Contamination	6	35	75	35	44	35000	44	104	22000	104	309	65						
2-E28-76	B-62 Crib	Contamination	4	32	40	32	80	99999	80	98	500									
2-E33-018	B-7 Crib	Contamination	4	30	60	30	220	75	220	242	100	242	246	200						
2-E33-058	B-7 Crib	Contamination	4	14	60	14	74	25000	74	147	75									
2-E33-059	B-7 Crib	Contamination	5	24	65	24	44	9000	44	149	75									
2-E33-075	B-7B Crib	Contamination	5	28	60	28	42	45000	42	144	100									
2-E33-015	B-8 Crib	Contamination	5	218	75	218	242	10000	242	250	600									
2-E33-016	B-8 Crib	Contamination	4	9	40	9	52	2500	52	80	100	80	120	1700	120	232	50	232	256	1000
2-E33-066	B-8 Crib	Contamination	5	19	75	19	34	40000	34	122	1200	122	140	90						
2-E33-067	B-8 Crib	Contamination	4	26	75	26	110	35000	110	149	70									
2-E33-068	B-8 Crib	Contamination	7	30	75	30	46	40000	46	110	8000	110	148	70						

Table B5-3. B Plant Contamination Intervals and Average Gamma Activity. (sheet 2 of 4)

Well	Site	Category	Top1	Base	Value1	Top2	Base	Value2	Top3	Base	Value3	Top4	Base	Value4	Top5	Base	Value5	Top6	Base	Value6
2-E33-069	B-8 Crib	Contamination	4	22	70	22	58	40000	58	92	3000	92	145	70						
2-E33-070	B-8 Crib	Contamination	5	29	75	29	98	40000	98	110	200	110	146	70						
2-E33-071	B-8 Crib	Contamination	4	28	75	28	36	45000	36	54	3200	54	72	200	72	108	15000	108	144	40
2-E33-011	B-8 Tile	Contamination	5	168	75	168	175	120	175	214	75	214	230	3000						
2-E33-012	B-8 Tile	Contamination	4	218	80	218	235	500	235	320	90	320	332	250	332	405	90	405	408	500
2-E33-073	B-8 Tile	Contamination	3	4	2700	4	22	60	22	42	17000	42	145	75						
2-E33-089	B-8 Tile	Contamination	4	20	30	20	44	44000	44	84	15000	84	108	500	108	144	75			
2-E28-02	B-9 Crib	Contamination	5	246	100	246	254	200	254	306	90	306	310	175						
2-E28-05	B-9 Crib	Contamination	5	242	60	242	248	100	248	300	60	300	306	225						
2-E28-10	B-9 Crib	Contamination	3	296	70	296	312	500	312	319	100									
2-E28-53	B-9 Crib	Contamination	6	24	100	14	24	40000												
2-E28-54	B-9 Crib	Contamination	5	14	110	14	20	500	20	30	15000									
2-E28-55	B-9 Crib	Contamination	6	12	60	12	34	99999	34	150	75									
2-E28-57	B-9 Crib	Contamination	5	9	80	9	40	30000	40	46	150	46	150	75						
2-E28-61	B-9 Crib	Contamination	6	14	60	14	23	99999	23	32	175	32	150	80						
2-E13-01	B14-19 Crib	Contamination	3	55	99999	55	108	1000	108	112	4500	112	198	300	198	270	200	270	345	75
2-E13-02	B14-19 Crib	Contamination	3	10	300	10	40	99999	40	82	1500	82	346	100						
2-E13-03	B14-19 Crib	Contamination	2	9	70	9	21	40000	21	48	2000	48	72	200	72	353	100			
2-E13-04	B14-19 Crib	Contamination	3	12	50	12	26	15000	26	78	200	78	100	50	100	361	75			
2-E13-05	B14-19 Crib	Contamination	4	20	99999	8	63	1500	63	74	100	74	85	15000	85	365	100			
2-E13-06	B14-19 Crib	Contamination	2	16	99999	16	36	1500	36	50	150	60	99	75	99	362	120			
2-E13-20	B14-19 Crib	Contamination	3	15	100	15	54	1000	54	170	115	170	180	190	180	357	90			
2-E13-21	B14-19 Crib	Contamination	3	114	40000	114	187	1700	187	226	2700	226	289	400	289	302	1900	302	335	80
2-E33-008	B35-41 Crib	Contamination	5	26	40	26	60	900	60	255	50									
2-E33-010	B35-41 Crib	Contamination	4	20	90	20	34	800	34	284	100	284	288	150						
2-E33-021	B35-41 Crib	Contamination	4	25	40000	25	42	15000	42	62	1000	62	282	120						
2-E33-286	B35-41 Crib	Contamination	2	20	40	20	50	25000												
2-E33-287	B35-41 Crib	Contamination	4	8	2500	8	23	60	23	51	35000									
2-E33-288	B35-41 Crib	Contamination	3	10	1500	10	20	75	20	49	25000									
2-E33-289	B35-41 Crib	Contamination	3	18	125	18	30	20000	30	49	1000									
2-E33-001	B43-50 Crib	Contamination	2	25	90	25	40	600	40	44	99999	44	80	2000	80	220	750	220	225	99999
2-E33-002	B43-50 Crib	Contamination	3	48	75	48	62	12000	62	231	350									
2-E33-003	B43-50 Crib	Contamination	1	26	125	26	142	9000	142	156	500	156	233	2000						
2-E33-004	B43-50 Crib	Contamination	1	12	100	12	62	30000	62	86	250	86	98	2500	98	227	700			
2-E33-005	B43-50 Crib	Contamination	5	42	80	42	122	99999	122	224	80									
2-E33-006	B43-50 Crib	Contamination	3	10	60	10	120	99999	120	152	200	152	226	100	226	232	400			
2-E33-007	B43-50 Crib	Contamination	1	12	60	12	50	40000	50	123	250	123	126	2000	126	155	200	155	160	1200
2-E33-013	B43-50 Crib	Contamination	2	4	250	4	150	125	150	155	200	155	208	300						
2-E33-022	B43-50 Crib	Contamination	4	40	99999	40	198	30000	198	230	2500									
2-E33-023	B43-50 Crib	Contamination	2	10	150	10	45	40000	45	100	15000	100	120	1500	120	228	500			

Table B5-3. B Plant Contamination Intervals and Average Gamma Activity. (sheet 3 of 4)

