DISCLAIMER

NVO--313

DE88 002371

ANALYSIS OF NUCLEAR TEST TRINITY

RADIOLOGICAL AND METEOROLOGICAL DATA

Virgil E. Quinn*

National Oceanic and Atmospheric Administration
Weather Service Nuclear Support Office
Post Office Box 14985
Las Vegas, Nevada 89114

September 1987

Prepared For

U.S. Department of Energy
Nevada Operations Office
Contract No. DE-AI08-76DP00351

* The author can be contacted in care of:
Holmes and Narver, Inc.
M/S 580
Post Office Box 93838
Las Vegas, Nevada 89193-3838

DISCLAIMER

TABLE OF CONTENTS

		PAGE
ABSTRACT		v
CHAPTER		
1	INTRODUCTION	1
2	RADIOLOGICAL DATA	7
	2.1 Data Available	7
	2.2 Radiological Data	7
	2.3 Instruments	7
	2.4 Radiological Data Considerations	8
	2.4.1 Monitor Locations	8
	2.4.2 Background Radioactivity	9
	2.4.3 Exposure Rate Versus Time Profiles and Radioactivity Decay	9
	2.4.4 Exposure Rate Versus Distance Profiles	13
3	METEOROLOGICAL SUMMARY	21
	3.1 Surface Weather, Winds Aloft, and Climatological Data Available	21
	3.2 Surface Weather Conditions	21
	3.3 Winds Aloft	21
	3.4 Surface Winds	24
4	FALLOUT-ARRIVAL TIMES	31
	4.1 Introduction	31
	4.2 Meteorologically Derived Fallout-Particle-Arrival Times	31
	4.3 Fallout-Arrival-Time Lines	32
5	THE FALLOUT PATTERNS	35
	5.1 The WSNSO 1987 TRINITY Fallout Patterns	35
	5.2 Comparison of the 1987 (WSNSO) and 1940s Fallout Patterns	35
	5.3 The WSNSO 1987 H+12 Hour Fallout-Pattern Map	37

CONTENTS - CONTINUED

REFERENCES 39

APPENDIX A A1

LIST OF FIGURES

FIGURE PAGE

1. Fallout contours (R/h) at ground level at H+4 hours (Ref. 1) 2

2. Fallout contours (R/h) at ground level at H+1 hour in terms of the product of radiation intensity and the time of observation (Ref. 2 and Ref. 7) 3

3. WSNSO 1987 TRINITY fallout contours (R/h) and time-of-arrival lines. Contours are for ground level at H+4 hours 4

4. WSNSO 1987 TRINITY fallout contours (R/h) and time-of-arrival lines. Contours are for ground level at H+1 hour. 5

5. WSNSO 1987 TRINITY fallout contours (mR/h) and time-of-arrival lines. Contours are for 1 meter above the ground at H+12 hours 6

6. Graph showing the sum of eleven exponential functions decay curve (solid), $t^{-1.0}$ decay curve (dashed), and $t^{-1.5}$ decay curve (dash-dot) 10

7. Exposure rate versus time data (represented by boxes) at Bingham, NM, and the sum of eleven exponential functions decay curve (dashed line). 11

8. Exposure rate versus time data (represented by boxes) at White Store and the sum of eleven exponential functions decay curve (dashed line). 12

9. Exposure rate versus time data at Searchlight Station L-8 and the sum of eleven exponential functions decay curve (dashed line). The triangles represent measurements of gamma-exposure rates on the ground, boxes represent measurements of beta-plus-gamma-exposure rates in air (1 meter), circles represent measurements of gamma-exposure rates in air, and the dot (0.11 R/h) at H+2.25 hours represents a beta-plus-gamma-exposure rate measurement on the ground. 14

FIGURES - CONTINUED

10. Exposure rate versus time data at Hot Canyon and the sum of eleven exponential functions decay curve (dashed line). Boxes represent data extracted from Figure 4 of Reference 1 and triangles represent data taken from the text of Reference 1 15

11. H+1 hour exposure rate versus distance profile from San Antonio to Carrizozo, NM 16

12. H+1 hour exposure rate versus distance profile from Vaughn to Carthage, NM 17

13. H+1 hour exposure rate versus distance profile from Lucy to Vaughn, NM. 18

14. H+1 hour exposure rate versus distance profile from Roswell to Santa Fe, NM. The boxes represent H+1 hour values from measurements taken on the trip north on D+1 day and the triangles represent H+1 hour values from measurements taken on the trip south on D+2 days. 20

15. Dotted areas indicate where precipitation was recorded during a 24-hour period ending at various times on D day (July 16, 1945). 22

16. Dotted areas indicate where precipitation was recorded during a 24-hour period ending at various times on D+1 day (July 17, 1945). 23

17. Streamlines of winds aloft at 12,000 feet ASL at H-3 hours . . . 25

18. Streamlines of winds aloft at 12,000 feet ASL at H+3 hours . . . 26

19. Streamlines of winds aloft at 12,000 feet ASL at H+9 hours . . . 27

20. Streamlines of winds aloft at 12,000 feet ASL at H+15 hours. . . 28

21. Streamlines of winds aloft at 12,000 feet ASL at H+21 hours. . . 29

22. Trajectory (path) of a 40-micrometer particle as it falls from 35,000 feet ASL to the bottom of the lowest layer (5,000 feet ASL). The number at the end point is the time in H+hours. The particle reached this location at H+18.1 hours 33

23. Overlay of the fallout contours in Figure 1 on the WSNSO fallout pattern in Figure 3. 36

24. Overlay of the fallout contours in Figure 2 on the WSNSO fallout pattern in Figure 4. 38

LIST OF TABLES

TABLE		PAGE
A1.	Gamma exposure-rate data for New Mexico from Reference 1, Table IV, taken D through D+7 days. Exposure rate readings were taken in air (waist height), in cars, and at ground level. Those readings identified as being taken in air or in cars are so noted. All other readings were assumed to have been taken at ground level	A2
A2.	Gamma-exposure-rate data for New Mexico from Reference 3, taken during the 3 weeks following the TRINITY nuclear detonation. Those readings identified as being taken in air or in cars are so noted. All other readings were assumed to have been taken at ground level	A7
A3.	Gamma exposure-rate data for New Mexico from Reference 1, Appendix II, taken on D+26 days (August 12, 1945). Readings were taken on the ground or at waist height, as noted	A27
A4.	Gamma exposure-rate data for New Mexico from Reference 1, Appendix III, taken on D+148 through D+151 days (December 11-14, 1945). Readings were assumed taken at ground level..	A29
A5.	Exposure rate versus time data for Bingham, White Store, Hot Canyon, and Searchlight Station L-8. Exposure rate versus time data for Bingham, White Store, and Hot Canyon were extracted from Figures 1 and 4, the text, and Table IV of Reference 1. Exposure rates are at ground level unless otherwise noted. Exposure rates for Searchlight Station L-8 are from Reference 3 and include gamma and gamma-plus-beta readings in air and on the ground as noted	A35

ABSTRACT

This report describes the Weather Service Nuclear Support Office (WSNSO) analyses of the radiological and meteorological data collected for the TRINITY nuclear test. Inconsistencies in the radiological data and their resolution are discussed. The methods of normalizing the radiological data to a standard time and estimating fallout-arrival times are presented. The meteorological situations on event day and the following day are described. Comparisons of the WSNSO fallout analyses with analyses performed in the 1940s are presented. The radiological data used to derive the WSNSO 1987 fallout patterns are tabulated in appendices.

CHAPTER 1

INTRODUCTION

The TRINITY test, the first atmospheric nuclear test, was conducted in New Mexico at 0530 MST on July 16, 1945 (D day). The geographic coordinates of surface-ground zero (SGZ) are 33° 40' 31" N and 106° 28' 29" W, or about 57 miles northwest of Alamogordo, NM. The device, with a yield of 19 kilotons, was detonated on top of a 100-foot steel tower. Participants in the test performed an analysis of the distribution of local fallout from this test and published the resulting fallout pattern (Fig. 1) in February 1947 (Ref. 1). Another, somewhat different, fallout pattern (Fig. 2) was published in May 1979 (Ref. 2). As a part of the Fallout Verification Task Group of the Offsite Radiation Exposure Review Project (ORERP), the Weather Service Nuclear Support Office (WSNSO) performed an independent analysis of the TRINITY radiological and meteorological data (Figs. 3, 4, and 5). The results reported herein are based on the best sources of information known to be available.

One of the WSNSO goals was to determine the TRINITY fallout-pattern contours. This was accomplished by examining and analyzing the radiological data collected at ground level by mobile ground monitors. This set of data consists of external gross-gamma exposure-rate readings taken at numerous locations within the fallout field. To compensate for radioactive decay, the ground-monitor exposure-rate readings were normalized to three standard times: H+4 hours (Fig. 3) to compare with Figure 1, H+1 hour (Fig. 4) to compare with Figure 2, and H+12 hours (Fig. 5) to compare with fallout contours derived by analysts for nuclear tests conducted in the 1950s and early 1960s. The normalized values were plotted on a map and isopleths (fallout contours) were drawn connecting points of equal exposure rates for the times mentioned above.

Another WSNSO goal was to estimate the fallout-arrival times along the fallout pattern. This was accomplished by (1) examining exposure-rate data collected at those locations where readings were taken immediately before and during fallout, and, (2) using meteorologically-derived trajectories of fallout particles. The resultant arrival times were plotted on the fallout-pattern map and isopleths (time lines) were drawn to them.

In addition to describing the analyses performed in deriving the WSNSO 1987 TRINITY fallout patterns, this report describes the winds that influenced the fallout and the general weather conditions along the fallout pattern in New Mexico. Finally, a comparison of the 1987 and 1940s fallout patterns is presented.

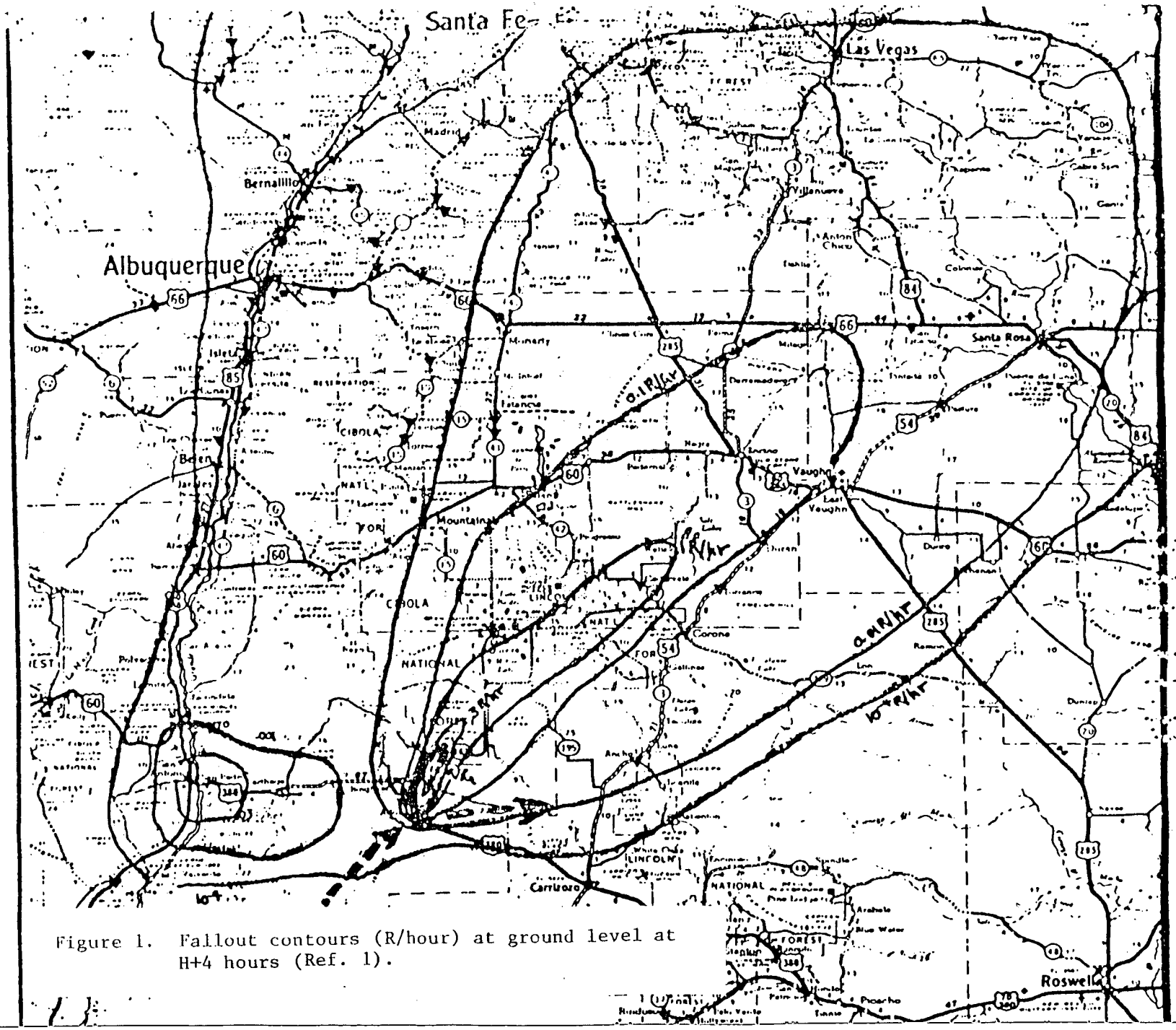

Figure 1. Fallout contours (R/hour) at ground level at H+4 hours (Ref. 1).

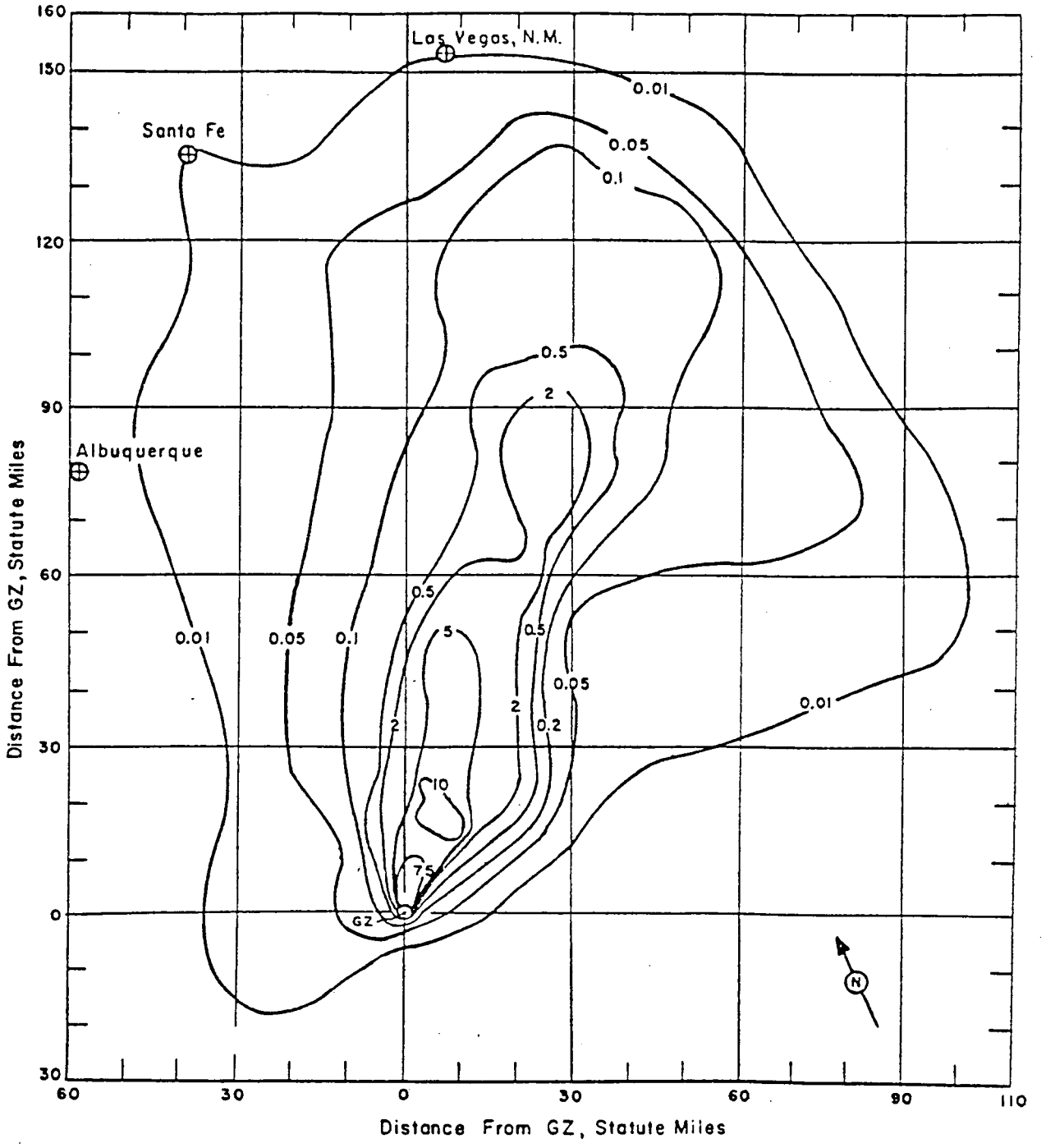

Figure 2. Fallout contours (R/hour) at ground level at H+1 hour in terms of the product of radiation intensity times the time of observation (Ref. 2 and Ref. 7).

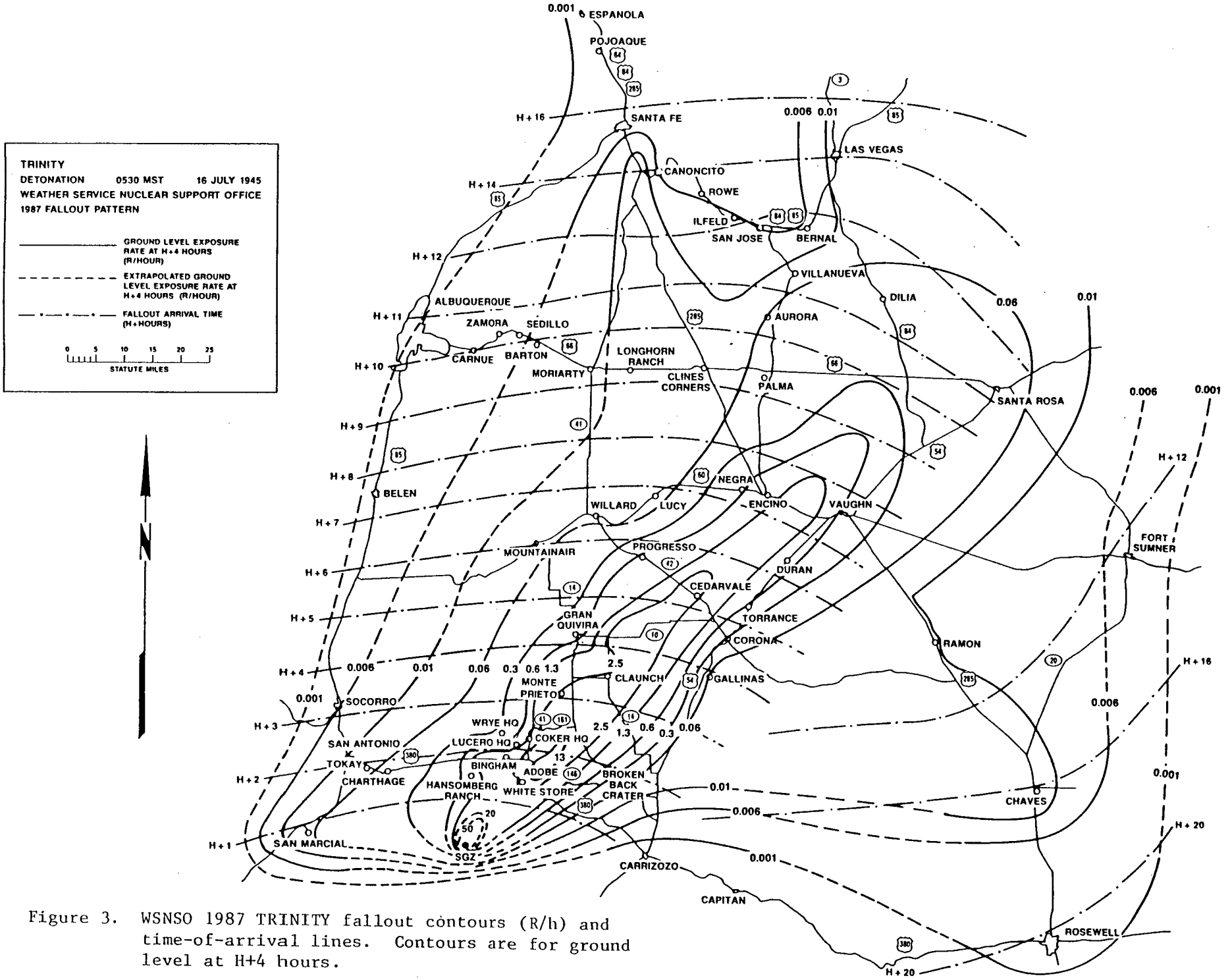

Figure 3. WSNSO 1987 TRINITY fallout contours (R/h) and time-of-arrival lines. Contours are for ground level at H+4 hours.

