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OPERATION ROLLER COASTER

Oral Report, Sandia Meeting, 14 - 15 April 1964

PROJECT 2.8 Off Site Survey

DTL-067461

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Las Vegas, Nevada

SUMMARY OF  
DATA COLLECTED IN OFF-SITE  
POPULATED AREAS DURING THE  
PROJECT ROLLER COASTER EVENTS

The Roller Coaster Project consisted of four alpha debris scattering events running from May 15, 1963, to June 9, 1963.

The USPHS provided air samplers, ground monitoring, and fallout collectors both on and off-site for this project.

Of the four events only the first two (Double Track and Clean Slate 1) were detected on air sampler filters located in off-site populated areas.

Maximum gross alpha concentrations found on air filters collected at populated locations from the Double Track Event were 12.1 dpm/M<sup>3</sup> at Scotty's Junction, Nevada, and 11.3 dpm/M<sup>3</sup> at Beatty, Nevada. An air sampler located at Stake No. 76, adjacent to a highway department asphalt batch plant, produced a filter with a gross alpha activity of 29.0 dpm/M<sup>3</sup>.

Air filters collected in off-site populated locations from the Clean Slate 1 Event showed a maximum of 0.32 dpm/M<sup>3</sup> gross alpha at Lathrop Wells, Nevada. Traces were detected at eight other populated stations.

Ground monitoring in off-site populated areas after the Double Track Event produced no readings above background levels with the exception of small concentrations (0-27 cpm) along Highway 95 from approximately fifteen miles south of Goldfield to Springdale.

No readings above background levels were taken in populated locations after the other three events.

Of the 308 fallout film collectors exposed during the Double Track Event 150 were selected for chemical and radioanalysis. The results from ninety-eight of these samples have been forwarded to the USPHS, Off-Site Surveillance Section. Film collectors along Highway 95 from Springdale to Lida Junction showed concentrations above background levels. The maximum activity reported to date from a populated location was  $2154 \pm 46$  dpm/ft<sup>2</sup> of Pu<sup>239</sup> at Stake 92 located approximately five miles north of Springdale on Highway 95. Several collectors located along this route showed concentrations above 1000 dpm/ft<sup>2</sup> of Pu<sup>239</sup>.

No results from the 746 film collectors collected after Clean Slate 1, 2, and 3 have been received by this office.

Additionally 1078 50 mm x 75 mm glass slide fallout collectors were placed and collected by the PHS. It is not known whether the results from these devices will be made available to this facility.

Water samples collected from populated locations showed no alpha activity above background levels.

SUMMARY OF DATA COLLECTED FROM ON-SITE AREAS DURING THE PROJECT  
ROLLER COASTER EVENTS

Due to the considerable difference in areas covered by ground monitors only the air, fallout collectors, and water sampling will be summarized here. Ground monitoring results will be found in tabular form along with maps on the following pages. In brief, maximum concentrations of 600-1000 cpm were found after Double Track, Clean Slate 1 and Clean Slate 2 at on-site locations within 12-15 miles of Ground Zero. Rain storms during the last three events made ground monitoring difficult and quickly washed alpha emitters into the soil. No readings above background were taken after Clean Slate 3.

Air sampler filter results may best be summarized by dividing the events into two parts; Double Track, and Clean Slate 1, 2, and 3. Ground Zero for the Double Track Event was located on Stonewall Flat while Clean Slate 1, 2, and 3 were located in Cactus Flats.

The maximum gross alpha concentration found on an on-site filter from the Double Track Event was 193.69 dpm/M<sup>3</sup> at Stake No. 262 located approximately twelve miles southeast of Ground Zero. Analysis of filters from eight other on-site samplers showed levels of alpha activity below 10 dpm/M<sup>3</sup>. By the following day most locations had reached background levels. Although some "smearing" of the released contaminates took place after the event, the main part of the cloud moved south to southeast on both sides of Stonewall Mountain eventually crossing Highway 95 between Lida Junction and Springdale.

Levels of activity from on-site air samplers from the Clean Slate 1, 2, and 3 Events indicated maximum concentrations of 38.52 dpm/M<sup>3</sup> gross alpha at Stake 824 approximately 12-15 miles southeast of Ground Zero. This filter was taken during the Clean Slate 1 Event. Filters taken from the same areas during Clean Slate 2 and 3 showed maximum gross alpha concentrations of only 1.33 dpm/M<sup>3</sup>. Clean Slate 3 debris was concentrated very close to Ground Zero with air samplers located as close as twelve miles of Ground Zero indicating only background levels.

Water samples taken from standing ponds on-site showed only small concentrations of alpha emitters.