Well	Site	Category	Top1	Base	Value1	Top2	Base	Value2	Top3	Base	Value3	Top4	Base	Value4	Top5	Base	Value5	Top6	Base	Value6
2-E13-07	BC Cribs	Contamination	2	16	75	16	22	9000	22	37	2000	37	156	80	156	355	100			
2-E13-51	BC Cribs	Contamination	2	14	300	14	26	1500	26	75	105									
2-E13-54	BC Cribs	Contamination	2	6	210	6	17	60	17	24	16000	24	45	1000						
2-E13-55	BC Cribs	Contamination	3	18	90	18	25	210	25	43	130									
2-E13-56	BC Cribs	Contamination	2	11	75	11	31	2800	31	39	80	39	45	300						
2-E13-57	BC Cribs	Contamination	3	10	36000	10	22	600	22	45	150									
2-E13-59	BC Cribs	Contamination	3	18	75	18	23	270	23	44	120									
2-E13-60	BC Cribs	Contamination	3	17	85	17	23	300	23	44	120									
2-E13-61	BC Cribs	Contamination	2	16	70	16	21	140	21	45	80									
2-E33-027	BX Tank Farm	Contamination	4	14	40	14	30	0	30	68	4000	68	84	800	84	100	40	124	142	100
2-E33-061	BX Tank Farm	Contamination	2	30	20	30	72	32	72	104	130	104	120	40	120	138	58			
2-E33-078	BX Tank Farm	Contamination	2	44	20	44	64	50	64	143	26									
2-E33-133	BX Tank Farm	Contamination	2	70	28	70	88	800	88	120	150	120	146	50						
2-E33-134	BX Tank Farm	Contamination	2	70	26	70	79	400	79	92	34	92	112	120	112	137	30			
2-E33-135	BX Tank Farm	Contamination	2	8	40	8	13	400	13	56	26	56	78	100	78	96	30			
2-E33-141	BX Tank Farm	Contamination	2	70	30	70	75	350	75	97	30									
2-E33-143	BX Tank Farm	Contamination	2	39	20	39	45	200	45	97	26									
2-E33-144	BX Tank Farm	Contamination	2	15	55	15	22	15000	22	43	2500	43	58	100	58	96	40			
2-E33-145	BX Tank Farm	Contamination	2	38	22	38	41	70	41	82	30	82	85	60	85	96	35			
2-E33-146	BX Tank Farm	Contamination	2	44	22	44	78	150	78	97	50	97	112	200	112	147	40			
2-E33-152	BX Tank Farm	Contamination	2	8	2000	8	30	22	30	51	250	51	98	32						
2-E33-165	BX Tank Farm	Contamination	2	36	28	36	43	10000	43	57	45									
2-E33-167	BX Tank Farm	Contamination	2	6	60	6	38	26	38	44	180	44	98	30						
2-E33-168	BX Tank Farm	Contamination	2	32	2	32	50	11000	50	63	400	63	76	3	76	82	80	82	97	3
2-E33-171	BX Tank Farm	Contamination	2	41	20	41	44	60	44	97	25									
2-E33-173	BX Tank Farm	Contamination	2	35	20	35	45	50000	45	97	26									
2-E33-222	BX Tank Farm	Contamination	2	10	80	10	21	2	21	54	20000	54	62	30	62	78	2000	78	102	600
2-E33-223	BX Tank Farm	Contamination	2	8	4	8	25	4000	25	38	140	38	54	20	54	77	0	77	85	3
2-E33-224	BX Tank Farm	Contamination	2	6	6000	6	21	60	21	46	24	46	99	28						
2-E33-237	BX Tank Farm	Contamination	2	16	240	16	38	22	38	49	70000	49	66	90	66	74	2100	74	98	250
2-E33-238	BX Tank Farm	Contamination	2	18	30	18	28	50000	28	95	26									
2-E33-084	BY Tank Farm	Contamination	2	48	20	48	98	100	98	120	30	120	124	80	124	132	25	132	143	60
2-E33-101	BY Tank Farm	Contamination	2	18	70	18	43	28	43	53	400	52	96	28						
2-E33-102	BY Tank Farm	Contamination	2	8	100	8	44	26	44	49	60	49	98	30						
2-E33-103	BY Tank Farm	Contamination	2	22	80	22	46	14000	46	61	300	61	71	40	71	86	150	86	98	40
2-E33-105	BY Tank Farm	Contamination	2	9	250	9	64	28	64	78	38	78	96	80						
2-E33-113	BY Tank Farm	Contamination	2	61	28	61	82	170	82	92	26									
2-E33-115	BY Tank Farm	Contamination	2	10	50	10	58	25	58	70	60	70	98	40						
2-E33-117	BY Tank Farm	Contamination	2	22	200	22	33	20000	33	80	34	80	98	45						
2-E33-118	BY Tank Farm	Contamination	2	7	30000	7	38	32	38	73	85	73	98	45						
2-E33-121	BY Tank Farm	Contamination	2	19	26	19	28	20000	28	96	26									
2-E33-126	BY Tank Farm	Contamination	2	9	170	9	22	22	22	27	200	27	97	25						
2-E33-177	BY Tank Farm	Contamination	2	12	200	12	23	50	23	28	4000	28	96	35						
2-E33-207	BY Tank Farm	Contamination	2	7	200	7	22	60	22	27	150	27	98	30						
2-E33-208	BY Tank Farm	Contamination	2	7	4000	7	77	30	77	93	160	93	101	55						

Table B5-3. B Plant Contamination Intervals and Average Gamma Activity. (sheet 4 of 4)

Well	Site	Category	Top1	Base	Value1	Top2	Base	Value2	Top3	Base	Value3	Top4	Base	Value4	Top5	Base	Value5	Top6	Base	Value6
2-E33-209	BY Tank Farm	Contamination	2	8	20000	8	46	26	46	76	50	76	102	28						
2-E33-211	BY Tank Farm	Contamination	2	26	80	26	99	28												
2-E33-240	BY Tank Farm	Contamination	5	12	80	12	60	25	60	97	35									
2-E33-245	BY Tank Farm	Contamination	2	5	250	5	42	80	42	97	26									
2-E33-251	BY Tank Farm	Contamination	2	86	25	86	98	40												
2-E33-252	BY Tank Farm	Contamination	2	42	200	42	96	26												
2-E33-253	BY Tank Farm	Contamination	1	12	250	12	20	26	20	24	65	24	97	26						
2-E33-259	BY Tank Farm	Contamination	2	14	220	14	32	80	32	98	28									
2-E28-27	E-10 Burial	Contamination	3	6	120	6	264	190	264	289	75									
2-E33-290	E-10 Burial	Contamination	4	24	80	24	35	20000	35	50	10000									
6-53-50	Gable Pond	Contamination	5	94	45	94	160	300	160	168	55	168	195	130						

Table B5-4. Selected RLS Survey Wells for B Plant.

Well	Tank farm Well	Disposal Site	Drill Date	Drill Depth
299-E13-21		B14-19 Cribs	11/30/65	335
299-E13-56		BC Cribs	8/31/82	50
299-E28-18		B-62 Crib	7/31/69	309
299-E28-24		B-5 Crib	2/28/80	322
299-E28-57		B-9 Crib	7/31/48	150
299-E28-65		B-12 Crib	2/28/51	763
299-E33-14		B-56 Crib	12/31/53	227
299-E33-16		B-8 Crib	11/30/53	256
299-E33-20		B-11 Crib	7/31/56	244
299-E33-21		B35 - 41 Crib	4/30/57	282
299-E33-24		B-57 Crib	5/31/67	253
299-E33-26		B-61 Crib	3/31/69	240
299-E33-58		B-7 Crib	5/31/47	147
299-E33-89		B-8 Tile Field	12/31/47	144
299-E33-290		E-10 Burial Gnd	8/31/82	50
299-E33-191	20-06-06	B Tank farm	3/31/72	99
299-E33-168	21-10-05	BX Tank farm	9/30/71	97
299-E33-103	22-03-05	BY Tank farm	8/31/70	98

APPENDIX B6

PUREX TABLES

Table B6-1. PUREX Aggregate Area Disposal Facilities and RLS Logging Recommendations.