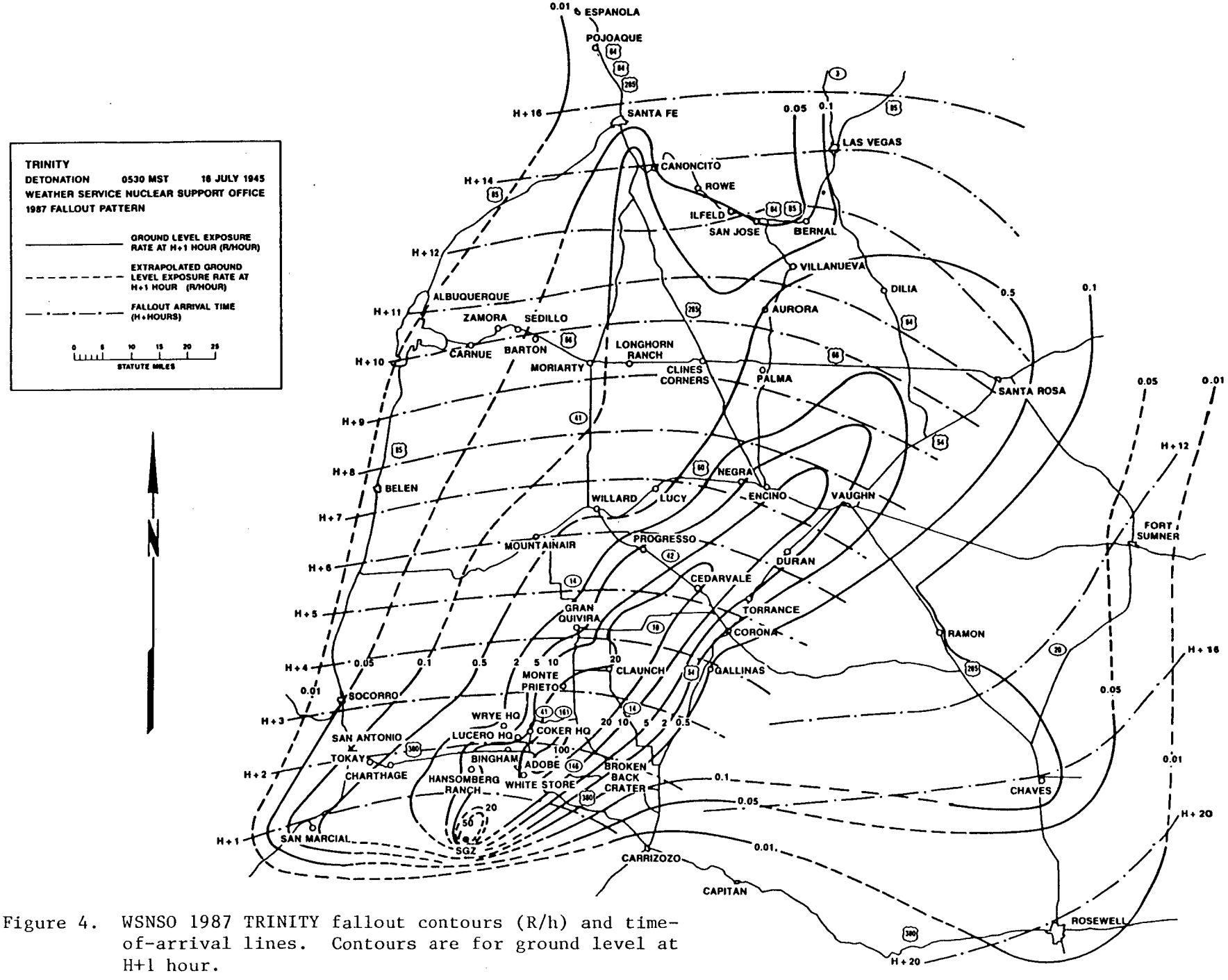

Figure 4. WSNSO 1987 TRINITY fallout contours (R/h) and time-of-arrival lines. Contours are for ground level at H+1 hour.

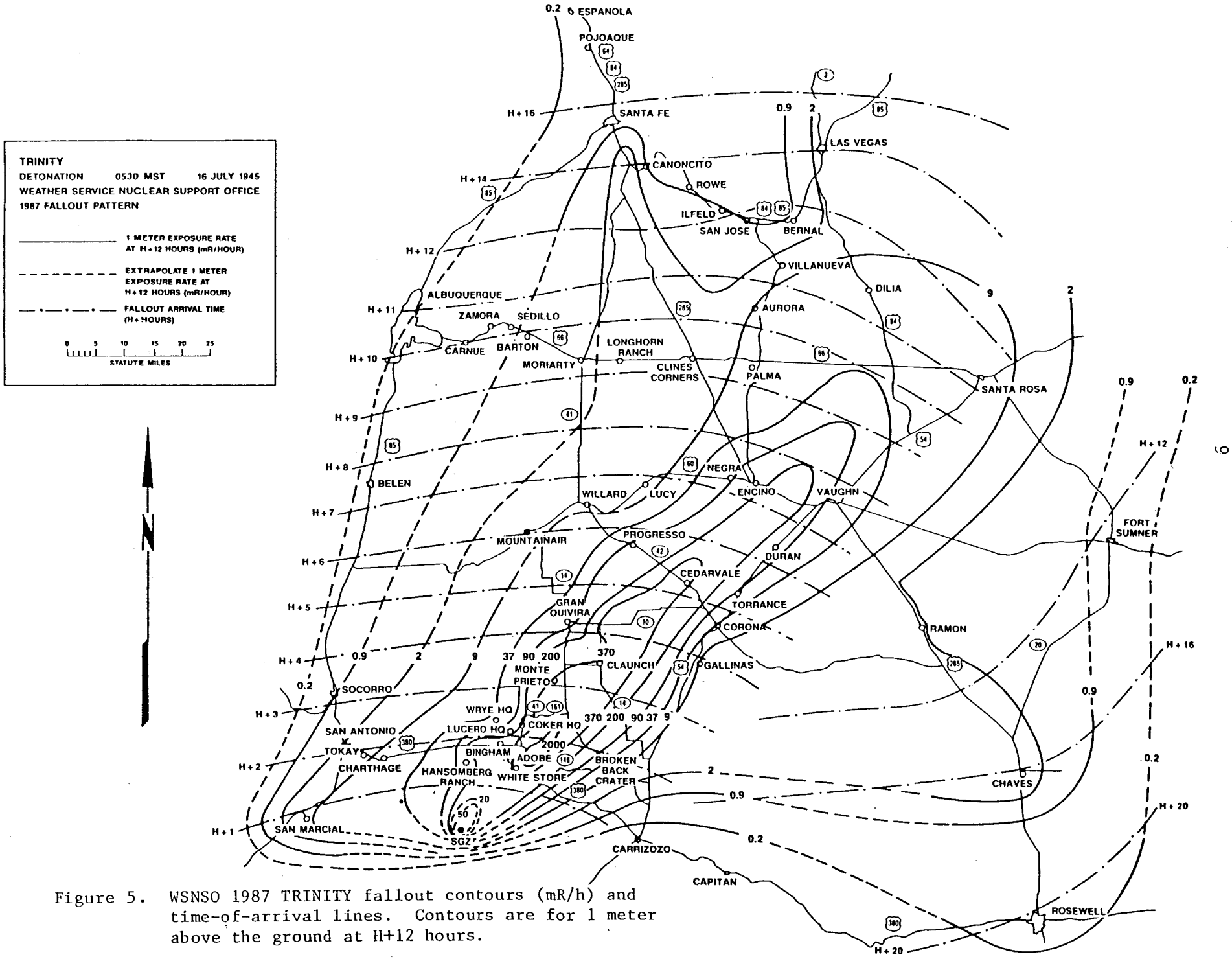

Figure 5. WSNSO 1987 TRINITY fallout contours (mR/h) and time-of-arrival lines. Contours are for 1 meter above the ground at H+12 hours.

CHAPTER 2

RADIOLOGICAL DATA

2.1 Data Available

The radiological data available for analysis are those data in the text, figures, and tables of Reference 1 and the data in the transcripts of monitor's field notes in Reference 3. The original monitor's notebooks could not be located. Information concerning the radiological data discussed in the following sections was extracted from References 1, 3, and 4.

2.2 The Radiological Data

The radiological data for TRINITY were collected by U.S. Army and civilian project personnel working as two-person teams, usually one civilian and one Army.

Ground-monitor readings were taken by placing the survey meters on the ground, and by holding the meters at waist height (1 meter) above the ground. One monitoring team reported readings as being taken at "jeep-seat level." The readings noted as being taken at ground level were used as is. The waist-height and jeep-seat-level readings were converted to approximate ground-level values using a conversion factor of 1.54. Some survey-meter readings were taken inside the vehicles as the monitoring teams traveled along their monitoring routes with occasional readings being noted as "outside." It could not be determined if the outside readings were made by physically taking the meter out of the vehicle and placing it on the ground, or if the meter was simply held out of the window. For the outside readings, it was assumed they were taken at ground level. Those monitoring readings with no notation as to whether they are ground or waist height were assumed to be ground-level measurements.

For the TRINITY test, considerable monitoring was done during the 3 weeks following the nuclear detonation. Monitoring continued at irregular intervals for at least 6 months (December 1945). Monitoring was done at towns and ranches and along the roads and highways in New Mexico downwind of SGZ. Data were recorded for only gamma radiation and frequently gamma-plus-beta radiation readings were recorded. Data for gamma only radiation were used in this analysis. Those data taken during the three weeks following the test were given the most weight in this analysis.

2.3 Instruments

Each monitor team was issued the following set of instruments: (1) a methane filled proportional counter for detecting alpha-particle radiation in the presence of beta plus gamma radiation, (2) a Victoreen, model 247, three-range (0.01 to 0.1 R/h, 0.1 to 1.0 R/h, and 1 to 10 R/h) portable gamma-ray survey meter which was reported to be the most useful instrument for field work, and (3) the Hallicrafter, Geiger-Mueller tube, model 5, portable survey meter for

gamma and gamma plus beta radiation (ranges reported as 0.00004 to 0.001 R/8 hours and 0.0008 to 0.02 R/8 hours) (Ref. 1). Other instruments were noted on the transcripts of the monitor's field notes (Ref. 3) and include Watts' meters, small (one scale) Victoreens, and a Landsverk and Wollan (beta plus gamma) quartz-fiber electrometer. The Victoreen Model 247 was used to make most of the gamma-radiation measurements.

2.4 Radiological Data Considerations

Minor problems were encountered with the TRINITY monitor data. To begin with, the data table in the available copies of Reference 1 is difficult to read. However, it is felt that the locations and data derived from Reference 1 are reasonably accurate. The transcripts of monitor's field notes (Ref. 3) are quite readable except in a few instances. Other minor problems with the data occurred which are not unique to the TRINITY data but tend to occur whenever large areas are monitored by personnel using field-survey instruments. These problems and what was done about them are discussed below.

2.4.1 Monitor Locations

The large majority of the monitoring data were taken at populated locations (e.g., towns) and along roads and highways between populated locations. Most of the populated locations are clearly marked on the base map. In several cases, readings were taken at ranches and other places away from the main roads and highways and do not appear on the base map. For these cases, monitor locations were determined from other maps (Refs. 5, 6, and 7) contemporary with the TRINITY nuclear detonation. The one exception was one monitoring trip south of U.S. Highway 380 (US380) toward SGZ in which no identifiable locations were listed. Locations in terms of specific places (e.g., towns, ranches, and highway junctions) were used as is. Locations in terms of distances between specific places occasionally had to be adjusted to agree with carefully measured distances on the base map.

The locations of the so called "Hot Canyon" and Searchlight Station L-8 were not marked on available maps. Hot Canyon is described in Reference 1 as being: (1) south of Chupadera Mesa, (2) 2 miles from the junction of roads 161 and 146 on road 146, (3) 30 miles from zero, and (4) 7 miles due east of Bingham. Description (2) is felt to be where Hot Canyon is because the monitor trip on December 11, 1945, went east from Bingham on road 161 to the junction of roads 161 and 146. From the junction the trip continued through Hot Canyon and ended at Broken Back Crater, which is southeast of the junction and Bingham. The distance from the junction to Hot Canyon from the mileage recorded is 2 miles. This location is in a canyon based on the topographic contours on the base map and is 7 miles east-southeast of Bingham. The location described in Reference 1 as Searchlight Station L-8 is 3 miles east of Bingham on road 161. The name Hot Canyon was coined by the monitors because of the high gamma intensities which were found there.

2.4.2 Background Radioactivity

Radiation intensity from natural background radioactivity is not reported in Reference 1. However, since the monitor readings are in terms of R/h and background was probably a few hundredths of an mR/h, it is felt that the effect of not subtracting background from the gross-gamma readings is insignificant.

2.4.3 Exposure Rate Versus Time Profiles and Radioactivity Decay

Exposure-rate data, when recorded at the same location over an extended time period, can be plotted versus time to give a profile that usually yields important information such as estimates of fallout-arrival time, peak exposure rate during fallout, end-of-fallout time, and residual (after end of fallout) radioactivity-decay rate. Such profiles are usually obtained by: (1) a continuous exposure-rate recording instrument, (2) a monitor who remains at one location and takes numerous readings over a long period of time, and (3) several monitors who take readings at the same location at different times. The profiles used in this TRINITY analysis were based on the third alternative.

According to Reference 1, the fallout contours shown in Figure 1 are based on data normalized to H+4 hours using a decay rate of $t^{-1.0}$. Other decay rates mentioned in Reference 1 are $t^{-1.3}$ and $t^{-1.5}$. Analysts in the 1950s used the $t^{-1.2}$ decay rate for normalizing exposure-rate data to a standard time. During the ORERP the task group at Lawrence Livermore National Laboratory (LLNL) calculated radionuclide inventories and external gamma-exposure rates as functions of time for the atmospheric tests including TRINITY (Ref. 8). The task group at Los Alamos National Laboratory (LANL) derived sum of eleven exponential expressions to approximate closely the LLNL calculated exposure-rate values. Figure 6 shows the $t^{-1.0}$, $t^{-1.5}$, and TRINITY sum of eleven exponential functions decay curves plotted on the same graph. The LLNL calculated exposure rates are normalized to 1 at H+12 hours. The curves in Figure 6 were normalized to 1 at H+12 hours to agree with the LLNL values represented by the sum of eleven exponential functions decay curve.

Figure 7 shows exposure rate versus time data for Bingham that were extracted from Figure 1 of Reference 1. Also shown in Figure 7 is the sum of eleven exponential functions decay curve (dashed line). The earliest data point is at about H+3 hours and fallout arrival was probably earlier. In Figure 7, visual comparison of the data with the sum of eleven exponential functions decay curve shows reasonably good agreement although there is scatter in the data at times less than 100 hours. When the data points in Figure 1 of Reference 1 are compared with the exposure-rate data in Table IV of Reference 1, it appears that four of the data points in the figure were taken 4 miles east of Bingham and two data points were taken 1 mile east of Bingham. These six data points were not plotted in Figure 7 of this report.

Figure 8 shows exposure rate versus time data for White Store which were extracted from Figure 4 of Reference 1. Also shown in Figure 8 is the sum of eleven exponential functions decay curve (dashed line). The earliest data point is at H+5 hours and fallout arrival was earlier. Visual comparison of the data with the decay curve shows good agreement.

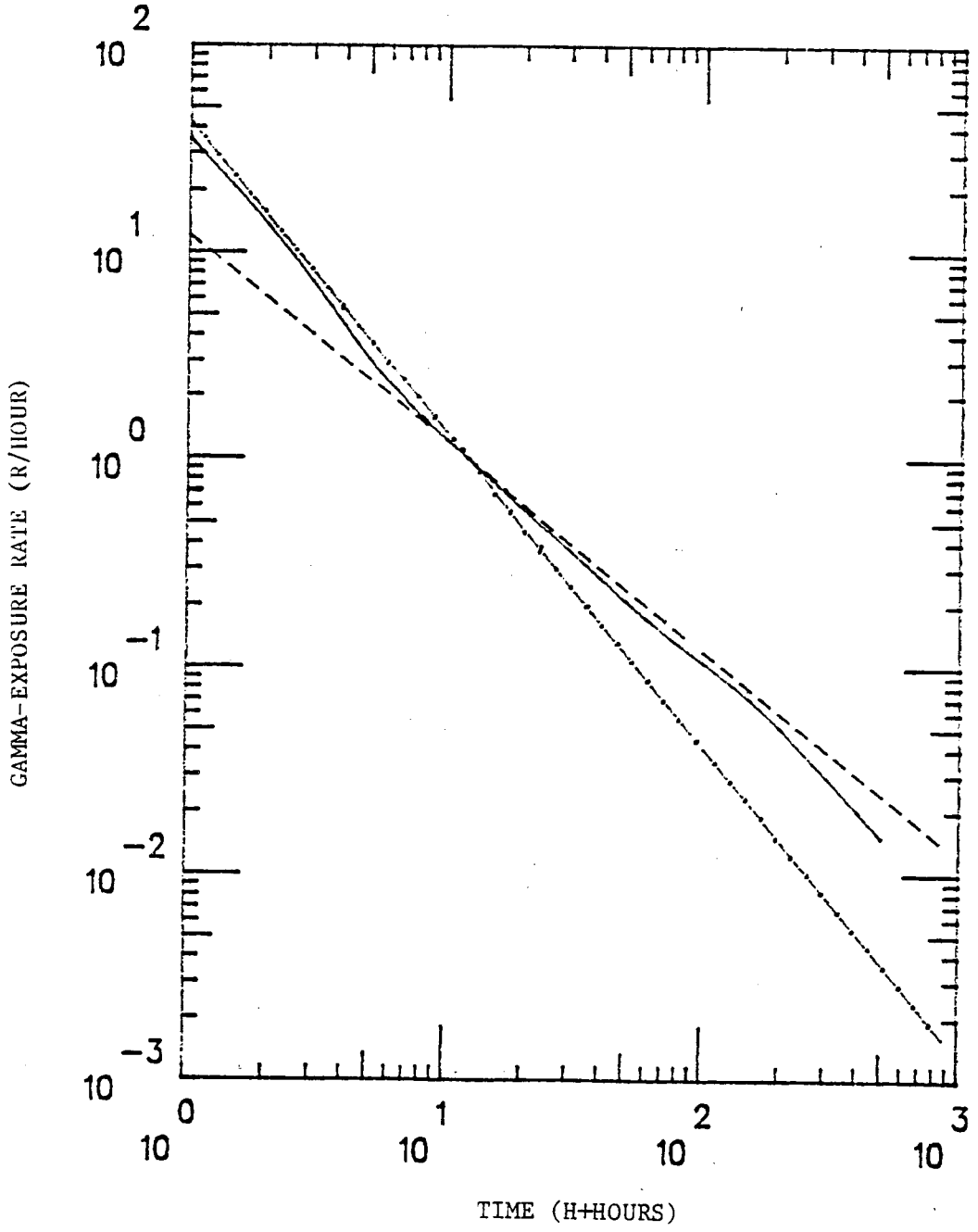

Figure 6. Graph showing the sum of eleven exponential functions decay curve (solid), $t^{-1.0}$ decay curve (dashed) and $t^{-1.5}$ decay curve (dash-dot).

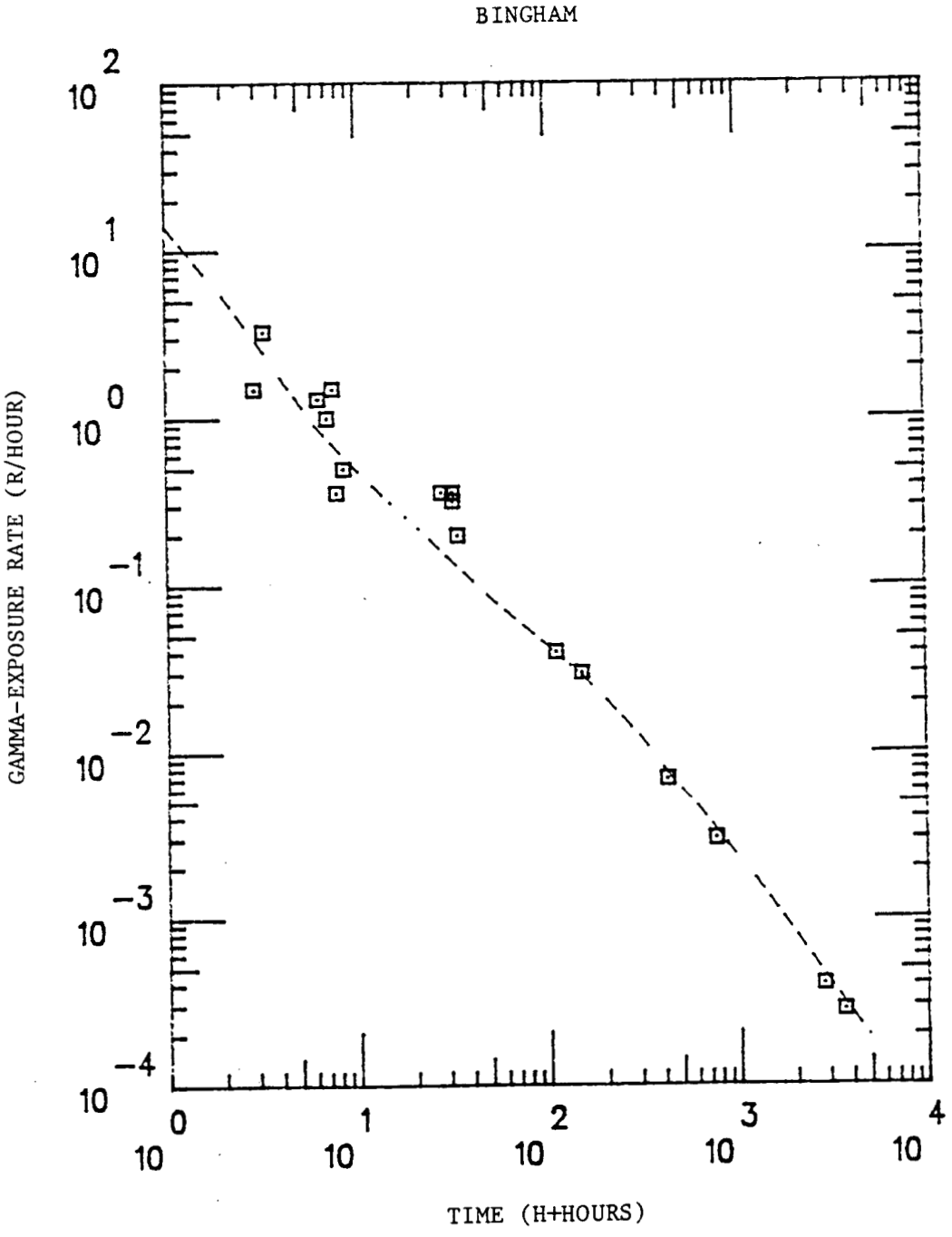

Figure 7. Exposure rate versus time data (represented by boxes) at Bingham, NM, and the sum of eleven exponential functions decay curve (dashed line).

