LOS ALAMOS SCIENTIFIC LABORATORY

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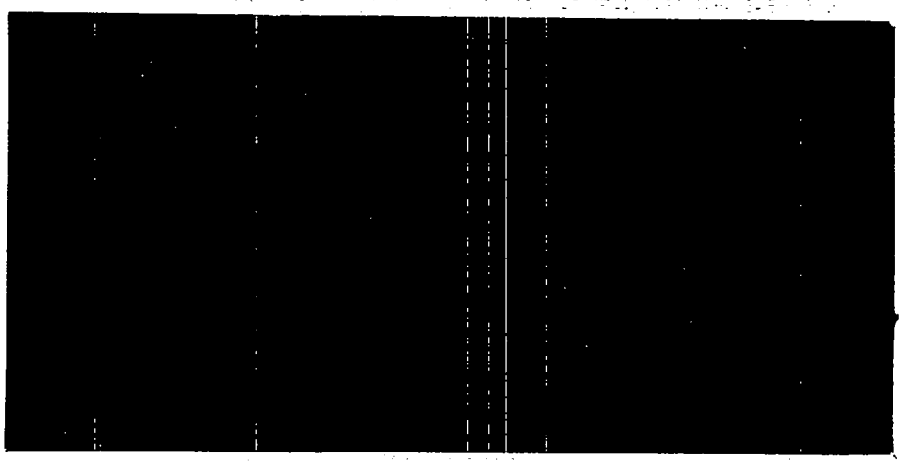
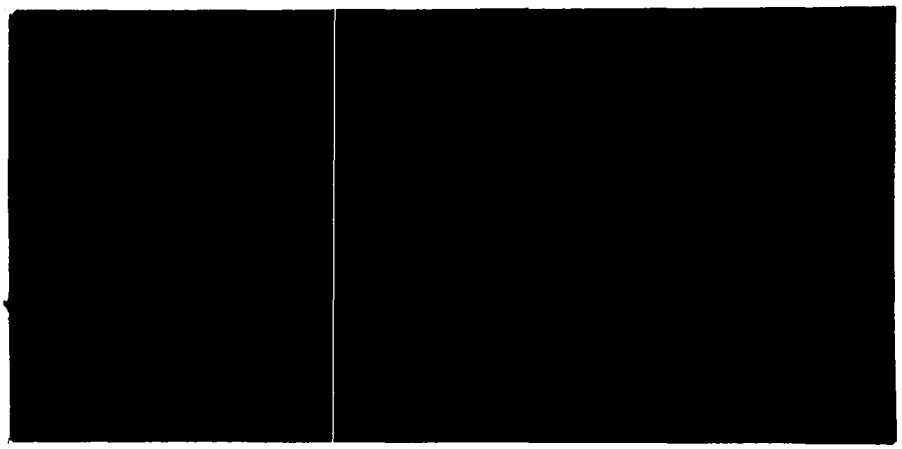
LOS ALAMOS, NEW MEXICO



CONTRACT W-7405-ENG.36 WITH THE
U.S. ATOMIC ENERGY COMMISSION



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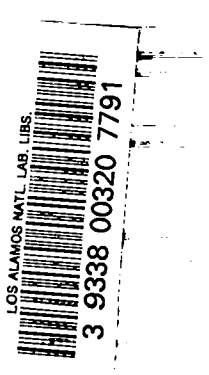
AIR, PRECIPITATION, AND SURFACE CONTAMINATION AT CERTAIN LOCALITIES IN NEW MEXICO FROM OPERATION TEAPOT, SPRING 1955

by

William S. Johnson

HEALTH AND BIOLOGY



1. General

Immediately following the Wasp detonation of Operation Teapot, February 18, 1955, an air sampling station on the roof of the HRL-Building, TA-43, Los Alamos, was activated. A modified Electrolux vacuum cleaner sampled at a rate of 85 M^3/hr through Mine Safety Appliance Company All Dust respirator filters. This program was supplemented from time to time with ground monitoring and precipitation analysis.

An air sampling station similar to the Los Alamos station was operated at the Sandia Corporation, Albuquerque, by members of the Industrial Hygiene Group under W. H. Kingsley. The air sampling and counting equipment was the same type as that used at Los Alamos.

The Eberline Instrument Division of Reynolds Electrical and Engineering Company, Inc., operated a background monitor in Santa Fe during part of Operation Teapot.

2. Sampling Methods

Air sampling was started at Los Alamos following each shot and continued until normal background was attained. Normally two samples per 24 hours were collected except during periods of fallout, when filters were changed more frequently. For a time at the start of the program two samplers were run simultaneously. The resulting concentrations were in

excellent agreement, and the two samplers were then alternated in order to extend running time before maintainance was required.

Precipitation samples were collected in a shallow glass pan outside HRL-Building and later in a rain gage at the Los Alamos TA-1 Weather Station. Surface level readings were taken periodically outside HRL-Building with a Victoreen 263B G-M type instrument or equivalent. Readings were made at ground level and at 3 feet above the ground for beta and gamma activity. These readings were supplemented occasionally with more extensive surveys throughout the project.

3. Counting Methods

The filter papers were counted directly for beta activity in a methane-flow proportional scaler. A standard time differential of 10 minutes following the removal of the sample and the first count was observed. Selected samples were retained for further counting to determine decay rates.

Precipitation samples were acidified with nitric acid and evaporated onto a 4 by 9 inch planchet formed from aluminum foil. The residue was counted directly for beta activity on the same scaler as the filter papers.

Concentration results in both cases were based on comparisons to calibrated Sr^{90}-Y^{90} sources.

4. Results

4.1 Los Alamos Results

The average air concentration from the first count of each filter paper (after allowing for 10 minutes' decay of natural activity) is plotted vs time of day of sample collection on the graphs of Appendix A. Through decay studies any real increase in air concentration could be attached to fallout originating from the latest detonation, with one exception. This occurred after the two shots of March 29, when the increase was due to Apple I and not Wasp Prime, the later of the two.

A tabulation of the concentration of fission product beta activity in precipitation samples is given in Table I.

Associated with each rise in air concentration was an increase in the level of surface activity. Although numerous readings could be quoted, the results are summarized as being generally from ten times normal to less than this figure. The maximum occurred following Apple I. At 1000 on March 30 the readings were as follows:

Shield open on the ground	2	mr/hr
Shield open at 3 feet above ground	1	mr/hr
Shield closed at 3 feet above ground	0.1	mr/hr

The predominance of beta activity was observed on all occasions.

Ground levels lagged behind peak air concentrations from a few hours to a day or so. In the latter case (after Zucchini) the ground activity was less than twice background until the onset of intermittent rain showers, when it rose to levels comparable to those given above for Apple I.

TABLE I

FISSION PRODUCT ACTIVITY OF PRECIPITATION SAMPLES COLLECTED

AT LOS ALAMOS, NEW MEXICO, SPRING 1955

Collection Time and Date From	To	Sample Volume (ml)	Count Time and Date	Concentration at Time of Count (μc/l)
0900 3/10	1300 3/10	- -	1520 3/10	2.7×10^{-3}
1800 4/6	0900 4/7	360	1430 4/7	5.8×10^{-3}
0900 4/7	1430 4/7	25	0105 4/8	3.6×10^{-3}
1430 4/7	0900 4/8	500	1400 4/8	2.4×10^{-3}
1800 5/7	0900 5/9	500	1200 5/9	1.3×10^{-3}
0900 5/9	0900 5/10	175	1315 5/10	1.3×10^{-3}
1800 5/10	0900 5/11	200	1010 5/18	0.5×10^{-3}
1800 5/17	1200 5/18	115	1550 5/18	0.5*
1200 5/18	1000 5/19	200	1340 5/19	0.1*
1200 5/18	1000 5/19	250	1350 5/19	0.1
0800 5/18	0800 5/19	230	2050 5/19	0.12*
0800 5/19	0800 5/20	100	1450 5/20	0.09
0800 5/21	2300 5/21	20	1005 5/23	0.88*
2300 5/21	1900 5/22	25	1010 5/23	0.34*
0800 5/21	0800 5/23	40	1730 5/23	0.13
0200 6/1	0600 6/1	50	1415 6/6	3.8×10^{-3}

*These samples were followed for decay purposes. Log-log slopes of -1.0 to -1.3 based on Zucchini origin were obtained.

4.2 Albuquerque Air Concentrations

The graphs of air concentration vs time of day derived from the Albuquerque sampling are included in this report as Appendix B to give more complete New Mexico data. In general, the material from a Nevada detonation arrives in Los Alamos slightly ahead of Albuquerque and in higher, though comparable, concentrations. During Teapot the arrival times varied from approximately 12 to 32 hours post shot at Los Alamos and from 15 to 36 hours post shot at Albuquerque.

4.3 Santa Fe Results

The results of the Santa Fe investigation were reported to the author by a letter dated July 13, 1955, from Howard C. Eberline. Pertinent details are quoted from this letter as follows:

"After much excitement in this area, due to fall-out measurements by unqualified personnel during the first part of the present test series, it was decided that this organization would set up measuring equipment to make this determination and correlate their results with that of your laboratory.

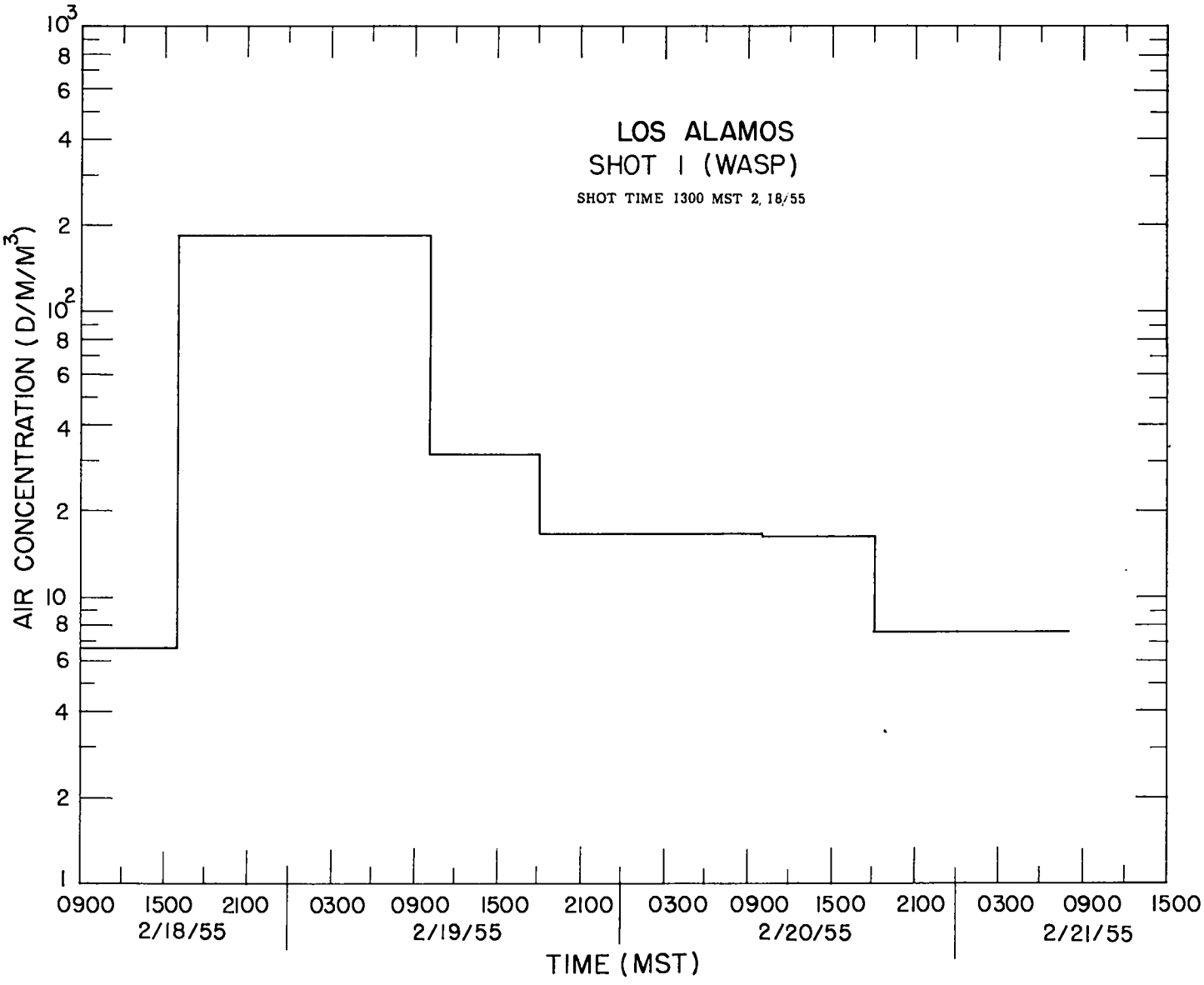
"About the middle of March a continuous recording background monitor was set up measuring gamma radiation. This instrument was operated continuously until after the end of the present test series. Until May 18 we had observed no change greater than twice normal background. At 9:00 A. M. on May 18 we experienced a short duration rain shower. A few minutes after the beginning of the rain our background started climbing and reached, in a very short time, a level of approximately 15 times normal