DISPOSAL FACILITY	LOG WITH RLS	COMMENTS
216-A-1 Crib	NO	LOW ACTIVITY
216-A-2 thru A-4 Cribs	YES	ACTIVITY
216-A-5 Crib	YES	ACTIVITY
216-A-6 Crib	YES	ACTIVITY
216-A-7 Crib	NO	ACTIVITY
216-A-8 Crib	NO	LOGGED FOR A-8 CRIB RESTART
216-A-9 Crib	NO	LOW ACTIVITY
216-A-10 Crib	YES	ACTIVITY
216-A-14 Crib	NO	NO LOGGING DATA
216-A-15 Crib	NO	NO LOGGING DATA
216-A-18 Trench	NO	LOW ACTIVITY
216-A-19 & A-20 Trench	NO	NO MONITORING WELLS
216-A-21 Crib	NO	LOW ACTIVITY
216-A-24 Crib	YES	ACTIVITY
216-A-27 Crib	YES	ACTIVITY
216-A-29 Crib	YES	ACTIVITY
216-A-30 Crib	YES	ACTIVITY
216-A-31 Crib	NO	LOW ACTIVITY
216-A-32 Crib	NO	NO LOGGING DATA
216-A-36A & A-36B Crib	YES	ACTIVITY
216-A-37-1 & A-37-2 Cribs	NO	LOW ACTIVITY
216-A-38 Crib	NO	LOW ACTIVITY
216-A-39 Crib	NO	NO MONITORING WELLS
216-A-40 Trench	NO	NO LOGGING DATA
216-A-41 Crib	NO	NO MONITORING WELLS
216-A-45 Crib	NO	NO LOGGING DATA
241-A TANK FARM	YES	ACTIVITY
241-AX TANK FARM	YES	ACTIVITY
241-C TANK FARM	YES	ACTIVITY
216-E-1 Burial Ground	NO	LOW ACTIVITY
216-E-12 Burial Ground	NO	LOW ACTIVITY
216-E-13 Burial Ground	NO	LOW ACTIVITY

Table B6-2. PUREX Aggregate Area Radioactivity Categorized by Facility and Well. (sheet 1 of 9)

Well	Tankfarm	Facility	Log Date	Category	E	N
2-E24-013	10-00-08	A Tank Farm	6/08/90	Natural	-47875	41187
2-E24-014	10-00-07	A Tank Farm	6/08/90	Shallow	-47799	41125
2-E24-015		A Tank Farm	8/24/82	Contamination		
2-E24-015	10-00-06	A Tank Farm	6/08/90	Natural	-48920	39300
2-E24-019		A Tank Farm			-47821	41076
2-E24-064		A Tank Farm			-47819	41155
2-E24-065		A Tank Farm	9/16/87	Contamination	-47819	41170
2-E24-066	10-04-07	A Tank Farm	6/08/90	Shallow	-47819	41262
2-E24-067	10-04-08	A Tank Farm	6/08/90	Shallow	-47849	41287
2-E24-068	10-04-10	A Tank Farm	6/08/90	Natural	-47848	41328
2-E24-069	10-04-12	A Tank Farm	6/08/90	Shallow	-47815	41355
2-E24-070	10-01-06	A Tank Farm	5/11/92	Natural	-47809	41157
2-E24-071	10-01-08	A Tank Farm	5/11/92	Shallow	-47845	41178
2-E24-072	10-01-10	A Tank Farm	5/11/92	Natural	-47850	41224
2-E24-073	10-01-11	A Tank Farm	5/11/92	Shallow	-47822	41250
2-E24-075	10-01-09	A Tank Farm	5/18/92	Natural		
2-E24-170	10-01-16	A Tank Farm	5/18/92	Contamination		
2-E24-204	10-01-28	A Tank Farm	5/18/92	Contamination		
2-E25-001		A Tank Farm			-47759	41166
2-E25-015	10-00-06	A Tank Farm			-47650	41125
2-E25-016		A Tank Farm			-47800	41125
2-E25-055	10-03-10	A Tank Farm	5/05/92	Shallow	-47651	41223
2-E25-056	10-04-04	A Tank Farm	6/08/90	Shallow	-47753	41283
2-E25-057	10-00-01	A Tank Farm	6/08/90	Natural	-47565	41397
2-E25-058	10-00-04	A Tank Farm	6/08/90	Natural	-47540	41160
2-E25-061	10-04-01	A Tank Farm	6/08/90	Shallow	-47774	41345
2-E25-062	10-05-09	A Tank Farm	6/08/90	Shallow	-47753	41304
2-E25-063	10-04-05	A Tank Farm	6/08/90	Natural	-47768	41275
2-E25-066	10-05-10	A Tank Farm	6/08/90	Contamination	-47737	41340
2-E25-067	10-05-12	A Tank Farm	6/08/90	Shallow	-47697	41355
2-E25-068	10-05-02	A Tank Farm	6/08/90	Shallow	-47663	41335
2-E25-069	10-06-09	A Tank Farm	6/08/90	Shallow	-47651	41304
2-E25-070	10-05-05	A Tank Farm	5/18/92	Natural	-47679	41264
2-E25-071	10-05-07	A Tank Farm	6/08/90	Shallow	-47721	41263
2-E25-072	10-06-10	A Tank Farm	6/08/90	Shallow	-47637	41338
2-E25-073	10-06-12	A Tank Farm	6/08/90	Shallow	-47598	41356
2-E25-074	10-06-02	A Tank Farm	6/08/90	Shallow	-47562	41337
2-E25-075	10-06-04	A Tank Farm	6/08/90	Contamination	-47552	41296
2-E25-076	10-06-05	A Tank Farm	3/24/80	Contamination	-47577	41264
2-E25-077	10-06-07	A Tank Farm	6/08/90	Shallow	-47623	41264
2-E25-078	10-03-01	A Tank Farm	5/18/92	Shallow	-47583	41250
2-E25-079	10-03-02	A Tank Farm	5/18/92	Shallow	-47553	41234
2-E25-080	10-03-04	A Tank Farm	5/18/92	Natural	-47558	41180
2-E25-081	10-03-05	A Tank Farm	5/18/92	Shallow	-47591	41158
2-E25-082	10-03-07	A Tank Farm	5/18/92	Possible Contamination	-47632	41168
2-E25-083	10-02-03	A Tank Farm	5/05/92	Contamination	-47652	41201
2-E25-084	10-03-11	A Tank Farm	5/18/92	Shallow	-47635	41250

Table B6-2. PUREX Aggregate Area Radioactivity Categorized by Facility and Well. (sheet 2 of 9)

Well	Tankfarm	Facility	Log Date	Category	E	N
2-E25-085	10-02-05	A Tank Farm	5/11/92	Natural	-47674	41166
2-E25-086	10-02-06	A Tank Farm	5/05/92	Natural	-47714	41158
2-E25-087	10-02-08	A Tank Farm	5/05/92	Shallow	-47748	41184
2-E25-088	10-02-10	A Tank Farm	5/05/92	Shallow	-47746	41226
2-E25-089	10-02-11	A Tank Farm	5/05/92	Shallow	-47720	41250
2-E25-090	10-02-01	A Tank Farm	5/11/92	Shallow	-47670	41240
2-E25-091	10-01-03	A Tank Farm	5/15/92	Shallow	-47757	41213
2-E25-092	10-01-04	A Tank Farm	5/15/92	Contamination	-47770	41172
2-E25-097	10-01-01	A Tank Farm	5/15/92	Shallow	-47781	41247
2-E25-098	10-05-08	A Tank Farm	6/08/90	Shallow	-47749	41274
2-E25-171		A Tank Farm			-47777	41178
2-E25-172		A Tank Farm			-47777	41183
2-E25-179		A Tank Farm			-47650	41480
2-E25-184		A Tank Farm			-47800	41085
2-E25-189		A Tank Farm			-47800	41085
2-E25-192		A Tank Farm			-47772	41179
2-E25-204		A Tank Farm			-47768	41187
2-E25-002		A-1 Crib	6/20/84	Possible Contamination	-47190	41270
2-E17-01		A-10 Crib	8/24/82	Contamination	-48942	39053
2-E17-19		A-10 Crib	8/31/88	Contamination	-48810	39147
2-E17-20		A-10 Crib	8/31/88	Contamination	-49070	39149
2-E24-002		A-10 Crib	8/24/84	Contamination	-48953	39404
2-E24-016		A-10 Crib	8/31/88	Contamination	-48809	39310
2-E24-017		A-10 Crib	8/17/88	Contamination	-49070	39309
2-E24-059		A-10 Crib	8/24/82	Contamination	-48913	39215
2-E24-060		A-10 Crib	8/24/82	Contamination	-48984	39216
2-E24-121		A-10 Crib			-49121	39159
2-E24-160		A-10 Crib	3/04/86	Contamination	-48910	39320
2-E25-052		A-14 Crib			-48000	39600
2-E17-50		A-15 Crib			-48500	39000
2-E24-055		A-15 Crib			-48676	39631
2-E25-010		A-18 Crib	12/03/76	Natural	-46900	42000
2-E24-012		A-21 Crib	4/28/76	Possible Contamination	-48203	39219
2-E26-02		A-24 Crib	8/12/87	Natural	-45664	42400
2-E26-03		A-24 Crib	2/27/86	Natural	-46057	42324
2-E26-04		A-24 Crib	8/12/87	Natural	-46449	42245
2-E26-05		A-24 Crib			-46842	42172
2-E26-07		A-24 Crib	6/20/84	Contamination	-46650	42285
2-E26-51		A-24 Crib			-46890	42203
2-E26-52		A-24 Crib			-46843	42280