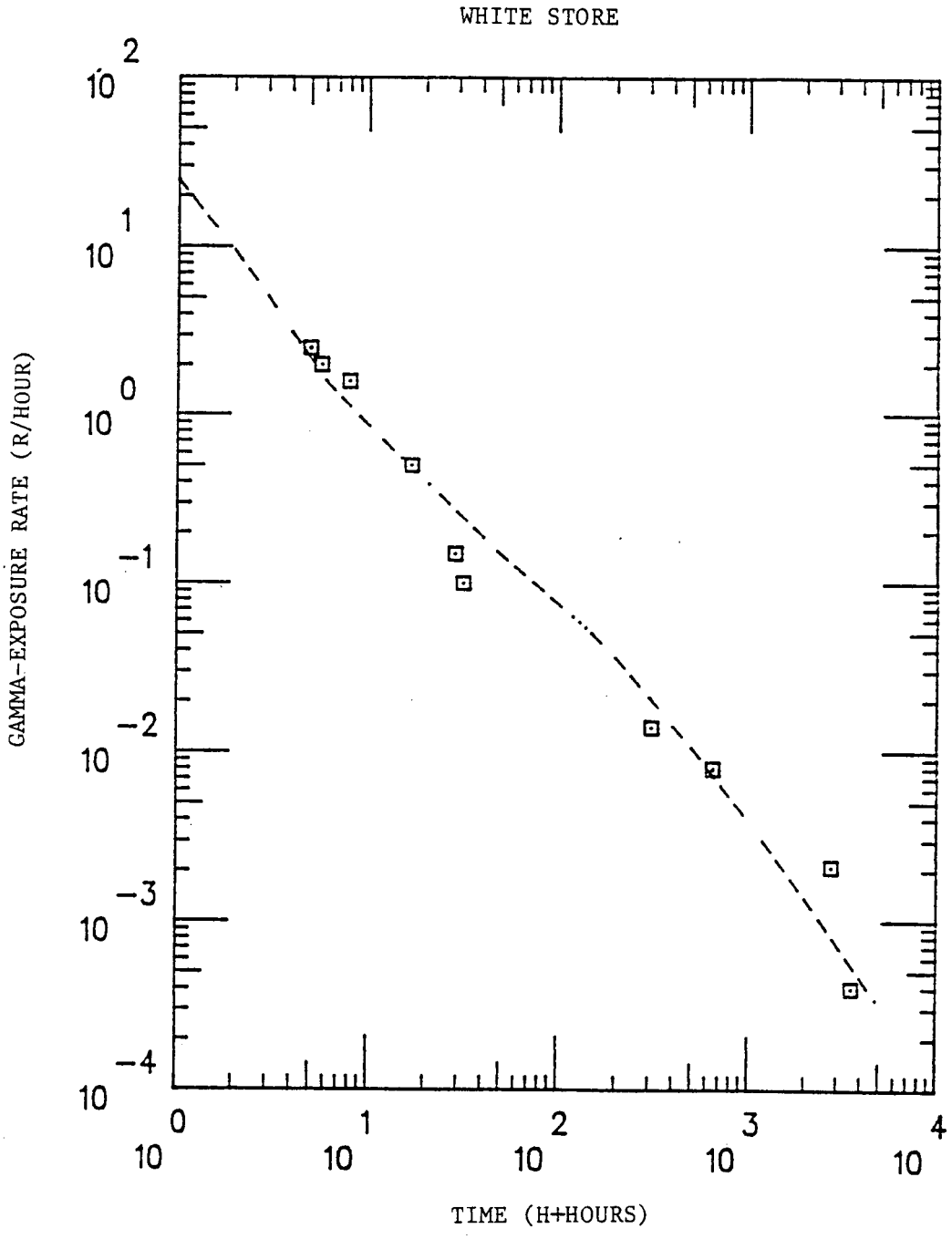

Figure 8. Exposure rate versus time data (represented by boxes) at White Store and the sum of eleven exponential functions decay curve (dashed line).

Figure 9 shows exposure rate versus time data for L-8 from Reference 3. Also shown is the sum of eleven exponential functions decay curve (dashed line). In Figure 9, the triangles represent measurements of gamma-exposure rates on the ground, boxes represent measurements of beta-plus-gamma-exposure rates in air (1 meter), circles represent measurements of gamma-exposure rates in air, and the dot (0.11 R/h) at H+2.25 hours represents a beta-plus-gamma-exposure rate measurement on the ground. The earliest above-background was taken at H+2.0 hours. Fallout arrival at this location is between H+1.25 and H+2.0 hours, probably about H+1.5 hours, and end of fallout is estimated to be H+4.0 hours.

Figure 10 shows exposure rate versus time data taken at Hot Canyon, which were extracted from Figure 4 (squares) and the text (triangles) of Reference 1. Also shown is the sum of eleven exponential functions decay curve (dashed line). The earliest reading was taken at H+3.3 hours and fallout arrival at this location is estimated to be about H+1.5 hours. Visual comparison of the data with the sum of eleven exponential functions decay curve shows good agreement.

In summary, visual comparison of the data with the sum of eleven exponential functions decay curve shows good agreement. The WSNSO used the LLNL TRINITY exposure-rate values as represented by the LANL sum of eleven exponential functions to normalize all exposure-rate data to H+1, H+4, and H+12 hours.

2.4.4 Exposure Rate Versus Distance Profiles

As mentioned in Section 2.4.1, exposure-rate readings were taken at populated locations and along the roads and highways between populated locations. These readings were normalized to H+1 hour to account for radioactive decay of the exposure-rate readings which were taken at quite different times, sometimes a week or more apart. The H+1 hour exposure-rate values for those monitoring trips that cross the fallout field were plotted versus distance to obtain exposure rate versus distance profiles.

Figure 11 shows the H+1 hour exposure rate versus distance profile along US380 from San Antonio, NM, eastward to Carrizozo, NM. This profile shows H+1 hour values increasing east of San Antonio reaching a maximum of about 25 R/h in the vicinity of White Store, then decreasing toward Carrizozo. There are no data available between White Store and Carrizozo.

Figure 12 shows the H+1 hour exposure rate versus distance profile from Vaughn, NM, southwest to Carthage, NM. This profile is along U.S. Highway 54 (US54) from Vaughn to Corona, NM, then cross country from Corona to Claunch, Monte Prieto, Wrye Ranch, and Carthage, NM. This profile shows H+1 hour values increasing from Vaughn to a maxium of 6.18 R/h at Duran, NM, then decreasing at Torrance, NM, and Corona, then increasing to another maximum of about 33 R/h at Claunch with decreasing values to the southwest.

Figure 13 shows H+1 hour exposure-rate values versus distance east of Lucy, NM, on U.S. Highway 60 (US60). The H+1 hour exposure rates increase toward the east reaching a maximum of about 14 R/h east of Encino, NM, then decrease to the east.

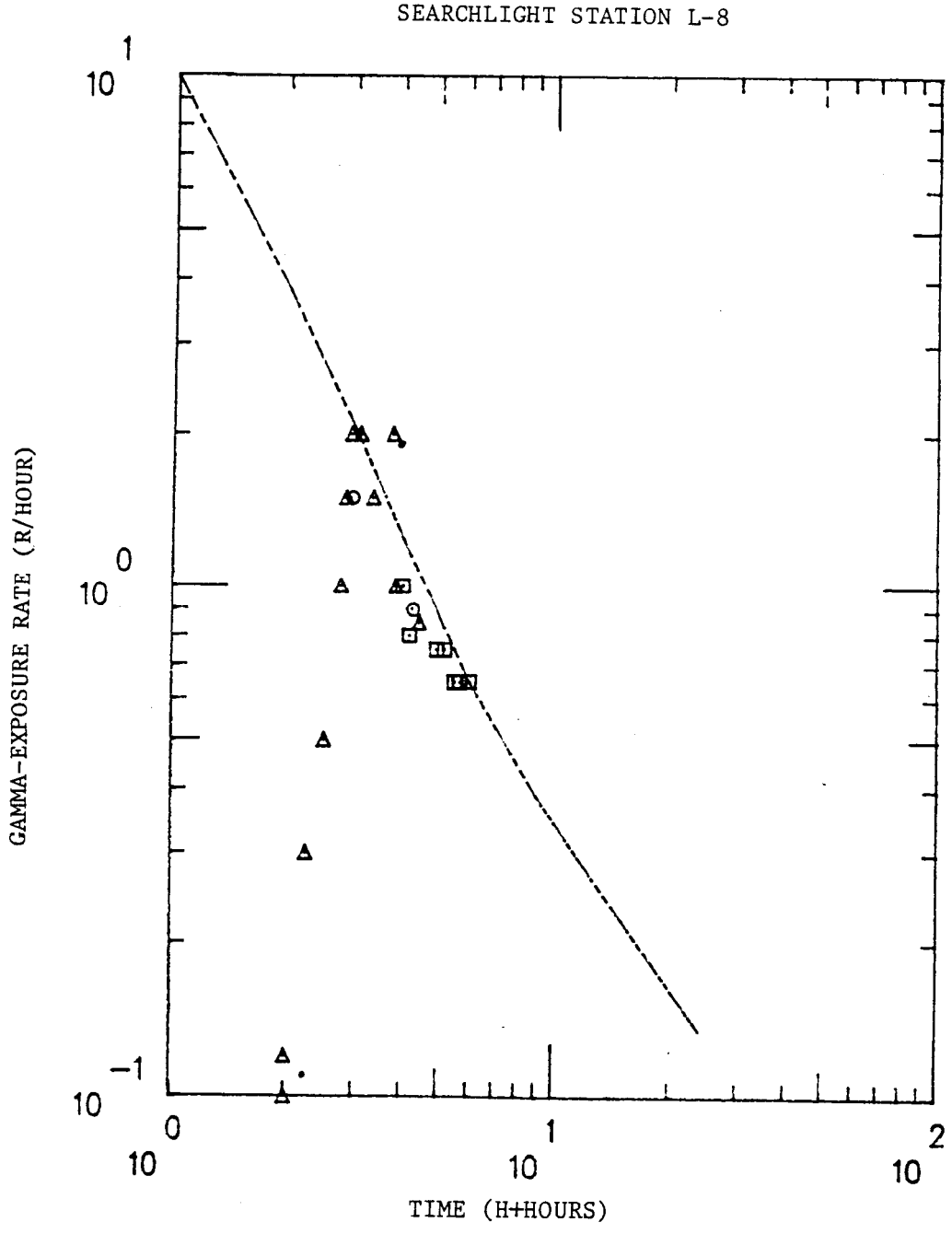

Figure 9. Exposure rate verus time data at Searchlight Station L-8 and the sum of eleven exponential functions decay curve (dashed line). The triangles represent measurements of gamma-exposure rates on the ground, boxes represent measurements of beta-plus-gamma-exposure rates in air (1 meter), circles represent measurements of gamma-exposure rates in air, and the dot (0.11 R/h) at H+2.25 hours represents a beta-plus-gamma-exposure rate measurement on the ground.

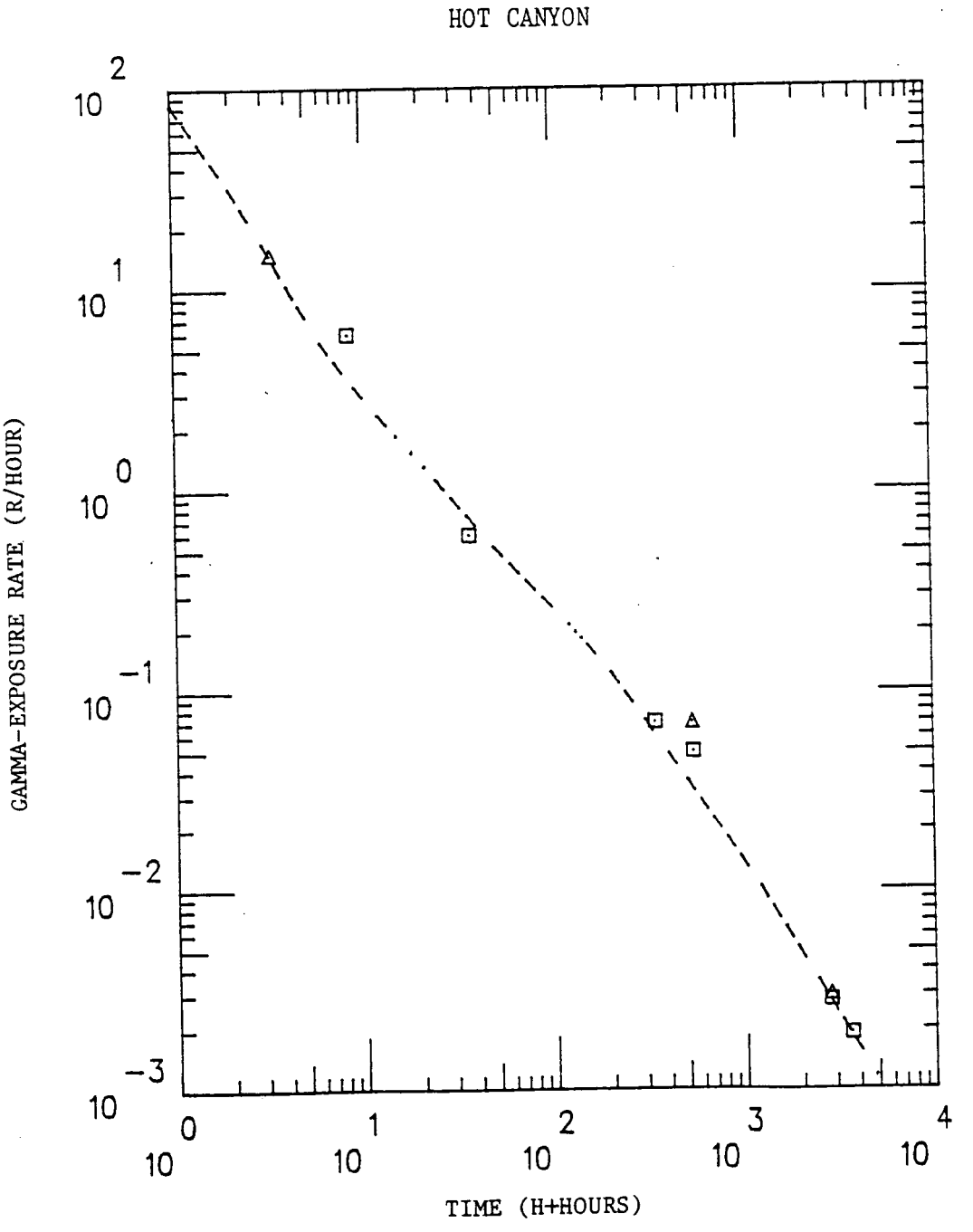

Figure 10. Exposure rate versus time data at Hot Canyon and the sum of eleven exponential functions decay curve (dashed line). Boxes represent data extracted from Figure 4 of Reference 1 and triangles represent data taken from the text of Reference 1.

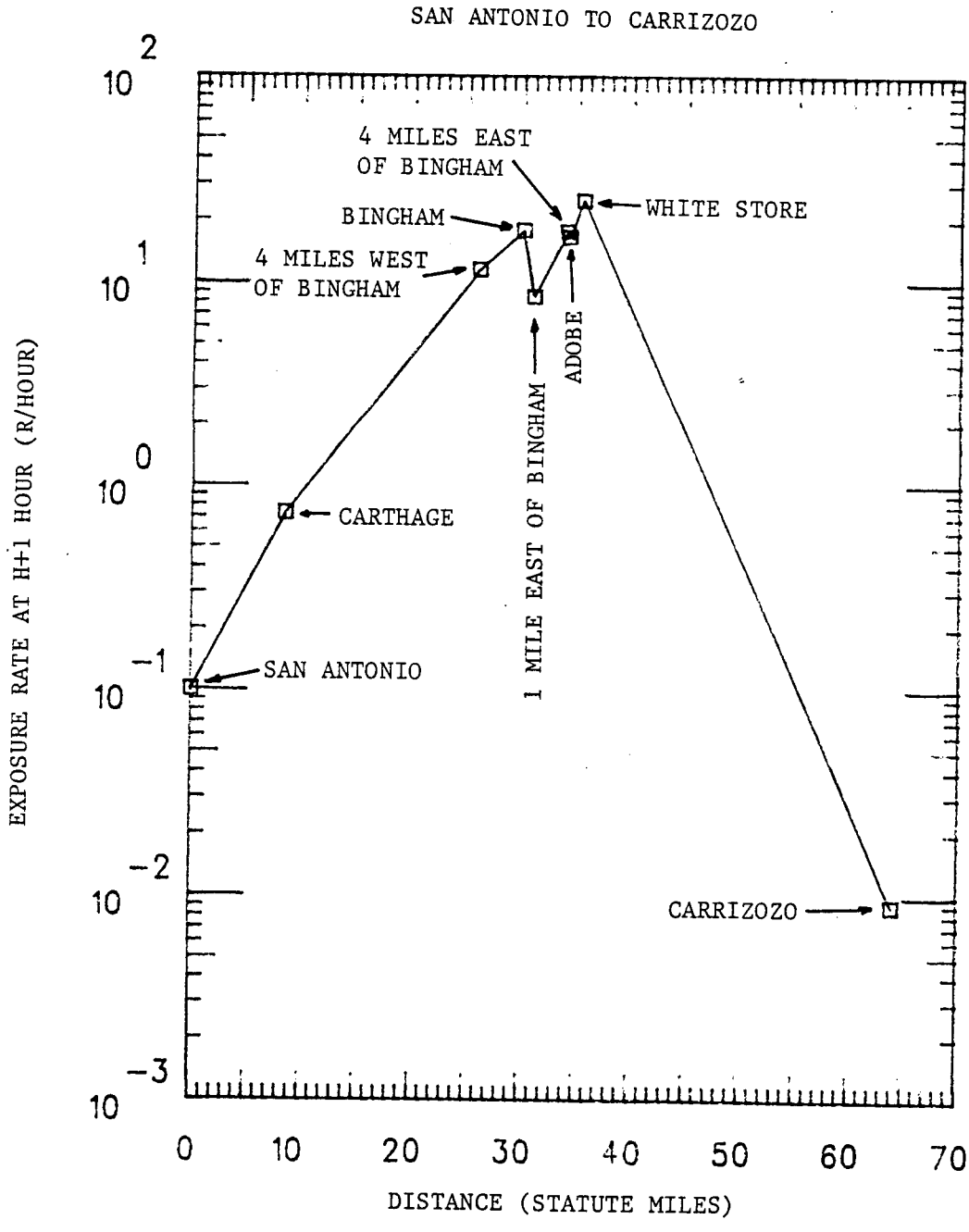

Figure 11. H+1 hour exposure rate versus distance profile from San Antonio to Carrizozo, NM.

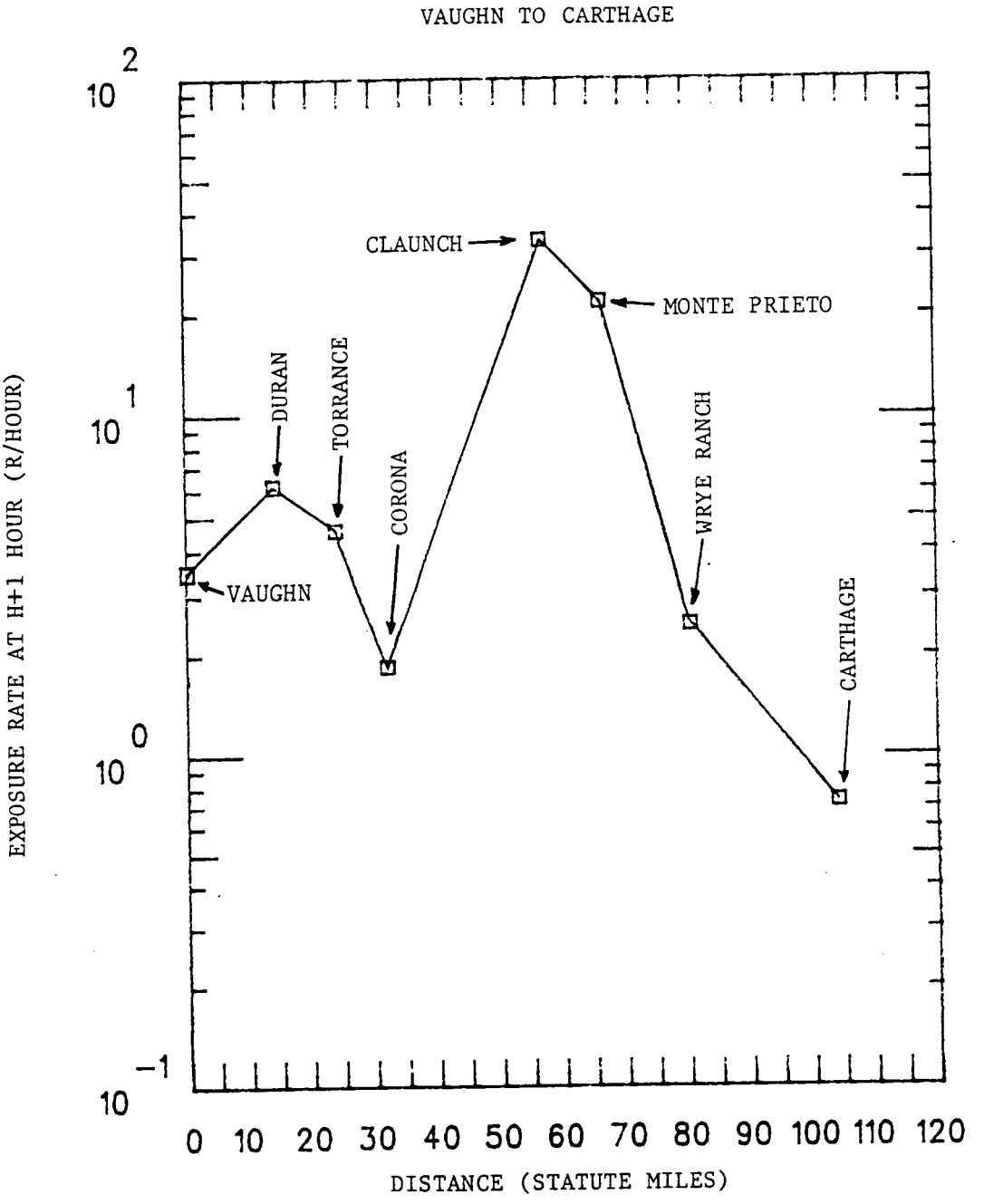

Figure 12. H+1 hour exposure rate versus distance profile from Vaughn to Carthage, NM.