PROJECT ROLLER COASTER

"Double Track"

May 15, 1963

SUMMARY

A non-nuclear experiment took place on Stonewall Flats at 0255 hours on May 15, 1963. The purpose of this event was to determine the extent of debris scattering. To accomplish this purpose conventional high explosives were used to scatter an alpha emitting isotope into the atmosphere.

Fallout collectors coated with a non-drying resin, hand carried alpha detection instruments, and high volume air samplers were used to determine the extent and concentration of the alpha contaminated debris.

Ground monitors utilizing portable survey instruments found a maximum concentration of 1,000 counts per minute in the area of stake 259 to stake 262.

Air filters from non-populated areas showed a maximum concentration of 194 disintegrations per minute/ $M^3$  of air at stake 262.

Filters taken at populated locations indicated a maximum concentration of 12.1 DPM/ $M^3$  at Scotty's Junction. This particular air sampler had a burned out motor and the total air flow had to be estimated. A filter from Beatty counted 11.3 DPM/ $M^3$  from 1245 hours on May 14 to 1300 hours on May 15. Other filters from populated locations showed concentrations above .04 DPM/ $M^3$  background levels.

### 1.1 Ground Monitoring

Eleven ground monitors were equipped with Eberline Model PAC-3G gas proportional survey instruments. This device uses a propane filled chamber covered with a .1 mg/sq cm mylar window with an area of 55 cm<sup>2</sup>. It was calibrated for 1 CPM = 2 DPM.

Readings were taken on the ground for one minute and each time a reading was taken an instrument background was also determined.

### 1.2 Air Samplers

Both Staplex and General Metal Works high volume air samplers were used during this event. Each air sampler was equipped with an 8" x 10" glass fiber filter. Those samplers running from portable generators were equipped with frequency and running time meters. In the event a machine was not running at the time of the removal of the air filter, a drop of four cubic feet per minute was estimated to determine total air volume.

### 1.3 Fallout Trays

Both 12" x 12" cellophane and 50 mm x 75 mm glass fallout collectors were located at each stake. Approximately 215 such stations were located south to southeast and southwest of Ground Zero. Each tray was coated with Canada Balsam. Fallout collectors were the same as those used by Isotopes, Incorporated in the close-in array.

### 1.4 Additional Environmental Sampling

Water samples were taken and the results of these samples will be included in the final report.

### 1.5 Air Filter Processing

Each filter was counted on a Nuclear Chicago Model 193A Ultrascaler using an Eberline large area probe with an effective area of 49.98 square inches.

Each machine was calibrated using a high and low intensity standard counted in the front, middle, and back of the chamber. The average efficiency of each standard and the average of these averages were taken to determine the overall efficiency. This calculated out to be approximately 24% for the machines used to count the air filters.

After the count was obtained the disintegrations per minute/ $M^3$  of air were determined by the following formula:

$$DPM/M^3 = \frac{\text{Counts per Minute}}{\text{Efficiency} \times 0.79 \times \text{air volume in } M^3} \quad \text{where } 0.79 = \text{the area of the probe/area of the sample.}$$

## 1.6 Results

Ground monitors found a maximum concentration of 1,000 CPM in an area from fallout stake 259 to stake 262. Small readings above background were obtained at stakes located along Highway 95 south of Goldfield, particularly on a line southeast of Ground Zero.

With the exception of a Highway Construction Batch Plant located across the highway from stake 76, and a ranch house located adjacent to stake 435, the above areas are non-populated.

The maximum concentration found on a filter from a non-populated location was 193.69 DPM/ $M^3$  at stake 262.

Maximum concentrations on filters from populated locations were found at Scotty's Junction and Beatty where a count of 12.1 DPM/ $M^3$  (Scotty's Junction) and 11.3 DPM/ $M^3$  (Beatty) was obtained. The air sampler motor at Scotty's Junction burned out shortly before the filter was removed and a total air volume was estimated. Complete air filter results will be found in Tables 1.2 and 1.3.

## 1.7 Discussion

It can be determined that the majority of the material was deposited close to Ground Zero. Material tenuous enough to be borne by the 0 to 4 MPH winds moved southeast, west of Stonewall Mountain, along Sarcobatus Flat, across Highway 95, Scotty's Junction, and as far south as Furnace Creek.

Positive results from air filter analysis indicate the material was "smeared" out from just south of Goldfield to southeast of Lathrop Wells along Highway 95. Filters from Indian Springs, Pahrump, and Las Vegas will be analyzed and included in the final report.

PROJECT ROLLER COASTER

"Clean Slate No. 1"

May 25, 1963

SUMMARY

At 0417 hours, May 25, 1963, a conventional high explosives device with a Plutonium <sup>239</sup> component was detonated at Cactus Flats, Nevada. The purpose of this experiment was to determine the extent and concentration of alpha debris scattering.

