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ENVIRONMENTAL SURVEILLANCE JANUARY – JUNE 1964: A SEMIANNUAL REPORT

by M. A. Glora and B. L. Brown

Reynolds Electrical & Engineering Co., Inc.
Radiological Sciences Department
Mercury, Nevada

August 1964

Work done for the U. S. Atomic Energy Commission
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Reynolds ELECTRICAL & ENGINEERING Company

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Introduction

Radiation conditions within the Nevada Test Site are appraised continually through routine collection, analysis, and evaluation of samples of air, water, soil, vegetation, and surface dust. Such a program permits technicians to detect even the smallest changes in radiation conditions. Records of the measurements thus obtained provide up-to-date accounts of current levels of contamination, and indicate how radiation conditions vary.

This report deals with radiological conditions--and changes in conditions--throughout the entire Test Site, without regard to nuclear tests and radiation in test areas immediately after the detonation and postshot reentry.

While it is clear that tests have immediate effects on the general environs, the data in this report and the overall program of environmental surveillance are not related to specific tests, but to general conditions of radiation. Only when a specific test affects the environment beyond the controlled test area is general surveillance intensified.

Data from these special surveillance activities are included in this report. Data from specific areas after tests are in the reports for those tests.

Aside from the immediate health-related aspects of the program reported here, long-range studies are under way and being planned.

Data from Airborne-Particulate Samples

Twelve permanent air-monitoring stations were maintained to sample air at the Nevada Test Site. (See Exhibit A, page 5, appendix.) Filter Queen air samplers and 8-by-10-inch glass-fiber filter paper were used. Operating time was determined by integral electric timers; flow rate, by calibrated rotometers. Depending on the particular sampler characteristics, the flow rate varied from 3 to 6 cubic feet per minute. Samples were collected weekly.

(At the end of this report period, the Filter Queen samplers were being replaced with positive-displacement Gast pumps, which were equipped with total-volume meters. This change was instigated to increase sampling efficiency and reduce maintenance costs. Also, continuously operating caustic scrubbers were being installed at each location for collection of radioiodine samples.)

For this report, air samples were analyzed only for gross alpha and beta contamination and, under certain conditions, for actinium 227. An "alert level"

for air contamination was set at 10^{-5} microcurie of gross radioactive substances per cubic meter of air, based on the absence of actinium 227.* If gross beta activity in a sample exceeded this level, an analysis for actinium was made. If there was no actinium, the most hazardous beta emitter present was identified through scanning with a spectrometer, and the alert level was increased to the level appropriate for this emitter.

Table I (page 7, appendix) shows the highest and lowest amounts of gross beta contamination detected each month during this period through air sampling.

Weekly changes in beta air contamination for all permanent sampling stations within the Nevada Test Site are shown in Exhibit B (page 6, appendix). It is apparent that air-contaminant concentrations during March neared the alert level. However, within one week concentrations fell to the normal range of 10^{-6} microcurie of gross beta per cubic meter of air.

During a test in March there was an escape of low-level radioactivity in Area 3. A few hours later there was a notable increase in air contamination at nine of the 12 sampling stations. It was interesting to note that data from sampling stations, whether upwind or downwind from the source of contamination, indicated increases in airborne contamination.

Alpha activity on the filter paper represented normal radon-thoron daughter-product concentrations upon initial count. No long-lived alpha emitters were detectable after a five-day decay period.

During lulls of a week or more in test activities, concentrations of air contamination decreased gradually. However, the periods during which no testing occurred were too short to provide a reliable index for what might be considered a "normal" rate of decrease at the respective stations.

Data from Water Samples

Samples of both potable and industrial water were collected routinely. The frequency of sampling depended on the use of the water: drinking water was sampled weekly; all other water was sampled monthly. (Industrial water was defined as that from exposed reservoirs, natural springs, and sump and waste ponds that were not used for human consumption.)