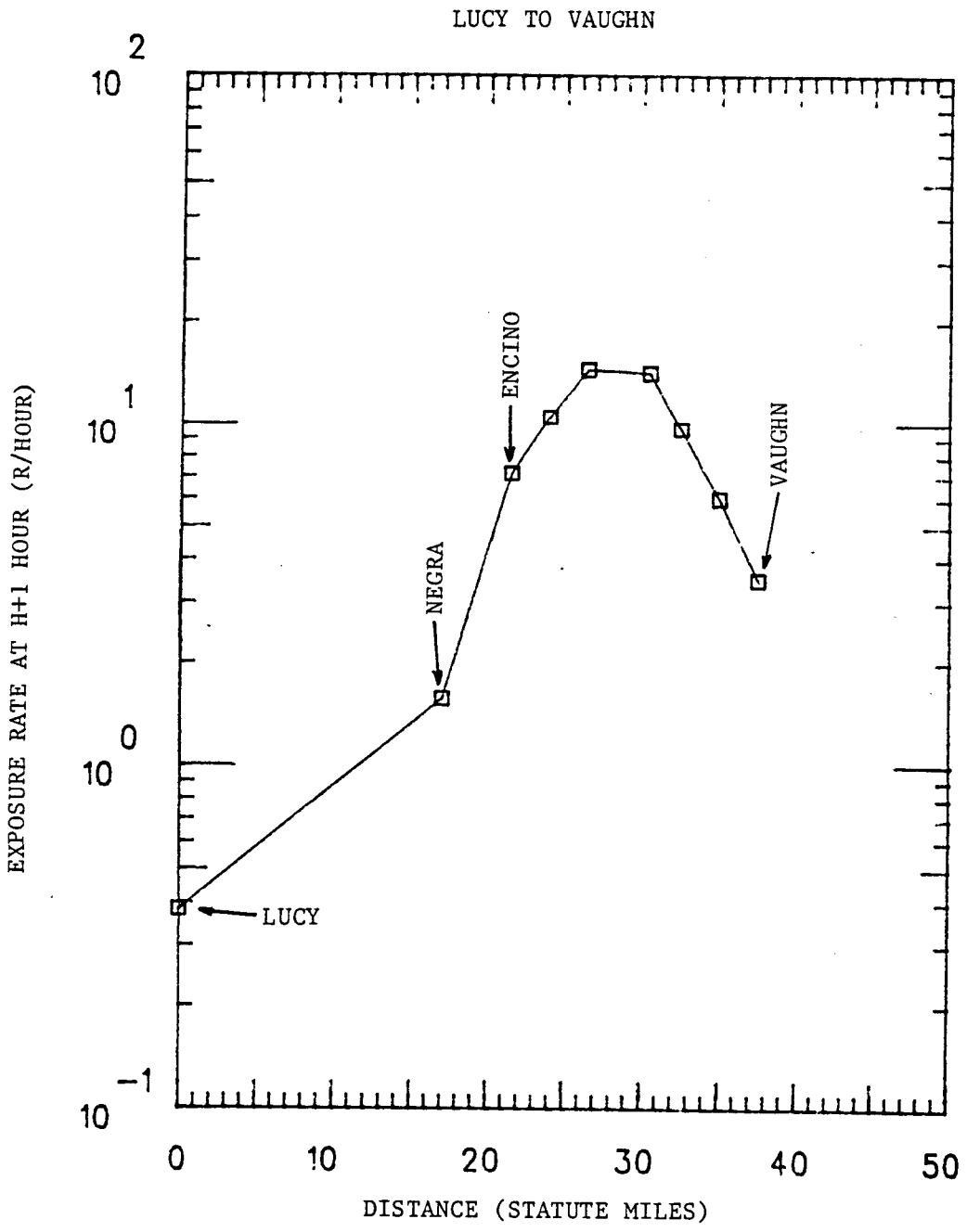

Figure 13. H+1 hour exposure rate versus distance profile from Lucy to Vaughn, NM.

Figure 14 shows the H+1 hour values plotted versus distance along U.S. Highway 285 (US285) from Roswell, NM, to Vaughn; along US285/US60 from Vaughn to just west of Encino; then to the northwest along US285 from Encino to Santa Fe, NM. The boxes represent H+1 hour values from measurements taken on the trip north on D+1 day and the triangles represent H+1 hour values from measurements taken on the trip south from Santa Fe to Vaughn the next day. The H+1 hour values from both monitoring trips show a maximum between Vaughn and Encino with decreasing values to the southeast toward Roswell and to the northwest toward Santa Fe.

The normalized exposure-rate values derived from observed monitor readings used in plotting the exposure rate versus distance profiles shown in Figures 11 through 14 were used in locating the fallout contours shown in Figures 3, 4, and 5.

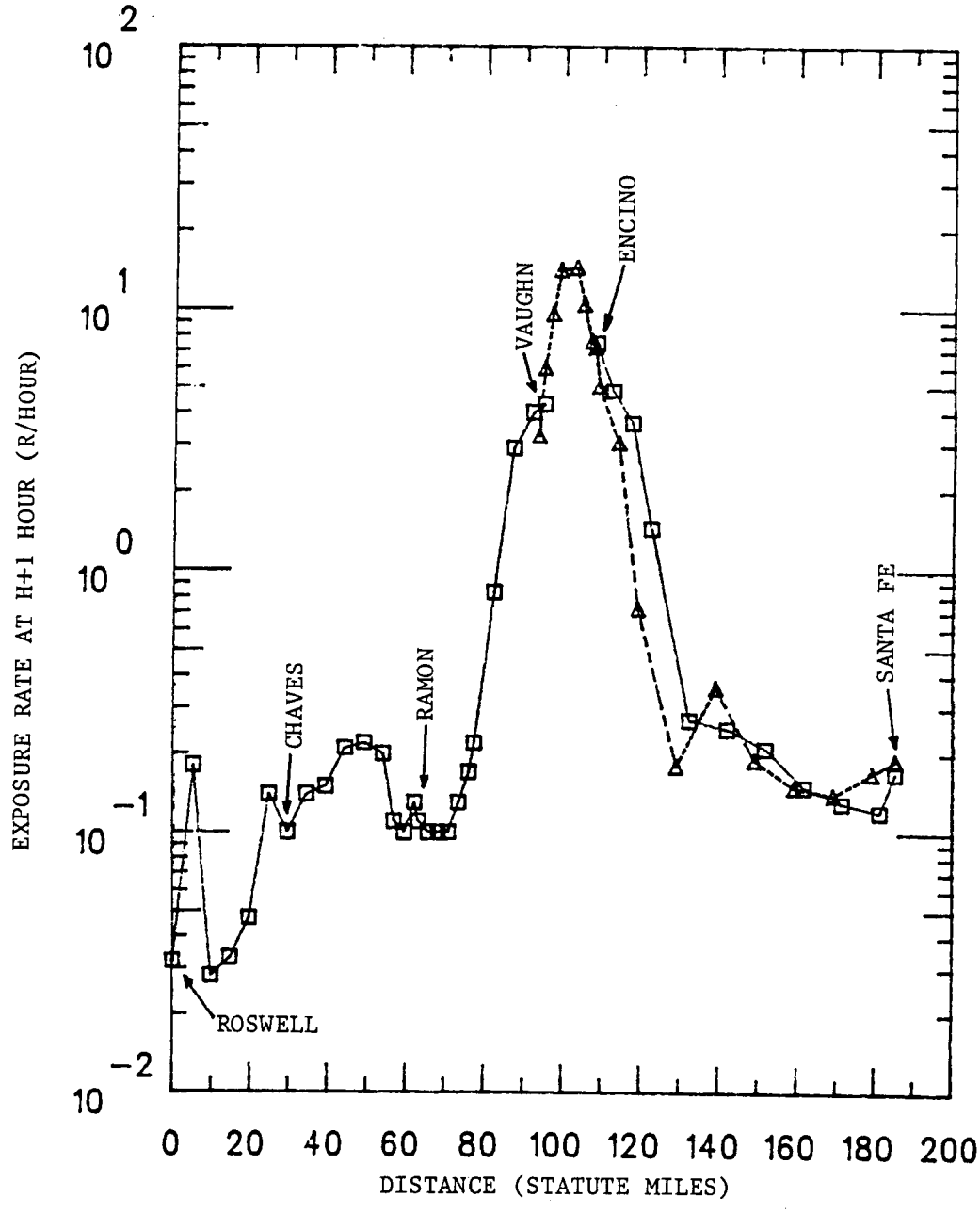

Figure 14. H+1 hour exposure rate versus distance profile from Roswell to Santa Fe, NM. The boxes represent H+1 hour values from measurements taken on the trip north on D+1 day and the triangles represent H+1 hour values from measurements taken on the trip south on D+2 days.

CHAPTER 3

METEOROLOGICAL SUMMARY

3.1 Surface Weather, Winds Aloft, and Climatological Data Available

Surface weather, winds aloft, and climatological data were obtained from the National Climatic Data Center (NCDC) in Asheville, NC. These data were supplemented with winds-aloft data from References 1 and 2, and with winds aloft and upper-air temperature and pressure data from Reference 7 (Appendix 58).

3.2 Surface Weather Conditions

At event time, a small high-pressure center was just north of the Four Corners area. A stationary front extended from North Dakota southward through central Texas to the Gulf Coast. A very weak pressure gradient was over New Mexico. At H+12 hours, a small high-pressure center was along the central New Mexico-Arizona border. The stationary front had dissipated and a weak warm front had formed that extended from North Dakota to northern Oklahoma. A weak pressure gradient was over New Mexico. By H+24 hours, a small high-pressure center was just east of the Four Corners area. The warm front extended from eastern North Dakota to northern Oklahoma. A weak pressure gradient was across New Mexico. At H+36 hours, a small high-pressure center was along the southern New Mexico-Arizona border. The warm front had dissipated. A weak pressure gradient was over New Mexico. At H+48 hours, there was a weak high-pressure center along the south central New Mexico-Arizona border. A weak pressure gradient remained across New Mexico.

At event time at the TRINITY site, the sky was reported clear to the east, over SGZ, and S 10,000 (i.e., 10,000 yards south of SGZ). The edge of solid overcast at 12,000 feet above the ground extended from base camp west of W 10,000 (i.e., 10,000 yards west of SGZ). The visibility was greater than 60 miles and the surface wind was from the east-southeast at 3 to 6 miles per hour (MPH) (Ref. 7 Appendix 58). Over the downwind area (north of the site), skies were reported clear or with scattered cirrus clouds based above 20,000 feet ASL. No later weather observations are available for the TRINITY site. Thunderstorms, rain showers, and cumulonimbus clouds (thunderheads) were reported over or in the vicinity of all weather-observation stations in New Mexico during the afternoon and early evening on D day. Precipitation accumulations reported by the weather-observation stations ranged from a trace (less than 0.01 inch) to about a tenth of an inch. Essentially the same type of weather was reported over New Mexico on D+1 day. The dotted areas in Figures 15 and 16 indicate locations where precipitation was recorded during 24-hour periods ending at various times on D and D+1 days.

3.3 Winds Aloft

At event time at the TRINITY site, winds aloft from 6,000 to 12,000 feet ASL were from the southwest at 6 to 12 MPH; from 14,000 to 19,000 feet ASL

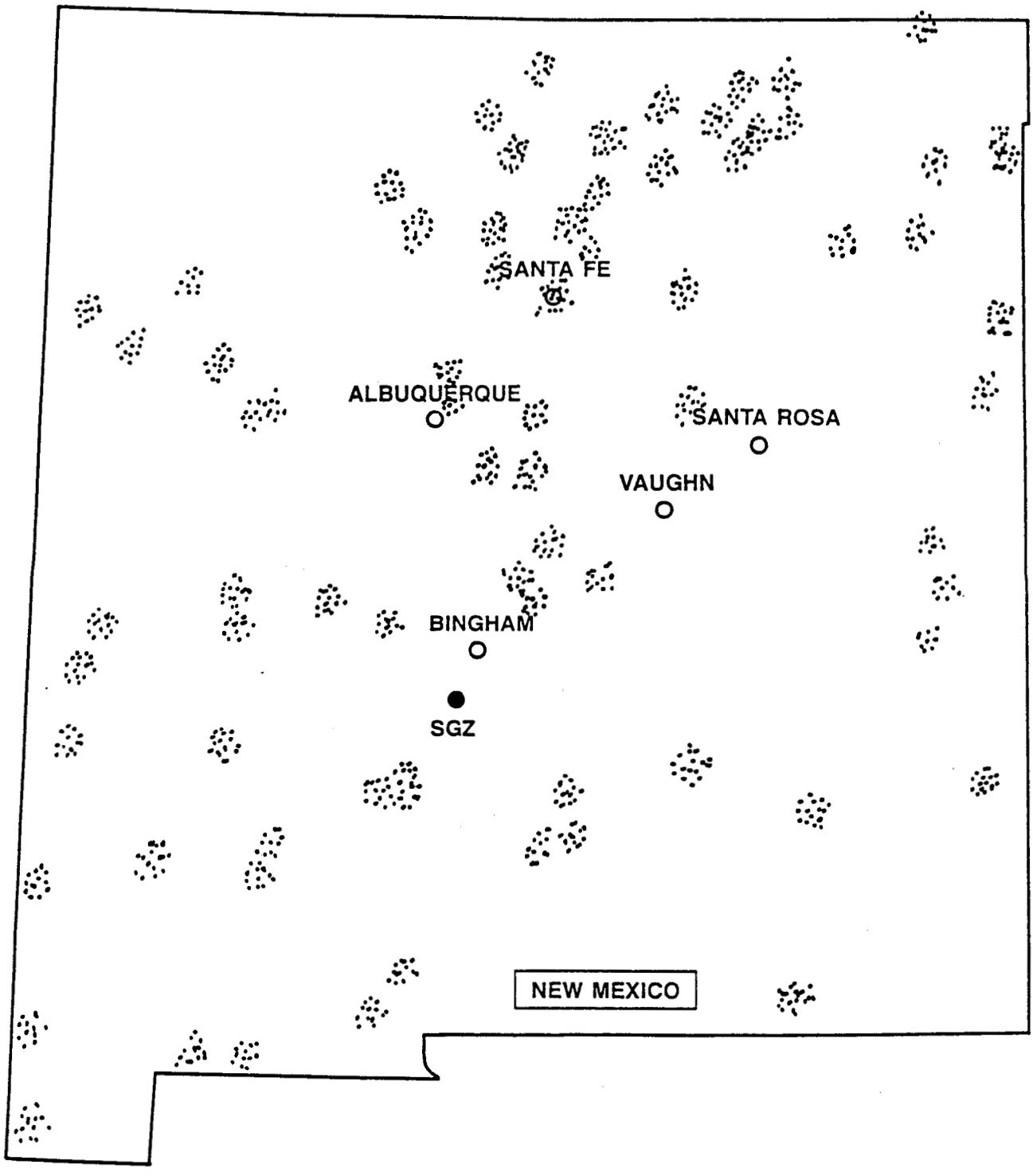

Figure 15. Dotted areas indicate where precipitation was recorded during a 24-hour period ending at various times on D day (July 16, 1945).

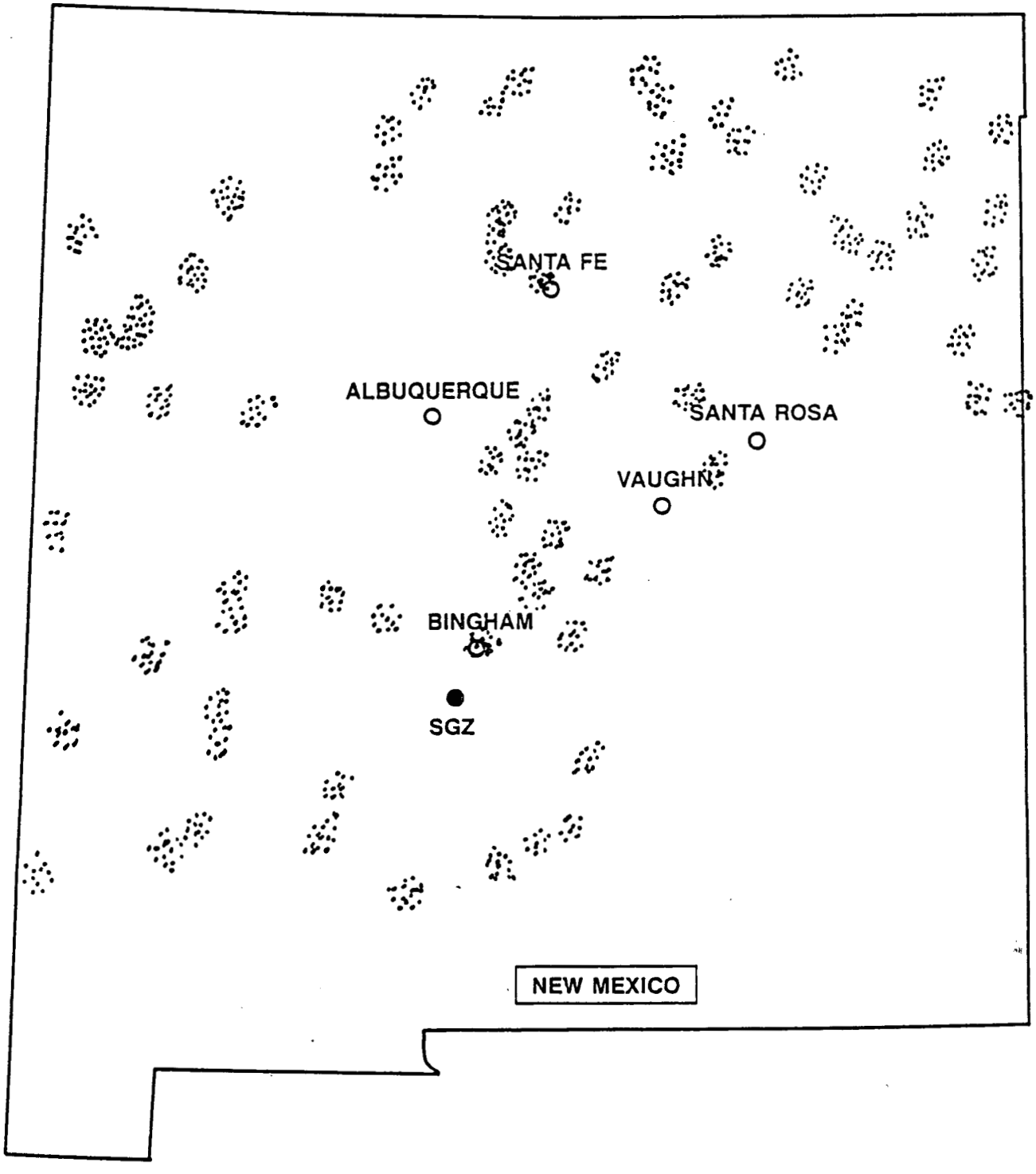

Figure 16. Dotted areas indicate where precipitation was recorded during a 24-hour period ending at various times on D+1 day (July 17, 1945).

winds were from the southeast at 12 to 16 MPH; and above 20,000 feet to near 50,000 feet ASL winds were from the southwest at 11 to 27 MPH. The top of the radioactive cloud was estimated at 35,000 feet ASL. No wind data above about 23,000 feet ASL are available for later times. At H+1.5 hours the winds aloft were essentially the same except the southeast winds between 14,000 and 19,000 feet ASL had shifted to south. At H+4 hours the winds aloft at TRINITY were southeast 3 to 5 MPH between 6,000 and 9,000 feet ASL, and south to southwest at 7 to 16 MPH above 9,000 feet ASL. The H+7 hours winds aloft were southeast at 2 to 10 MPH from 6,000 to 11,500 feet ASL, and from the west to southwest at 3 to 10 MPH above 12,000 feet ASL. The winds aloft at H+10.25 hours at TRINITY were from the south to southeast at 3 to 7 MPH from 6,000 to about 11,000 feet ASL; west to northwest at 3 to 7 MPH from 12,000 to 18,000 feet ASL; and variable 1 to 8 MPH from 19,000 to 22,000 feet ASL. These winds-aloft data are tabulated in References 2 and 7.