The U.S. Public Health Service provided fallout collectors, portable survey instruments, high volume air samplers and the necessary personnel to determine the amount and distribution of the alpha contaminated material released to the off-site area.

Ground monitors, utilizing portable survey instruments, found concentrations of alpha debris from stakes 816 to 824 southeast of Ground Zero with maximum readings of 750 counts per minute. Early morning heating of the air mass over Cactus Flats caused the winds to shift to the northeast resulting in contaminated material being deposited on the west side of the Kawich Range. Apparently the material passed over the Kawich Range or the cloud split and a segment passed to the east of this range, as a single reading of 600 counts per minute was taken five miles northeast of Reed in the Railroad Valley. Rain began to fall shortly after this reading was taken, making it impossible to continue alpha monitoring. A number of readings taken at Diablo (a highway maintenance station located on Highway 25) showed no readings above background, indicating the material must have passed to the south of this station.

Air filters from non-populated areas showed a maximum concentration of 38.52 disintegrations per minute/M<sup>3</sup> of air. This machine was located almost due south of Ground Zero approximately twenty miles out. Machines operating to the south, southeast, and southwest all showed positive results.

As might be expected from the fluctuating wind patterns, air filters from populated areas northeast and southeast of Ground Zero showed small concentrations of alpha contaminated material with a maximum reading of 0.32 disintegrations per minute/M<sup>3</sup> of air (Lathrop Wells).

Complete ground monitoring readings and air filter results will be found in tables 1.1, 1.2, and 1.3.

### 1.1 Ground Monitoring

Ground monitors were equipped with Eberline Model PAC-3G gas proportional survey instruments. This device uses a propane filled chamber covered with a .1 mg/sq cm mylar window with an area of 55 cm<sup>2</sup>. It was calibrated for 1 CPM = 2 DPM.

Readings were taken on the ground for one minute and each time a reading was taken an instrument background was also determined.

### 1.2 Air Samplers

Both Staplex and General Metal Works high volume air samplers were used during this event. Each air sampler was equipped with an 8" x 10" glass fiber filter. These samplers running from portable generators were equipped with frequency and running time meters. In the event a machine was not running at the time of the removal of the air filter, a drop of four cubic feet per minute was estimated to determine total air volume.

### 1.3 Fallout Trays

Both 12" x 12" cellophane and 50 mm x 75 mm glass fallout collectors were located at each stake. Approximately 315 such stations were located south, southeast, southwest, and north on a line from Tonopah to Warm Springs. Each tray was coated with Canada Balsam. Fallout collectors were the same as those used by Isotopes, Incorporated, in the close-in array.

These trays were delivered to Tracerlab, Incorporated, for disposition.

### 1.4 Additional Environmental Sampling

Water samples were taken and the results of these samples will be included in the final report.

### 1.5 Air Filter Processing

Each filter was counted on a Nuclear Chicago Model 193A Ultrascaler using an Eberline large area probe with an effective area of 49.98 square inches.

Each machine was calibrated using a high and low intensity standard counted in the front, middle, and back of the chamber. The average efficiency of each standard and the average of these averages were taken to determine the overall efficiency. This calculated out to be approximately 24% for the machines used to count the air filters.

After the count was obtained the disintegrations per minute/M<sup>3</sup> of air was determined by the following formula:

$$\text{DPM/M}^3 = \frac{\text{Counts per Minute}}{\text{Efficiency} \times 0.79 \times \text{air volume in M}^3} \quad \text{where}$$

0.79 = the area of the probe/area of the sample.

## 1.6 RESULTS

### 1.6.1 Ground Monitoring Results

Ground monitors obtained readings in non-populated areas from 200 to 600 CPM gross alpha, in the areas of stakes 816 to 824. This comprises a distance of approximately four miles in width some fifteen miles southeast of Ground Zero.

A shift in wind direction caused the material to move to the northeast where readings of equal magnitude were found along Cedar Pass in the Kawich Range. Maximum readings were in the 400-600 CPM range.

A single reading of 600 CPM, taken five miles northeast of Reed, indicated a portion of the cloud either passed over the Kawich Range, or split, with a portion passing to the east. A rain storm prevented further alpha monitoring in the Railroad Valley.

Ground monitor readings along Highway 25 and at Diablo were background. A number of negative readings at Diablo indicates the cloud passed to the south of this location.