Table B6-2. PUREX Aggregate Area Radioactivity Categorized by Facility and Well. (sheet 3 of 9)

Well	Tankfarm	Facility	Log Date	Category	E	N
2-E26-53		A-24 Crib	6/21/84	Contamination	-46605	42325
2-E26-54		A-24 Crib	6/21/84	Contamination	-46449	42355
2-E26-55		A-24 Crib			-46216	42403
2-E26-56		A-24 Crib			-46815	42143
2-E26-57		A-24 Crib			-46578	42188
2-E26-58		A-24 Crib			-46423	42221
2-E26-59		A-24 Crib			-46188	42266
2-E26-60		A-24 Crib			-46831	42217
2-E26-61		A-24 Crib			-46418	42493
2-E26-62		A-24 Crib			-46047	42369
2-E26-63		A-24 Crib			-45653	42447
2-E26-64		A-24 Crib			-46570	42142
2-E26-65		A-24 Crib			-46859	42349
2-E26-66		A-24 Crib			-46614	42367
2-E26-67		A-24 Crib			-46457	42391
2-E26-68		A-24 Crib			-46644	42525
2-E26-69		A-24 Crib			-46475	42488
2-E26-70		A-24 Crib			-46622	42405
2-E26-71		A-24 Crib			-46599	42287
2-E26-72		A-24 Crib			-46052	42394
2-E26-73		A-24 Crib			-45657	42481
2-E26-74		A-24 Crib			-46593	42264
2-E26-75		A-24 Crib			-46631	42455
2-E26-76		A-24 Crib			-46715	42290
2-E17-02		A-27 Crib	7/14/87	Contamination	-48141	39063
2-E17-03		A-27 Crib	7/01/86	Contamination	-48340	39066
2-E25-025		A-29 Ditch	4/25/85	Natural	-43648	41002
2-E25-026		A-29 Ditch	4/25/85	Natural	-45884	40773
2-E25-028		A-29 Ditch	3/25/86	Natural	-45541	41424
2-E25-032		A-29 Ditch			-44326	41200
2-E25-034		A-29 Ditch			-45517	41386
2-E25-035		A-29 Ditch	5/31/88	Natural	-46539	40617
2-E25-037		A-29 Ditch			-45749	40462
2-E25-039		A-29 Ditch			-43673	40518
2-E25-169		A-29 Ditch	9/30/82	Contamination	-45550	41675
2-E24-053		A-2:A-4 Crib	8/24/82	Contamination	-48245	39515
2-E24-054		A-2:A-4 Crib	9/16/87	Contamination	-48130	39542
2-E16-1	South of	A-30 Crib	3/02/82	Natural		
2-E16-2		A-30 Crib	9/28/82	Possible Contamination	-45162	39151
2-E25-011		A-30 Crib	9/28/82	Natural	-46126	39611
2-E25-012		A-30 Crib	8/20/82	Natural	-45655	39388
2-E25-191		A-30 Crib	8/20/82	Contamination	-45800	39560
2-E25-193		A-30 Crib	8/20/82	Contamination	-45532	39430

Table B6-2. PUREX Aggregate Area Radioactivity Categorized by Facility and Well. (sheet 4 of 9)

Well	Tankfarm	Facility	Log Date	Category	E	N
2-E24-009		A-31 Crib	9/16/87	Natural	-48292	39295
2-E25-033		A-32 Crib			-45609	40116
2-E17-04		A-36 Crib	7/14/87	Contamination	-48480	38999
2-E17-05		A-36 Crib	9/29/82	Contamination	-48560	38699
2-E17-06		A-36 Crib	5/03/79	Natural	-48499	38140
2-E17-07		A-36 Crib	7/14/87	Contamination	-48559	38711
2-E17-09		A-36 Crib	4/02/79	Contamination	-48538	39027
2-E17-10		A-36 Crib	9/19/86	Natural	-48650	38896
2-E17-11		A-36 Crib	9/29/82	Contamination	-48509	38924
2-E17-14		A-36 Crib	4/14/88	Contamination	-48406	38880
2-E17-15		A-36 Crib	4/14/88	Natural	-48400	38710
2-E17-16		A-36 Crib	3/28/88	Natural	-48391	38476
2-E17-18		A-36 Crib	5/04/88	Natural	-48501	38190
2-E17-51		A-36 Crib	9/29/82	Contamination	-48510	38540
2-E17-17		A-36:A-45	4/11/88	Natural	-48717	38474
2-E25-017		A-37 Crib	8/20/82	Natural	-46570	40086
2-E25-018		A-37 Crib	8/20/82	Natural	-46187	40070
2-E25-019		A-37 Crib	9/29/82	Natural	-46060	39935
2-E25-020		A-37 Crib	9/29/82	Natural	-45875	39925
2-E25-029		A-37 Crib			-45735	40170
2-E25-029		A-37 Crib			-45735	40170
2-E25-031		A-37 Crib			-45753	40311
2-E25-021		A-37-2 Crib			-45377	39609
2-E25-022		A-37-2 Crib			-45589	39776
2-E25-023		A-37-2 Crib			-44746	39308
2-E25-024		A-37-2 Crib			-44949	39484
2-E25-027		A-37-2 Crib	6/17/85	Natural	-45136	39855
2-E25-030		A-37-2 Crib			-44900	39710
2-E25-030		A-37-2 Crib			-44900	39710
2-E25-038		A-37-2 Crib			-45469	40056
2-E25-190		A-37-2 Crib	8/20/82	Contamination	-45775	39700
2-E17-08		A-38 Crib	4/28/76	Contamination	-49247	39123
2-E24-011		A-38 Crib	7/14/87	Natural	-49252	39371
2-E24-076		A-38 Crib	1/24/83	Contamination	-49422	39161
2-E24-077		A-38 Crib	1/24/83	Natural	-49415	39161
2-E24-078		A-38 Crib	1/24/83	Natural	-49409	39161
2-E24-079		A-38 Crib	1/24/83	Natural	-49402	39161
2-E24-080		A-38 Crib	1/24/83	Natural	-49420	39156
2-E24-081		A-38 Crib	1/24/83	Natural	-49416	39152
2-E24-082		A-38 Crib	1/24/83	Natural	-49411	39147
2-E24-083		A-38 Crib	1/24/83	Natural	-49406	39179

Table B6-2. PUREX Aggregate Area Radioactivity Categorized by Facility and Well. (sheet 5 of 9)