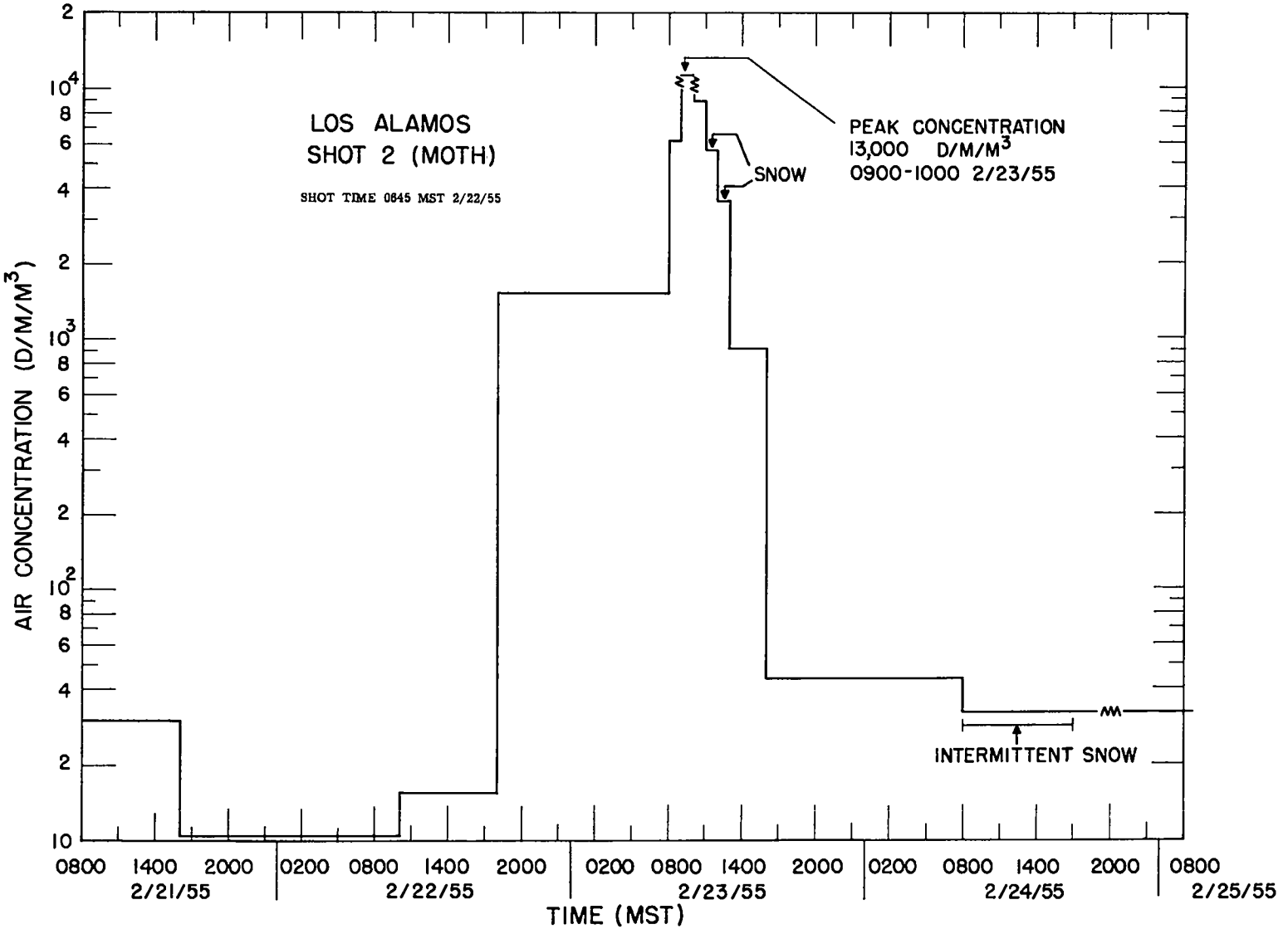
background, or .3 mr/hr, as detected by a Geiger type instrument. After the rain no further increase was observed and decay of the radiation was normal for this type of deposit. A search of a large ground area with a shielded beta counter showed that the fall-out was in the nature of relatively hot particles widely spaced. We were never able to actually isolate a particle physically, but could determine its position by a very well resolved beta count. As near as we could determine, there were but very few particles in a square yard area.

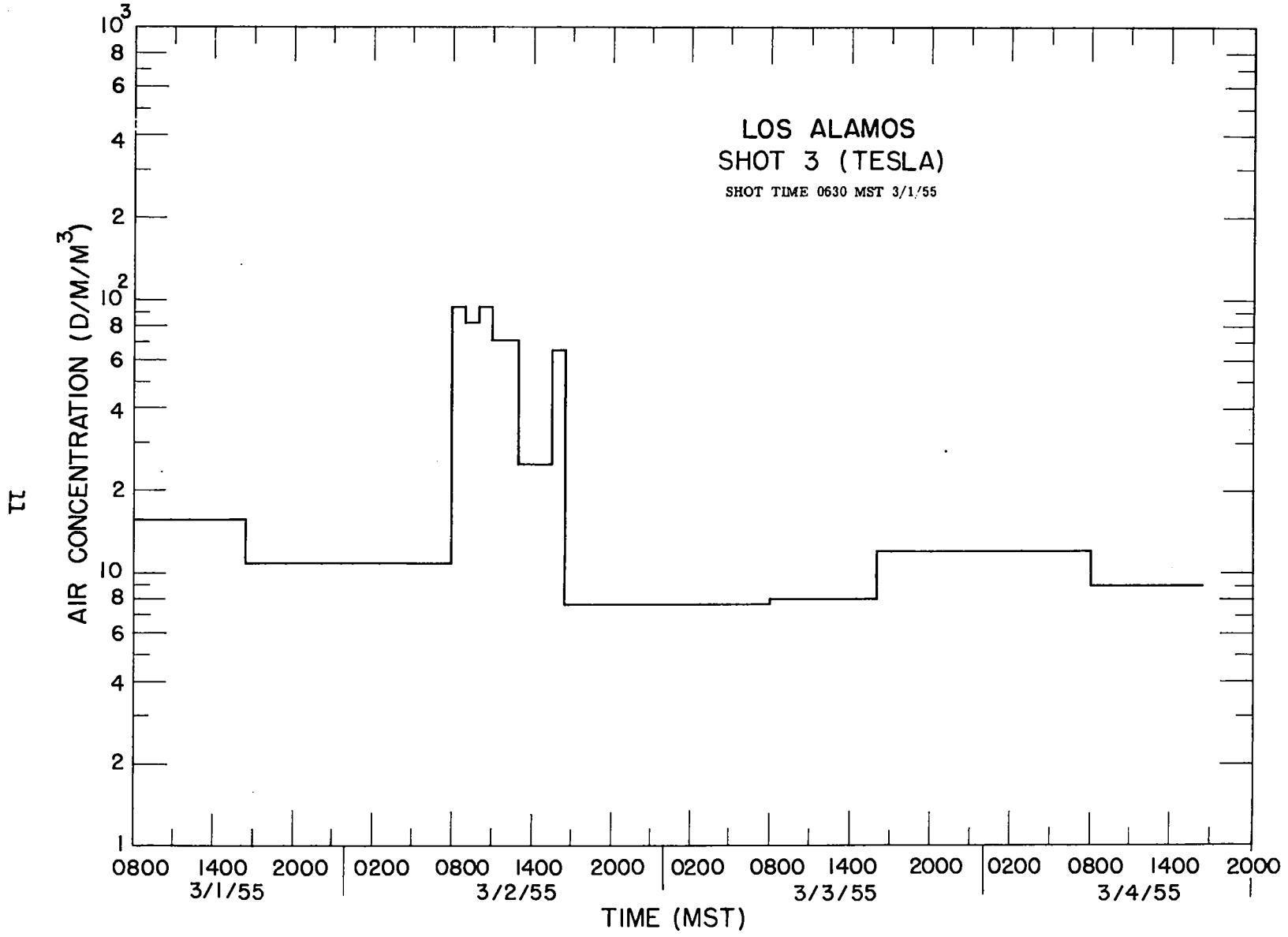
"The instrument was operated until the decay had reached a point of almost normal background and it was definitely determined the test series was concluded."