### 1.6.2 Air Filter Results

Air filters in non-populated areas showed positive results from stakes 808 through 848 with maximum concentrations of 38.52 DPM/M<sup>3</sup> at stake 816. This is in the same general area as the maximum ground monitoring readings. Small concentrations (.09 DPM/M<sup>3</sup>) at stake 913 and stake 921 (.08 DPM/M<sup>3</sup>) indicated some material passed to the southwest of Ground Zero.

Filters from populated areas showed small concentrations at Hiko, Lund, Mesquite, Ploche, Tonopah, Warm Springs, Las Vegas, Furnace Creek, and Lathrop Wells. Lathrop Wells with 0.32 DPM/M<sup>3</sup> had the maximum concentration of the above stations.

Unfortunately the machine at Diablo burned out a motor sometime during the collection period. A count of this filter showed no levels above background.

PROJECT ROLLER COASTER

"Clean Slate No. 2"

May 31, 1963

SUMMARY

The third in a series of non-nuclear experiments was carried out on Cactus Flats, Nevada at 0347 hours, May 31, 1963.

The purpose of this detonation was to determine the extent and concentration of debris scattering from a conventional high explosives device equipped with one or more alpha isotope components.

U.S. Public Health Service personnel, equipped with fallout trays, portable alpha survey meters, and high volume air samplers, carried out the alpha monitoring mission in the off-site area.

Ground monitoring revealed the presence of alpha emitting isotopes from Stake 829 to Stake 847 located on a line running roughly east - west approximately twenty-two miles south to southeast of Ground Zero where a maximum reading of 600 counts per minute was taken.

Positive readings were also obtained from Stake 903 to Stake 919 approximately twenty miles south to slightly southwest of Ground Zero. Stakes located farther south to southwest and stakes located along Highway 95 from Scotty's Junction to Beatty were at background levels. This would seem to indicate that most of the released material was deposited close to Ground Zero.

Monitoring to the north and east of Ground Zero produced no results above background.

Air filters running from portable generators located at Stakes 824, 832, 838, 843, and 848 all showed concentrations of alpha emitting isotopes above background levels. The highest concentration appeared at Stake 848 with 1.33 disintegrations per minute per cubic meter of air running from 1600 hours, May 30, to 0954 hours, May 31.

A filter from the Tonopah Test Range running from 1130 hours, May 31, to 1110 hours, June 1, showed a concentration of .03 DPM/M<sup>3</sup>. This is just slightly above background levels. Two filters from Warm Springs running from 0600 hours, May 31, to 0600, June 1, and from 0600 hours, June 1, to 0600, June 2, had concentrations of .02 DPM/M<sup>3</sup>. This is approximately at background and it is not known whether this is a result of Clean Slate No. 2.

Heavy rains falling in the area during and after the monitoring and air sampling period made accurate surveillance difficult.

Air filter results from some 31 permanent stations surrounding the test area indicate that any material released from Clean Slate No. 2 was confined to the Cactus Flats location.

Complete ground monitoring and air filter tables will be found in the body of the report, along with maps of the on-site and off-site areas.

### 1.1 Ground Monitoring

Ground monitors were equipped with Eberline Model PAC-3G gas proportional survey instruments. This device uses a propane filled chamber covered with a .1 mg/sq cm mylar window with an area of 55 cm<sup>2</sup>. It was calibrated for 1 CPM = 2 DPM.

Readings were taken on the ground for one minute and each time a reading was taken an instrument background was also determined.

### 1.2 Air Samplers

Both Staplex and General Metal Works high volume air samplers were used during this event. Each air sampler was equipped with an 8" x 10" glass fiber filter. These samplers, running from portable generators, were equipped with frequency and running time meters. In the event a machine was not running at the time of the removal of the air filter, a drop of four cubic feet per minute was estimated to determine total air volume.

### 1.3 Fallout Trays

Both 12" x 12" cellophane and 50 mm x 75 mm glass fallout collectors were located at each stake. Approximately 300 such stations were located south, southeast, southwest, and north of Ground Zero. Each tray was coated with Canada Balsam. Fallout collectors were the same as those used by Isotopes, Incorporated in the close-in array.

These trays were delivered to Tracerlab, Incorporated, for disposition.

### 1.4 Additional Environmental Sampling

Water samples were taken and the results of these samples will be included in the final report.

### 1.5 Air Filter Processing

Each filter was counted on a Nuclear Chicago Model 193A Ultrascaler using an Eberline large area probe with an effective area of 49.98 square inches.

Each machine was calibrated using a high and low intensity standard counted in the front, middle, and back of the chamber. The average efficiency of each standard and the average of these averages were taken to determine the overall efficiency. This calculated out to be approximately 24% for the machines used to count the air filters.