Well	Tankfarm	Facility	Log Date	Category	E	N
2-E24-084		A-38 Crib	3/21/83	Contamination	-49425	39164
2-E24-085		A-38 Crib	3/21/83	Natural	-49425	39171
2-E24-086		A-38 Crib	3/21/83	Natural	-49425	39177
2-E24-087		A-38 Crib	3/21/83	Natural	-49420	39180
2-E24-088		A-38 Crib	1/24/83	Natural	-49430	39166
2-E24-089		A-38 Crib	1/24/83	Natural	-49434	39170
2-E24-090		A-38 Crib	1/24/83	Natural	-49437	39175
2-E24-091		A-38 Crib	1/24/91	Natural	-49444	39180
2-E24-092		A-38 Crib	1/24/83	Contamination	-49428	39161
2-E24-093		A-38 Crib	1/24/83	Natural	-49436	39161
2-E24-094		A-38 Crib	1/24/83	Natural	-49441	39161
2-E24-095		A-38 Crib	1/24/83	Natural	-49448	39161
2-E24-096		A-38 Crib	1/24/83	Contamination	-49430	39165
2-E24-097		A-38 Crib	1/24/83	Natural	-49434	39170
2-E24-098		A-38 Crib	1/24/83	Natural	-49439	39175
2-E24-099		A-38 Crib	1/24/83	Natural	-49444	39142
2-E24-100		A-38 Crib	3/21/83	Contamination	-49425	39158
2-E24-101		A-38 Crib	3/21/83	Natural	-49425	39151
2-E24-102		A-38 Crib	3/21/83	Natural	-49425	39145
2-E24-103		A-38 Crib	3/21/83	Natural	-49425	39138
2-E24-104		A-38 Crib	1/24/83	Contamination	-49420	39156
2-E24-105		A-38 Crib	1/24/83	Natural	-49416	39152
2-E24-106		A-38 Crib	1/24/83	Natural	-49411	39147
2-E24-107		A-38 Crib	1/24/83	Natural	-49406	39142
2-E24-108		A-38 Crib			-49425	39218
2-E24-109		A-38 Crib			-49425	39211
2-E24-110		A-38 Crib			-49425	39205
2-E24-112		A-38 Crib			-49407	39104
2-E24-113		A-38 Crib			-49481	39172
2-E24-122		A-38 Crib			-49437	39164
2-E24-123		A-38 Crib			-49432	39163
2-E27-002		A-40 Crib			-48025	42186
2-E27-003		A-40 Crib			-48500	42000
2-E27-003		A-40 Crib			-48500	42000
2-E27-003		A-40 Crib			-48500	42000
2-E27-006		A-40 Crib			-48055	42155
2-E17-12		A-45 Crib	4/15/86	Natural	-49180	38200
2-E17-13		A-45 Crib	8/11/86	Natural	-49040	38353
2-E17-53		A-45 Crib			-49065	38266
2-E17-54		A-45 Crib			-49246	38354
2-E24-001		A-5 Crib	6/25/84	Contamination	-48761	39396
2-E24-010		A-5 Crib	9/16/87	Contamination	-48710	39379
2-E24-056		A-5 Crib			-48704	39350
2-E24-057		A-5 Crib	9/16/87	Contamination	-48704	39447

Table B6-2. PUREX Aggregate Area Radioactivity Categorized by Facility and Well. (sheet 6 of 9)

Well	Tankfarm	Facility	Log Date	Category	E	N
2-E24-058		A-5 Crib	9/16/87	Natural	-48666	39397
2-E25-056		A-5 Crib	9/16/87	Contamination		
2-E25-003		A-6 Crib	7/13/87	Contamination	-46960	39980
2-E25-053		A-6 Crib	8/12/87	Natural	-47000	39795
2-E25-054		A-7 Crib	9/30/86	Contamination	-47169	41205
2-E25-004		A-8 Crib	9/30/82	Contamination	-46739	41615
2-E25-005		A-8 Crib	9/30/82	Contamination	-46632	41667
2-E25-006		A-8 Crib	9/30/82	Contamination	-46619	41598
2-E25-007		A-8 Crib	9/30/82	Contamination	-46416	41709
2-E25-008		A-8 Crib	4/30/76	Natural	-46187	41682
2-E25-009		A-8 Crib	9/29/82	Natural	-45860	41779
2-E25-014		A-8 Crib	4/30/82	Contamination	-46650	41600
2-E24-003		A-9 Crib	4/22/85	Natural	-48310	41011
2-E24-004		A-9 Crib	4/22/85	Natural	-48483	41182
2-E24-005		A-9 Crib	4/22/85	Natural	-48727	41275
2-E24-006		A-9 Crib			-48644	41335
2-E24-063		A-9 Crib	9/23/87	Natural	-48644	41335
2-E26-06		AN Tank Farm			-47350	42370
2-E25-146		AP Tank Farm			-47360	40605
2-E25-197		AP Tank Farm			-46760	40680
	11-01-10	AX Tank Farm	5/11/92	Shallow		
	11-02-01	AX Tank Farm	6/14/90	Natural		
	11-02-03	AX Tank Farm	6/14/90	Natural		
	11-02-12	AX Tank Farm	5/05/92	Contamination		
	11-02-22	AX Tank Farm	6/14/90	Natural		
	11-04-19	AX Tank Farm	6/14/90	Shallow		
2-E25-013		AX Tank Farm			-47670	41522
2-E25-040		AX Tank Farm			-47335	41760
2-E25-041		AX Tank Farm			-47331	41542
2-E25-099	11-01-01	AX Tank Farm	5/11/92	Shallow	-47453	41776
2-E25-100	11-01-02	AX Tank Farm	5/11/92	Natural	-47429	41753
2-E25-101	11-01-04	AX Tank Farm	5/11/92	Natural	-47429	41710
2-E25-102	11-01-05	AX Tank Farm	5/11/92	Shallow	-47458	41682
2-E25-103	11-01-07	AX Tank Farm	5/11/92	Shallow	-47500	41692
2-E25-104	11-01-09	AX Tank Farm	5/11/92	Natural	-47520	41726
2-E25-105	11-01-11	AX Tank Farm	5/11/92	Natural	-47495	41773
2-E25-106	11-02-02	AX Tank Farm	6/14/90	Shallow	-47429	41648
2-E25-107	11-02-04	AX Tank Farm	6/14/90	Natural	-47428	41600
2-E25-108	11-02-05	AX Tank Farm	6/14/90	Shallow	-47455	41585
2-E25-109	11-02-07	AX Tank Farm	6/14/90	Natural	-47495	41585

Table B6-2. PUREX Aggregate Area Radioactivity Categorized by Facility and Well. (sheet 7 of 9)