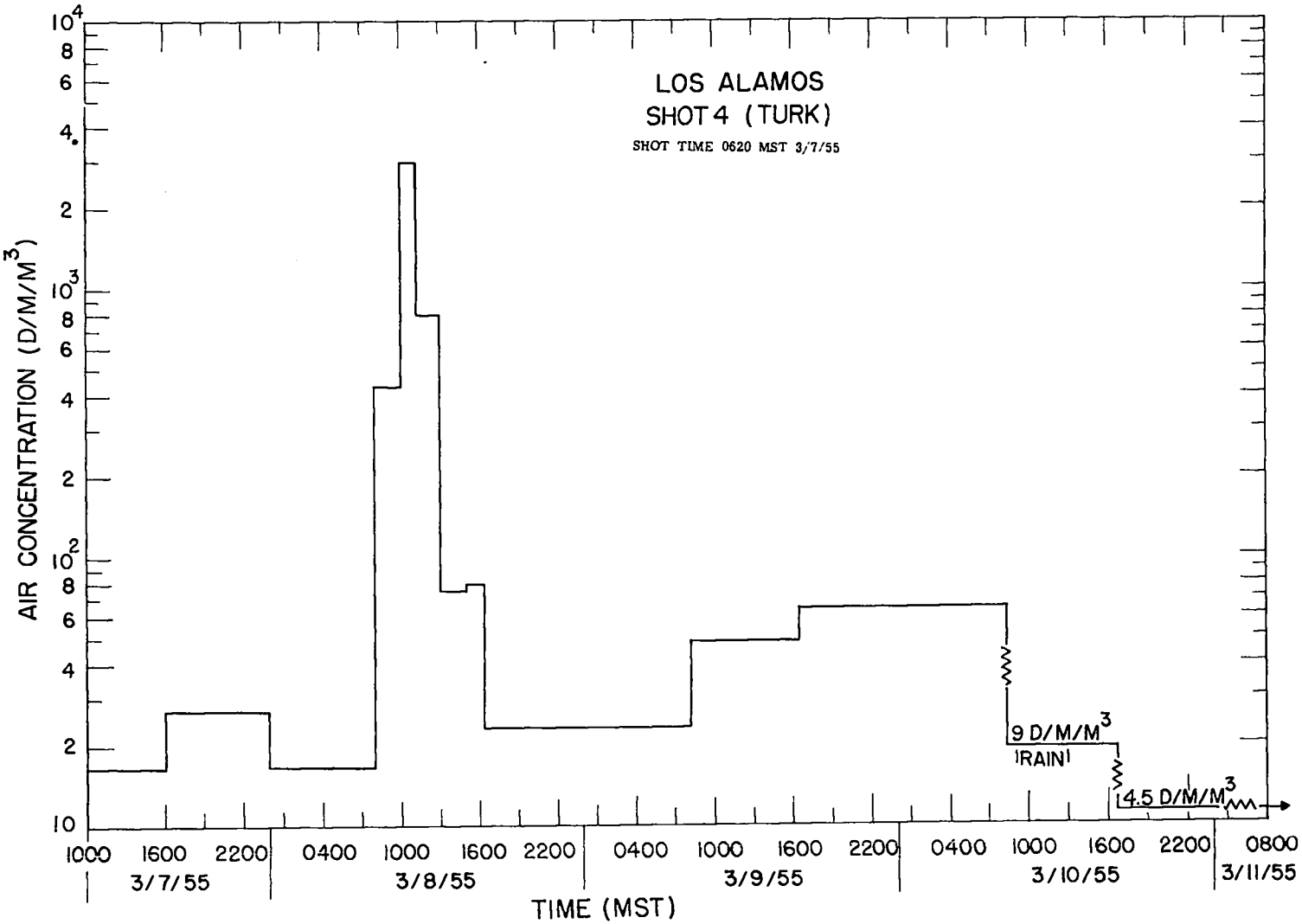
APPENDIX A

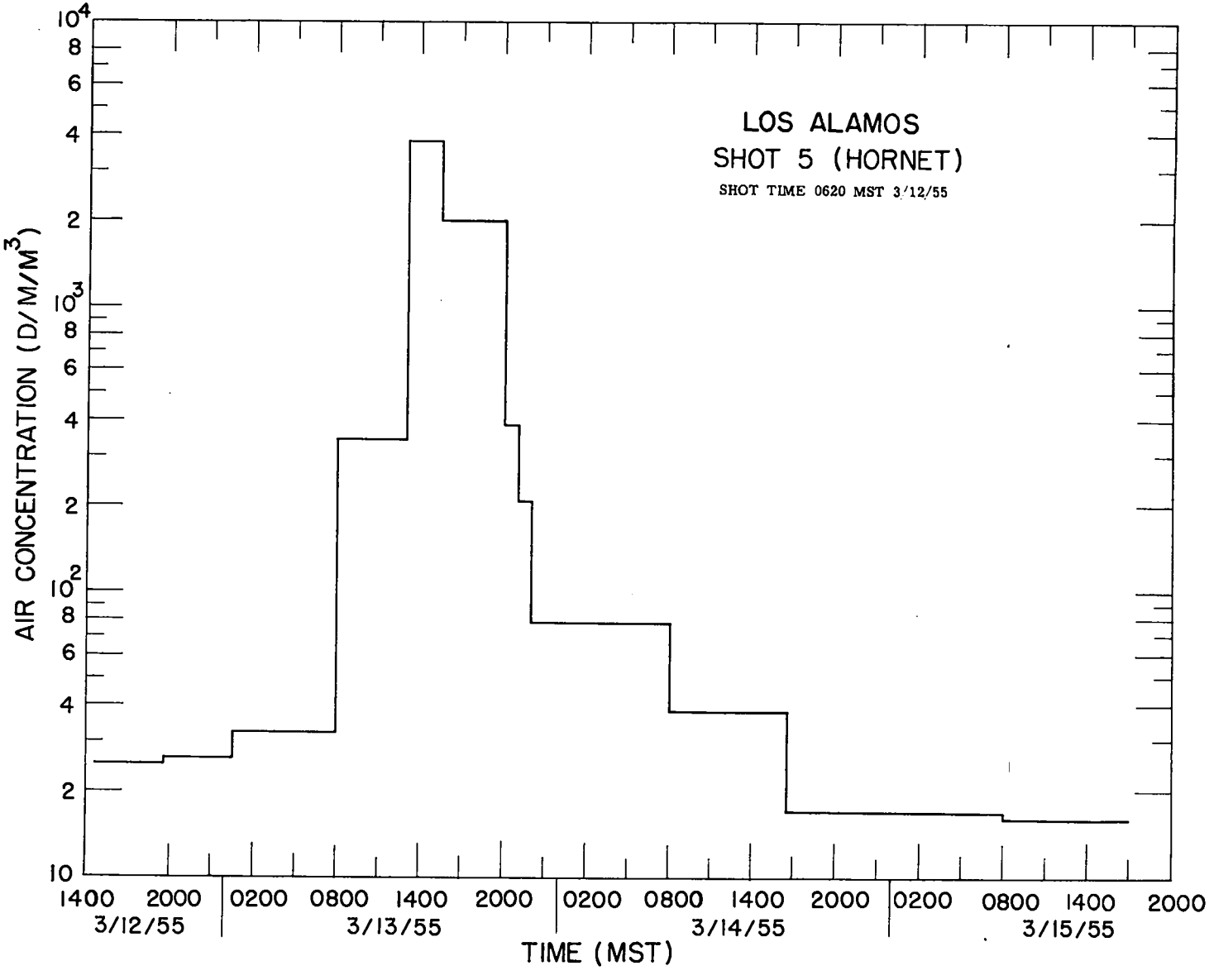
LOS ALAMOS DATA

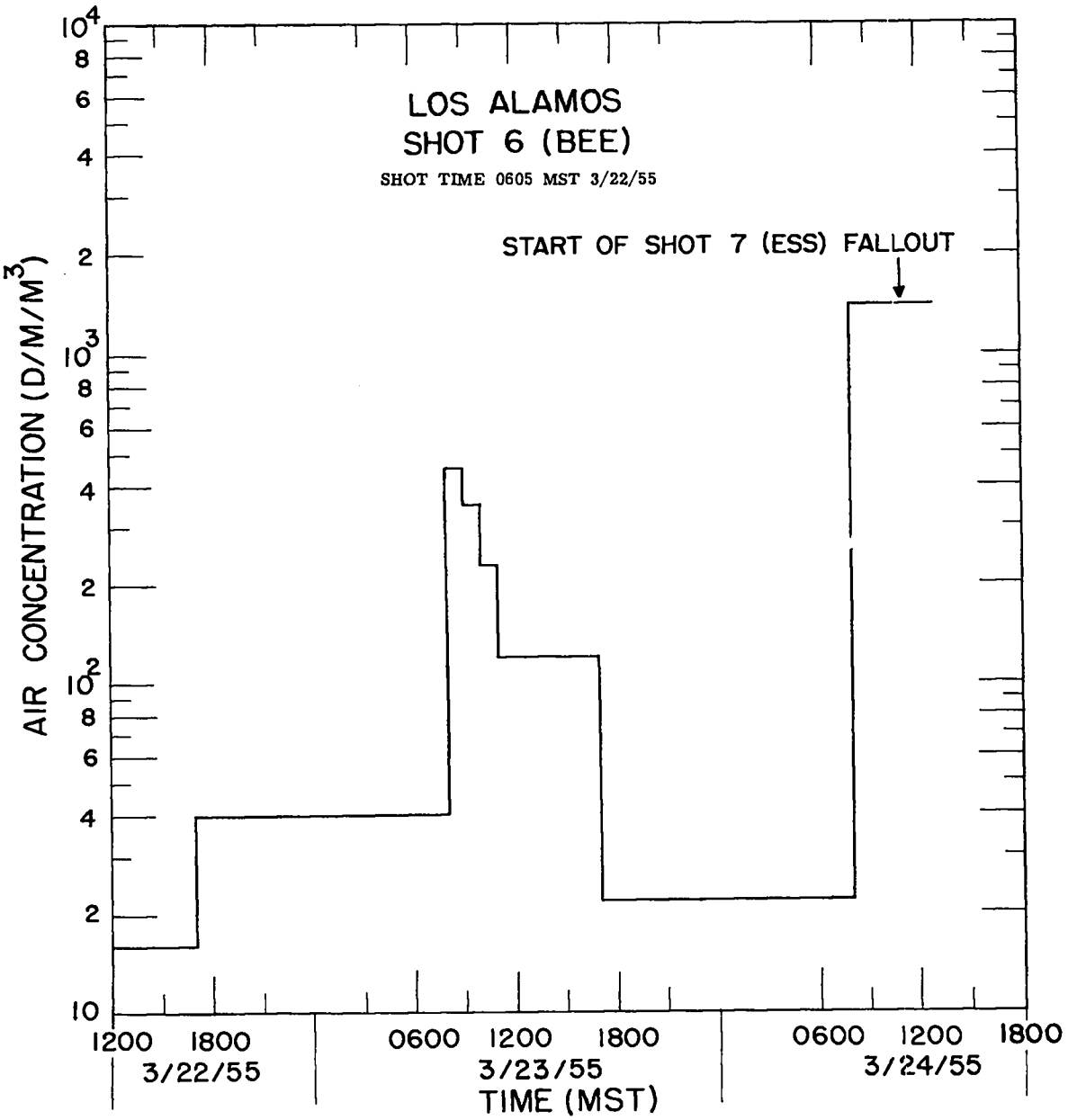

LOS ALAMOS
SHOT I (WASP)
SHOT TIME 1300 MST 2, 18/55
AIR CONCENTRATION (D/M/M3)
10^3
8
6
4
2
10^2
8
6
4
2
10
8
6
4
2
1
0900 1500 2100 0300 0900 1500 2100 0300 0900 1500 2100 0300 0900 1500
2/18/55
2/19/55
2/20/55
2/21/55
TIME (MST)

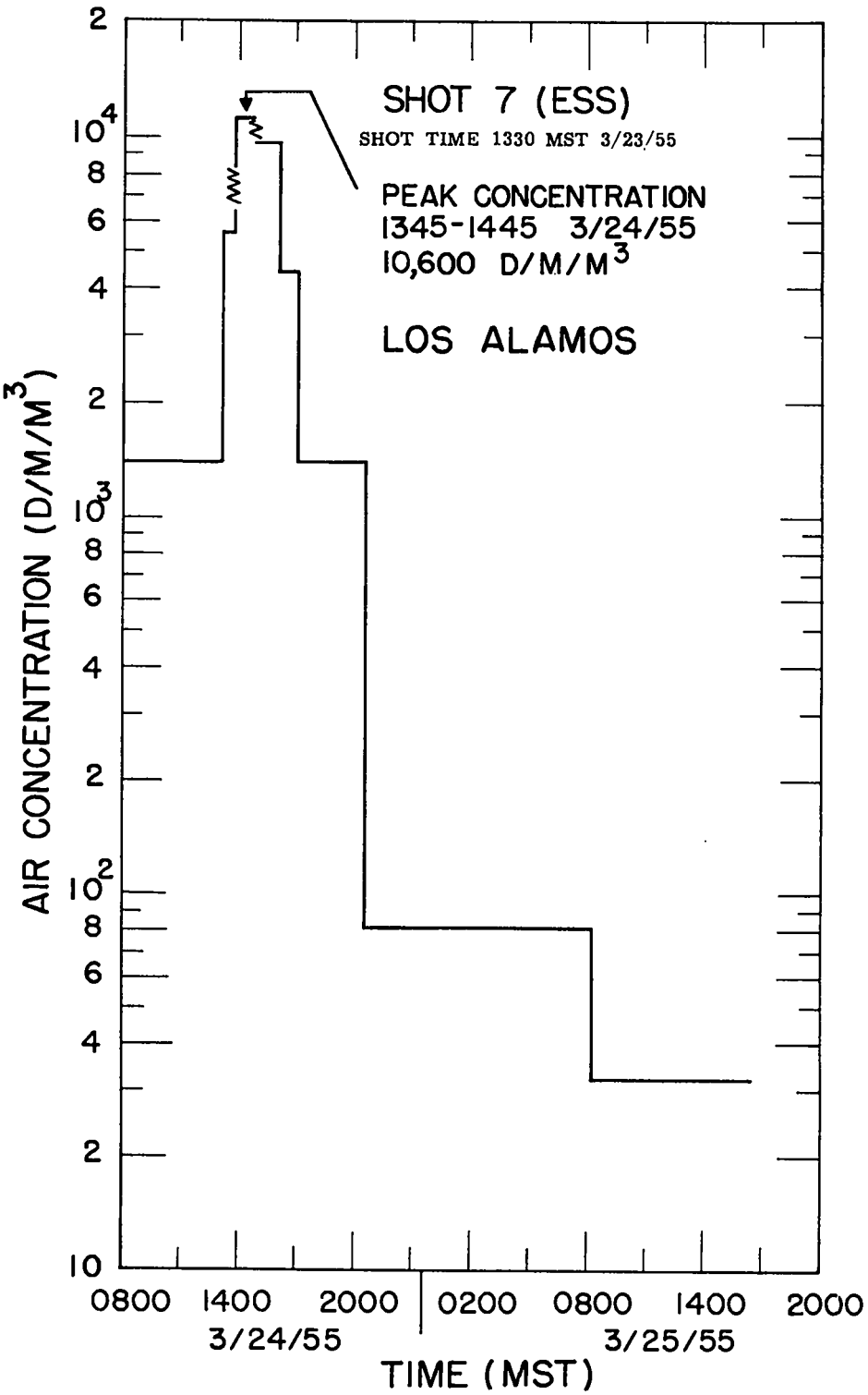

LOS ALAMOS
SHOT 2 (MOTH)
SHOT TIME 0645 MST 2/22/55
PEAK CONCENTRATION
13,000 D/M/M3
0900-1000 2/23/55
SNOW
INTERMITTENT SNOW
AIR CONCENTRATION (D/M/M3)
TIME (MST)
0800 1400 2000 0200 0800 1400 2000 0200 0800 1400 2000 0200 0800 1400 2000 0800
2/21/55
2/22/55
2/23/55
2/24/55
2/25/55