Winds-aloft data for D and D+1 days for other locations in New Mexico, eastern Arizona, and west Texas were extracted from winds-aloft charts received from the NCDC. The wind data on the charts were taken at H-3, H+3, H+9, H+15, and H+21 hours and are for 5,000, 8,000, 10,000, 12,000, 15,000, and 20,000 feet ASL. These wind data, along with the wind data from the TRINITY site, were plotted on maps and streamlines were drawn to show wind-circulation patterns over eastern Arizona, New Mexico, and west Texas. The streamline maps for 12,000 feet ASL are shown in Figures 17 through 21. The circulation patterns at 15,000 and 20,000 feet ASL are similar to the patterns shown at 12,000 feet ASL. At H-3 hours (Fig. 17) the streamlines show an anticyclonic (clockwise) circulation centered along the Arizona-New Mexico border to the west of SGZ. Another anticyclonic circulation is centered between Amarillo (AMA) and Lubbock (LBB) in west Texas. The streamlines at H+3 hours (Fig. 18) show that the anticyclonic center along the Arizona-New Mexico border moved west into Arizona, and the west-Texas anticyclonic center moved to the northeast leaving south to southwest flow over central and eastern New Mexico. The streamlines at H+9 hours (Fig. 19) show an anticyclonic center to the southwest of SGZ with northwest flow over the TRINITY site, west flow over northern New Mexico, and northeast flow over southeast New Mexico. At H+15 hours (Fig. 20) the streamlines show the anticyclonic circulation centered near SGZ. Essentially the same circulation pattern over New Mexico is shown at H+21 hours (Fig. 21). The effect of the anticyclonic circulations over New Mexico on fallout-particle trajectories will be discussed in Chapter 4.

3.4 Surface Winds

Over eastern New Mexico, observing stations reported southerly winds at 10 to 20 MPH all day D day. The observers at Socorro, NM, reported south to southeast winds at 4 to 12 MPH until H+12 hours then winds became variable and gusty due to thunderstorms in the vicinity. Weather observations over the remainder of New Mexico showed variable surface winds at 5 to 10 MPH until afternoon then variable gusty surface winds to 30 MPH due to rain showers and thunderstorms over or in the vicinity of the observation stations. Surface winds on D+1 Day were essentially the same as on D day except the winds at Socorro were variable 5 to 10 MPH during the morning instead of south to southeast.

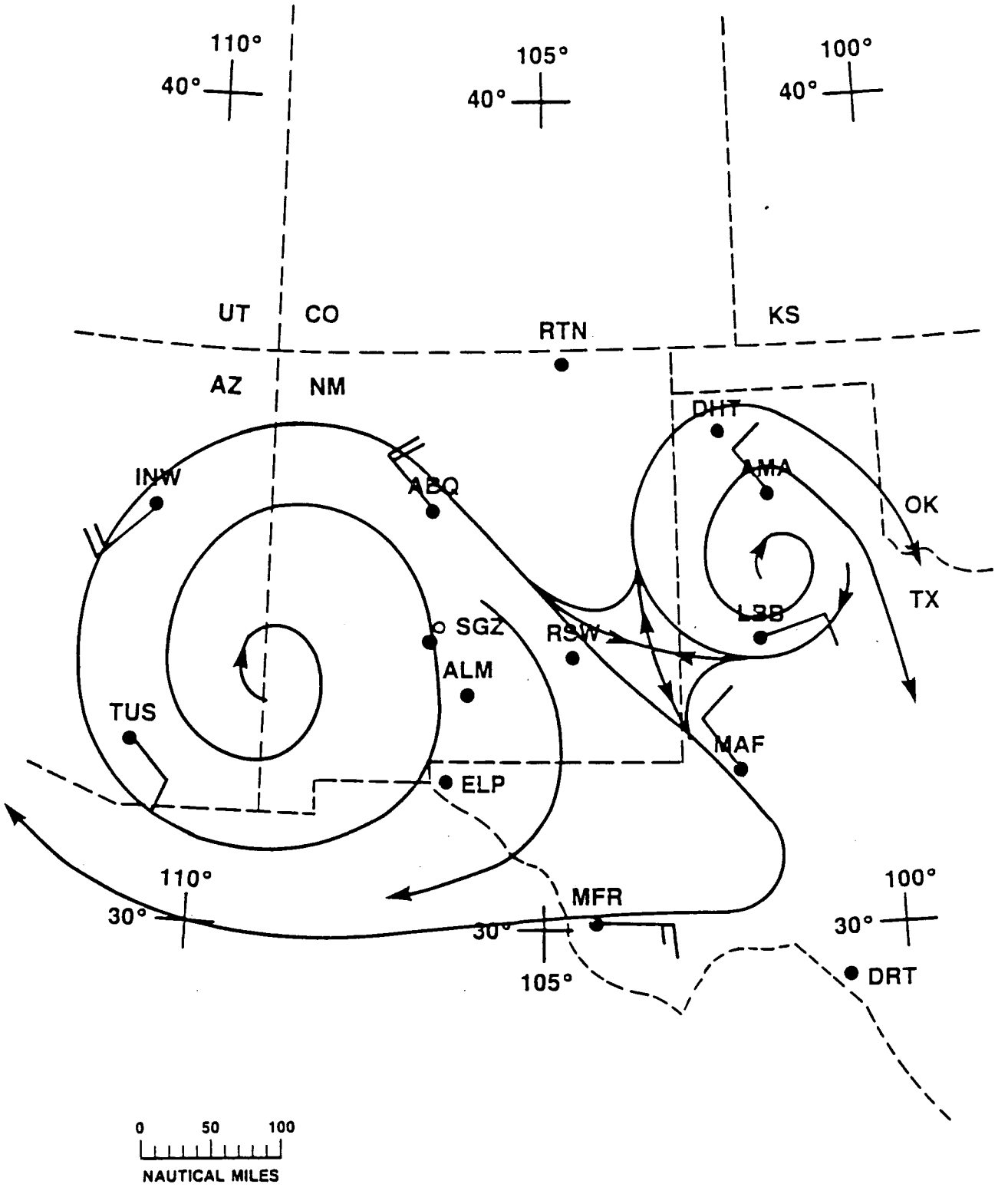

Figure 17. Streamlines of winds aloft at 12,000 feet ASL at H-3 hours.

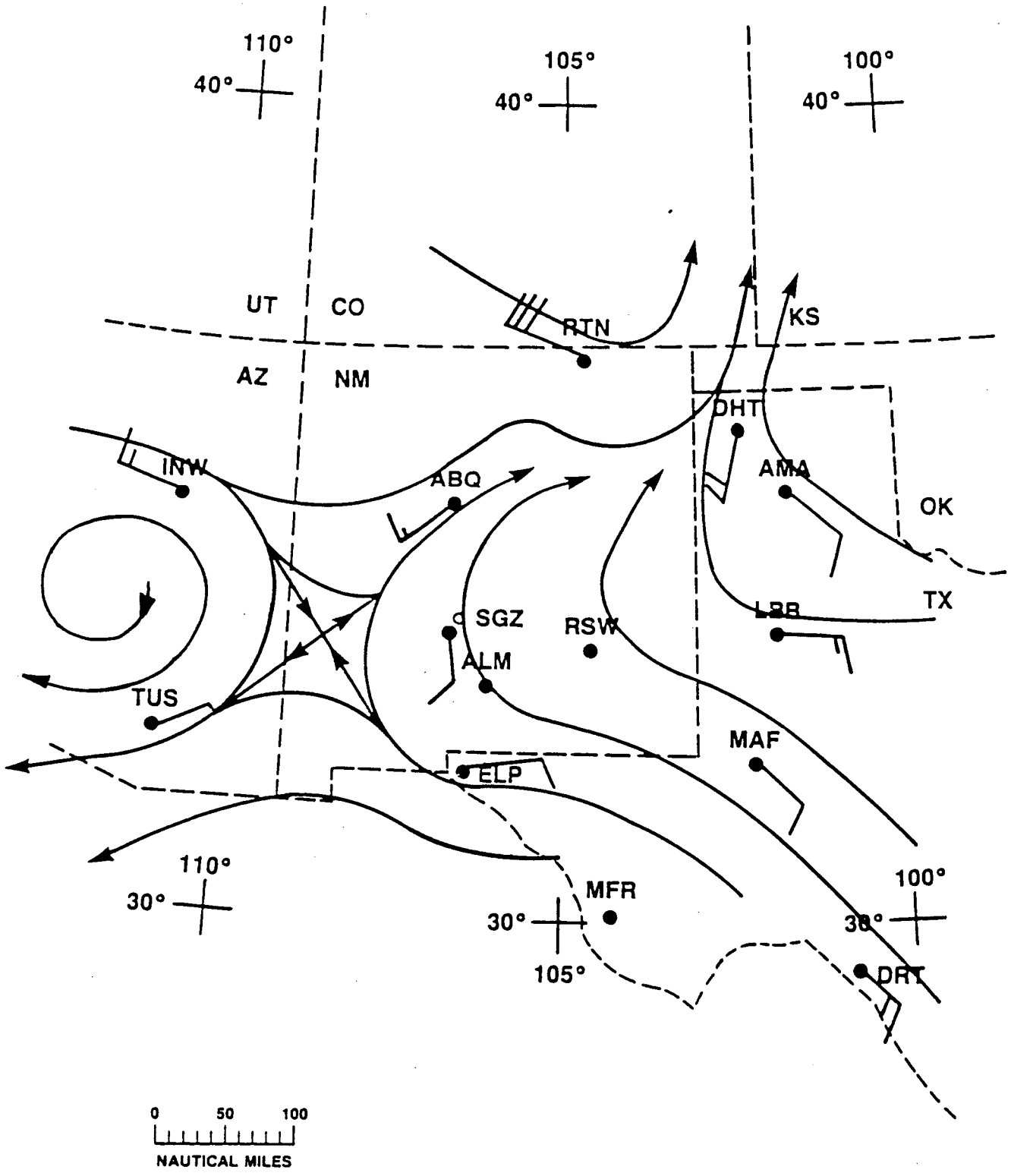

Figure 18. Streamlines of winds aloft at 12,000 feet ASL at H+3 hours.

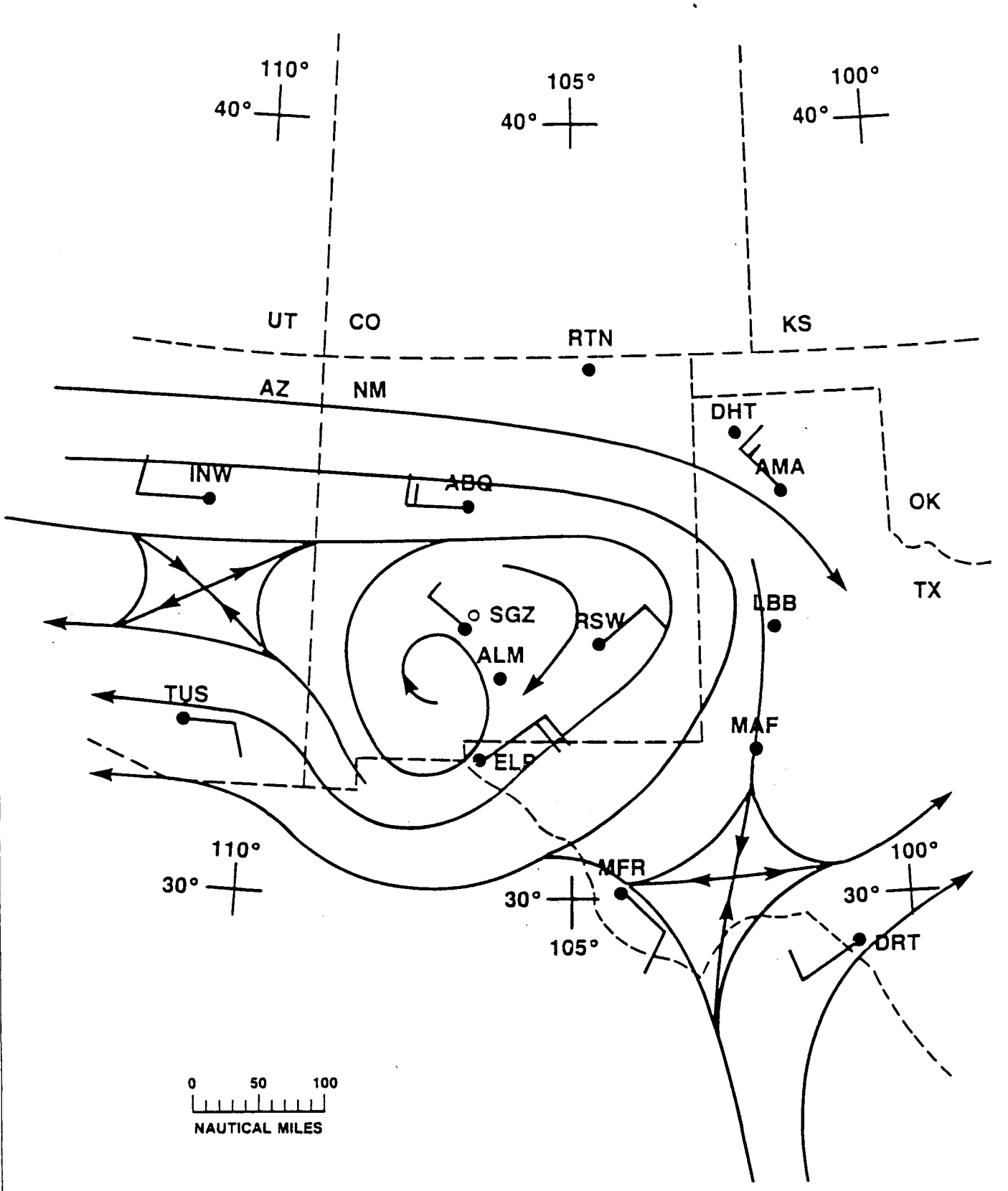

Figure 19. Streamlines of winds aloft at 12,000 feet ASL at H+9 hours.

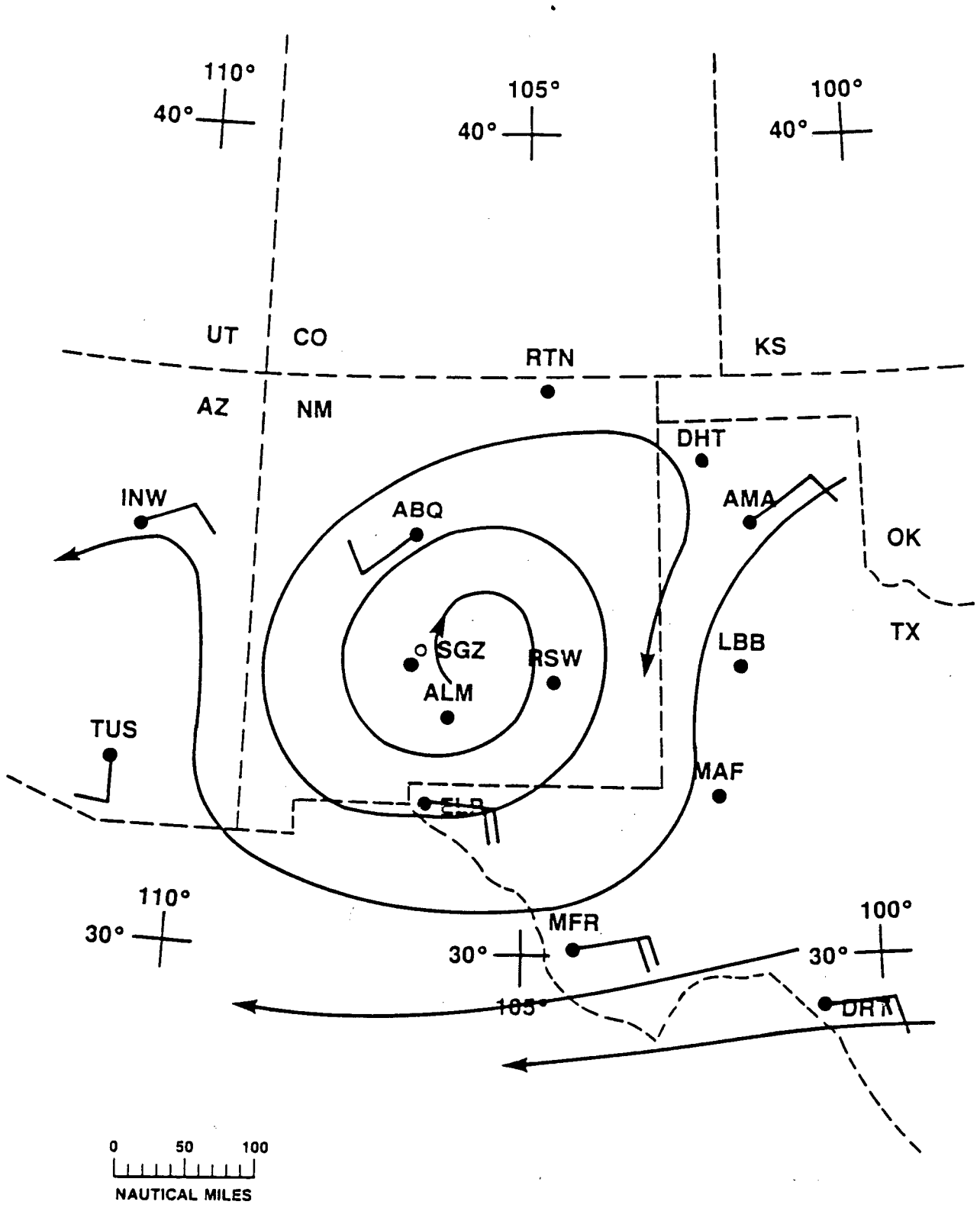

Figure 20. Streamlines of winds aloft at 12,000 feet ASL at H+15 hours.

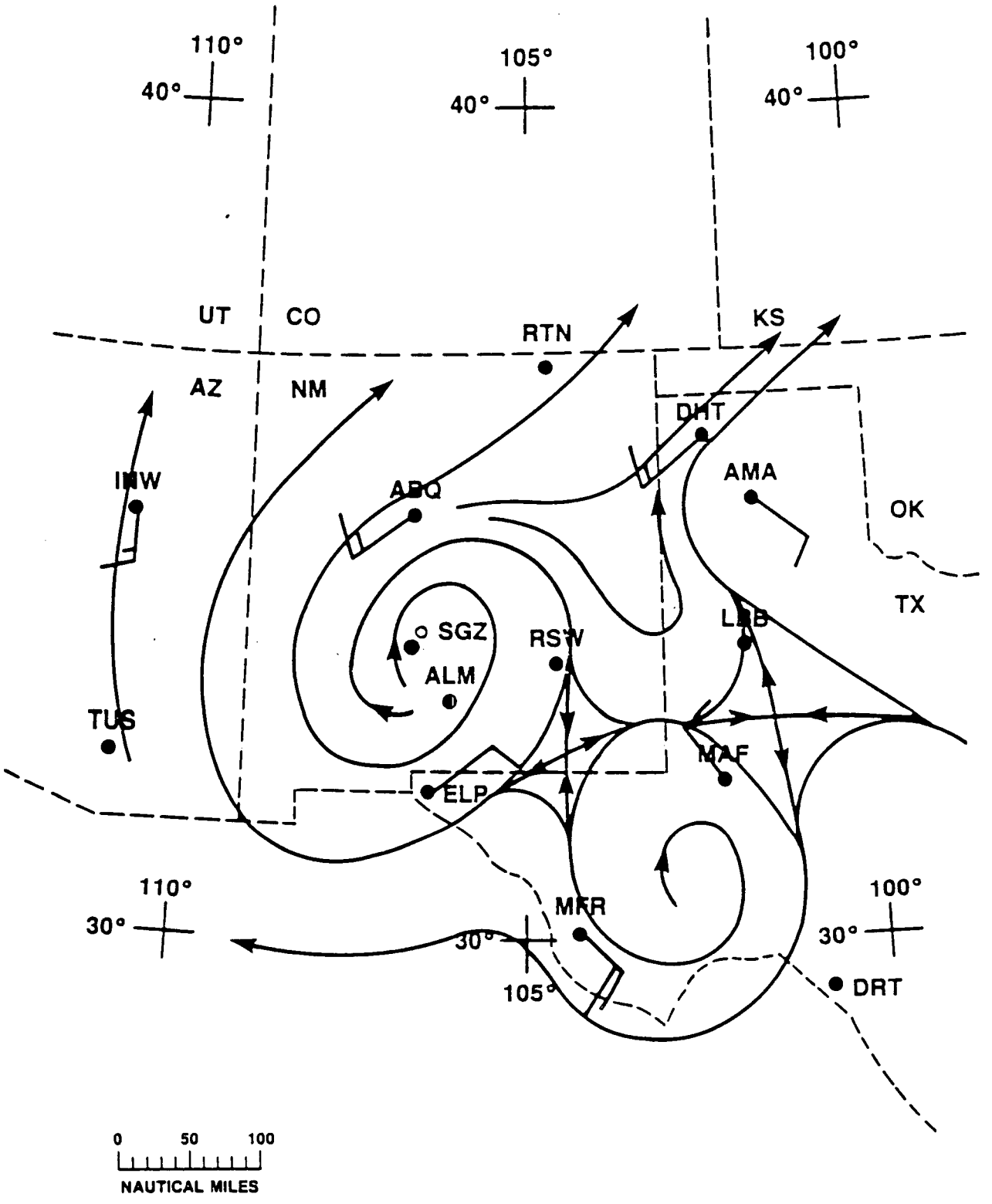

Figure 21. Streamlines of winds aloft at 12,000 feet ASL at H+21 hours.

CHAPTER 4

FALLOUT-ARRIVAL TIMES

4.1 Introduction

As discussed in Chapter 1, fallout-arrival times can be derived either from exposure-rate data collected at those sites where readings were made immediately before and during fallout, or in the absence of such data, from meteorologically derived trajectories of fallout particles. This chapter discusses meteorologically derived fallout-particle-arrival times.

4.2 Meteorologically Derived Fallout-Particle-Arrival Times

Meteorologically derived trajectories of fallout particles were constructed and used to make estimates of particle-arrival times. Wind directions for differing altitudes and times, and vertical plots of wind speeds for differing times were examined, and average wind velocities for 5,000-foot-thick layers out to H+24 hours were determined. Sedimentation velocities of the fallout particles were computed using the method described in Chapters 3 and 6 of the Handbook on Aerosols (Ref. 9). This method uses the Drag Coefficient/Reynolds Number relations for spherical particles as determined by Maxworthy and Fuchs, and requires, as input, values for the acceleration of gravity, viscosity of the air, and density of the air and particle.