After the count was obtained the disintegrations per minute/M<sup>3</sup> of air was determined by the following formula:

$$\text{DPM/M}^3 = \frac{\text{Counts per Minute}}{\text{Efficiency} \times 0.79 \times \text{air volume in M}^3} \quad \text{where}$$

0.79 = the area of the probe/area of the sample.

## 1.6 RESULTS

### 1.6.1 Ground Monitoring Results

Alpha emitting isotopes were detected from Stake 829 to Stake 847 approximately twenty-two miles south to southeast of Ground Zero. A maximum concentration of 600 counts per minute was obtained at Stake 835. Readings taken from Stakes 903 to 919 almost due south of Ground Zero, showed concentrations of alpha emitting isotopes with a maximum reading of 450 CPM at Stake 907.

Stakes located farther than 23 miles south, southeast, and southwest showed no activity above the 100 gross CPM cut-off level.

Ground monitors covered the Cedar Pass area to the east and north of Ground Zero with no counts above background. Heavy rains caused a suspension of activities and remonitoring the next day produced background readings at all locations including those areas that had positive readings the day before.

Complete ground monitoring and ground re-monitoring results will be found in Tables 1.2 and 1.3.

### 1.6.2 Air Filter Results

Air filters from Stakes 824, 832, 838, 843, and 848 produced readings above the .02 DPM/M<sup>3</sup> background levels with a maximum of 1.33 DPM/M<sup>3</sup> at Stake 848. All the above filters are for a period running from the afternoon of May 30 to the morning of May 31. All filters were at background levels by the following day.

Filters from Warm Springs and Tonopah Test Range showed activity at high background levels. It cannot be determined that this is a result of Clean Slate No. 2.

PROJECT ROLLER COASTER

"Clean Slate No. 3"

June 9, 1963

SUMMARY

At 0330 hours on the morning of June 9, 1963, an experiment was conducted at Cactus Flats, Nevada to determine the extent and concentration of alpha debris scattering from a conventional high explosives device with one or more radioactive components.

This was the fourth, and last, event of the Roller Coaster series.

The U.S. Public Health Service was assigned the task of monitoring the off-site areas for possible contamination.

Ground monitors, equipped with portable survey instruments, high volume air samplers, and fallout trays, were used to monitor the assigned areas.

Of the 129 air filters counted for alpha contamination, only two showed the presence of alpha isotopes. One filter located at Stake 848 had 2.07 disintegrations per minute/cubic meter of air. This filter ran from 1400 hours June 8, to 0900 hours, June 9. Another filter located at Stake 838 ran from 1435 hours June 8, to 1053 hours, June 9, and showed a concentration of 0.18 DPM/M<sup>3</sup> of air.

The air sampler at Stake 843, located between the above stakes, shut off at 0441 hours, June 9, before the cloud reached this location.

Careful ground monitoring to the southeast and southwest of Ground Zero failed to find any readings above background. It is reasonable to assume that some contamination did take place in the area to the southeast of Ground Zero, but heavy rains washed this material below the surface before ground monitors were able to enter the area.

Complete ground monitoring and air filter results will be found in Tables 1.1 and 1.2 of this report.

### 1.1 Ground Monitoring

Ground monitors were equipped with Eberline Model PAC-3G gas proportional survey instruments. This device uses a propane filled chamber covered with a .1 mg/sq cm mylar window with an area of 55 cm<sup>2</sup>. It was calibrated for 1 CPM = 2 DPM.

Readings were taken on the ground for one minute and each time a reading was taken an instrument background was also determined.

### 1.2 Air Samplers

Both Staplex and General Metal Works high volume air samplers were used during this event. Each air sampler was equipped with an 8" x 10" glass fiber filter. These samplers, running from portable generators, were equipped with frequency and running time meters. In the event a machine was not running at the time of the removal of the air filter, a drop of four cubic feet per minute was estimated to determine total air volume.

### 1.3 Fallout Trays

Both 12" x 12" cellophane and 50 mm x 75 mm glass fallout collectors were located at each stake. Approximately 200 such stations were located south, southeast, southwest, and north of Ground Zero. Each tray was coated with Canada Balsam. Fallout collectors were the same as those used by Isotopes, Incorporated in the close-in array.

The results of these trays have not been processed to date.

### 1.4 Additional Environmental Sampling

Water samples were taken and the results of these samples will be included in the final report.

### 1.5 Air Filter Processing

Each filter was counted on a Nuclear Chicago Model 193A Ultrascaler using an Eberline large area probe with an effective area of 49.98 square inches.

Each machine was calibrated using a high and low intensity standard counted in the front, middle, and back of the chamber. The average efficiency of each standard and the average of these averages were taken to determine the overall efficiency. This calculated out to be approximately 24% for the machines used to count the air filters.