Well	Tankfarm	Facility	Log Date	Category	E	N
2-E25-110	11-02-08	AX Tank Farm	2/18/75	Natural	-47520	41595
2-E25-111	11-02-10	AX Tank Farm	6/14/90	Natural	-47519	41644
2-E25-112	11-02-11	AX Tank Farm	6/14/90	Natural	-47499	41669
2-E25-113	11-03-02	AX Tank Farm	5/19/92	Contamination	-47532	41764
2-E25-114	11-03-05	AX Tank Farm	5/19/92	Natural	-47540	41691
2-E25-115	11-03-07	AX Tank Farm	5/19/92	Shallow	-47589	41691
2-E25-116	11-03-09	AX Tank Farm	5/19/92	Natural	-47610	41720
2-E25-117	11-03-10	AX Tank Farm	5/19/92	Natural	-47602	41761
2-E25-118	11-03-12	AX Tank Farm	5/19/92	Shallow	-47569	41776
2-E25-119	11-04-01	AX Tank Farm	6/14/90	Shallow	-47547	41672
2-E25-120	11-04-05	AX Tank Farm	6/14/90	Shallow	-47544	41583
2-E25-121	11-04-07	AX Tank Farm	6/13/90	Shallow	-47586	41588
2-E25-122	11-04-08	AX Tank Farm	6/14/90	Natural	-47604	41605
2-E25-123	11-04-10	AX Tank Farm	6/14/90	Shallow	-47612	41650
2-E25-124	11-04-11	AX Tank Farm	6/14/90	Natural	-47581	41672
2-E25-127	11-02-11	AX Tank Farm			-47508	41670
2-E25-128	11-02-12	AX Tank Farm			-47485	41675
2-E25-147	11-04-19	AX Tank Farm			-47588	41591
2-E25-148		AY Tank Farm			-47769	41185
2-E25-149		AY Tank Farm			-47776	41177
2-E25-152		AY Tank Farm			-47765	41195
2-E25-173		AY Tank Farm			-47650	41655
2-E25-174		AY Tank Farm			-47650	41605
2-E25-182		AY Tank Farm			-47689	41687
2-E25-183		AY Tank Farm			-47687	41696
2-E25-185		AY Tank Farm			-47650	41676
2-E26-01		Burial	11/12/76	Natural	-48025	44774
2-E34-7		Burial			-47949	45520
2-E35-1		Burial			-47339	45870
6-43-45		Burial			-44644	42977
	30-07-07	C Tank Farm	5/20/92	Natural		
	30-12-13	C Tank Farm	5/20/92	Contamination		
2-E27-007	NE -C-TF	C Tank Farm			-48132	43098
2-E27-012	W -C-TF	C Tank Farm			-48678	42981
2-E27-013	SW-C-TF	C Tank Farm			-48644	42672
2-E27-014	SE-C-TF	C Tank Farm			-48144	42700
2-E27-015	NW-C-TF	C Tank Farm			-48543	43135
2-E27-051	30-08-03	C Tank Farm	6/16/92	Natural	-48345	42932
2-E27-052	30-00-12	C Tank Farm	6/16/92	Natural	-48322	43096
2-E27-053	30-00-10	C Tank Farm	6/16/92	Natural	-48549	43029
2-E27-054	30-00-03	C Tank Farm	5/20/92	Shallow	-48149	42771
2-E27-055	30-00-06	C Tank Farm	6/16/92	Natural	-48370	42677
2-E27-056	30-00-01	C Tank Farm	5/20/92	Natural	-48191	42954

Table B6-2. PUREX Aggregate Area Radioactivity Categorized by Facility and Well. (sheet 8 of 9)

Well	Tankfarm	Facility	Log Date	Category	E	N
2-E27-057	30-00-09	C Tank Farm	5/20/92	Natural	-48583	42889
2-E27-058	30-01-09	C Tank Farm	6/16/92	Contamination	-48373	42719
2-E27-059	30-01-06	C Tank Farm	6/16/92	Contamination	-48328	42676
2-E27-060	30-01-01	C Tank Farm	5/07/92	Natural	-48295	42747
2-E27-061	30-01-12	C Tank Farm	5/20/92	Shallow	-48339	42762
2-E27-062	30-11-09	C Tank Farm	6/16/92	Natural	-48514	43002
2-E27-063	30-11-01	C Tank Farm	5/20/92	Natural	-48441	43036
2-E27-064	30-11-06	C Tank Farm	6/16/92	Natural	-48469	42957
2-E27-065	30-04-12	C Tank Farm	5/20/92	Natural	-48405	42835
2-E27-066	30-04-08	C Tank Farm	5/20/92	Contamination	-48437	42759
2-E27-067	30-04-02	C Tank Farm	6/16/92	Contamination	-48365	42827
2-E27-068	30-05-10	C Tank Farm	5/22/92	Natural	-48366	42893
2-E27-069	30-05-04	C Tank Farm	5/20/92	Shallow	-48294	42825
2-E27-070	30-05-02	C Tank Farm	5/20/92	Shallow	-48290	42893
2-E27-071	30-06-10	C Tank Farm	5/13/92	Shallow	-48291	42963
2-E27-072	30-06-02	C Tank Farm	5/13/92	Natural	-48244	42967
2-E27-073	30-06-04	C Tank Farm	5/13/92	Contamination	-48288	42897
2-E27-074	30-03-01	C Tank Farm	5/20/92	Contamination	-48168	42901
2-E27-075	30-03-03	C Tank Farm	5/13/92	Contamination	-48140	42861
2-E27-076	30-03-05	C Tank Farm	5/13/92	Natural	-48165	42820
2-E27-077	30-03-07	C Tank Farm	5/07/92	Contamination	-48215	42825
2-E27-078	30-03-09	C Tank Farm	5/13/92	Contamination	-48231	42861
2-E27-079	30-04-04	C Tank Farm	5/20/92	Shallow	-48352	42790
2-E27-080	30-04-05	C Tank Farm	5/20/92	Contamination	-48377	42748
2-E27-081	30-05-03	C Tank Farm	5/20/92	Contamination	-48282	42861
2-E27-082	30-05-05	C Tank Farm	5/20/92	Contamination	-48328	42813
2-E27-083	30-05-09	C Tank Farm	5/20/92	Natural	-48375	42861
2-E27-084	30-06-03	C Tank Farm	5/13/92	Shallow	-48209	42933
2-E27-085	30-06-09	C Tank Farm	5/13/92	Shallow	-48302	42932
2-E27-086	30-06-12	C Tank Farm	5/20/92	Natural	-48260	42976
2-E27-087	30-07-01	C Tank Farm	5/20/92	Natural	-48448	42911
2-E27-088	30-07-02	C Tank Farm	5/20/92	Natural	-48419	42883
2-E27-089	30-07-05	C Tank Farm	5/20/92	Shallow	-48447	42823
2-E27-090	30-07-07	C Tank Farm			-48485	42815
2-E27-091	30-07-08	C Tank Farm	5/20/92	Natural	-48512	42842
2-E27-092	30-07-10	C Tank Farm	5/20/92	Natural	-48515	42879
2-E27-093	30-07-11	C Tank Farm	5/20/92	Shallow	-48489	42898
2-E27-094	30-08-02	C Tank Farm	6/16/92	Contamination	-48363	42965
2-E27-095	30-08-12	C Tank Farm	6/16/92	Natural	-48398	42978
2-E27-096	30-09-01	C Tank Farm	6/16/92	Natural	-48313	43047
2-E27-097	30-09-02	C Tank Farm	6/16/92	Contamination	-48284	43023
2-E27-098	30-09-06	C Tank Farm	6/16/92	Contamination	-48327	42956
2-E27-099	30-09-10	C Tank Farm	5/20/92	Contamination	-48385	43026
2-E27-100	30-09-11	C Tank Farm	5/20/92	Natural	-48349	43045
2-E27-101	30-10-01	C Tank Farm	5/20/92	Natural	-48528	42979
2-E27-102	30-10-02	C Tank Farm	5/20/92	Contamination	-48494	42945
2-E27-103	30-10-09	C Tank Farm	5/20/92	Natural	-48585	42926

Table B6-2. PUREX Aggregate Area Radioactivity Categorized by Facility and Well. (sheet 9 of 9)