All water samples were analyzed for gross-alpha and -beta emitters. Selected samples were analyzed for a specific beta-emitting isotope. An alert level for potable water was set at 10^{-6} microcurie of gross radioactive substances per milliliter of water, based on the absence of radium 226 and radium 228.* Samples indicating a concentration of radioisotopes above this level were completely analyzed for isotopic content.

POTABLE WATER.--The concentration of radioisotopes in potable water did not exceed safe levels during the six months of this reporting period. With one exception, contamination was so slight as to be statistically insignificant.

* Maximum Permissible Body Burdens and Maximum Permissible Concentrations of Radionuclides in Air and in Water for Occupational Exposure, National Bureau of Standards Handbook 69 (Washington, D. C.: U. S. Government Printing Office, 1959), p. 94.

The exception showed an activity of 5.6×10^{-7} microcurie of gross beta emitters per milliliter of water. This amount was still below the alert level (or maximum permissible concentration of 10^{-6} microcurie per milliliter of water). Follow-up samples from this source indicated a substantial decrease in concentration from this lower level.

No alpha contamination was detected in the analysis of potable water.

INDUSTRIAL WATER.--Contamination levels of industrial water ranged from the detection limit of 10^{-8} microcurie of gross beta per milliliter of water, to 1.1×10^{-3} microcurie of specific beta-emitting isotopes per milliliter of water from some waste ponds.

Samples of water from springs, natural ponds, and reservoirs were taken routinely. Analysis of these samples provided an index of the degree of contamination contributed to surface and underground water by nuclear detonations and reactor tests. It was interesting to note that in both cases contamination was not significant, if it was present at all. In a few cases in which detectable contamination was present in standing surface water, its apparent origin was old fission products present in the soil, rather than freshly deposited contamination.

Data from spring and deep-well-water samples indicated that underground testing contributed insignificant amounts of radioisotopes, if any, to the normal low background of the water.

Data from Swipes

During the report period, 1,283 routine swipes were taken. Of this amount, five samplings, all at the Nuclear Rocket Development Station, indicated low levels of contamination after reactor tests. The maximum level measured was 320 disintegrations a minute, per square foot of surface. In all five cases, the user of the contaminated area or location (shop, dispensary, etc.) was notified of the contamination. Follow-up samples were taken, and facilities were decontaminated when it was necessary.

Swipes were counted for gross-alpha and -beta emitters only. Significant counts above background were considered justification for follow-up surveys and decontamination.

Data from Soil and Vegetation Samples

Soil and vegetation samples were taken concurrently to monitor generalized low-level increases or decreases in contamination in "clean" areas. Whenever it was possible, soil and vegetation were collected near standing surface water and springs; this provided a further check on the origin and dissemination of water contamination.

There were no significant changes in the soil- and vegetation-sample data obtained during this report period.

Data from Special Samples

Special samples, in addition to the routine samples, were collected as the

need arose. In this category were samples collected during mining operations, postshot reentry, and drilling.

Radon-thoron samples were collected periodically in the Area 15 shaft at depths to 1,000 feet. Sample data indicated that the radon concentrations in the shaft were safely below the MPC of 3×10^{-8} microcurie per cubic centimeter. Thoron activity, as indicated by decay, was negligible. As expected, radon concentrations increased after blasting. Also, concentrations at the mouth of the shaft were, on the average, twice as high as those at the lowest levels. (Ventilation air was routinely exhausted through the mouth of the shaft.)

Another special sampling program was begun in March after radiation escaped during a test in Area 3, mentioned on page 2. All permanent air-sampling-station filters on the downwind side of the test area were collected on the day of the event. All other stations on the Site were sampled within three days. In addition, special sampling stations were established in locations predicted to be in the cloud path. The special samples were taken with high-volume samplers. Sampling continued for about five hours. While a notable general increase in airborne contamination levels was observed during this period of intensified surveillance, no significant inhalation-exposure hazards were indicated.