After the count was obtained the disintegrations per minute/M<sup>3</sup> of air was determined by the following formula:

$$\text{DPM/M}^3 = \frac{\text{Counts per Minute}}{\text{Efficiency} \times 0.79 \times \text{air volume in M}^3} \quad \text{where}$$

0.79 = the area of the probe/area of the sample.

## 1.6 RESULTS

### 1.6.1 Ground Monitoring Results

Ground monitors were unable to find any readings above background levels because of heavy rains which fell during the morning and afternoon of June 9.

The locations where ground monitoring readings were taken will be found in Table 1.2.

### 1.6.2 Air Filter Results

Only two air filters showed activity above background levels. One filter located at Stake 848 had a concentration of 2.07 DPM/M<sup>3</sup> while the other filter located at Stake 838 showed alpha activity of 0.18 DPM/M<sup>3</sup>.

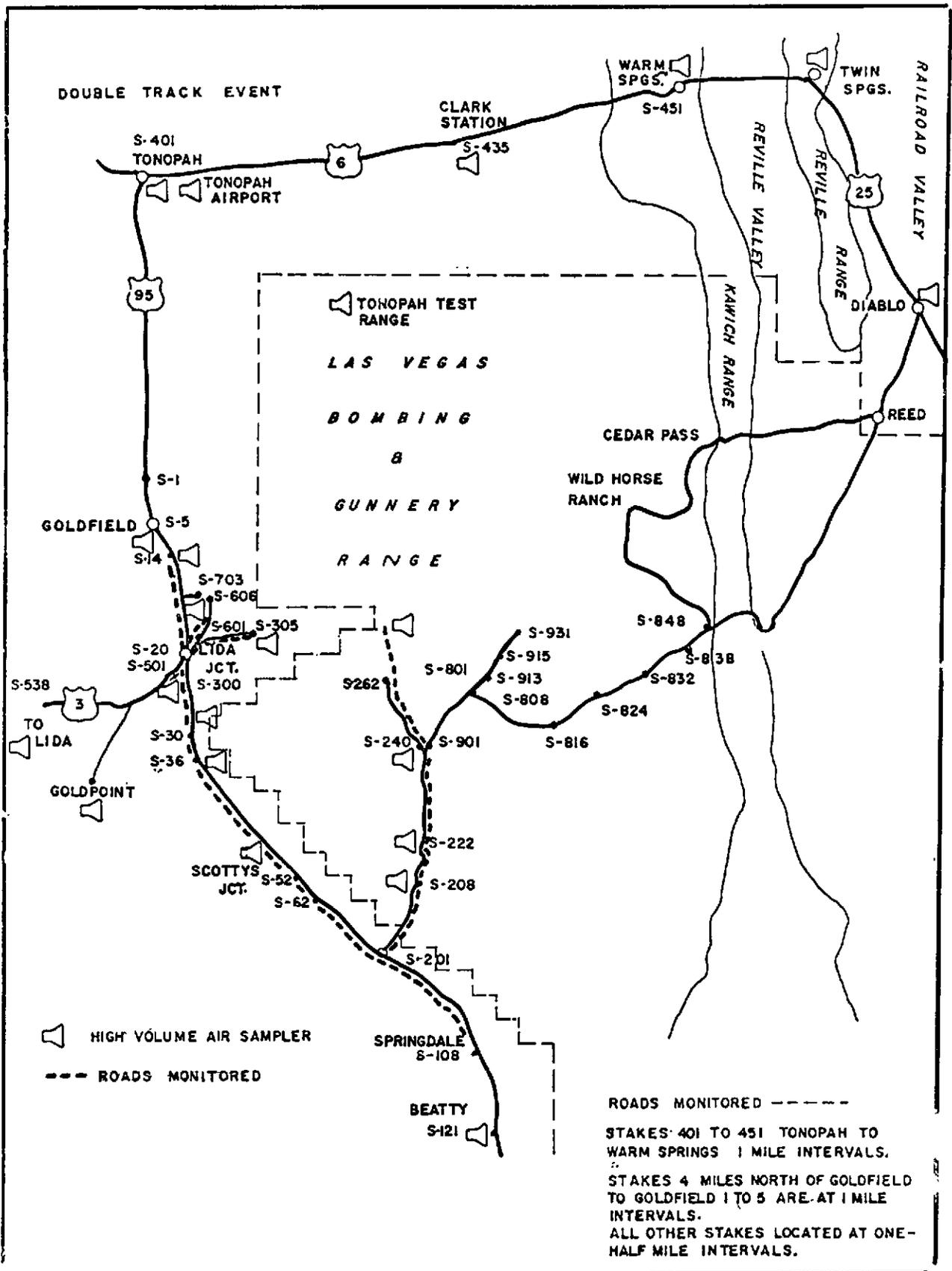
Exact running time and air volumes of the above filters along with all other filters processed for this event will be found in Table 1.1 of this report.