Values of the acceleration of gravity for the differing altitudes were taken from the Handbook of Geophysics (Ref. 10). Temperature (T, in degrees Kelvin) data from the radiosonde taken on the day of the event were used in the equation

$$\text{Viscosity} = \frac{145.8\ T^{3/2}}{T + 110.4} \times 10^{-8}\ (\text{kg m}^{-1}\ \text{sec}^{-1})$$

to derive a representative viscosity of each layer. Temperature (T) and pressure (P, in millibars) from the radiosonde data were used in the equation

$$\text{Density} = .34838\ \frac{P}{T}\ (\text{kg m}^{-3})$$

to derive a representative air density of each layer.

Fall times of the various particle sizes were computed for each layer, assuming a particle density of 2.5 grams per cubic centimeter. The layer-averaged wind velocity for the approximate time and geographical location of the particle was used together with the computed fall time in the layer to compute a horizontal trajectory of the particle in each layer. The particle trajectories and fall times for each layer were then summed to compute the particle-arrival position and time at the bottom of the lowest layer. No allowance was made for possible, but unknown, mean-vertical motion of the air. The computed time of particle arrival should represent the time of maximum rate of fallout at a particular location. The maximum rate of fallout occurs between the time of initial-debris arrival and time of peak activity.

4.3 Fallout-Arrival-Time Lines

In this TRINITY analysis, the meteorologically derived fallout-arrival times were used in conjunction with a few early-time ground-monitor data to construct the fallout-arrival-time lines shown superimposed on the fallout-contour maps in Figures 3, 4, and 5.

The anticyclonic circulation over New Mexico discussed in Chapter 3, Section 3.3, caused some difficulty in determining fallout-arrival times on the eastern edge of the fallout pattern. The streamline map at H+3 hours (Fig. 19) shows south to southwest flow over most of New Mexico. By H+9 hours the streamline map (Fig. 19) shows an anticyclonic flow center southwest of SGZ which moved to near SGZ by H+15 hours (Fig. 20) and remained stationary through H+21 hours (Fig. 21). The time the anticyclonic flow became established cannot be determined from the available winds-aloft data so it was assumed the anticyclonic flow existed at H+6 hours. The smaller fallout particles, diameter less than 60-μm, falling from the upper levels of the radioactive cloud, and reaching 20,000 feet ASL by H+6 hours, were transported toward the east and south by this flow. Below 10,000 feet ASL the winds were south to southeast and carried the particles toward the north and northwest. A trajectory of a 40-μm particle falling from the top of the radioactive cloud is shown in Figure 22. This particle reached the bottom of the lowest layer to the north of Roswell at about H+18 hours. The 50-μm particles from the top of the cloud reached the bottom of the lowest layer north of this location at earlier times and the 30-μm particles reached the bottom of the lowest layer south of the 40-μm position at later times. Larger particles (diameter 60-μm and larger) and smaller particles from lower in the cloud reached the bottom of the lowest layer along the center and western side of the fallout pattern at much earlier times as shown in Figures 3, 4, and 5. Because of the "return" flow around the anticyclonic circulation, an apparent discontinuity occurs in the time lines along the center of the pattern and the time lines on the eastern edge along a line from Carrizozo and Santa Rosa. A moderate degree of confidence (plus or minus 1/2 hour) is placed in the time-of-arrival lines along the center and west side of the pattern out to H+12 hours; a lesser degree of confidence (plus or minus 1 hour) is placed in the time lines beyond H+12 hours; and, a still lesser degree of confidence (plus or minus 2 to 3 hours) is placed in the time lines east of the discontinuity line mentioned above.

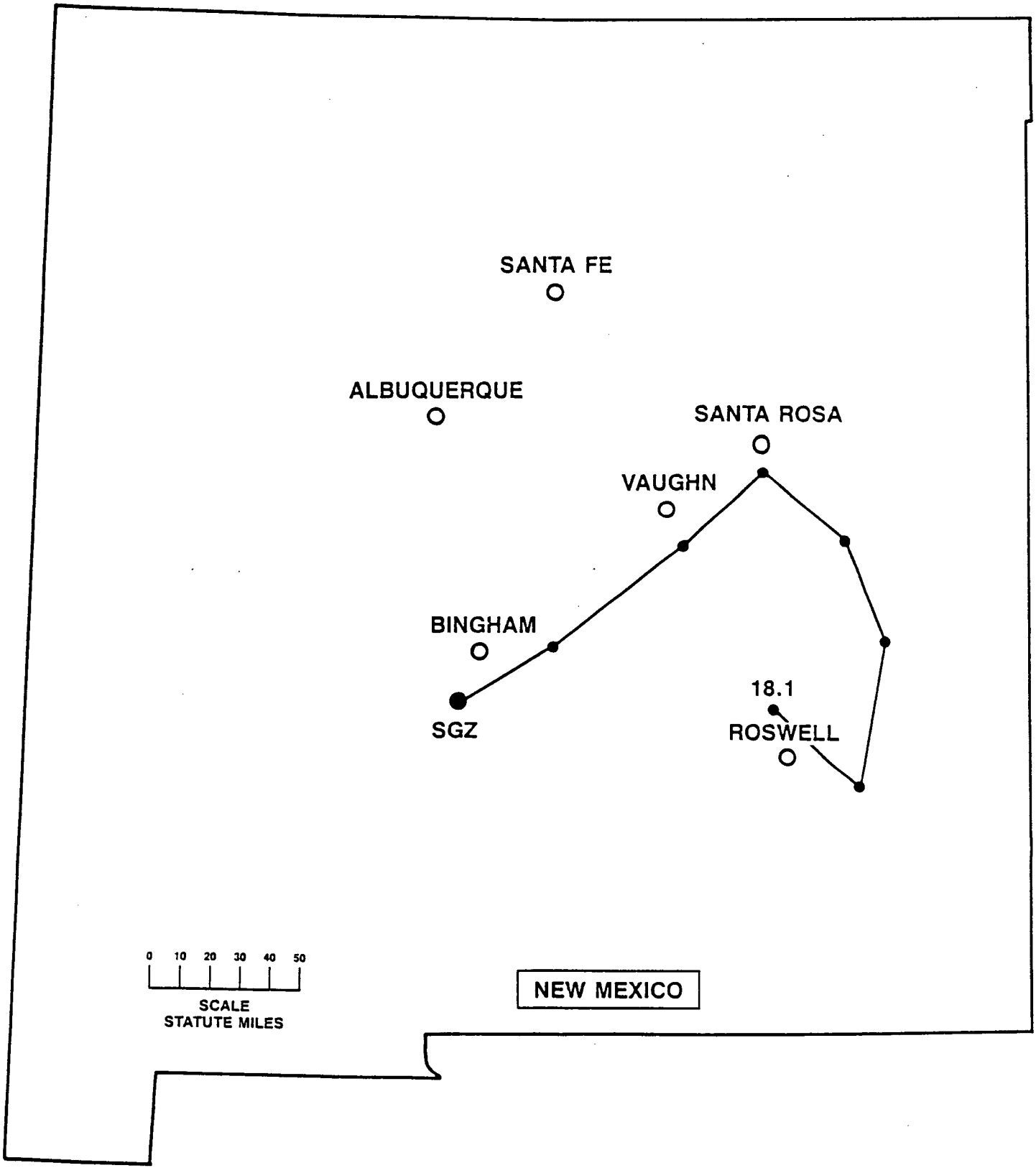

Figure 22. Trajectory (path) of a 40-micrometer particle as it falls from 35,000 feet ASL to the bottom of the lowest layer (5,000 feet ASL). The number at the end point is the time in H+hours.

CHAPTER 5

THE FALLOUT PATTERNS

5.1 The WSNSO 1987 TRINITY Fallout Patterns

The WSNSO 1987 TRINITY fallout-pattern maps are shown in Figures 3, 4, and 5. The fallout contours and time lines appearing on the WSNSO fallout-pattern maps are not unique; other interpretations of the data are possible due to the fact that a considerable amount of subjectivity is involved in this type of analysis.

5.2 Comparison of the 1987 (WSNSO) and 1940s Fallout Patterns

The WSNSO fallout contours shown in this section are based, to a large extent, on exposure-rate readings taken at or converted to approximate values at ground level, as discussed in Chapter 2, Section 2.2. However, other data were used in the WSNSO analysis that were not clearly marked as being ground-level values, and if they were not, then the WSNSO contours in some areas are not truly ground-level contours. It is not clear that all of the data used in deriving the 1940s fallout contours were taken at or converted to ground-level values. The text of Reference 1 implies that the exposure-rate values in Table IV (Ref. 1) are for ground level. However, comparison of the transcripts of monitor's field notes (Ref. 3) with exposure-rate values in Table IV (Ref. 1) shows that many of the values in Table IV were taken inside a car. For example, the exposure-rate values for the monitoring trip along U.S. Highway 66 (US66) from Albuquerque through Carnue, Zambora, Barton, Moriarty, and Long Horn Ranch, NM, were obtained with the survey meter in the car while the car traveled at 60 miles per hour. If these data were used to derive the contours in Reference 1 and Reference 8, then the 1940s contours also are not truly ground-level contours over the entire fallout patterns.

The fallout-pattern map shown in Figure 1 is from Reference 1 and shows fallout contours for H+4 hours. A decay rate of $t^{-1.0}$ was used to normalize the monitor data to H+4 hours. The fallout-contour map shown in Figure 2 is from Reference 2. It appears the contours on this map were taken from Reference 7 (Appendix 56) and are contours of radiation intensity (exposure rate) times the time of observation (R/hour X time of observation). This product would yield exposure rates at H+1 hour if the decay rate were $t^{-1.0}$. The product of exposure rate times the time of observation results in values that are smaller than H+1 hour values derived using the LANL sum of eleven exponential functions decay rate. Neither of the 1940s fallout-pattern maps included arrival-time lines.

Figure 23 shows an overlay of the contours in Figure 1 on the WSNSO fallout-pattern map shown in Figure 3. The contours along the center and west side of the pattern cover essentially the same area but the contour values are different with the WSNSO H+4 hour values being generally larger than the 1945 contour values. The difference in the contour values is at least partially attributable to the different decay rates used. The 1945 fallout-pattern map does not have contours to the east and southeast of SGZ in the vicinity of Roswell and Chaves.

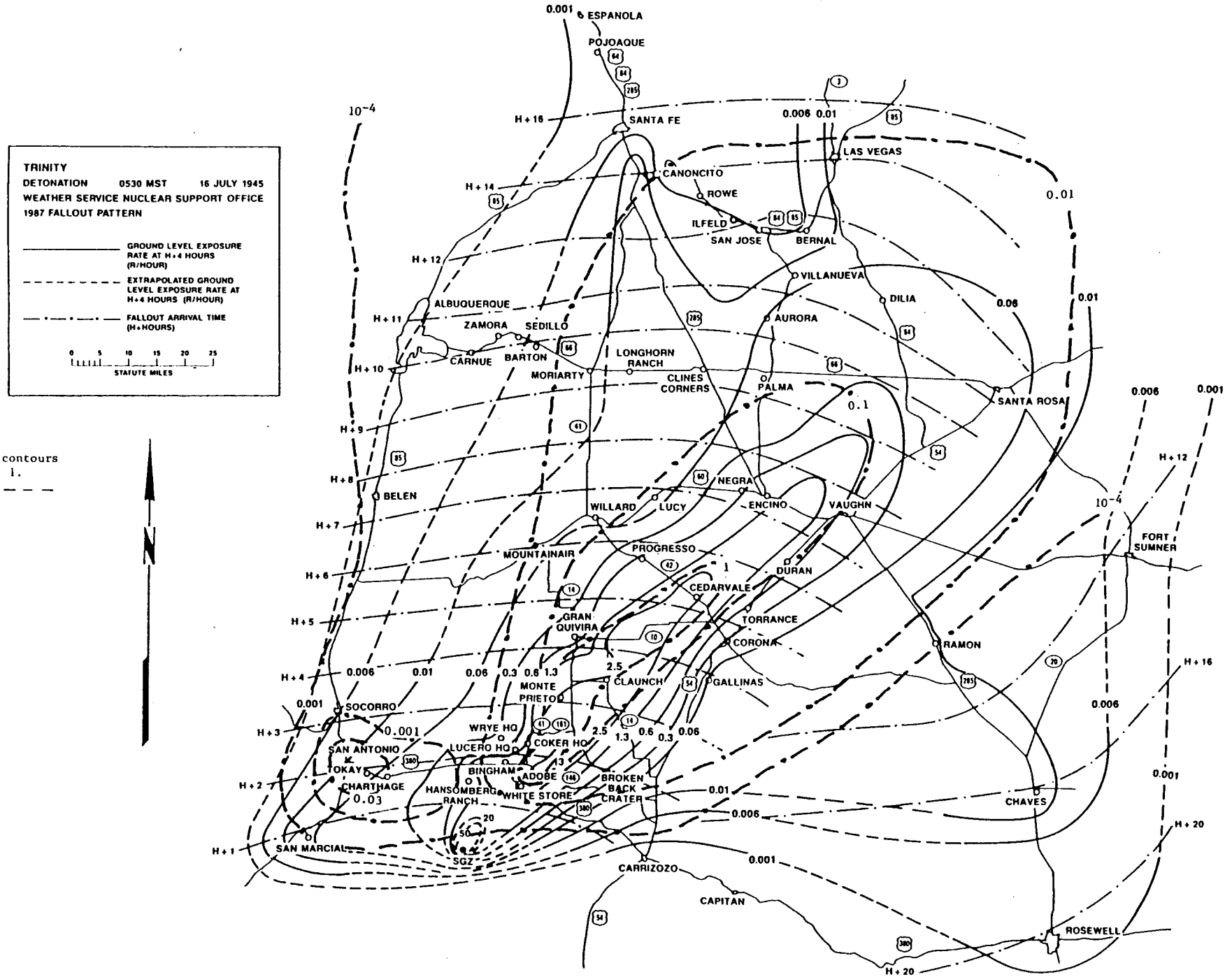

Figure 23. Overlay of the fallout contours in Figure 1 on the WSNSO fallout pattern in Figure 3.

No apparent reason could be found for this difference except that the monitor data at Roswell and Chaves were taken on D+1 day and may not have been used by the 1940s analysts.

Figure 24 shows an overlay of the fallout contours in Figure 2 on the WSNSO fallout pattern in Figure 4. The contours cover essentially the same area but the WSNSO contour values are larger for the reason discussed above.

5.3 The WSNSO 1987 H+12 Hour Fallout-Pattern Map

Figure 5 shows the WSNSO TRINITY fallout contours in terms of H+12 hour exposure-rate values (mR/h) at 1 meter above the ground. A ground-to-air-conversion factor of 0.65 was used to convert the ground-level readings to 1-meter values. This conversion factor was derived from the observed data shown in Table II (Table 2) of Reference 1, page 25.

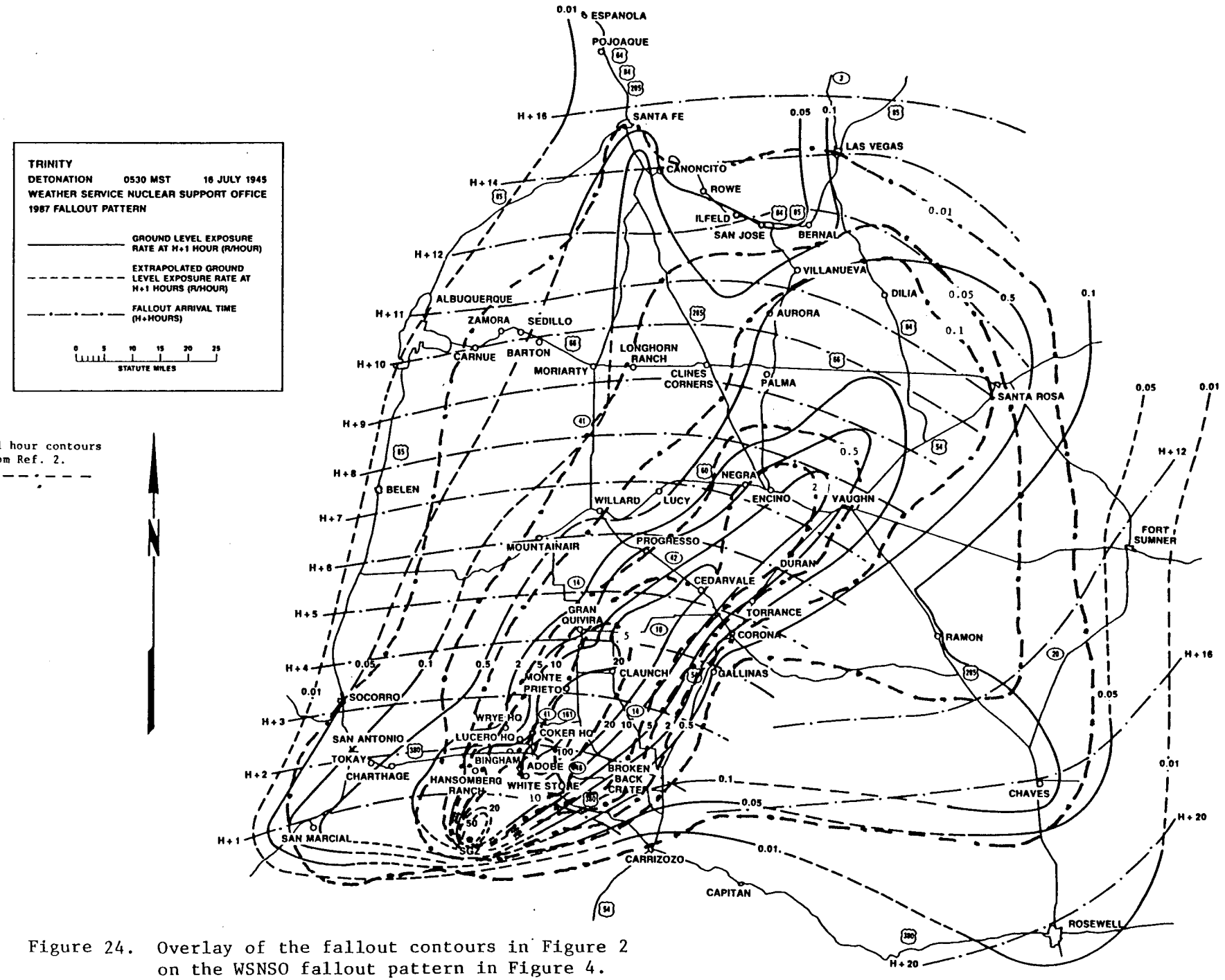

Figure 24. Overlay of the fallout contours in Figure 2 on the WSNSO fallout pattern in Figure 4.

REFERENCES

1. Hoffman, J.G., Nuclear Explosion 16 July 1945 Health Physics Report on Radioactive Contamination Throughout New Mexico following the Nuclear Explosion, Part A: Physics. LA-626, Los Alamos Scientific Laboratory, Los Alamos, NM, February 1947. (CIC number 15790)*

2. Hawthorne, H.A., Editor, Compilation of Local Fallout Data from Test Detonations 1945-1962 Extracted from DASA-1251 Volume 1-Continental U.S. Tests, DNA 1251-1-EX, General Electric Company-TEMPO, Santa Barbara, CA, May 1979. (CIC number 1428)*

3. Hoffman, J.G., Nuclear Explosion 16 July 1945 Health Physics Report on Radioactive Contamination Throughout New Mexico following the Nuclear Explosion, Part C: Transcript of Radiation Monitor's Field Notes. Film Badge Data on Town Monitoring. LA-626, Los Alamos Scientific Laboratory, Los Alamos, NM, February 1947. (CIC number 67288)*

4. Los Alamos Scientific Laboratory (now Los Alamos National Laboratory (LANL)), Volume 24 TRINITY Appendix, Appendices 55 through 77. LA-1027 DEL. Los Alamos Scientific Laboratory, Los Alamos, NM, December 1947. (CIC number 65160)*

5. Radiological Survey Map, TRINITY Area, Alamogordo, NM. (CIC number 7251)*

6. New Mexico Map No. 44, Grazing Service C.C.C., Albuquerque Drafting Office. (CIC number 7255)*

7. New Mexico Road Map and Fallout Contours. (CIC number 51305)*

8. Hicks, H.G., Results of Calculations of External Gamma Radiation Exposure Rates from Fallout and the Related Radionuclide Compositions-the TRINITY Event, UCRL-53705, Lawrence Livermore National Laboratory, Livermore, CA 94550, December 1985. (CIC number 54012)*

9. Dennis, Richard, Editor, Handbook on Aerosols, TID-26608, Technical Information Center, Office of Public Affairs, USERDA, 1976. (USERDA is now the U.S. Department of Energy.) Available from the National Technical Information Center, U.S. Department of Commerce, Springfield, VA 22161.

10. United States Air Force, Handbook of Geophysics, McMillan Company, New York, NY, 1960.

---

* CIC refers to the Department of Energy's Coordination and Information Center located at 3084 South Highland Drive, Las Vegas, Nevada 89109. Mailing address: Reynolds Electrical and Engineering Company
P.O. Box 98521, M/S 548
Las Vegas, NV 89193-8521

APPENDIX A

This Appendix contains the following tables:

Table A1. Gamma-exposure-rate data for New Mexico from Reference 1, Table IV, taken D through D+7 days. Exposure-rate readings were taken in air (waist height), in cars, and at ground level. Those readings identified as being taken in air or in cars are so noted. All other readings were assumed to have been taken at ground level.

Table A2. Gamma-exposure-rate data for New Mexico from Reference 3, taken during the 3 weeks following the TRINITY nuclear detonation. Those readings identified as being taken in air or in cars are so noted. All other readings were assumed to have been taken at ground level.

