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LRAD Surface Monitoring Results at TA-21

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Introduction

In August/September 1994, NIS-6 personnel used LRAD soil surface monitor technology to characterize the extent of alpha contamination on the surface of a parking lot adjacent to TA-21, LANL, known as Material Disposal Area B. This report documents that monitoring.

Monitor Description

Radiation interacts with air by ionizing the air molecules. A series of detectors have been developed¹ that collect and measure the amount of ionized air around an object or above a surface; the measurement is proportional to the amount and type of radioactivity present. Beta and gamma radiation have long path lengths and tend to not cause many ions in these detectors. Alpha radiation, on the other hand, has a path length of only about two inches in air and creates a large number of ions in a short distance. Because these air ions can be transported up to several meters before recombining, the approach has been named Long-Range Alpha Detector (LRAD) technology. LRAD detectors have proven more efficient and practical than traditional alpha detectors for many monitoring tasks.

Uranium and plutonium each decay by alpha emission and so are ideal candidates for detection by an LRAD. For monitoring soil surfaces contaminated with alpha emitters, a large-footprint detector is used, which measures the ionized air by collecting ions on a charged plane. The collected ions cause a measurable current, which is recorded for each monitored location. Higher soil contamination produces higher measured currents. Prior to TA-21 it had been used to monitor,² with excellent results, a total of eleven sites for seven groups at three DOE facilities. The LRAD soil surface monitors are so rugged that the largest ones measure 1 m² and are mounted on the front end of a tractor, withstanding the beating obtained by driving over rough terrain and being placed on the ground with occasional hydraulic pressure. Figure 1 shows the construction of the detector.

Figure 1. Schematic of the LRAD Soil Surface Monitor. DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

Site Description

The parking lot on the south side of DP road and adjacent to TA-21 is suspected of having alpha contamination from activities at TA-21. The parking lot was used first by DOE, then as a county parking area for recreational vehicles, and is now back under the oversight of DOE. The parking lot is fenced off and stays locked. It slopes down to the south and away from DP road. With weathering, any surface activity could be assumed to have been washed down and accumulated on the southern edge of the parking area. Curbs funnel water runoff to drains through the fence at regular intervals. The asphalt is in generally good condition, with sporadic weeds poking through. There were few cracks in the pavement, and none were so severe as to reveal dirt underneath.

Procedure

The parking area lines were used to establish a regular sampling pattern once it was determined that the lines were regularly spaced. Data was generally taken on the center line of the parking spots. Any vegetation was removed prior to monitoring, and most readings were obtained within a meter of the outside edge of the pavement. The exception was on the northeast side where low tree branches would have made placing the detector difficult. In addition, under these trees were up to 3 cm of needles and leaves that, from their relatively recent nature, would have covered any contamination present. For this dogleg of the parking area, data was collected down the middle of the area instead of on its northern edge.

Results and Interpretation

The data obtained is presented as both a contour plot (Fig. 2) and in Table 1. Areas between the grid points on the plot have interpolated values as determined by the normal graphics plotting routine in the computer program DeltaGraph Pro for the Macintosh. The table gives the parking space number, its x and y positions for the graphs, the current reading (where $1 \text{ fA} = 10^{-15} \text{ A}$), and the corresponding activity in $\text{dpm}/100 \text{ cm}^2$. The conversion from fA to $\text{dpm}/100 \text{ cm}^2$ is $(\text{fA}-250)*0.06$, where 250 is the intrinsic background level in the detector.

Other than on a few occasions, this was the first time the LRAD soil sample monitor had been used on asphalt. All readings were below natural background activity levels for soils on the LANL mesa tops. These low readings were expected because asphalt contains a large amount of hydrocarbons. Hydrocarbons have intrinsically lower activity than soil with its natural uranium and thorium decay chains. Nonetheless, readings were roughly five times larger than the intrinsic background level in the detector.