Well	Tankfarm	Facility	Log Date	Category	E	N
2-E27-104	30-10-11	C Tank Farm	5/20/92	Natural	-48570	42967
2-E27-105	30-11-05	C Tank Farm	6/16/92	Natural	-48438	42964
2-E27-106	30-11-11	C Tank Farm	6/16/92	Natural	-48495	43043
2-E27-107	30-12-01	C Tank Farm	5/20/92	Natural	-48380	43120
2-E27-108	30-12-03	C Tank Farm	5/20/92	Natural	-48352	43088
2-E27-109	30-12-09	C Tank Farm	5/20/92	Natural	-48446	43074
2-E27-115	30-04-01	C Tank Farm	5/20/92	Shallow	-48378	42829
2-E27-116	30-04-03	C Tank Farm	5/20/92	Contamination	-48365	42817
2-E27-117	30-05-08	C Tank Farm	5/20/92	Contamination	-48367	42838
2-E27-118	30-05-07	C Tank Farm	5/20/92	Contamination	-48353	42826
2-E27-119	30-05-06	C Tank Farm	5/20/92	Shallow	-48353	42814
2-E27-125	30-00-13	C Tank Farm	6/16/92	Natural	-48387	43116
2-E27-135	30-09-07	C Tank Farm	6/16/92	Contamination	-48342	42965
2-E34-5		E12 Burial	7/13/87	Natural	-50014	46791
2-E34-6		E12 Burial	7/13/87	Natural	-50609	46784
2-E27-154		E12A Burial			-49045	44238
2-E27-009		E12B Burial	8/03/87	Natural	-49122	44484
2-E27-010		E12B Burial	7/29/87	Natural	-48522	44520
2-E34-1		E12B Burial	11/12/76	Natural	-50023	45129
2-E34-2		E12B Burial	7/28/87	Natural	-50048	45076
2-E34-3		E12B Burial	7/28/87	Natural	-48488	45337
2-E34-4		E12B Burial	7/18/87	Natural	-49419	46791
2-E25-235		Grout			-45185	40054
2-E25-036		Storage Tank	8/02/88	Natural	-47541	39641

Table B6-3. PUREX Contamination Intervals and Average Gamma Activity. (sheet 1 of 2)

Well	Site	Category	Top1	Base	Value1	Top2	Base	Value2	Top3	Base	Value3	Top4	Base	Value4	Top5	Base	Value5	Top6	Base	Value6
2-E24-015	A Tank Farm	Contamination	6	44	45	44	90	17000	90	122	2500	122	158	85						
2-E24-065	A Tank Farm	Contamination	5	26	80	26	50	30000												
2-E24-170	A Tank Farm	Contamination	2	26	100	26	46	1300	46	52	250									
2-E24-204	A Tank Farm	Contamination	2	6	120	6	18	28	18	38	6500	38	42	2000						
2-E25-066	A Tank Farm	Contamination	2	18	90	18	28	28	28	56	70	56	78	22	78	86	80	86	122	24
2-E25-075	A Tank Farm	Contamination	2	10	65	10	16	26	16	22	90	22	122	20						
2-E25-076	A Tank Farm	Contamination	2	12	1500	12	72	22	72	73	80									
2-E25-083	A Tank Farm	Contamination	2	16	55	16	77	21	77	81	60	81	122	20						
2-E25-092	A Tank Farm	Contamination	2	15	90	15	38	90	38	46	250	46	72	60	72	123	22			
2-E17-01	A-10 Crib	Contamination	3	57	55	57	110	1900	110	170	125	170	328	55						
2-E17-19	A-10 Crib	Contamination	2	52	70	52	75	6500	75	326	80									
2-E17-20	A-10 Crib	Contamination	2	54	75	54	64	8000	64	323	80									
2-E24-002	A-10 Crib	Contamination	5	45	55	45	58	100	58	92	10000	92	333	50						
2-E24-016	A-10 Crib	Contamination	2	53	75	53	74	13000	74	100	450	100	120	170	120	328	80			
2-E24-017	A-10 Crib	Contamination	2	54	60	54	72	10000	72	140	120	140	328	75						
2-E24-059	A-10 Crib	Contamination	5	50	65	50	78	17000	78	95	200	128	150	75						
2-E24-060	A-10 Crib	Contamination	5	52	50	52	79	10000	79	94	180	94	196	70						
2-E24-160	A-10 Crib	Contamination	2	40	50	40	80	9000	80	158	2000	158	184	80	184	194	300	194	217	60
2-E26-07	A-24 Crib	Contamination	2	12	99999	12	80	20000	80	94	12000	94	127	8000						
2-E26-53	A-24 Crib	Contamination	3	18	65	18	24	2500	24	50	60									
2-E26-54	A-24 Crib	Contamination	3	18	75	18	22	360	22	38	60									
2-E17-02	A-27 Crib	Contamination	3	20	60	20	40	15000	40	83	7000	83	98	220	98	337	75			
2-E17-03	A-27 Crib	Contamination	3	86	170	86	128	1100	128	280	170	280	312	2400	312	400	130			
2-E25-169	A-29 Ditch	Contamination	5	18	60	18	28	1300	28	80	70									
2-E24-053	A-2:A-4 Crib	Contamination	5	28	70	28	50	31000												
2-E24-054	A-2:A-4 Crib	Contamination	4	25	60	25	66	1400	66	80	250	80	97	110						
2-E25-191	A-30 Crib	Contamination	6	14	100	14	22	3500	22	32	70	32	36	125	36	49	100			
2-E25-193	A-30 Crib	Contamination	5	14	100	14	24	99999	24	42	50	42	59	75						
2-E17-04	A-36 Crib	Contamination	3	59	60	59	108	1400	108	281	120	281	312	800	312	379	80			
2-E17-05	A-36 Crib	Contamination	4	29	40	29	72	500	72	90	60	90	103	160	103	334	55			
2-E17-07	A-36 Crib	Contamination	2	26	60	26	32	160	32	377	65									
2-E17-09	A-36 Crib	Contamination	4	28	80	28	46	38000	46	89	1400	89	286	130	286	294	400	294	319	100
2-E17-11	A-36 Crib	Contamination	5	24	60	24	42	36000	42	85	10000	85	150	130						
2-E17-14	A-36 Crib	Contamination	2	80	70	80	97	220	97	331	105									
2-E17-51	A-36 Crib	Contamination	5	27	55	27	56	35000	56	82	10000	82	130	4000	130	146	400			
2-E25-190	A-37-2 Crib	Contamination	5	15	70	15	22	400	22	49	60									
2-E17-08	A-38 Crib	Contamination	3	312	70	312	356	250	356	363	500									
2-E24-076	A-38 Crib	Contamination	4	12	65	12	21	160	21	58	75									
2-E24-084	A-38 Crib	Contamination	4	14	75	14	20	400	20	58	80									

Table B6-3. PUREX Contamination Intervals and Average Gamma Activity. (sheet 2 of 2)