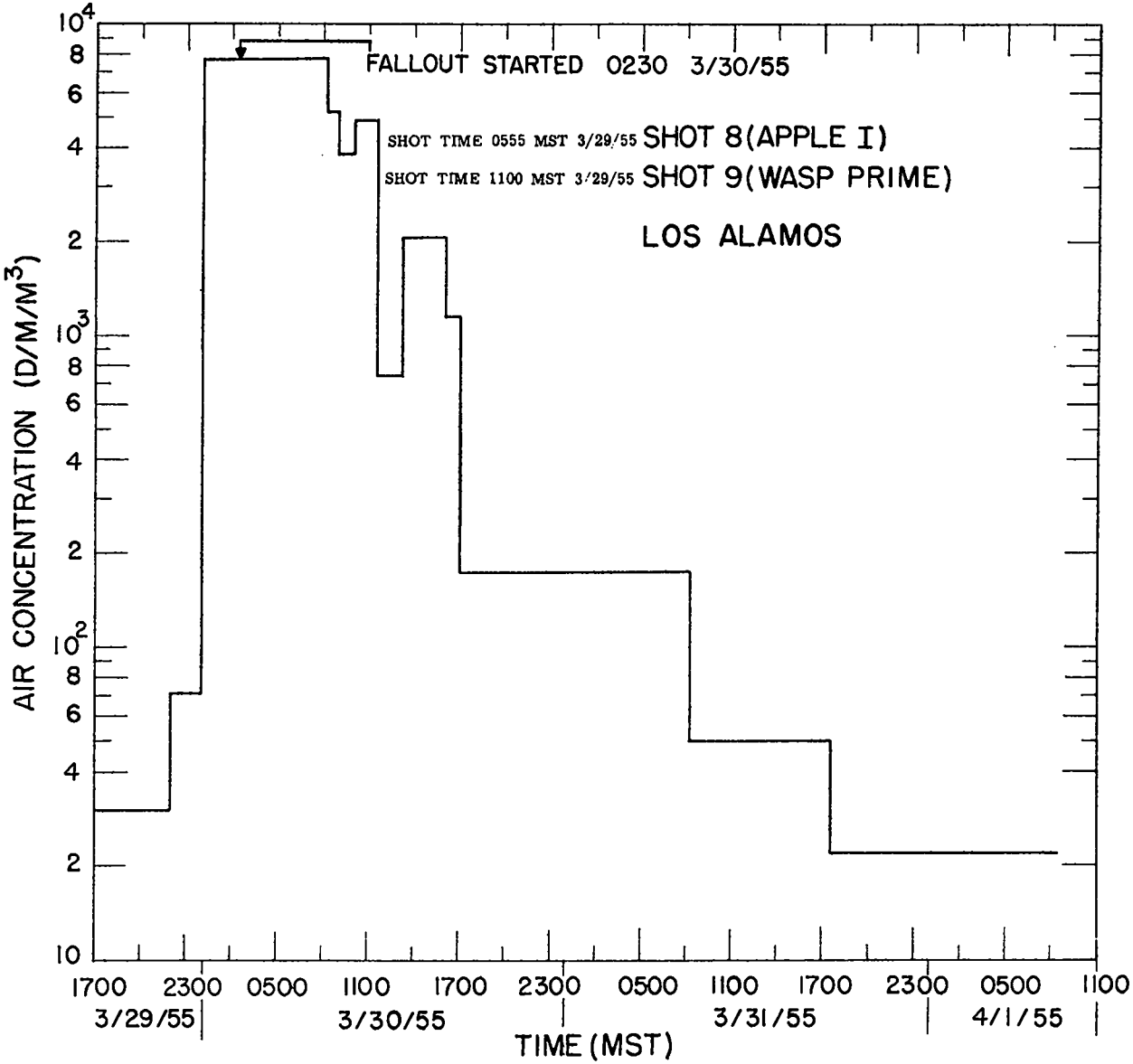

LOS ALAMOS
SHOT 3 (TESLA)
SHOT TIME 0630 MST 3/1/55
AIR CONCENTRATION (D/M/M3)
10^3
8
6
4
2
10^2
8
6
4
2
10
8
6
4
2
1
0800 1400 2000 0200 0800 1400 2000 0200 0800 1400 2000 0200 0800 1400 2000
3/1/55
3/2/55
3/3/55
3/4/55
TIME (MST)

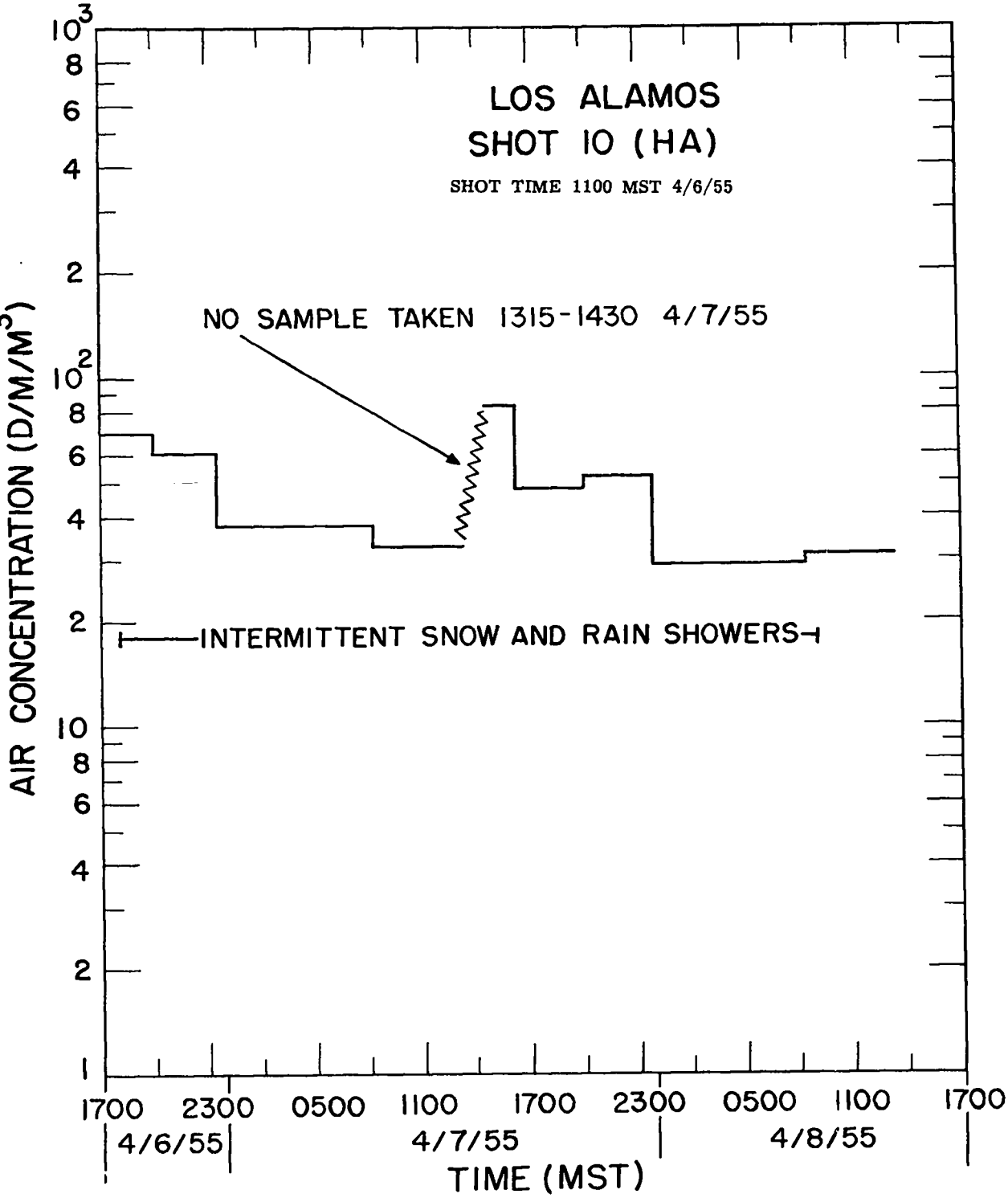

LOS ALAMOS
SHOT 4 (TURK)
SHOT TIME 0620 MST 3/7/55
AIR CONCENTRATION (D/M/M3)
10^4
8
6
4
2
10^3
8
6
4
2
10^2
8
6
4
2
10
9 D/M/M3
'RAIN'
4.5 D/M/M3
1000
1600
2200
0400
1000
1600
2200
0400
1000
1600
2200
0400
1000
1600
2200
0800
3/7/55
3/8/55
3/9/55
3/10/55
3/11/55
TIME (MST)