Because so few paved locations have been monitored with the LRAD, we looked at the distribution of readings to see if it fit a normal bell curve. If it did, we could assume the parking lot was all clean or was all uniformly contaminated. The significant area covered by the parking lot made the latter unlikely. The distribution of readings is shown in the form of a histogram in Fig. 3. The distribution is nearly normal in shape, but has at least one eye-catching high reading. Closer inspection reveals that four of the highest six readings occurred together in the eastern

Figure 2. Contour Plot of LRAD Surface Readings at TA-21's Area B. Squares indicate measurement locations. The inset shows the area of highest readings.

Table 1. LRAD Readings

Description	Reading #	Feet West	Feet North	fA	dpm/100 cm ²
mid east fence	1	2.5	31.8	1300	63
far corner	2	3.5	5	1200	57
drain	3	8.8	3.5	1250	60
midpoint	4	2.8	20.5	1300	63
other side	5	2.5	56.8	1300	63
high side	6	2.7	80.3	1300	63
210 line	7	25	46	1800	93
208 line	8	55	46	1600	81
206 line	9	85	46	1500	75
204 line	10	115	46	1500	75
"202" line	11	145	46	1600	81
210 fence	12	25	3	1900	99
208 fence	13	55	3	2700	147
206 fence	14	85	3	1500	75
204 fence	15	115	3	1600	81
"202" fence	16	145	3	erratic	
"202" fence	17	145	3	1200	57
"202" I repeat	18	145	46	1200	57
208 north	19	55	7	1450	72
208 f repeat	20	53	3	2300	123
202 line	21	178	27	1200	57
200 line	22	202	27	1200	57
198 line	23	226	27	1200	57
196 line	24	250	27	1050	48
194 line	25	274	27	1000	45
202 fence	26	178	3	1400	69
200 fence	27	202	3	1350	66
198 fence	28	226	3	1400	69
196 fence	29	250	3	1100	51
194 fence	30	274	3	erratic	
192 line	31	298	27	1200	57
194 fence	32	274	3	erratic	
192 fence	33	298	3	erratic	
192 line	34	298	27	erratic	
192 fence	35	298	3	1400	69
180 fence	36	405.3	-50.67	1400	69
170 fence	37	512.66	-104.34	1100	51
160 fence	38	620	-158	1500	75
150 fence	39	727.33	-211.67	1400	69
140 fence	40	834.66	-265.33	1100	51
130 fence	41	942	-319	1500	75
120 fence	42	1049.33	-372.67	1500	75
110 fence	43	1156.66	-426.33	1300	63
100 fence	44	1264	-480	1400	69
96 fence	45	1307	-501.5	1300	63
90 north fence	46	1351.62	-412.14	1600	81
88 north fence	47	1308.7	-390.67	1500	75
78 north fence	48	1201.36	-337	1200	57
68 north fence	49	1094.05	-283.33	1000	45
58 north fence	50	986.7	-229.66	1500	75
39 north fence	51	879.37	-176	800	33
32 north fence	52	772.05	-122.23	2000	105
25 north fence	53	664.72	-68.57	1800	93
19 north fence	54	557.38	-14.9	1200	57
12 north fence	55	450.05	38.77	1100	51

section of the parking area, at or near parking space number 208. The region is expanded for clarity in the inset of Fig. 2. It includes two additional readings adjacent to the hot spot to determine its extent. We found nothing directly north of it and a similar hot spot directly downstream from it. However, the fence drain further downstream showed no high activity. Likewise the next grid point further upstream along the fence showed no high activity.

Figure 3. Distribution of LRAD Readings in Area B.

Conclusions

Based on this survey, we do not see any reason for concern about significant contamination in the parking area as a whole, although unexpected small hot spots could exist between the grid points where monitoring was performed. However, the grouping of high readings on the east side of the parking area does point to possible contamination at the level of 100 dpm/100 cm² or less (above background). Further monitoring or remediation of this area seems appropriate. In addition, because this was an alpha survey, we cannot rule out contamination under the asphalt or possibly between layers if it was paved more than once.

References

1. D.W. MacArthur et al., "LRAD Surface Monitors," Los Alamos National Laboratory report LA-12524-MS (1993).
2. S.E. Garner et al., "A Compendium of Results from Long-Range Alpha Detector Soil Surface Monitoring: June 1992 - May 1994," Los Alamos National Laboratory report LA-12861-MS (1994).