Table A3. Gamma-exposure-rate data for New Mexico from Reference 1, Appendix II, taken on D+26 days (August 12, 1945). Readings were taken on the ground or at waist height, as noted.

Table A4. Gamma exposure-rate data for New Mexico from Reference 1, Appendix III, taken on D+148 through D+151 days (December 11-14, 1945). Readings were assumed taken at ground level.

Table A5. Exposure rate versus time data for Bingham, White Store, Hot Canyon, and Searchlight Station L-8. Exposure rate versus time data for Bingham, White Store, and Hot Canyon were extracted from Figures 1 and 4, the text, and Table IV of Reference 1. Exposure rates are at ground level unless otherwise noted. Exposure rates for Searchlight Station L-8 are from Reference 3 and include gamma and gamma-plus-beta readings in air and on the ground as noted.

In Tables A1 and A2, an asterisk (*) to the right of an H+1 hour value means that value was used to locate the fallout contours. Double asterisks (**) to the right of an H+1 hour value means the geometric mean of the H+1 hour values (number in square brackets) for that location was used to locate the contours. A "d" to the right of an observed value in Table A2 means that value is a duplicate of the same value in Table A1. The "d" value times may be somewhat different due to round off and, observed and H+1 hour values in Table A2 for Teams 2 and 12 are different because of conversion of those observed values to approximate ground-level values before normalization to H+1 hour. In Table A4, a pound sign (#) to the right of an H+1 hour value means that value was used as a guide in locating the contours between Bingham and SGZ. For Bingham, White Store, and Hot Canyon the geometric mean of the H+1 hour values derived using the data in Table A5 were used to locate the fallout contours in those areas. These geometric means are in Table A5.

Table A1. Gamma-exposure-rate data for New Mexico from Reference 1, Table IV, taken D through D+7 days. Exposure-rate readings were taken in air (waist height), in cars, and at ground level. Those readings identified as being taken in air or in cars are so noted. All other readings were assumed to have been taken at ground level.

LOCATION	TIME (H+HOURS)	EXTERNAL EXPOSURE RATES (R/h) OBSERVED	AT H+1 HOUR	
Adobe	4.87	1.5	16.57	*
Adobe	3.3	6.5	37.11	During fallout
Carnue (about 11 miles east of Albuquerque) (In car)	28.9	0.001	0.09	
Aurora	54.6	0.003	0.55	*
Barton (In car)	29.2	0.001	0.09	
On US380 4 miles west of Bingham	4.86	1.5	16.51	**
On US380 4 miles west of Bingham	31.75	0.08	7.97	** [11.47]
Canoncito	59.5	0.0002	0.04	*
Carthage	38.5	0.03	3.71	**
Carthage	32.3	0.01	1.02	**
Carthage	11.8	0.003	0.10	** [0.73]
On US380 1/4 mile west of Carthage	3.0	0.11	0.54	During fallout
Claunch	30.7	0.18	17.29	
Claunch	38.3	0.19	23.36	
Carrizozo	10.5	0.0003	0.009	*
Clines Corners	29.8	0.003	0.28	
Clines Corners	30.5	0.002	0.19	
Corona	29.6	0.02	1.85	*
Cedarvale	11.25	0.11	3.60	*

Table A1 - Continued

LOCATION	TIME (H+HOURS)	EXTERNAL EXPOSURE RATES (R/h) OBSERVED	AT H+1 HOUR
Chaves	30.7	0.0015	0.14 *
Dilia	34.7	0.006	0.66 *
Duran	28.4	0.07	6.18 *
Encino	56.3	0.024	4.53
Encino (at railroad depot)	10.4	0.06	1.80
Encino	13.4	0.05	1.98
Espanola	61.4	0.0001	0.02 *
Gran Quivera (Jeep seat level)	36.5	0.035	4.08
Gran Quivera	150.0	0.005	2.44
Ilfeld	58.9	0.0002	0.04 *
Las Vegas	35.5	0.001	0.11 *
Long Horn Ranch (In car)	29.6	0.001	0.09
Lucy	12.8	0.01	0.38 *
Moriarty (In car)	29.5	0.001	0.09
Monte Prieto (Jeep seat level)	36.0	0.19	21.79
Negra	13.2	0.04	1.56 *
Palma	30.7	0.001	0.09 *
Pojoaque	53.4	0.0001	0.02 *
Ramon	32.1	0.0011	0.11
Roswell	29.0	0.0005	0.045 *
Rowe	36.4	0.0005	0.06 **
Rowe	56.1	0.0002	0.04 ** [0.047]

Table A1 - Continued

LOCATION	TIME (H+HOURS)	EXTERNAL EXPOSURE RATES (R/h) OBSERVED	AT H+1 HOUR
San Antonio	11.5	0.003	0.10 *
San Marcial	30.0	0.005	0.47 *
Santa Rosa	31.6	0.005	0.50 *
Sedillo	29.1	0.001	0.09 *
Tokay	57.6	0.0001	0.02
Torrance	29.4	0.05	4.58 *
Vaughn	9.8	0.04	1.13
Vaughn	13.8	0.025	1.02
Vaughn	28.5	0.025	2.21
Vaughn	8.4	0.018	May have been during fallout
Vaughn	8.7	0.012	May have been during fallout
Villanueva	53.92	0.0	
Willard	150.0	0.0	
Zamora (In car)	29.0	0.0012	0.11
In or near Bingham	2.93	1.5	During fallout
In or near Bingham	3.30	3.30	During fallout
4 miles east of Bingham	4.8	1.5	16.18 (In car)
4 miles east of Bingham	4.8	1.6	17.26 **
4 miles east of Bingham	5.5	1.55	20.77 **
4 miles east of Bingham	6.0	1.70	25.94 **
4 miles east of Bingham	6.1	0.65	Reading at 1 meter
4 miles east of Bingham	16.8	0.08	Reading at 1 meter
4 miles east of Bingham	36.3	0.15	17.36 **

Table A1 - Continued

LOCATION	TIME (H+HOURS)	EXTERNAL EXPOSURE RATES (R/h) OBSERVED	AT H+1 HOUR	
4 miles east of Bingham	50.0	0.05	8.30	**
4 miles east of Bingham	170.0	0.043	24.04	** [17.84]
1 mile east of Bingham	17.7	0.15	Reading at 1 meter	
1 mile east of Bingham	31.75	0.08	7.97	**
1 mile east of Bingham	36.2	0.08	9.23	** [8.50]
First road west of White Store	5.08	3.0	35.48	*
Second ranch west of White Store	5.2	3.2	39.28	*
Ranch 0.5 mile east of Bingham	5.4	1.3	16.93	*
3 miles east of Bingham on road 161	8.0	0.9	20.05	*
3 miles east of Bingham on road 161	8.0	0.5	Reading at 1 meter	
T.R. Coker Ranch 300 yards east	9.0	0.27	6.90	**
At T.R. Coker Ranch	9.2	0.22	5.76	**
T.R. Coker Ranch 300 yards west	9.3	0.26	6.90	** [6.49]
W. Lucero Ranch	9.4	0.24	6.44	*
Hansomburg Ranch	3.2	0.45	2.44	May have been during fallout
1/2 mile south of ranch	4.5	0.80	7.75	*
White Store	33.5	0.10	10.58	
White Store	5.0	2.5	28.82	
White Store	56.0	0.20	37.56	

Table A1 - Continued

LOCATION	TIME (H+HOURS)	EXTERNAL EXPOSURE RATES (R/h) OBSERVED	AT H+1 HOUR	
White Store	29.0	0.15	13.54	
White Store	8.0	2.8	62.38	
White Store	17.0	0.25	12.76	
1 mile east of White Store	8.1	1.6	36.18	*
Arroyo 2 miles due south of Bingham	53.6	0.068	12.18	*
Road junction 4 miles due south of Bingham	54.0	0.11	19.86	*
W.H. Wrye Ranch on road 1 mile south of McDougal	5.2	0.20	2.46	
On road 1 mile south of McDougal	5.0	0.50	5.76	*
Searchlight Station L-8	4.0	1.00	7.93	

Table A2. Gamma-exposure-rate data for New Mexico from Reference 3 taken during the three weeks following the TRINITY nuclear detonation. Those readings identified as being taken in air or in cars are so noted. All other readings were assumed to have been taken at ground level.

LOCATION (MILEAGE)	TIME (H+HOURS)	EXTERNAL EXPOSURE RATES (R/HOUR) OBSERVED		(R/HOUR) AT H+1 HOUR	REMARKS
TEAM 1 First ranch with windmill on north side of road west of White.	5.17	3.3		40.14	
Second ranch west of White.	5.32	3.2	d	40.72	
Ranch 0.5 mile east of Bingham.	5.42	1.3	d	17.03	
Bingham	5.50	1.55		20.77	
One mile east of L-8.	8.08	0.9		20.29	
Two miles east of L-8.	8.25	3.2		73.95 *	
Three miles east of L-8.	8.45	6.0		142.60 *	
Five miles east of junction of roads 161 and 146.	8.72	2.0		49.30 *	
300 yard east of T.R. Coker ranch.	9.00	0.27	d	6.90	
At T.R. Coker ranch.	9.25	0.22	d	5.76	
300 yards west of Coker ranch.	9.28	0.26	d	6.90	
W. Lucero ranch.	9.33	0.24	d	6.39 *	

Table A2 - Continued

LOCATION (MILEAGE)	TIME (H+HOURS)	EXTERNAL EXPOSURE RATES (R/HOUR) OBSERVED		(R/HOUR) AT H+1 HOUR	REMARKS
TEAM 2. The Team 2 data were taken at "jeep seat" level and were converted to approximate ground level values using the conversion factor 1.54 before normalizing to H+1 hour values.					
Bingham	32.50	0.15		15.34	
Flag #10. (?)	32.96	0.29		30.13	
White Store.	33.5	0.15	d	15.87	
North from Bingham to Monte Prieto on road 161.					
5 miles.	33.88	0.29		31.07 *	
10	34.35	0.08		8.70 *	
15	34.81	0.29		32.02 *	
16	35.27	0.46		51.77 *	
20	35.73	0.29		32.97 *	
25 Monte Prieto.	36.00	0.29	d	33.25 *	
Gran Quivera to Claunch.					
Gran Quivera.	36.50	0.054	d	6.29 **	
4 miles east.	37.12	0.10		11.87 *	
5	37.58	0.15		18.05 *	
6	38.04	0.29		35.38	
Claunch.	38.30	0.29	d	35.87 **	
Bingham to Willard on road 161.					
Bingham.	148.50	0.023		11.08	
4 miles east of Bingham.	148.58	0.03		14.46	

Table A2 - Continued

LOCATION (MILEAGE)	TIME (H+HOURS)	EXTERNAL EXPOSURE RATES (R/HOUR) OBSERVED		(R/HOUR) AT H+1 HOUR	REMARKS
TEAM 2 (cont'd)					
5 miles east of Bingham.	148.66	0.069		33.29 *	
10	148.74	0.0015		0.72	
11	148.82	0.0015		0.73	
14	148.90	0.09		43.49 *	
15	148.98	0.15		72.93 *	
16	149.06	0.17		82.25 *	
17	149.14	0.146		70.68 *	
20	149.22	0.054		16.95	
25	149.30	0.069		33.44 *	
30	149.38	0.03		14.55 *	
35	149.46	0.008		3.88 *	
Gran Quivera.	149.54	0.008	d	3.88 ** [4.94]	
40	149.62	0.006		2.91 *	
45	149.70	0.0			
62	149.78	0.0			
Mountainair.	149.86	0.0			
Willard.	150.00	0.0	d		
TEAM 3					
East of Bingham.					
1	36.17	0.08		9.22	
3	36.33	0.07		8.11	

Table A2 - Continued

LOCATION (MILEAGE)	TIME (H+HOURS)	EXTERNAL EXPOSURE RATES (R/HOUR) OBSERVED		(R/HOUR) AT H+1 HOUR	REMARKS
TEAM 3 (cont'd)					
4	36.45	0.15		17.35	
7	36.83	0.70		82.35	
8	37.10	0.60		71.17	
Highway 161 (?)	37.50	0.20		24.01	
South entrance to forest. (?)	37.73	0.20		24.18	
Outside Carthage.	38.62	0.03		3.72	
TEAM 4					
5 miles north of Bingham.	5.05	0.50		5.86	
W.W. Wrye ranch.	5.25	0.20	d	2.49 *	
Bingham.	6.00	1.70		25.94	Observed value is in Ref. 1 Fig. 1.
Bingham.	7.50	1.50		30.89	
0.5 mile east of White Store on US380.	7.97	2.80		62.10	
1.5 miles east of Bingham on US380.	8.40	1.50		35.40	
6 miles northwest of Bingham on #161.	9.17	3.50		91.36	
8 miles northwest of Bingham on #161.	9.27	7.00		185.00	

Table A2 - Continued

LOCATION (MILEAGE)	TIME (H+HOURS)	EXTERNAL EXPOSURE RATES (R/HOUR) OBSERVED	(R/HOUR) AT H+1 HOUR	REMARKS
TEAM 5				
Southwest of Bingham toward Barsum ranch.	53.50	0.005	0.89	
Bingham.	52.50	0.05	8.76	
Bingham.	152.50	0.043	21.32	
TEAM 6				
About 1 mile north if Duran (can see town) or 13.2 miles southwest of Vaughn toward Corona.	414.42	0.0075	13.56 *	
18.2 miles southwest of Vaughn.	414.65	0.0065	11.76 *	
23.2	414.65	0.006	10.86 *	
27.8 miles north of Carrizozo on US380.	432.00	0.0085	16.25 *	
30.1 miles north, almost in Bingham.	432.00	0.006	11.47	
31.1	432.00	0.0075	14.34	
North of Claunch on #10 toward Corona.				
Just north of Claunch.	456.00	0.0145	29.79 **	(Monitor's note) on ground as usual.
0.9	456.00	0.0075	15.41 *	
3.4	456.00	0.0085	17.47 *	
6.1	456.00	0.013	26.71 *	

Table A2 - Continued

LOCATION (MILEAGE)	TIME (H+HOURS)	EXTERNAL EXPOSURE RATES (R/HOUR) OBSERVED	(R/HOUR) AT H+1 HOUR	REMARKS
TEAM 6 (cont'd)				
Turned right about 8 miles outside Claunch.				
10.9	465.92	0.013	27.49 *	
13.4	465.92	0.013	27.49 *	
16.1	466.00	0.014	29.61 *	
18.0	466.17	0.0155	32.79 *	
21.0	466.28	0.015	31.75 *	
23.4	466.38	0.0065	13.76 *	
25.9	466.83	0.0065	13.78 *	
30.9 miles on #10 on #42.	467.17	0.004	8.49 *	(Probably went northwest on #42
33.9	467.25	0.0075	15.92 *	
36.5	467.50	0.0095	20.18 *	
38.4	467.58	0.012	25.49 *	
41.1	467.67	0.0065	13.81 *	
43.6	468.00	0.0045	9.57 *	
48.0	468.0	0.004	8.51 *	
8 miles north of Claunch.	484.47	0.013	28.94 *	
South city limit of Claunch.	484.67	0.015	33.41 **	
Returned to Claunch. Taking #161 toward Bingham.	484.78	0.015	33.41 ** [33.05]	
4.8 miles west of Claunch.	484.92	0.0085	18.95 *	

Table A2 - Continued

LOCATION (MILEAGE)	TIME (H+HOURS)	EXTERNAL EXPOSURE RATES (R/HOUR) OBSERVED	(R/HOUR) AT H+1 HOUR	REMARKS
TEAM 6 (cont'd)				
10.0	485.10	0.0235	52.41 *	
12.4	485.22	0.015	33.46 *	
14.5	485.22	0.014	31.23 *	
16.9	485.83	0.038	84.91 *	
19.0	485.95	0.057	127.4	
21.5	486.03	0.017	38.01 *	
26.5	486.28	0.004	8.95 *	
29.0	486.38	0.015	33.57 *	
31.5	486.55	0.004	8.96 *	
34.0	486.67	0.004	8.96	
At Bingham.	486.70	0.0045	10.08	
At Bingham.	486.78	0.0045	10.08	
From intersection of 161 and 146 on 146.				
1.2 miles from intersection.	535.40	0.06	149.60 *	
"	535.40	0.04	102.20 *	
"	535.40	0.006	14.96	
1.8	535.67	0.05	127.00 *	
1.8	535.67	0.08	203.20 *	
2.2 (Just past house).	535.92	0.06	152.50 *	
"	535.92	0.07	177.90 *	

Table A2 - Continued

LOCATION (MILEAGE)	TIME (H+HOURS)	EXTERNAL EXPOSURE RATES (R/HOUR) OBSERVED	(R/HOUR) AT H+1 HOUR	REMARKS
TEAM 6 (cont'd)				
2.4 looks like the end of the road.	536.08	0.049	124.60	
Retraced steps about 1.5 tenths mile and started up old road.	536.33	0.049	124.70	
One mile down dirt road from #41. Road right from Maxwell ranch road.	539.25	0.011	28.20 *	
6.9	539.40	0.015	38.46	
TEAM 7				
East of Bingham on US380.				
4.0 miles.	7.95	0.95	21.10	
7.0	8.28	1.60	37.13	
At Bingham.	8.50	0.50	11.97	Observed value is in Ref. 1 Fig. 1.
4.0 miles west of Bingham on US380.	8.75	0.16	3.96	
(Unknown location)	9.27	0.0045	0.12	(Using "large" Victoreen)
1.0 mile south of foregoing road junction. (Unknown)	9.33	0.0084	0.22	
At junction of "Bosque Del" south of US380.	9.60	0.0065	0.18	
1.0 mile south of junction.	9.77	0.007	0.20	
2.0	9.92	0.0065	0.19	
3.0	10.00	0.0084	0.24	

Table A2 - Continued

LOCATION (MILEAGE)	TIME (H+HOURS)	EXTERNAL EXPOSURE RATES (R/HOUR) OBSERVED		(R/HOUR) AT H+1 HOUR	REMARKS
TEAM 7 (cont'd)					
4.0	10.08	0.0057		0.17	
5.0	10.17	0.0075		0.22	
6.0	10.37	0.0057		0.17	
7.0	10.50	0.0075		0.23	
8.0	10.93	0.0075		0.24	
At Carthage.	11.75	0.0045	d	0.15	
TEAM 8 It is believed that the following readings were taken with the survey meter inside of the car.					
4.0 miles east of Bingham on US380.	4.87	1.5	d	16.57	
6.0 miles east at White Store.	4.92	2.6		29.20	
9.0	5.04	0.65		7.59	
11.0	5.47	0.065		0.86	
12.0	5.58	0.05		0.69	
17.0	5.75	0.028		0.40	
24.0	6.00	0.033		0.50	
31	6.17	0.02		0.32	
35	6.33	0.02		0.33	
6.0 miles south of San Antonio.	10.52	0.002		0.06	
12.0	10.75	0.001		0.03	
18.0	10.97	0.004		0.13	
21.0 at San Marcial	11.58	0.003		0.10	

Table A2 - Continued

LOCATION (MILEAGE)	TIME (H+HOURS)	EXTERNAL EXPOSURE RATES (R/HOUR) OBSERVED	(R/HOUR) AT H+1 HOUR	REMARKS
TEAM 8 (cont'd)				
2.0 miles west of Cones. (?)	57.50	0.0001	0.02	
At Tokay.	57.58	0.0001 d	0.02	
San Pedro school district # 25.	58.33	0.00005	0.01	
4.0 miles west of school.	58.75	0.000425	0.08	
TEAM 9				
North of Carrizozo toward Gallinas.				
1.7	16.75	0.003	0.15	
3.6	16.93	0.002	0.10	
36.5	18.70	0.002+	0.11 *	
37.9	18.83	0.003+	0.17 *	
38.5	18.92	0.005	0.29 *	
39.0	19.08	0.01	0.58 *	
TEAM 10				
From Roswell to Santa Fe through Vaughn and Encino.				
0.0	29.08	0.00035	0.032 *	
4.9	29.33	0.002	0.18	
9.8	29.67	0.0003	0.028 *	
14.7	29.92	0.00035	0.033 *	
19.6	30.08	0.0005	0.047 *	

Table A2 - Continued

LOCATION (MILEAGE)	TIME (H+HOURS)	EXTERNAL EXPOSURE RATES (R/HOUR) OBSERVED		(R/HOUR) AT H+1 HOUR	REMARKS
TEAM 10 (cont'd)					
24.5	30.25	0.00145		0.14 *	
29.4	30.50	0.00105		0.10 *	
34.3 Chaves.	30.67	0.0015	d	0.14 *	
39.2	30.83	0.0015		0.15 *	
44.1	31.00	0.0022		0.21 *	
49.0	31.17	0.00225		0.22 *	
53.8	31.33	0.002		0.20 *	
56.8 Stake 9.	31.50	0.00115		0.11 *	
59.4 Stake 8.	31.58	0.001		0.10 *	
62.0 Stake 7.	31.75	0.0013		0.13 *	
63.0 Stake 1, Ramon.	32.08	0.0011	d	0.11 *	
65.6 Stake 2.	32.17	0.001		0.10 *	
68.2 Stake 3.	32.25	0.001		0.10 *	
70.8 Stake 4.	32.33	0.001		0.10 *	
73.4 Stake 5.	32.42	0.00125		0.13 *	
76.0 Stake 6.	32.50	0.0017		0.17 *	
77.3	32.67	0.0021		0.22 *	
82.2	32.75	0.008		0.83 *	
87.1	32.92	0.028		2.91 *	
92.0 Outside of Vaughn.	33.08	0.038		4.00 **	
Station at Vaughn.	33.83	0.020		2.14 **	