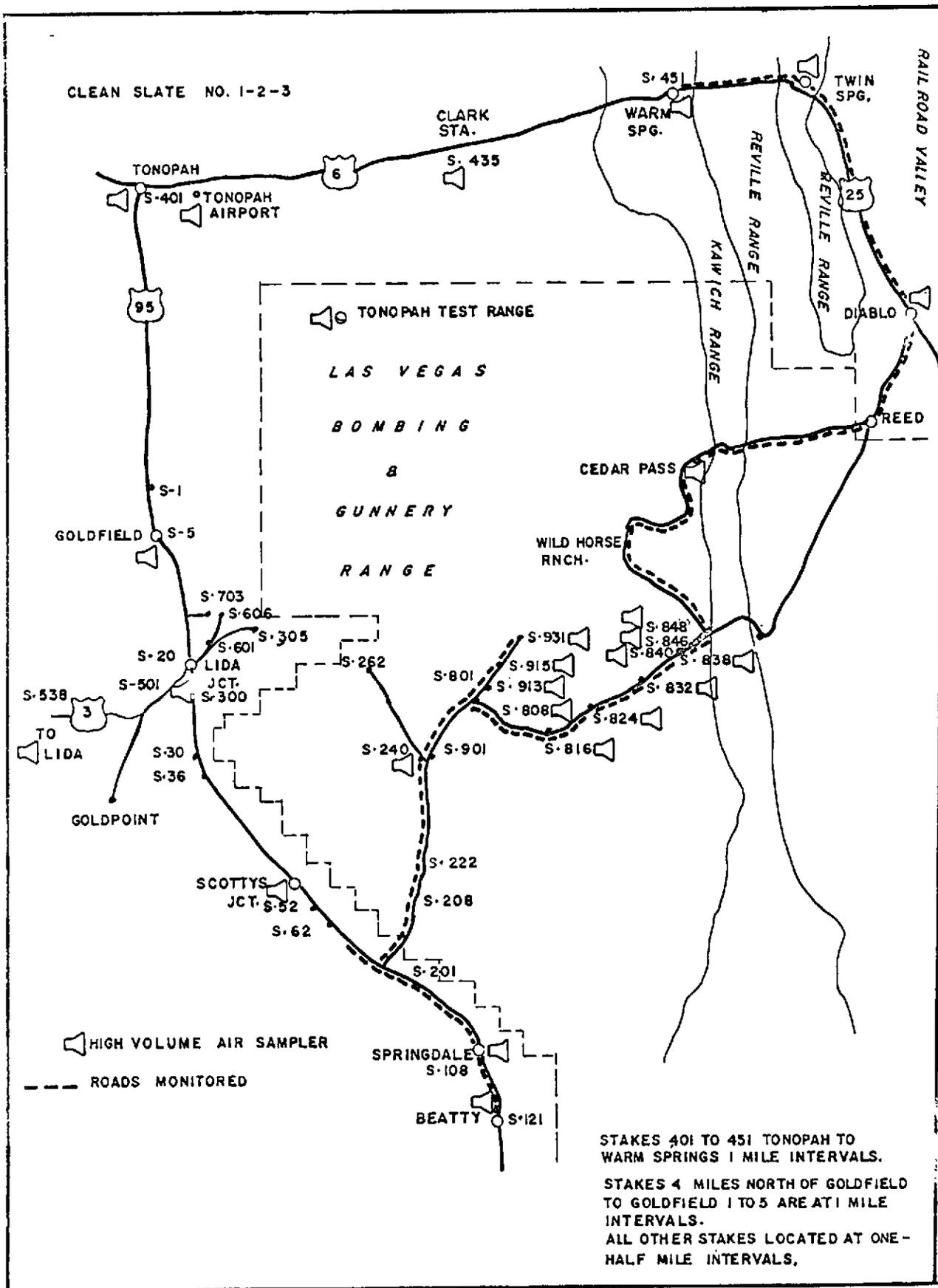
## 1.7 DISCUSSION

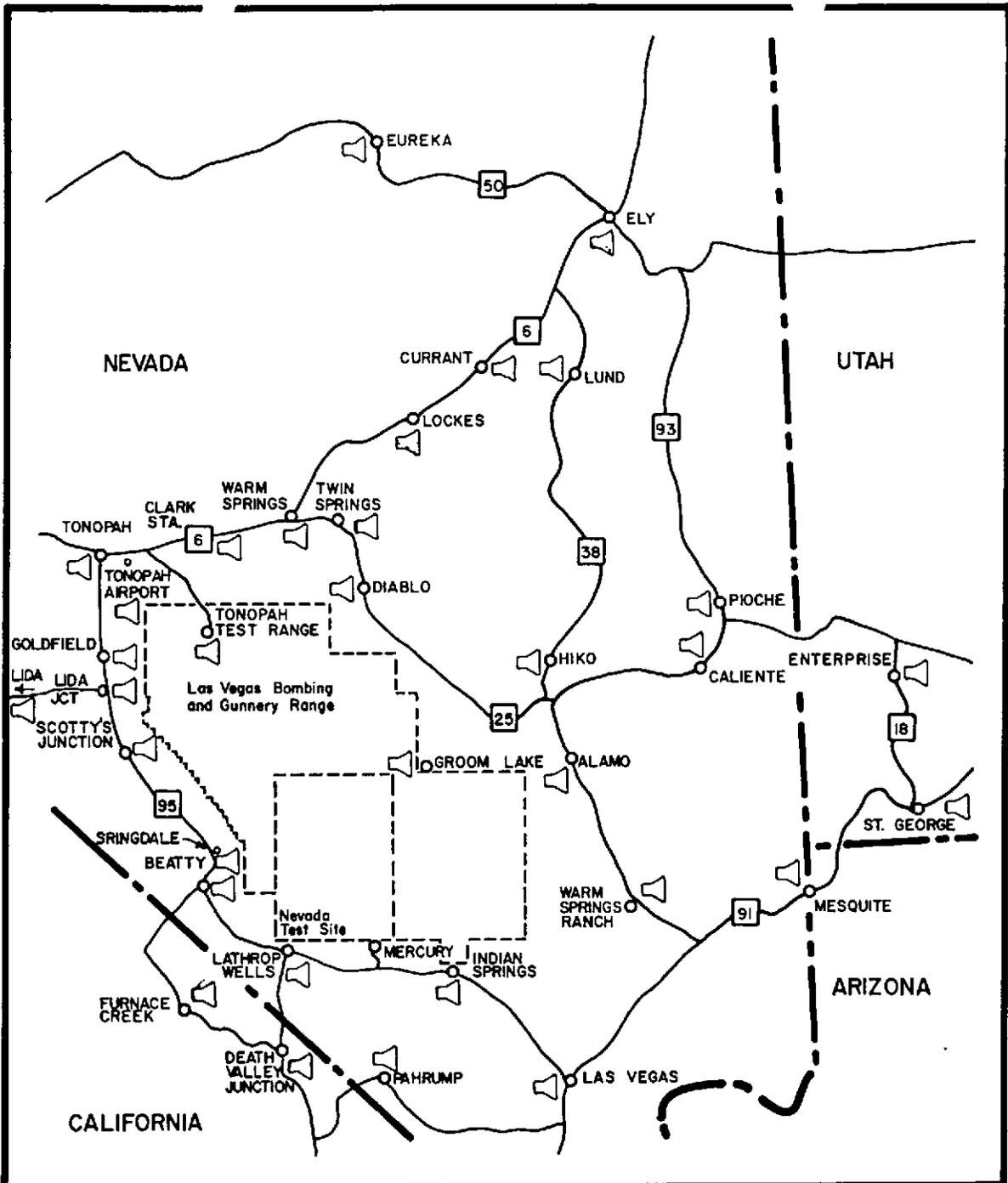
The lack of positive readings from ground monitoring and air filters makes it difficult to draw conclusions about cloud passage times and movement.

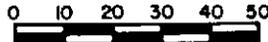
Obviously some of the material moved to the southeast over Stakes 838 to 848 within a few hours of detonation.

Weather Bureau information indicates the winds changed direction and began moving to the north after sunrise. Since no stations to the north of Ground Zero showed alpha activity above background it is assumed that the material was deposited fairly close to Ground Zero.







- LEGEND -		EVENT	
 AIR SAMPLER  AIR SAMPLER WITH CHARCOAL CARTRIDGE  RADIATION MONITORING RECORDER	ROLLER COASTER TITLE <b>OFF-SITE AREA          INSTRUMENT LOCATIONS</b>		
 0 10 20 30 40 50 SCALE OF MILES	DATE OF EVENT		FIGURE
USPHS RADIOLOGICAL SAFETY ORGANIZATION			

OPERATION ROLLER COASTER

Oral Report, Sandia Meeting, 14 - 15 April 1964

PROJECT 5.1A

SAMPLE PROCESSING FACILITY

A. L. BAIETTI

Tracerlab, Inc.  
Richmond, California