Table II (page 7, appendix) shows the amounts of airborne beta contamination collected by means of air samplers before the release of radiation in Area 3 (referred to on page 2), and after that release. No alpha activity above background was detected in either period.

Special water samples also were collected during this event. No contamination of potable water was detected.

Special swipes were collected in areas of particular interest both before and after this event. Minor surface contamination detected on the swipes was attributed to personnel traffic. Table III (page 8, appendix) shows the amounts, in disintegrations per minute per square foot of surface, of alpha and beta contamination detected on swipes taken before and after the radiation release in Area 3.

Analysis of the measurements made during this six-month period indicates that only those locations directly downwind received noticeable surface deposition. In no case was there evidence of internal-exposure hazards.

Table IV (page 8, appendix) shows a breakdown, by type and month, of routine samples collected and analyzed for this report period.

Conclusion

The general radiological conditions at the Nevada Test Site did not change significantly during the six-month reporting period of January through June 1964. This conclusion is based on the analysis and evaluation of data from routine and special samples, which data were correlated with reports of localized conditions from the Radiation Monitoring and Decontamination Branch.

EXHIBIT A

Locations of permanent air-sampling stations at the Nevada Test Site and Nuclear Rocket Development Station (NRDS).

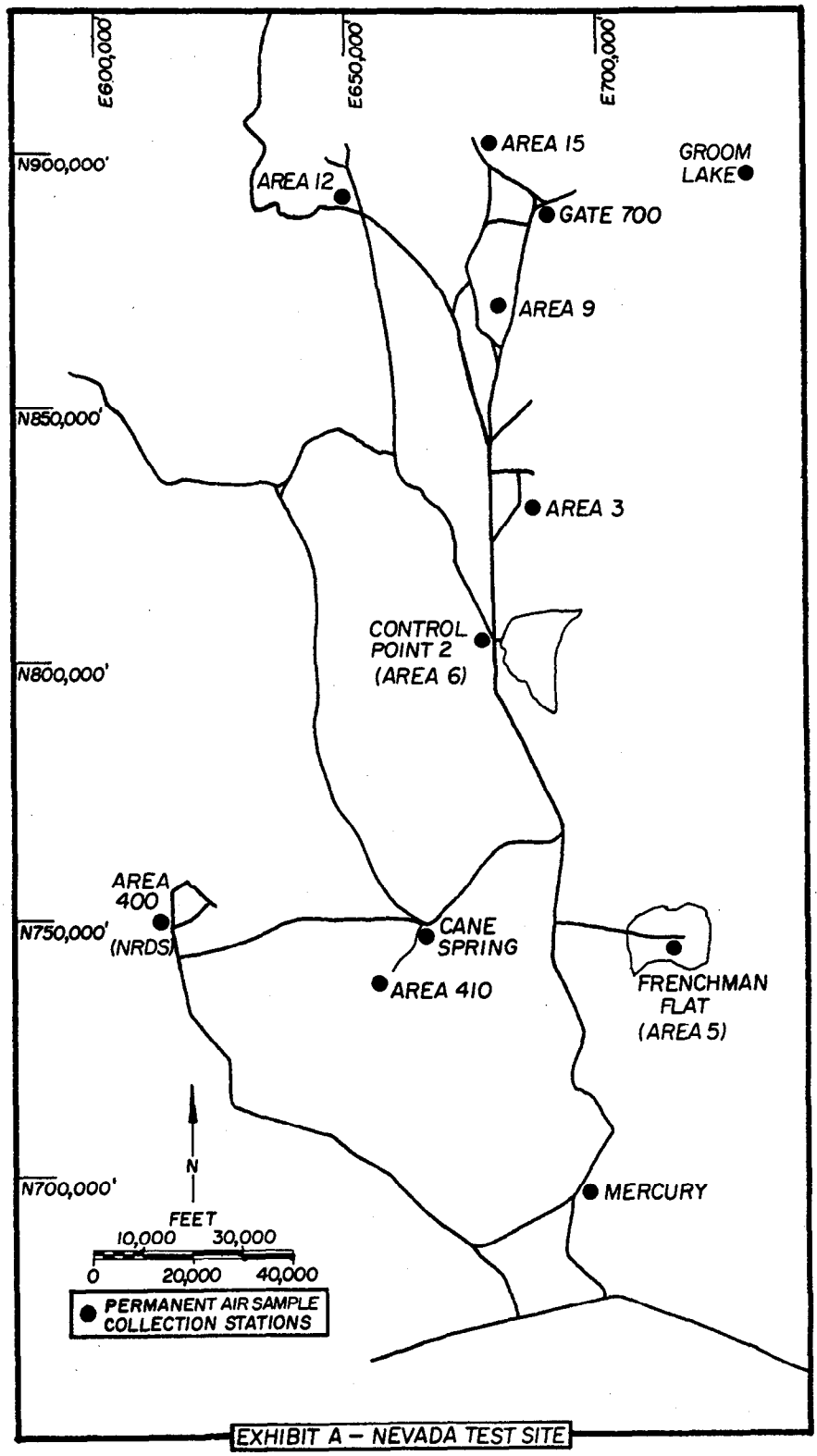
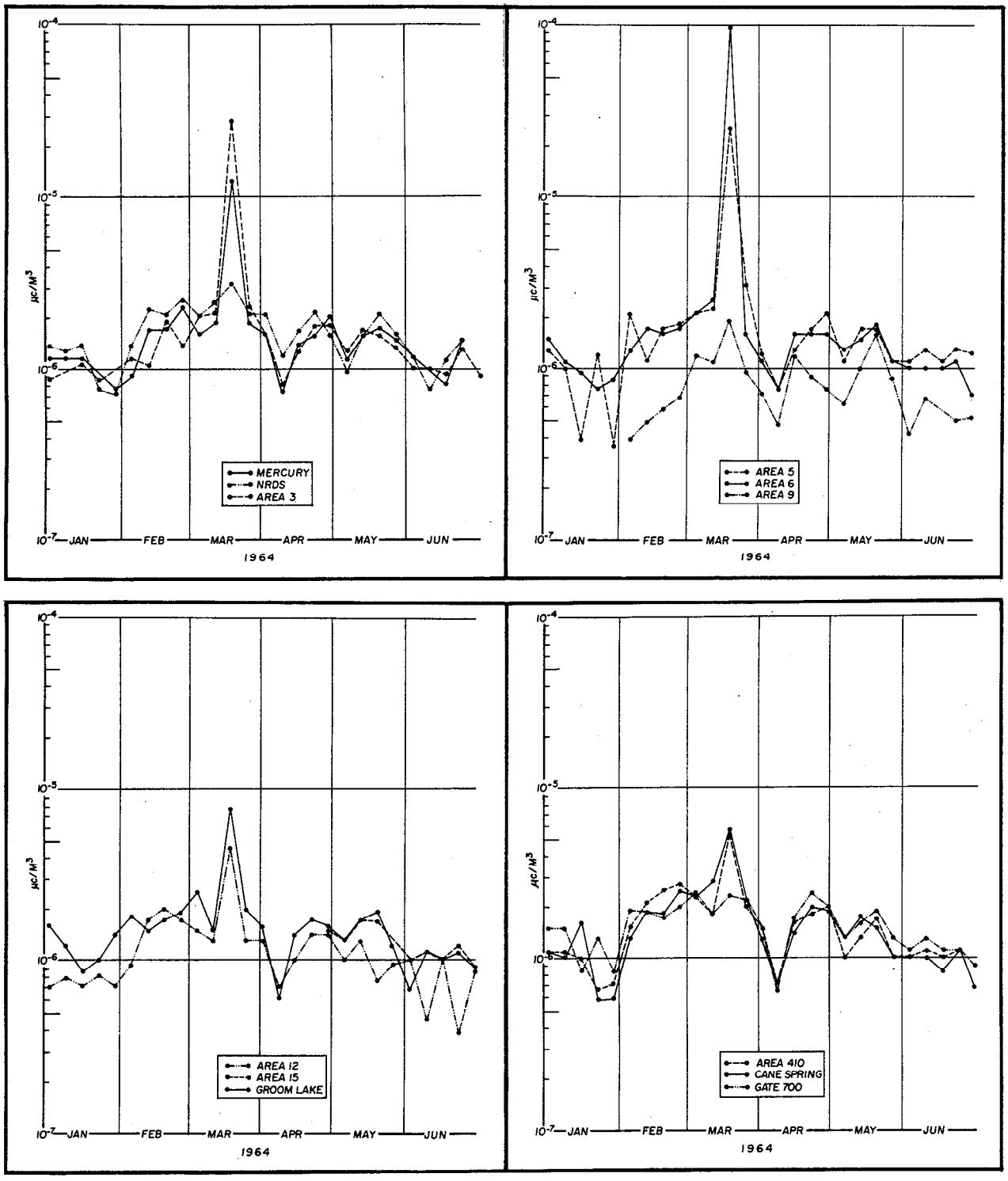