Table A2 - Continued

LOCATION (MILEAGE)	TIME (H+HOURS)	EXTERNAL EXPOSURE RATES (R/HOUR) OBSERVED	(R/HOUR) AT H+1 HOUR	REMARKS
TEAM 10 (cont'd)				
0.25 mile above station inside Vaughn.	33.83	0.040	4.28 **	
95.0 miles from Roswell, just west of Vaughn.	34.00	0.04	4.30 **	
97.1	34.08	> 0.1	> 10.78	
99.0	34.17	> 0.1	> 10.82	
100.8	34.22	> 0.1	> 10.83	
102.6	34.25	> 0.1	> 10.84	
104.4	34.33	> 0.1	> 10.87	
106.3	34.42	> 0.1	> 10.90	
108.1	34.50	> 0.1	> 10.93	
108.5 Encino.	34.53	0.068	7.44 **	
112.6 Going northwest on US285.	34.58	0.044	4.82 *	
117.5	34.75	0.033	3.64 *	
122.4	34.87	0.013	1.44 *	
132.2	35.08	0.0024	0.27 *	
142.0	35.33	0.0022	0.25 *	
151.7	35.55	0.00185	0.21 *	
161.5	35.75	0.0013	0.15 *	
171.3	36.00	0.00115	0.13 *	
181.1	36.22	0.001	0.12 *	
185.0 Santa Fe.	36.50	0.0015	0.17 *	

Table A2 - Continued

LOCATION (MILEAGE)	TIME (H+HOURS)	EXTERNAL EXPOSURE RATES (R/HOUR) OBSERVED	(R/HOUR) AT H+1 HOUR	REMARKS
TEAM 10 (cont'd)				
Trip from Santa Fe to Vaughn. Distances are from Roswell to Santa Fe.				
185.0 Santa Fe.	52.00	0.0011	0.19 *	
179.0	52.33	0.001	0.17 *	
169.0	52.58	0.0015	0.26 *	
159.0	52.75	0.00085	0.15 *	
149.0	52.95	0.0011	0.19 *	
139.0	53.17	0.002	0.36 *	
129.0	53.42	0.001	0.18 *	
119.0	53.58	0.004	0.72 *	
114.0	53.58	0.017	3.05 *	
109.0	53.75	0.028	5.03 *	
108.0 Encino.	53.92	0.04	7.21 **	
107.0	53.98	0.042	7.58 *	
105.0	54.03	0.058	10.48 *	
103.0	54.08	0.08	14.47 *	
99.0	54.23	0.078	14.15 *	
97.0	54.28	0.053	9.63 *	
95.0	54.35	0.033	6.00 *	
93.5 Just west of Vaughn.	54.42	0.018	3.28 **	
On US60 just east of Vaughn.	56.92	0.018	3.44 ** [3.48]	

Table A2 - Continued

LOCATION (MILEAGE)	TIME (H+HOURS)	EXTERNAL EXPOSURE RATES (R/HOUR) OBSERVED		(R/HOUR) AT H+1 HOUR	REMARKS
TEAM 10 (cont'd)					
On US60 east of Vaughn.					
2.0	57.00	0.013		2.49 *	
7.0	57.08	0.005		0.96 *	
12.0	57.22	0.005		0.96 *	
TEAM 11					
Pojoaque	53.17	0.0001	d	0.018 *	
2 miles north of Santa Fe on 85.	53.17	0.0001		0.018 *	
1.5 miles southeast of Santa Fe on US285.	55.75	0.00011		0.021 *	
At San Jose Road and Pecos river bridge.	55.92	0.0002		0.038 *	
At junction 3 and (84 & 85) road to Bernal 14 miles from Las Vegas, NM.	56.13	0.00031		0.058 *	
7.0 miles west of Pecos.	56.50	0.00034		0.065	
At Ilfeld.	58.83	0.00035	d	0.069 *	
1.0 mile west of Rowe.	59.17	0.0002		0.04 *	
Canoncito.	59.50	0.0002	d	0.04 *	
At Santa Fe marker.	59.83	0.00011		0.02	
At Pojoaque.	61.12	0.00011		0.02 *	
At Espanola.	61.42	0.00012	d	0.02 *	
On mesa.	64.00	0.0002		0.04	

Table A2 - Continued

LOCATION (MILEAGE)	TIME (H+HOURS)	EXTERNAL EXPOSURE RATES (R/HOUR) OBSERVED		(R/HOUR) AT H+1 HOUR	REMARKS
TEAM 12 Readings commencing at H+29.73 hours were converted to approximate ground level values using the conversion factor 1.54 before normalizing to H+1 hour.					
School house at Vaughn.	7.78	0.00014			(Taken during fallout)
School house at Vaughn.	7.88	0.0005			(Taken during fallout)
School house at Vaughn.	8.67	0.012	d	0.29	(Maybe during fallout)
Encino railroad station.	10.40	0.06	d	1.80 **	
11 miles east of Albuquerque (Carnue).	28.88	0.001	d		(Monitor's note) Traveling at 60 mi/hr in car.
Zamora.	28.93	0.0012			" " "
Barton.	29.17	0.001			" " "
Moriarty.	29.40	0.001			" " "
Long Horn Ranch.	29.50	0.001			" " "
Clines Corners.	29.73	0.005		0.46 *	Outside car. Waist height as all readings this day.
1.0 mile east of Clines Corners 25 feet south of road.	29.80	0.003		0.28 *	
By gas station 3 miles east of Clines Corners. 10 feet south of road.	29.88	0.002		0.19	
2.0 miles north of Clines Corners. 25 feet east of road.	29.98	0.003		0.28	
Middle of bridge. (?)	30.08	0.002		0.19	
1.0 miles west.	30.23	0.005		0.47	

Table A2 - Continued

LOCATION (MILEAGE)	TIME (H+HOURS)	EXTERNAL EXPOSURE RATES (R/HOUR) OBSERVED		(R/HOUR) AT H+1 HOUR	REMARKS
TEAM 12 (cont'd)					
2.0 miles west.	30.27	0.003		0.28	
3.0 miles west.	30.33	0.003		0.28	
Clines Corners. In car.	30.38	0.003			
Gas station 3 miles east of Clines Corners.	30.40	0.002		0.19	
1.0 mile east.	30.43	0.002		0.19	
12.0 miles east.	30.63	0.02		1.92	
Hill top.	30.77	0.035		3.37	
El Camba service station. (?) 25' south of road.	30.93	0.02		1.94	
17.0 miles east of Half Moon. (?)	31.32	0.019		1.87	
Santa Rosa city limit.	31.55	0.008	d	0.79 *	
2.0 miles east of Santa Rosa.	32.75	0.006		0.62 *	
6.0 miles east of Santa Rosa.	33.55	0.006		0.64 *	
10.0 miles north of junction of # 84 and # 66.	34.42	0.012		1.31 *	
Villanueva.	53.92	0.0	d		
12.0 miles south of Villanueva.	54.65	0.005		0.92 *	

Table A2 - Continued

LOCATION (MILEAGE)	TIME (H+HOURS)	EXTERNAL EXPOSURE RATES (R/HOUR) OBSERVED		(R/HOUR) AT H+1 HOUR	REMARKS
TEAM 12 (cont'd)					
21.0	55.02	0.012		2.21 *	
26.0	55.63	0.005		0.95 *	
32.0	55.62	0.008		1.49 *	
45.0	56.18	0.03		5.65 *	
Encino.	56.30	0.04	d	7.56 ** [5.20]	

Table A2 - Continued

LOCATION (MILEAGE)	TIME (H+HOURS)	EXTERNAL EXPOSURE RATES OBSERVED (mR/HOUR)	EXTERNAL EXPOSURE RATES AT H+1 HOUR (R/HOUR)
TEAM 13 This team collected these data on November 8 and 9, 1945, about D+116 days. Only starting times were recorded.			
4.0 miles south of Claunch.	2784	0.92	27.07
4.5 miles south.	2784	0.61	17.95
On US380 south of Bingham.	2788	0.27	7.96
2.1 miles south.	2788	0.95	28.01
3.2	2788	1.55	45.70
White Store.	2788	2.10	61.92
White Store to Bingham.			
1.5	2788	0.60	17.69
2.0	2788	0.60	17.69
Bingham to the junction of 161 and 146.			
1.0 miles east of Bingham.	2788.58	0.36	10.62
1.5	2788.58	0.23	6.78
2.0	2788.58	0.175	5.16
3.0 L-8	2788.58	0.175	5.16
3.5	2788.58	0.27	7.96
4.0	2788.58	0.47	13.86
4.5	2788.58	0.59	17.40
5.0	2788.58	1.25	36.87

Table A2 - Continued

LOCATION (MILEAGE)	TIME (H+HOURS)	EXTERNAL EXPOSURE RATES	
		OBSERVED (mR/HOUR)	AT H+1 HOUR (R/HOUR)
TEAM 13 (cont'd)			
5.5 Junction of 161 and 146.	2788.58	1.90	56.04
On road 146 6.0 miles from Bingham.	2788.58	2.5	73.73
6.5	2788.58	1.6	47.19
7.0	2788.58	3.6	106.20
7.5 Raitliff house west side.	2788.58	4.0	118.0
8.0 Raitliff house east side.	2788.58	4.0	118.0
North of junction of 161 and 146 on 161			
0.0	2788.58	1.95	57.51
0.4	2788.58	1.22	35.98
1.4	2788.58	0.81	23.98
2.4	2788.58	0.60	17.70
3.4	2788.58	0.335	9.88
5.4	2788.58	0.14	4.13
7.4	2788.58	0.31	9.14
At sign post and road which goes southeast 8.9 to Cooper's well.	2788.58	1.80	53.09
11.4	2788.58	2.90	85.53
15.4	2788.58	0.84	24.77

Table A2 - Continued

LOCATION (MILEAGE)	TIME (H+HOURS)	EXTERNAL EXPOSURE RATES	
		OBSERVED (mR/HOUR)	AT H+1 HOUR (R/HOUR)
TEAM 13 (cont'd)			
Came back to sign post junction and started on road east.			
0.6	2788.58	2.80	82.58
1.1	2788.58	3.2	94.38
1.4	2788.58	2.9	85.53

Table A3. Gamma exposure-rate data for New Mexico from Reference 1, Appendix II, taken on D+26 days (August 12, 1945). Readings were taken on the ground or at waist height, as noted.

LOCATION	EXTERNAL EXPOSURE RATES OBSERVED (mR/h)	AT H+1h (R/h)	
Odometer readings from Bingham (mileage at Bingham 776.0)	0.003		
781.2 at junction with road which leads to Hot Canyon.	0.020 (ground) 0.013 (waist)		
781.45 on road to Hot Canyon	0.022 (ground) 0.018 (waist)	68.34	*
781.7 on road to Hot Canyon	0.022 (ground) 0.020 (waist)	68.34	*
781.8 on road to Hot Canyon	0.030 (ground) 0.025 (waist)	93.20	*
781.95 on road to Hot Canyon	0.027 (ground) 0.020 (waist)	83.88	*
782.2 measurement at roadside	0.027 (ground) 0.025 (waist)	83.88	*
782.2 measurement 20 feet off road	0.029 (ground) 0.026 (waist)		
782.45 point corresponding to previous highest reading in Hot Canyon	0.024 (ground) 0.023 (waist)	74.56	*
Same place but 20 feet off road	0.032 (ground) 0.029 (waist)		
782.5 at roadside	0.027 (ground) 0.025 (waist)	83.88	*
782.5 20 feet off road	0.029 (ground) 0.027 (waist)		
782.7	0.030 (ground) 0.027 (waist)	93.20	*
782.7 on and off road	0.032 (ground) 0.030 (waist)	99.41	*
782.9	0.028 (ground) 0.025 (waist)	87.00	*

Table A3 - Continued

LOCATION	EXTERNAL EXPOSURE RATES OBSERVED (mR/h)	AT H+1h (R/h)
From the M.C. Raitliff house to road to Hot Canyon		
1/2 mile from house	0.033 (ground) 0.028 (waist)	102.50 *
1/4 mile from house	0.026 (ground) 0.025 (waist)	80.77 *
Just below house-this reading was checked	0.0013 (ground) 0.0018 (waist)	
From Reference 1, Appendix II, "the following measurements were made in various locations in the yard, the nearby countryside and in the house."		
Yard Position I	0.027 (ground) 0.023 (waist)	
Position II	0.025 (ground) 0.022 (waist)	
Position III	0.023 (ground) 0.023 (waist)	
Position IV	0.028 (ground) 0.025 (waist)	
Position V	0.027 (ground) 0.021 (waist)	
Position VI	0.023 (ground) 0.022 (waist)	
Position VII (doorstep)	0.017 (ground) 0.013 (waist)	
Position VIII (behind house)	0.028 (ground) 0.022 (waist)	
Position IX (inside house)	0.003 0.004	
On ground in front of White Store	0.008	
In air in front of White Store	0.005	
Inside of White Store	0.0005	

Table A4. Gamma exposure-rate data for New Mexico from Reference 1, Appendix III, taken on D+148 through D+151 days (December 11-14, 1945). Readings were assumed taken at ground level.

LOCATION (MILEAGE)	EXTERNAL EXPOSURE RATES OBSERVED (mR/h) AT H+1 (R/h)
Heading west toward White Store on U.S. Highway 380, December 11, 1945	
13166.4	0.027
168.4	0.022
170.4	0.13
172.4	0.72
173.4 west of White Store	0.39
176.2 came back just east of White Store; started south on dirt road	1.14
177.4	0.75
178.4 trail ended at 178.9 mileage	0.55
Background in car	0.39
181.2 came back to house and started west	0.64
181.9 think it was Rock Tank	0.62
183.3 now going east (2 cisterns or cement tanks) sample taken	0.84
Came out to highway 380 on dirt road running directly into White Store	
Bingham	0.285
Took road 161 east from Bingham and turned off at Nalda Hdqts. RCS Co.	
Nalda Hdqts	1.22
Back to 161, continued east to intersection 161-146, on east from intersection toward M. C. Raitliff place (Hot Canyon)	
13201.3 intersection 161-146	1.66

Table A4 - Continued

LOCATION (MILEAGE)		EXTERNAL EXPOSURE RATES OBSERVED (mR/h) AT H+1 (R/h)
202.3		1.66
	Background in car	0.84
203.3	near Raitliff house-old spot where sample was taken last trip (took another)	1.95
204.2		1.10
205.3		0.55
207.0		0.18
209.1		0.022
211.1		0.027
214.0	Hobbs Tank	0.027
215.7	Broken Back Crater	0.027
Turned off highway 54 north of Carrizozo, went west on dirt road toward Black Crater, December 12, 1945		
13249.0		
258.4	in bottom left square of section R.10 E-T5S on map No. 45	
259.9	Gallagher Hdqts	
264.9	going NW toward Harvey of French Ranch	0.023
267.0		0.026
269.0		0.029
270.1	at Harvey or French Ranch	0.03
270.4	intersection	
272.4	water hole	0.22
273.4		0.17
274.4	fence beyond hole	0.202

Table A4 - Continued

LOCATION (MILEAGE)		EXTERNAL EXPOSURE RATES OBSERVED (mR/h) AT H+1 (R/h)
275.4		0.154
276.4		0.205
277.4	intersection with main road between Morgan Well and Dulce Well-near Morgan Well turned S.E.	0.16
278.4		0.075
280.4		0.026
283.4		0.026
284.5	Dulce Well	
290.6	now back at last intersection we came from and went NW toward Morgan Well	
291.5	Morgan Well	0.28
292.5	still going NW	0.46
	Background in car	0.25
294.0	house	0.52
295.0		0.50
296.0		0.50
296.2	met road going N & S along fence	
297.3	Maxwell Ranch	
297.5	intersection, took road S.E.	0.61
298.5		0.37
299.2	came to road running N & S along Cibola Natl. forest-also a water tank and well-went south on highway 41	0.46
301.4		0.82
	Background in car	0.36

Table A4 - Continued

LOCATION (MILEAGE)		EXTERNAL EXPOSURE RATES OBSERVED (mR/h) AT H+1 (R/h)
301.7	turned left on dirt road but too bad so turned back to hwy 41	
304.9	changed mileage	
309.6	came to intersection leading to Harvey boundry-turned left-(place of sign posts on last trip Nov. 8)	0.93
310.6		1.38
311.3	at boundry fence of Harvey Ranch	2.08
312.3		1.95
	Reading in car	0.78
313.3		3.15
314.3	Coopers Well	1.64
315.3		1.32
	Reading in car	0.41
316.3		0.46
317.3		0.29
318.3		0.17
318.9	came to crossing of road we took day before, back past Broken Back Crater	
Snow on ground throughout day, all readings taken on bare spots, December 13, 1945		
	Background in car	0.021
13383.5	mileage at White Store-going east on highway 380	
386.0	turned south off main road (sign on fence-US Bombing Range)	0.18
388.0		0.016

Table A4 - Continued

LOCATION (MILEAGE)		EXTERNAL EXPOSURE RATES OBSERVED (mR/h) AT H+1 (R/h)
390.2		0.019
390.9	either Baca or Brush Tank	0.0215
392.2	going N on other road from tank -changed mileage scale at next intersection and reading	0.024
	Reading in car	0.25
399.5		0.21
400.7		0.87
401.1	by house-Ozane Well and windmill short distance up road	0.41
402.1	on way to what we thing in Chicken Springs	0.87
402.6	as far as we went on road to Chicken Springs	0.61
403.4	back at house; turned left on other road going NW	
404.4		0.76
	Reading in car	0.41
404.7	Bruton (dirt) Tank	
405.4		0.61
406.3	another dirt water hole	0.66
	Turned back to last intersection (at house)	
407.3		0.93
December 14, 1945		
	Reading in car	0.15
13526.0	mileage at Bingham, started NW on highway 380	
527.0	turned south on dirt road	0.18

Table A4 - Continued

LOCATION (MILEAGE)		EXTERNAL EXPOSURE RATES OBSERVED (mR/h)	AT H+1 (R/h)	
528.0		0.15		
529.0		0.12		
530.0	intersection with road to Julian Tank	0.20		
531.0		0.29		
531.9	Julian Tank	0.145	6.33	#
	Took road heading east from Julian Tank			
532.9		0.235	10.25	#
533.8	end of road-believe this road did go to Bruton Tank and Chicken Springs at one time	0.215	9.38	#
535.4	back at Julian Tank now going S to SE			
536.4		0.205	8.94	#
537.4		0.215	9.38	#
538.4		0.245	10.69	#
539.4		0.275	12.0	#
540.4		0.265	11.60	#
541.4	Smith Tank	0.67	29.23	#
	Background in car	0.60		
542.4		1.10	48.00	#
543.2	new steel tower on right with shack (new road running west from it) probably N tower of Trinity			
543.4		1.20	52.34	#
	East of shot at base of Oscura Mts near Canyon de las Venedes	0.35		

Table A5. Exposure rate versus time data for Bingham, White Store, Hot Canyon, and Searchlight Station L-8. Exposure rate versus time data for Bingham, White Store, and Hot Canyon were extracted from Figures 1 and 4, the text, and Table IV of Reference 1. Exposure rates are at ground level unless otherwise noted. Exposure rates for Searchlight Station L-8 are from Reference 3 and include gamma and gamma-plus-beta readings in air and on the ground as noted.

LOCATION	TIME (H+HOURS)	EXTERNAL EXPOSURE RATES (R/HOUR) OBSERVED	AT H+1 HOUR
Bingham			
	3.3	3.3	Taken during fallout
	6.3	1.3	21.27
	7.5	1.5	30.89
	7.8	0.36	7.78
	8.5	0.50	11.97
	28.0	0.36	31.27
	32.0	0.36	36.2
	32.0	0.32	32.17
	34.0	0.20	21.51
	110.0	0.04	14.35
	150.0	0.03	14.61
	420.0	0.007	12.89
	750.0	0.003	11.97
	2800.0	0.0004	11.87
The geometric mean of the H+1 hour values, excluding the value at H+3.3 hours, is 17.83.			
White Store			
	5.0	2.5	28.82
	5.7	2.0	28.29
	8.0	1.6	35.65

Table A5 - Continued

LOCATION	TIME (H+HOURS)	EXTERNAL EXPOSURE RATES (R/HOUR) OBSERVED	AT H+1 HOUR
White Store (continued)			
	8.0	2.8	62.38
	17.0	0.5	25.52
	17.0	0.25	12.76
	29.0	0.15	13.54
	32.0	0.10	10.05
	56.0	0.20	37.56
	310.0	0.014	17.01
	650.0	0.008	26.25
	2800.0	0.0021	62.30
	3600.0	0.0004	17.26

The geometric mean of the H+1 hour values is 24.95.

Hot Canyon

	3.30	15.0	Taken during fallout
	8.4	6.0	141.6
	36.0	0.6	68.8
	340.0	0.07	96.6
	535.0	0.07	177.5
	540.0	0.05	128.4
	2800.0	0.0028	83.06
	2800.0	0.003	89.00
	3600.0	0.0019	82.0

The geometric mean of the H+1 hour values, excluding the value at H+3.3 hours, is 103.34.

Table A5 - Continued

LOCATION	TIME (H+HOURS)	EXTERNAL EXPOSURE RATES (R/HOUR) OBSERVED
Searchlight Station (L-8)	2.00	0.10 Gamma on ground
	2.00	0.12 Gamma on ground
	2.25	0.11 Gamma + beta in air
	2.25	0.30 Gamma on ground
	2.50	0.50 Gamma on ground
	2.75	1.00 Gamma on ground
	2.83	1.50 Gamma on ground
	2.92	1.50 Gamma in air
	2.92	2.00 Gamma on ground
	3.08	2.00 Gamma on ground
	3.33	1.50 Gamma on ground
	3.75	2.00 Gamma on ground
	3.83	1.00 Gamma on ground
	4.00	1.00 Gamma + beta in air
	4.17	0.80 Gamma + beta in air
	4.25	0.90 Gamma in air
	4.42	0.85 Gamma on ground
	4.75	0.80 Gamma + beta in air
	4.92	0.75 Gamma + beta in air
	5.17	0.75 Gamma + beta in air
	5.50	0.65 Gamma + beta in air
	5.67	0.65 Gamma + beta in air
	6.00	0.65 Gamma + beta in air