Well	Site	Category	Top1	Base	Value1	Top2	Base	Value2	Top3	Base	Value3	Top4	Base	Value4	Top5	Base	Value5	Top6	Base	Value6
2-E24-092	A-38 Crib	Contamination	4	10	65	10	20	1400	20	58	80									
2-E24-096	A-38 Crib	Contamination	4	18	75	18	22	120	22	58	80									
2-E24-100	A-38 Crib	Contamination	4	12	70	12	22	600	22	58	80									
2-E24-104	A-38 Crib	Contamination	4	16	75	16	20	110	20	58	80									
2-E24-001	A-5 Crib	Contamination	3	56	50	56	94	3000	94	340	65									
2-E24-010	A-5 Crib	Contamination	2	26	65	26	44	10000	44	68	2000	68	96	300	96	315	70			
2-E24-057	A-5 Crib	Contamination	4	54	90	54	69	3300	69	147	120									
2-E25-056	A-5 Crib	Contamination	4	54	90	54	64	280	64	146	125									
2-E25-003	A-6 Crib	Contamination	3	25	60	25	40	350	40	306	55									
2-E25-054	A-7 Crib	Contamination	3	6	250	6	11	99999	11	35	70	11	148	120						
2-E25-004	A-8 Crib	Contamination	4	16	120	16	30	300	30	262	55									
2-E25-005	A-8 Crib	Contamination	6	15	50	15	50	30000	50	228	50	228	255	70	255	275	50			
2-E25-006	A-8 Crib	Contamination	4	16	50	16	40	1000	40	65	125	65	220	50	220	255	70	255	272	50
2-E25-007	A-8 Crib	Contamination	3	18	50	18	44	125	44	224	70	224	254	70	254	259	50			
2-E25-014	A-8 Crib	Contamination	6	12	250	12	24	30000	24	84	7000	84	106	30000	106	190	200			
	AX Tank Farm	Contamination	2	6	50	6	17	50000	17	24	50	24	48	24						
2-E25-113	AX Tank Farm	Contamination	2	6	19000	6	28	800	28	34	30	34	39	400	39	98	23			
	C Tank Farm	Contamination	2	8	30	8	14	9000	14	36	24	36	38	60	38	119	26			
2-E27-058	C Tank Farm	Contamination	2	25	23	25	34	9000	34	39	900	39	96	25						
2-E27-059	C Tank Farm	Contamination	2	36	20	36	39	1000	39	70	20	70	98	26						
2-E27-066	C Tank Farm	Contamination	2	18	40	18	22	200	22	35	50	35	143	26						
2-E27-067	C Tank Farm	Contamination	2	10	60	10	40	24	40	46	42	46	133	25						
2-E27-073	C Tank Farm	Contamination	2	10	200	10	24	45	24	28	100	28	127	28						
2-E27-074	C Tank Farm	Contamination	2	32	300	32	52	30	52	68	100	68	122	28						
2-E27-075	C Tank Farm	Contamination	2	13	500	13	35	100	35	95	26									
2-E27-077	C Tank Farm	Contamination	2	12	80	12	46	26	46	55	45	55	96	24						
2-E27-078	C Tank Farm	Contamination	2	10	150	10	44	25	44	51	45	51	78	24	78	96	55			
2-E27-080	C Tank Farm	Contamination	2	11	50	11	16	250	16	96	28									
2-E27-081	C Tank Farm	Contamination	2	36	200	36	96	26												
2-E27-082	C Tank Farm	Contamination	2	18	400	18	22	28	22	59	50	59	67	190	67	81	50	81	96	28
2-E27-094	C Tank Farm	Contamination	2	6	3000	6	18	25	18	26	22000	26	50	20	50	74	30	74	82	80
2-E27-097	C Tank Farm	Contamination	2	33	22	33	50	18	50	56	60	56	98	25						
2-E27-098	C Tank Farm	Contamination	2	80	25	80	86	50	86	96	25									
2-E27-099	C Tank Farm	Contamination	2	16	500	16	28	24	28	34	50	34	96	26						
2-E27-102	C Tank Farm	Contamination	2	46	26	46	49	75	49	96	26									
2-E27-116	C Tank Farm	Contamination	2	14	60	14	20	30	20	29	20000	29	46	100						
2-E27-117	C Tank Farm	Contamination	2	11	300	11	16	40	16	20	1000	20	46	28	46	48	55			
2-E27-118	C Tank Farm	Contamination	0	34	0	34	44	4000	44	48	2	48	62	600	62	66	2			
2-E27-135	C Tank Farm	Contamination	2	8	50	8	42	20	42	78	25	78	86	40	86	123	25			

Table B6-4. Selected RLS Survey Wells for PUREX AAMS.

Well	Tank farm Well	Disposal Site	Drill Date	Drill Depth
299-E17-03		A-27 Crib	3/31/60	400
299-E17-04		A-36 Crib	9/30/65	379
299-E24-10		A-5 Crib	10/31/65	315
299-E24-54		A-2:A-4 Crib	1/31/55	97
299-E24-160		A-10 Crib	3/31/86	217
299-E25-3		A-6 Crib	1/31/54	306
299-E25-169		A-29 Crib	1/31/66	80
299-E25-191		A-30 Crib	6/30/82	49
299-E26-07		A-24 Crib	1/31/66	127
299-E25-66	10-05-10	A Tank farm	4/30/62	122
299-E25-113	11-03-02	AX Tank farm	1/31/75	98
299-E27-82	30-05-05	C Tank farm	6/30/74	122

APPENDIX B7

SEMIWORKS TABLES

Table B7-1. Semiworks Aggregate Area Disposal Facilities and RLS Logging Recommendations.

DISPOSAL FACILITY	LOG WITH RLS	COMMENTS
216-C-1 Crib	NO	NO MONITORING WELLS
216-C-3 Crib	NO	NO MONITORING WELLS
216-C-4 Crib	NO	NO MONITORING WELLS
216-C-5 Crib	NO	NO MONITORING WELLS
216-C-6 Crib	NO	NO MONITORING WELLS
216-C-7 Crib	NO	NO LOGGING DATA
216-C-9 Pond	YES	ACTIVITY
216-C-10 Crib	YES	ACTIVITY

Table B7-2. Semiworks Aggregate Area Radioactivity Categorized by Facility and Well.

Well	Tankfarm	Facility	Log Date	Category	E	N
2-E27-133		C-1 Crib			-50220	42080
2-E27-005		C-10 Crib	5/04/76	Contamination	-49881	42075
2-E27-126		C-4 Crib			-50687	42182
2-E27-127		C-4 Crib			-50687	42132
2-E27-128		C-4 Crib			-50687	42181
2-E27-130		C-4 Crib			-50724	42132
2-E27-132		C-4 Crib			-50767	42177
2-E24-8		C-5 Crib			-50346	41962
2-E27-129		C-7 Crib			-50727	42092
2-E27-131		C-7 Crib			-50767	42086
2-E27-001		C-9 Crib	7/14/87	Contamination	-50440	42833

Table B7-3. Semiworks Contamination Intervals and Average Gamma Activity.

Well	Site	Category	Top1	Base	Value1	Top2	Base	Value2	Top3	Base	Value3	Top4	Base	Value4	Top5	Base	Value5	Top6	Base	Value6
2-E27-005	C-10 Crib	Contamination	5	316	75	316	334	500												
2-E27-001	C-9 Crib	Contamination	3	316	150	316	322	290												

Table B7-4. Selected RLS Survey Wells for Semiworks.

Well	Disposal Site	Drill Date	Drill Depth
299-E27-1	C-9 Crib	4/30/48	322
299-E27-5	C-10 Crib	10/31/62	333

APPENDIX B8

200 NORTH TABLES

Table B8-1. Well Selection for RLS Surveys in the 200 North Aggregate Area.

There were two existing wells located in the 200 North aggregate area. Both wells are located within a pump house that restricts the access by the RLS. Neither well was selected for logging at this time.

Well	E	N	Drill date	Drill depth
6-55-60A	-60100	55100	12/31/43	236
6-55-60B	-60140	55425	7/31/44	288

DISTRIBUTIONSHEET

To	From	Page 1 of 1
Distribution	Geosciences	Date 9-21-93
Project Title/Work Order		EDT No. 160857
Results of Spectral Gamma-Ray Logging of Select Boreholes for the Aggregate Area Management Study		ECN No.

Name	MSIN	Text With All Attach.	Text Only	Attach./ Appendix Only	EDT/ECN Only
Brodeur, J.B. (7)	H6-06	x			
Wittreich, C.D. (10)	H6-03	x			
Downey, H.D.	H6-27	x			
Carlson, R.A.	H6-03	x			
Pak, P.M.	A5-19	x			
Hilderbrand, R.D.	A5-55	x			
Fassett, J.W.	H6-06	x			
Price, R.K.	H6-06	x			
Galgoul, M.J.	H6-03	x			
Erb, D.B.	H6-03	x			
Thompson, R.R.	N1-73	x			
Trent, S.J.	H6-06	x			
Fecht, K.R.	H6-06	x			
Haygood, M.C.	H6-04	x			
Central Files (2)	L8-04	x			
IC (2)(1)	H6-08	x			
Offsite					
C. J. Koizumi Rust Geotech, Inc. P.O. Box 14000 Grand Junction, CO 81502-5504		x			
R.D. Wilson Rust Geotech, Inc. P.O. Box 14000 Grand Junction, CO 81502-5504		x			