EXHIBIT B

Weekly measurements of airborne beta radiation obtained at the air-sampling stations depicted in Exhibit A. Amounts are in microcuries of gross beta per cubic meter of air sampled.



APPENDIX

TABLE I

Highest and lowest measurements, per month, of airborne beta contamination from all sources after five-day decay periods--January through June 1964. Measurements are in microcuries of gross beta per cubic meter of air.

Month	Microcuries of Beta per Cubic Meter of Air	
	Highest	Lowest
January	1.6×10^{-6}	1.0×10^{-7}
February	2.7×10^{-6}	3.9×10^{-7}
March	8.4×10^{-5}	9.6×10^{-7}
April	2.4×10^{-5}	4.8×10^{-7}
May	2.1×10^{-6}	6.2×10^{-7}
June	1.3×10^{-6}	1.0×10^{-7}

TABLE II

Airborne beta contamination* from all sources, collected by means of air samplers one week before and after escape of radiation from an Area 3 nuclear event. Measurements are in microcuries of gross beta per cubic meter of air.

Location	Microcuries of Beta per Cubic Meter of Air	
	Before	After
Mercury, Cafeteria 2	2.0×10^{-6}	2.6×10^{-5}
Mercury, DOD Motor Pool	not sampled	6.0×10^{-6}
Security Station 200	not sampled	4.9×10^{-5}
Area 3, cafeteria	1.6×10^{-6}	1.3×10^{-6}
Area 5, REECo field office	not sampled	2.3×10^{-6}
Area 5, underground garage	1.6×10^{-6}	8.4×10^{-5}
Area 6	2.0×10^{-6}	2.3×10^{-6}

* No alpha activity above background levels was detected.

TABLE III

Alpha and beta activity on swipes of surface dust taken before and after the escape of radiation in Area 3. Measurements are in disintegrations per minute per square foot of surface.

Location	Disintegrations per minute per square foot of surface before and after escape of radiation			
	Before		After	
	Alpha	Beta	Alpha	Beta
Area 3, cafeteria	#	#	#	#
Area 3, superintendent's office	#	#	#	#
Area 3, laborers' office	#	#	#	70*
Area 3, Radiological Sciences trailer:				
Floor	-	-	#	2400*
Counter	-	-	-	380*
BJY dispensary	#	#	#	#

Less than 12 disintegrations per minute per square foot of surface, minimum detectable amount.

* Contamination tracked in by workmen.

TABLE IV

Number of routine samples of each type collected and analyzed for each month of the report period.

	Air	Water	Soil	Vegetation	Swipes	Total
January	55	47	13	11	219	345
February	48	40	11	8	156	263
March	60	40	10	4	159	273
April	58	38	11	6	173	286
May	48	56	11	7	246	368
June	56	58	12	8	330	464
Total	325	279	68	44	1283	1999