UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Federal Center, Denver 25. Colorado

In reply refer to:

Technical Letter
Dribble-37
June 11, 1963

Mr. James E. Reeves, Manager
Nevada Operations Office
U.S. Atomic Energy Commission
P. O. Box 1676
Las Vegas, Nevada

Dear Mr. Reeves:

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TECHNICAL LETTER: DRIBBLE-37

MEASUREMENTS OF SUBSURFACE NATURAL
GAMMA RADIOACTIVITY, PROJECT DRIBBLE,
LAMAR COUNTY, MISSISSIPPI

By

C. M. Bunker and W. A. Bradley

USGS-474-293

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Sincerely yours,

W. S. Twenhofel

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MEASUREMENTS OF SUBSURFACE NATURAL GAMMA RADIOACTIVITY,
PROJECT DRIBBLE, LAMAR COUNTY, MISSISSIPPI

By

C. M. Bunker and W. A. Bradley

Geophysical investigations at Project Dribble, Lamar County, Mississippi (fig. 1) included measurements of natural gamma radioactivity in the geologic formations underlying the Dribble site. The objectives of the radioactivity measurements are: (1) to determine semiquantitatively the natural radioactivity of the formations and (2) to determine the relative intensities of radioactivity in the lithologic units to aid geologic studies. These preexplosion data will be used as a basis of comparison with postexplosion data to determine the distribution of nuclear-explosion-produced radioisotopes and to determine whether these isotopes migrate into the ground water.

Preshot gamma-ray logs were made during April 1963 in available test holes and wells within a 1-mile radius of the working point. A list of the holes logged and data pertaining to them are summarized in table 1. Other holes drilled prior to April were not logged because they were plugged, contained drilling equipment or debris, or were too near the logged holes to contribute significantly to the radioactivity data.

Figure 1—Location of drill holes gamma-ray logged

Table 1.--Drill-hole data pertaining to holes gamma-ray logged, Project Dribble

Drill hole number	Elevation (feet)	1/ Collar coordinates	Casing		Log type	Depth logged (feet)	Date logged	Remarks
			Length (feet)	Size (inches)				
E-6	241.8 (casing top) 240.46 (pad top)	N.538,050.45 E.268,734.48	0 - 315 237 - 938	9-5/8 7-5/8	G-M Scintillation	1.0 - 958.3 2.5 - 959.8	4/10/63 4/10/63	Zero datum at casing top. Water level at 199 feet.
E-9	250.29 (casing top) 248.30 (pad top)	N.536,390.38 E.270,916.59	0 - 983	9-5/8	G-M Scintillation	1.1 - 965.3 2.6 - 966.8	4/12/63 4/12/63	Zero datum at casing top. Hole closed below 967 feet.
E-13	2/-----	N.537,047.73 E.268,098.43	0 - 1,551	11-3/4	G-M Scintillation	0.8 - 1,298.3 2.3 - 1,299.8	4/10/63 4/10/63	Zero datum at ground level. Dry hole to 1,300 feet.
E-14	-----	N.537,199.25 E.269,006.28	0 - 1,524	11-3/4	G-M Scintillation	9.3 - 1,473.3 10.8 - 1,474.8	4/8/63 4/8/63	Zero datum at casing top. Water level at casing top.
Multiple Test No. 1	306.48 (pad top) 308.23 (16-inch casing top)	N.539,390 E.272,660	0 - 324 300 - 2,246 0 - 2,400	16 9-5/8 3-1/2	G-M Scintillation	0.0 - 1,255.6 1.1 - 1,257.1	4/12/63 4/12/63	Zero datum at top of concrete pad.
HT - 2B	291.81 (pad top)	3/N.532,380 E.266,380	0 - 943 890 - 1,003	5 3-1/2	G-M Scintillation	0.0 - 947.1 1.5 - 948.6	4/12/63 4/12/63	Zero datum at top of concrete pad.
HT - 3	269.5 (casing top)	3/N.535,800 E.268,730	0 - 1,063	11-3/4	G-M Scintillation	1.2 - 936.0 2.7 - 937.5	4/12/63 4/12/63	Zero datum at casing top. Water level at 104.4 feet. Hole closed below 938 feet.
HT - 6	267 (estimated) (ground level)	3/N.535,800 E.268,780	0 - 740	8-5/8	G-M Scintillation	0.0 - 797.7 0.6 - 799.2	4/8/63 4/8/63	Zero datum at ground level (2 feet below casing top). Hole closed below 799.5 feet.

1/ Mississippi State coordinates. Survey by Holmes and Narver, Inc.

2/ Data unavailable at time report was written.

3/ Locations measured from base map.

Two types of gamma-ray detection equipment were used for the measurements. This equipment is essentially sensitive only to gamma radioactivity because of the protective metallic housing surrounding the detectors.

A highly sensitive scintillation detector was used to obtain data to be used primarily as an aid in correlating lithologic units. No attempt was made to calibrate the equipment to obtain quantitative data on the amount of radioactivity in the formations. Instead, the scintillation equipment was adjusted for maximum sensitivity to indicate small changes in relative amounts of radioactivity.

Geiger-Mueller detectors were used to obtain semiquantitative measurements of the radioactivity in the formations adjacent to the drill holes. This equipment was calibrated with radium-226 standards prior to logging to relate instrument response to known quantities of radioactivity.

The radioactivity incident on the G-M detector in most of the drill holes (figs. 2 through 9) results in a counting rate range of about 20 to 80 counts per minute (cpm). The radiation-equivalent of the cpm values is 0.003 to 0.012 milliroentgens per hour (mr/hr). The radioactivity emitted from natural radioisotopes in the formations adjacent to the drill holes is somewhat greater than the indicated value because of the absorption of gamma-rays by casing and water in the drill holes. The casing reduces the radioactivity by about 35 percent. Water-filled holes having a diameter ranging from

Figure 2—Gamma-ray logs and lithologic data Hole E-6

Figure 3-Gamma-ray logs and lithologic data Hole E-9

Figure 4—Gamma-ray logs and lithologic data Hole E-13

Figure 6—Gamma-ray logs and lithologic data Multiple Test Well 1

Figure 7—Gamma-ray logs and lithologic data Well HT-2B

Figure 8—Gamma-ray logs and lithologic data Well HT-3

Figure 9-Gamma-ray logs and lithologic data Well HT-6

7 to 12 inches causes a 35 to 45 percent reduction in radioactivity incident on the detector. Therefore, the formation radioactivity in the vicinity of the Dribble site is in the approximate range of 0.008 to 0.03 mr/hr. One exception to this general range of radioactivity was observed in the depth interval of 73 to 78 feet in hole E-9 (fig. 3). The counting rate in this highly radioactive zone is about 500 cpm, which is equal to about 0.15 mr/hr or approximately 5 times the radioactivity of other clay beds in the general area. This radioactivity is believed to be from natural radioisotopes, although the possibility of artificial radioisotopes being introduced in drilling and/or injected as a depth marker was considered.

The scintillation logs generally define the depth intervals of the sandy aquifers by a reduction in radioactivity. Clay beds are indicated by an increase in radioactivity. Some discrepancies between the geologic data and the gamma-ray data are probably caused by the use of a different reference point at the top of the hole and by the preliminary nature of some of the geologic data.

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