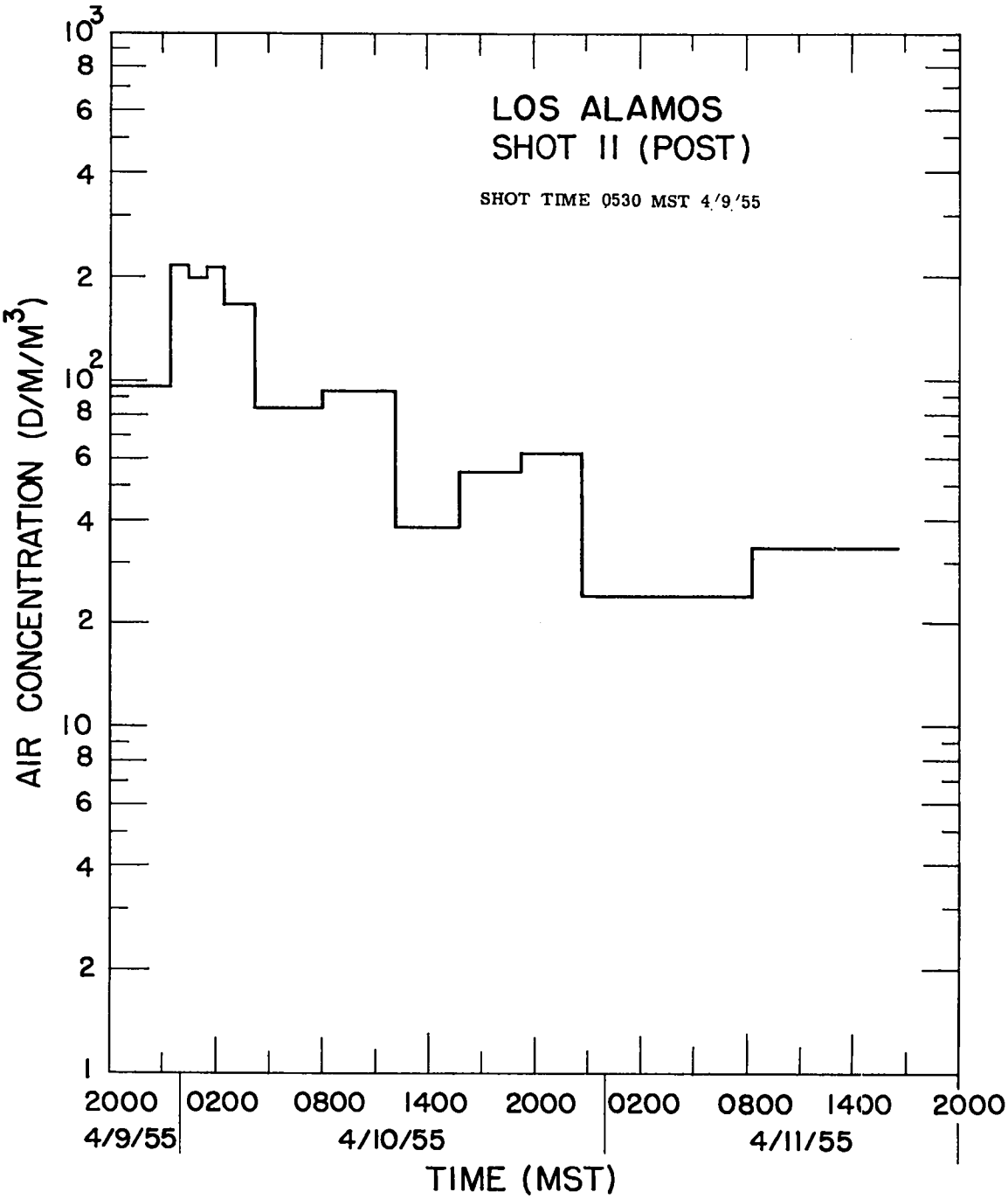

LOS ALAMOS
SHOT 5 (HORNET)
SHOT TIME 0620 MST 3/12/55
AIR CONCENTRATION (D/M/M3)
10^4
8
6
4
2
10^3
8
6
4
2
10^2
8
6
4
2
10
1400
2000
0200
0800
1400
2000
0200
0800
1400
2000
0200
0800
1400
2000
3/12/55
3/13/55
3/14/55
3/15/55
TIME (MST)

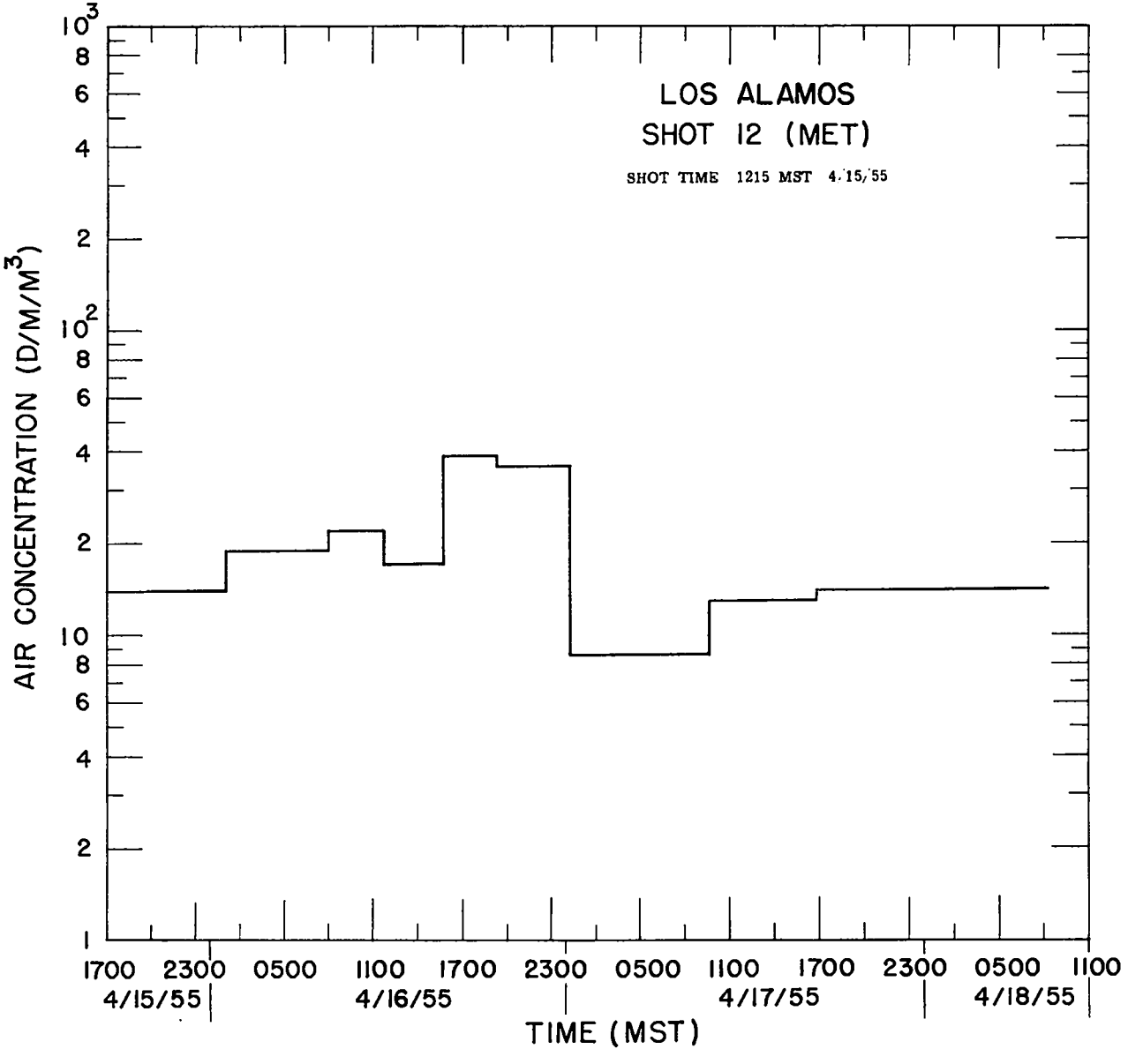

LOS ALAMOS
SHOT 6 (BEE)
SHOT TIME 0605 MST 3/22/55
START OF SHOT 7 (ESS) FALLOUT
AIR CONCENTRATION (D/M/M3)
10^4
8
6
4
2
10^3
8
6
4
2
10^2
8
6
4
2
10
1200
1800
3/22/55
0600
1200
1800
3/23/55
0600
1200
1800
3/24/55
TIME (MST)

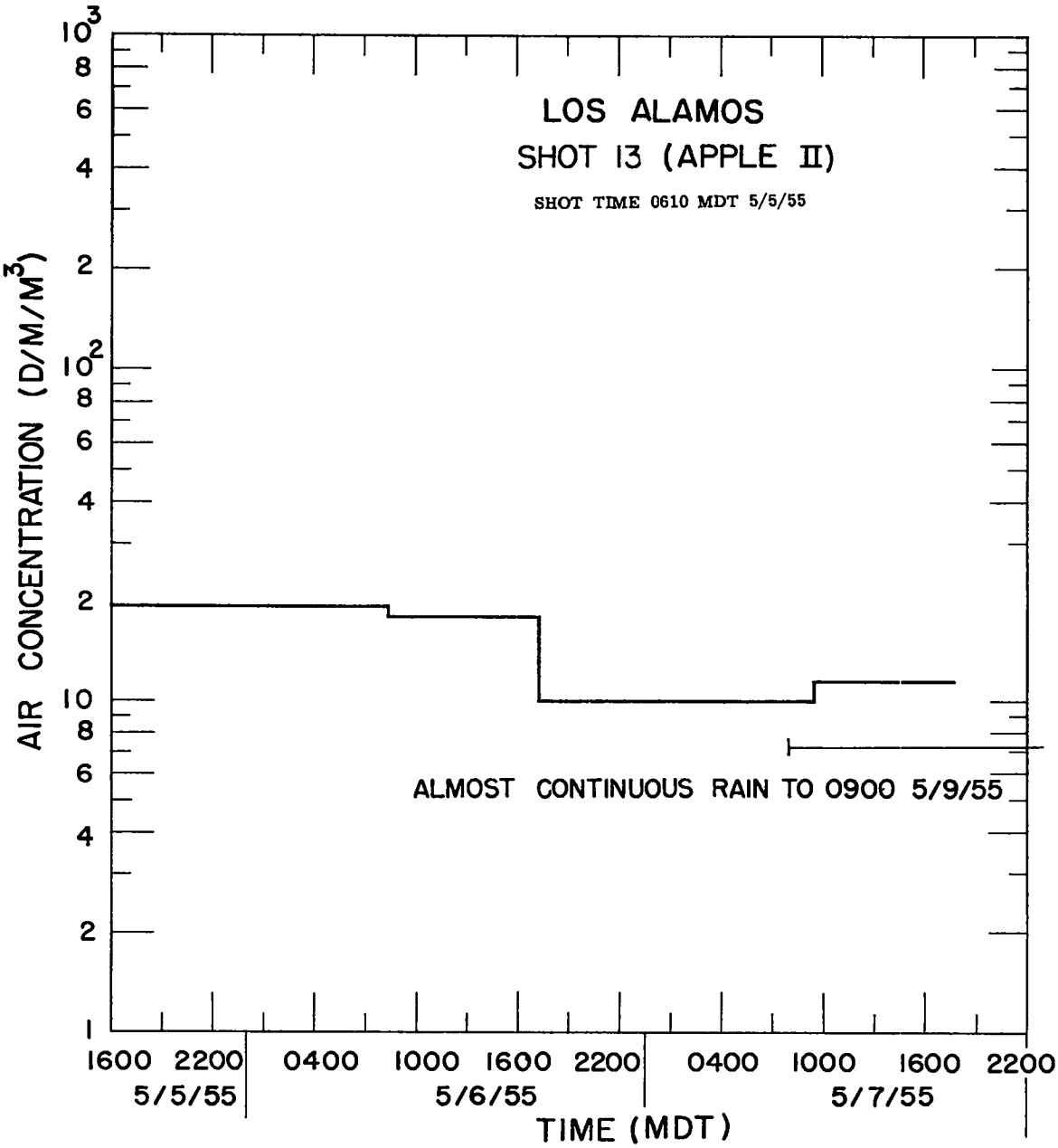

SHOT 7 (ESS)
SHOT TIME 1330 MST 3/23/55
PEAK CONCENTRATION
1345-1445 3/24/55
10,600 D/M/M3
LOS ALAMOS
AIR CONCENTRATION (D/M/M3)
2
10^4
8
6
4
2
10^3
8
6
4
2
10^2
8
6
4
2
10
0800
1400
2000
0200
0800
1400
2000
3/24/55
3/25/55
TIME (MST)

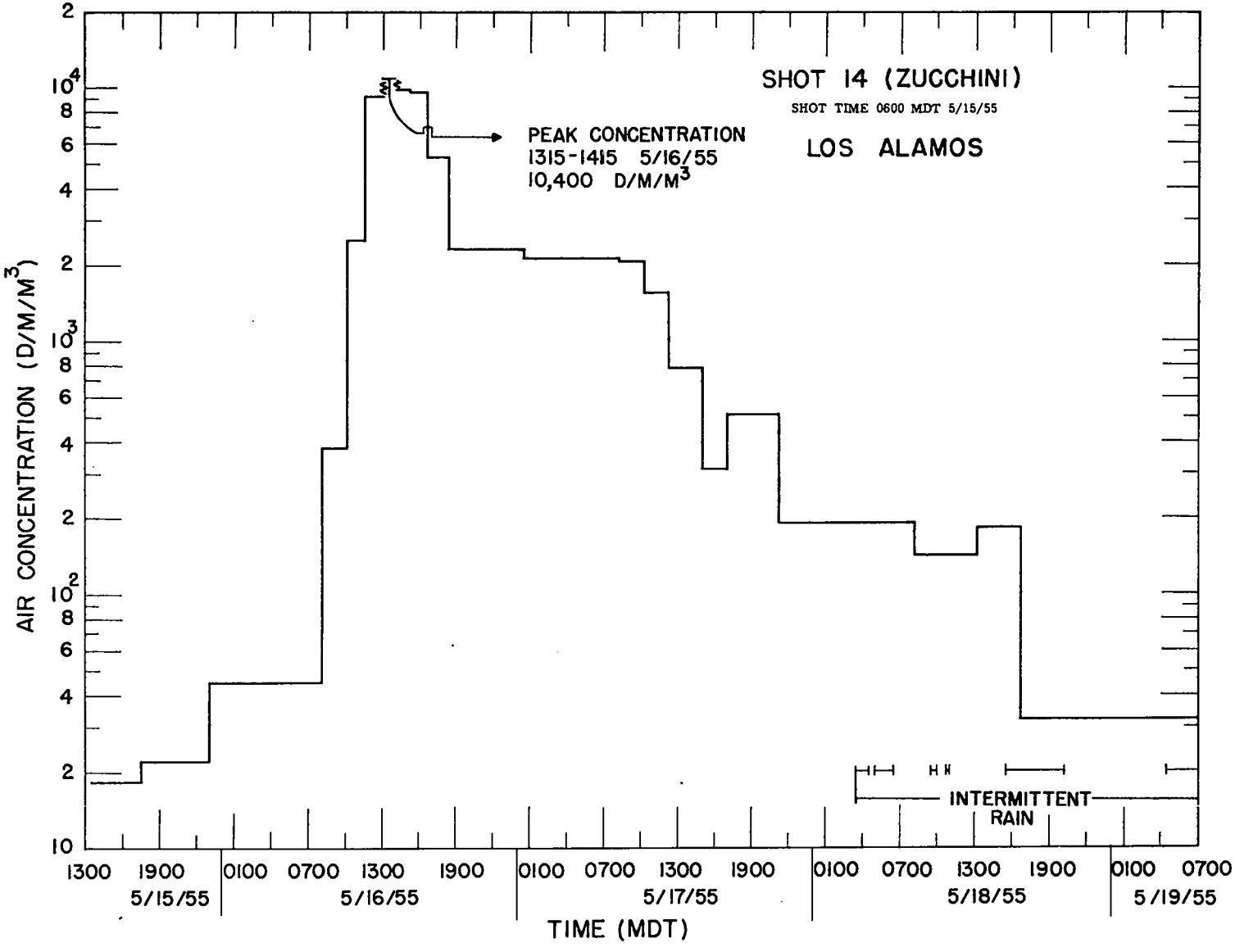

FALLOUT STARTED 0230 3/30/55
SHOT TIME 0555 MST 3/29/55 SHOT 8(APPLE I)
SHOT TIME 1100 MST 3/29/55 SHOT 9(WASP PRIME)
LOS ALAMOS
AIR CONCENTRATION (D/M/M3)
10^4
8
6
4
2
10^3
8
6
4
2
10^2
8
6
4
2
10
1700 2300 0500 1100 1700 2300 0500 1100 1700 2300 0500 1100
3/29/55
3/30/55
3/31/55
4/1/55
TIME (MST)

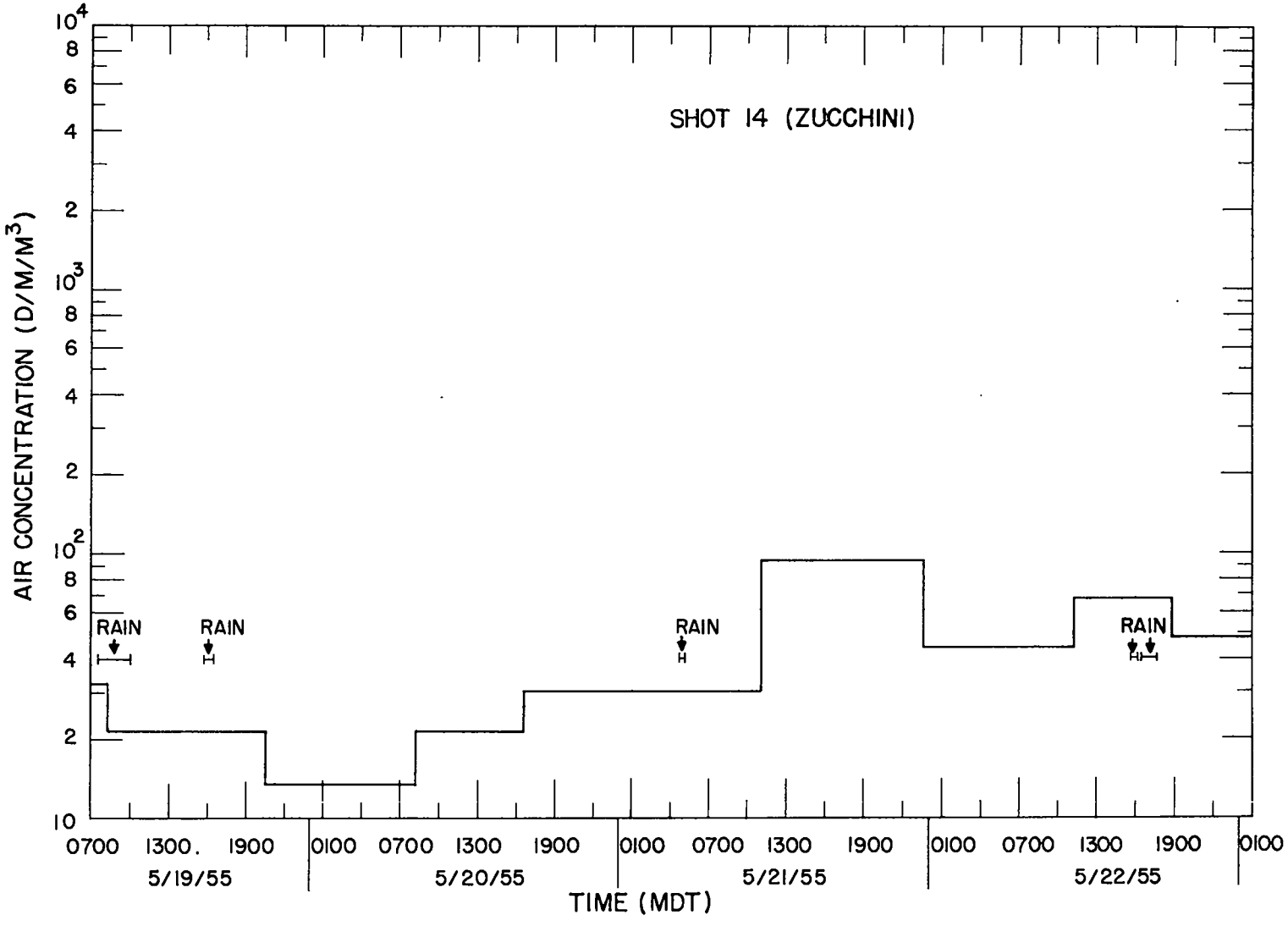

LOS ALAMOS
SHOT 10 (HA)
SHOT TIME 1100 MST 4/6/55
NO SAMPLE TAKEN 1315-1430 4/7/55
INTERMITTENT SNOW AND RAIN SHOWERS
AIR CONCENTRATION (D/M/M3)
10^3
8
6
4
2
10^2
8
6
4
2
10
8
6
4
2
1
1700
2300
0500
1100
1700
2300
0500
1100
1700
4/6/55
4/7/55
4/8/55
TIME (MST)

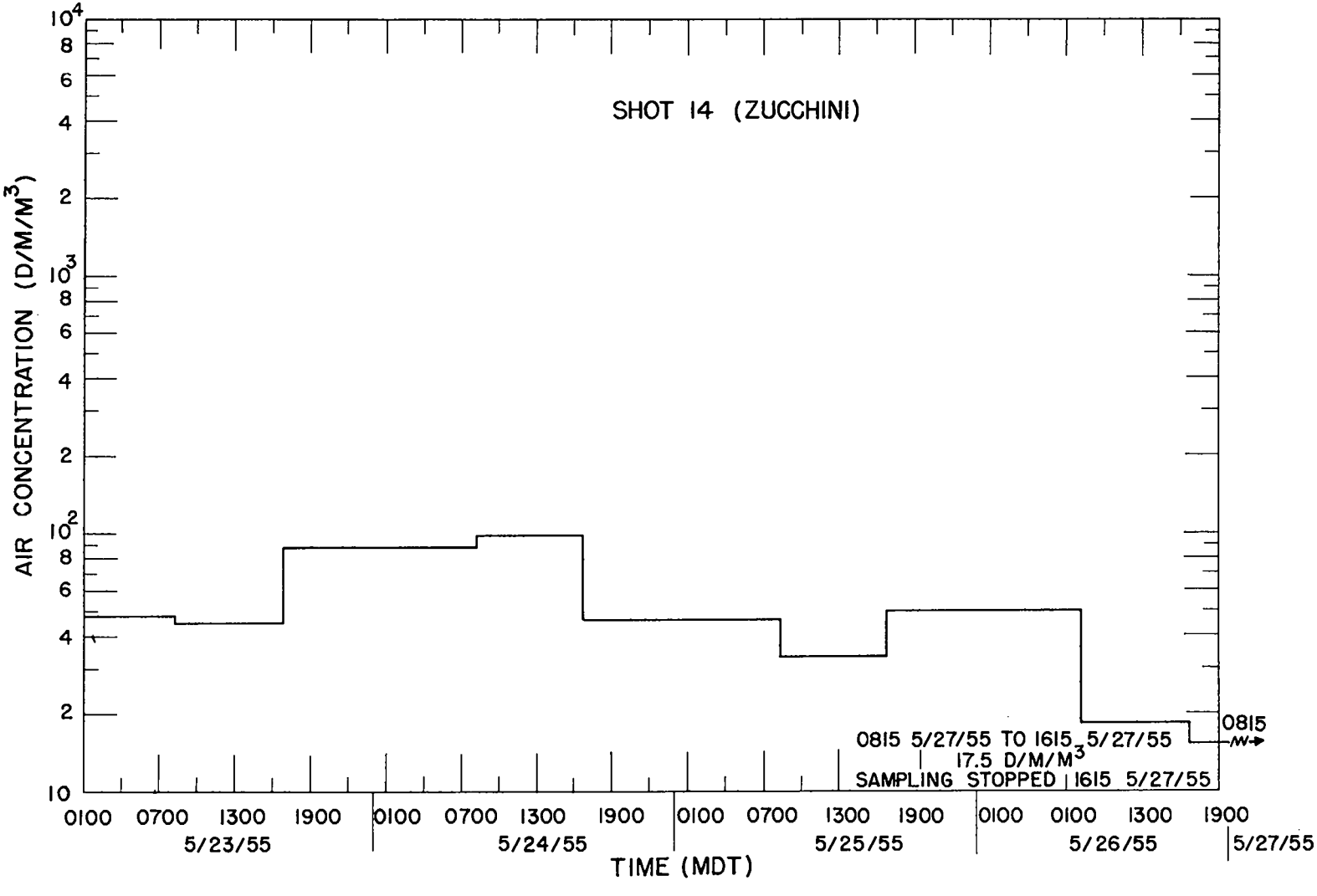

LOS ALAMOS
SHOT II (POST)
SHOT TIME 0530 MST 4/9/55
AIR CONCENTRATION (D/M/M3)
10 3
8
6
4
2
10 2
8
6
4
2
10
8
6
4
2
1
2000
0200
0800
1400
2000
0200
0800
1400
2000
4/9/55
4/10/55
4/11/55
TIME (MST)


LOS ALAMOS
SHOT 12 (MET)
SHOT TIME 1215 MST 4/15/55
AIR CONCENTRATION (D/M/M3)
10^3
8
6
4
2
10^2
8
6
4
2
10
8
6
4
2
1
1700 2300 0500 1100 1700 2300 0500 1100 1700 2300 0500 1100
4/15/55
4/16/55
4/17/55
4/18/55
TIME (MST)


LOS ALAMOS
SHOT 13 (APPLE II)
SHOT TIME 0610 MDT 5/5/55
AIR CONCENTRATION (D/M/M3)
ALMOST CONTINUOUS RAIN TO 0900 5/9/55
1600 2200 0400 1000 1600 2200 0400 1000 1600 2200
5/5/55
5/6/55
5/7/55
TIME (MDT)

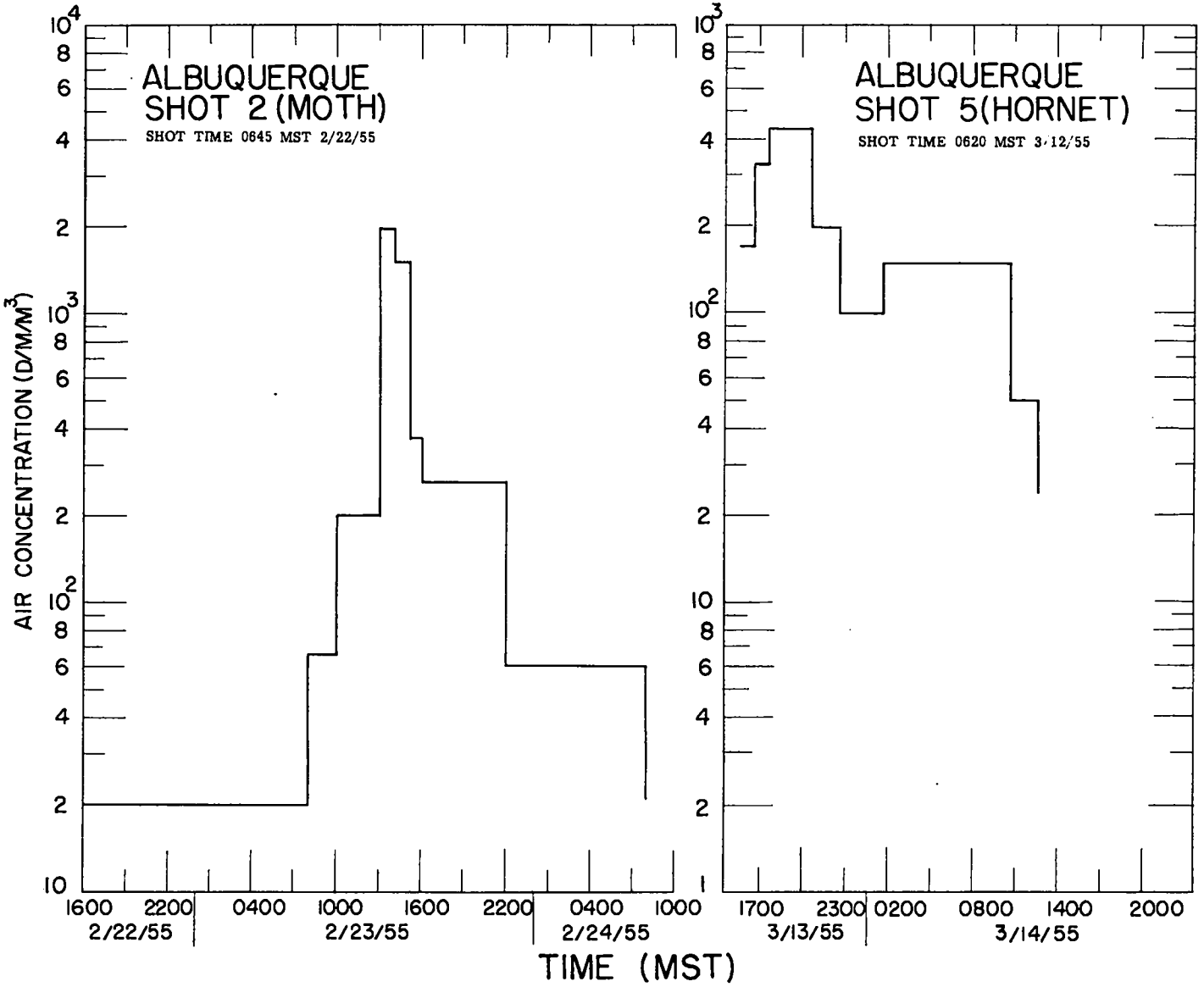

SHOT 14 (ZUCCHINI)
SHOT TIME 0600 MDT 5/15/55
LOS ALAMOS
PEAK CONCENTRATION
1315-1415 5/16/55
10,400 D/M/M3
INTERMITTENT
RAIN
AIR CONCENTRATION (D/M/M3)
TIME (MDT)
1300 1900 0100 0700 1300 1900 0100 0700 1300 1900 0100 0700 1300 1900 0100 0700
5/15/55 5/16/55 5/17/55 5/18/55 5/19/55

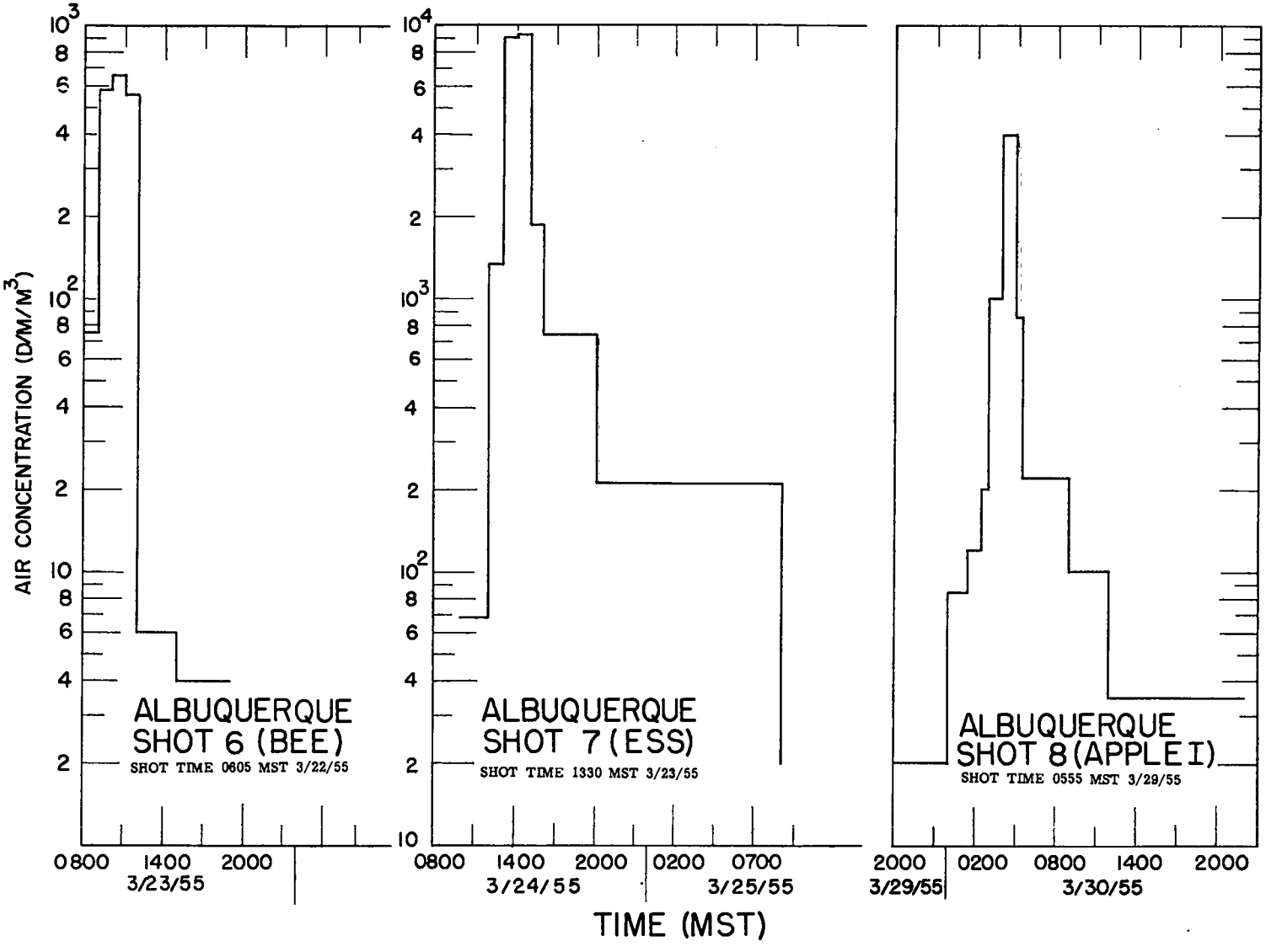

SHOT 14 (ZUCCHINI)
AIR CONCENTRATION (D/M/M3)
10^4
8
6
4
2
10^3
8
6
4
2
10^2
8
6
4
2
10
RAIN
RAIN
RAIN
RAIN
0700
1300.
1900
0100
0700
1300
1900
0100
0700
1300
1900
0100
0700
1300
1900
0100
5/19/55
5/20/55
5/21/55
5/22/55
TIME (MDT)

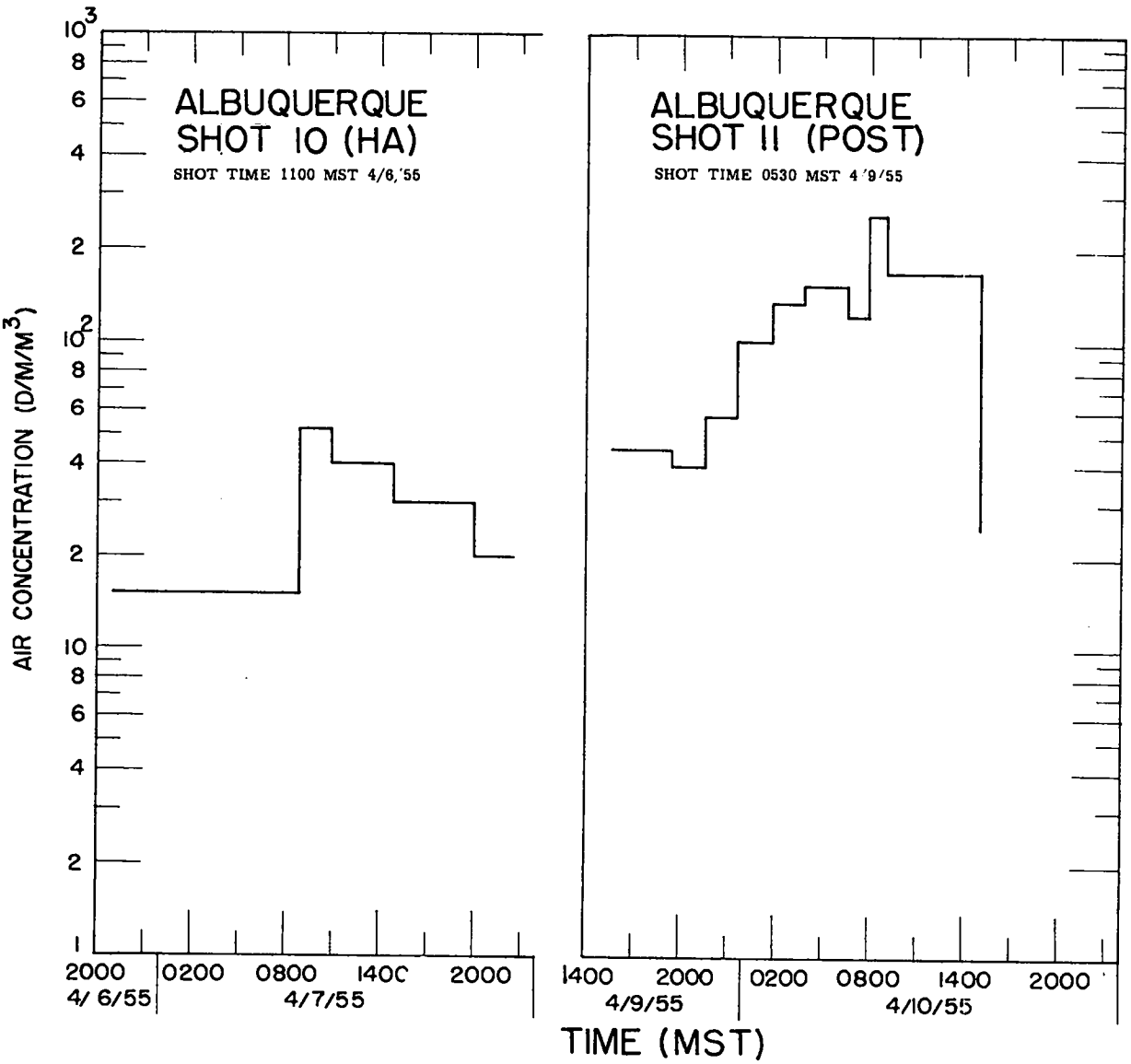

SHOT 14 (ZUCCHINI)
AIR CONCENTRATION (D/M/M3)
10^4
8
6
4
2
10^3
8
6
4
2
10^2
8
6
4
2
10
0815 5/27/55 TO 1615 5/27/55
17.5 D/M/M3
SAMPLING STOPPED 1615 5/27/55
0815
0100 0700 1300 1900 0100 0700 1300 1900 0100 0700 1300 1900 0100 0100 1300 1900
5/23/55
5/24/55
5/25/55
5/26/55
5/27/55
TIME (MDT)

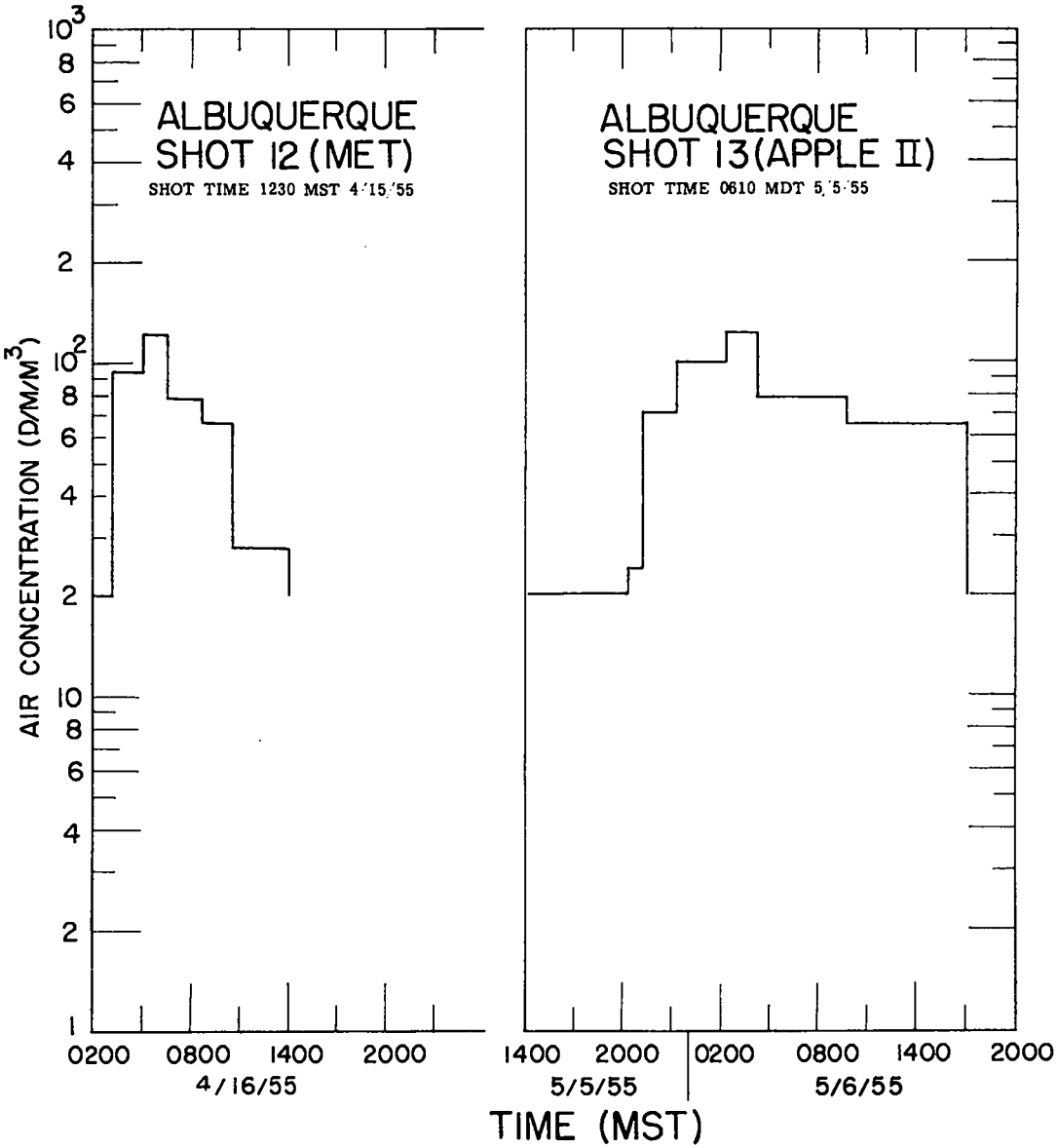
APPENDIX B

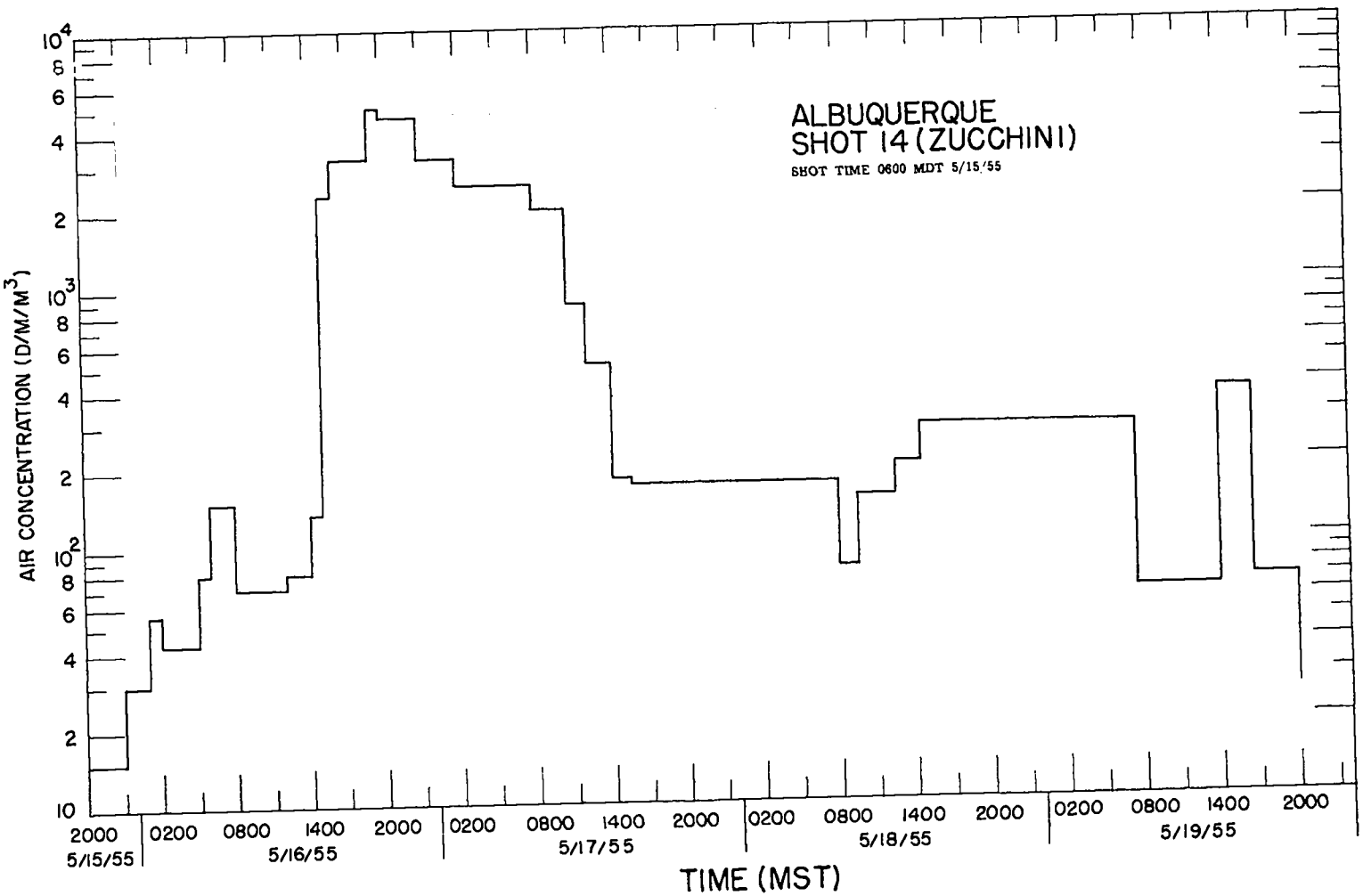
ALBUQUERQUE DATA


ALBUQUERQUE
SHOT 2 (MOTH)
SHOT TIME 0645 MST 2/22/55
ALBUQUERQUE
SHOT 5(HORNET)
SHOT TIME 0620 MST 3/12/55
AIR CONCENTRATION (D/M/M³)
TIME (MST)
1600 2200 0400 1000 1600 2200 0400 1000
2/22/55 2/23/55 2/24/55
1700 2300 0200 0800 1400 2000
3/13/55 3/14/55


AIR CONCENTRATION (D/M/M3)
ALBUQUERQUE
SHOT 6 (BEE)
SHOT TIME 0605 MST 3/22/55
ALBUQUERQUE
SHOT 7 (ESS)
SHOT TIME 1330 MST 3/23/55
ALBUQUERQUE
SHOT 8 (APPLE I)
SHOT TIME 0555 MST 3/29/55
0800 1400 2000
3/23/55
0800 1400 2000 0200 0700
3/24/55 3/25/55
2000 0200 0800 1400 2000
3/29/55 3/30/55
TIME (MST)


ALBUQUERQUE
SHOT 10 (HA)
SHOT TIME 1100 MST 4/6,'55
ALBUQUERQUE
SHOT 11 (POST)
SHOT TIME 0530 MST 4/9/55
AIR CONCENTRATION (D/M/M3)
10^3
8
6
4
2
10^2
8
6
4
2
10
8
6
4
2
1
2000
4/6/55
0200
0800
1400
4/7/55
2000
1400
2000
4/9/55
0200
0800
1400
4/10/55
2000
TIME (MST)


ALBUQUERQUE
SHOT 12 (MET)
SHOT TIME 1230 MST 4/15/55
ALBUQUERQUE
SHOT 13(APPLE II)
SHOT TIME 0610 MDT 5/5/55
AIR CONCENTRATION (D/M/M3)
10^3
8
6
4
2
10^2
8
6
4
2
10
8
6
4
2
1
0200
0800
1400
2000
4/16/55
1400
2000
0200
0800
1400
2000
5/5/55
5/6/55
TIME (MST)


ALBUQUERQUE
SHOT 14 (ZUCCHINI)
SHOT TIME 0600 MDT 5/15/55
AIR CONCENTRATION (D/M/M³)
10⁴
8
6
4
2
10³
8
6
4
2
10²
8
6
4
2
10
2000
5/15/55
0200
0800
1400
2000
5/16/55
0200
0800
1400
2000
5/17/55
0200
0800
1400
2000
5/18/55
0200
0800
1400
2000
5/19/55
TIME (MST)