

UNCLASSIFIED

AD NUMBER

AD339487

CLASSIFICATION CHANGES

TO: unclassified

FROM: secret

LIMITATION CHANGES

TO:

Approved for public release, distribution unlimited

FROM:

Distribution authorized to DoD only; Not releasable to foreign nationals.

AUTHORITY

Defense Nuclear Agency ltr dtd 29 Mar 96;
RD removed; DNA notice 29 Mar 96.

THIS PAGE IS UNCLASSIFIED

SECRET
RESTRICTED DATA

AD 339 487L

DEFENSE DOCUMENTATION CENTER

FOR

SCIENTIFIC AND TECHNICAL INFORMATION

CAMERON STATION, ALEXANDRIA, VIRGINIA



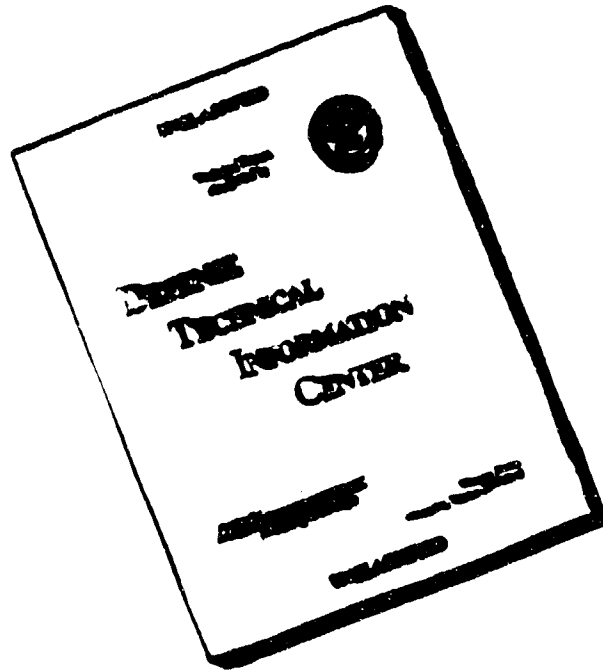
RESTRICTED DATA
SECRET

NOTICE: When government or other drawings, specifications or other data are used for any purpose other than in connection with a definitely related government procurement operation, the U. S. Government thereby incurs no responsibility, nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use or sell any patented invention that may in any way be related thereto.

NOTICE:

THIS DOCUMENT CONTAINS INFORMATION
AFFECTING THE NATIONAL DEFENSE OF
THE UNITED STATES WITHIN THE MEAN-
ING OF THE ESPIONAGE LAWS, TITLE 18,
U.S.C., SECTIONS 793 and 794. THE
TRANSMISSION OR THE REVELATION OF
ITS CONTENTS IN ANY MANNER TO AN
UNAUTHORIZED PERSON IS PROHIBITED
BY LAW.

DISCLAIMER NOTICE



**THIS DOCUMENT IS BEST
QUALITY AVAILABLE. THE
COPY FURNISHED TO DTIC
CONTAINED A SIGNIFICANT
NUMBER OF PAGES WHICH DO
NOT REPRODUCE LEGIBLY.**

11510

AIR FORCE
BALLISTIC MISSILE DIVISION
TECHNICAL LIBRARY

SECRET

RESTRICTED DATA

25-600

WT-1466

Document No. K-506

Copy No. _____

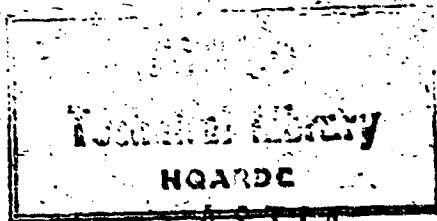
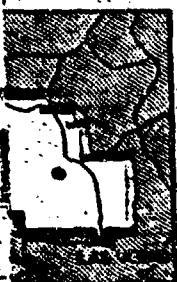
This document consists of 103 pages.

No. 149 of 310 copies, Series A

OPERATION

PLUMB BOB

NEVADA TEST SITE
MAY-OCTOBER 1957



MAY 20 1963

Project 39.1a

Scale 10

GAMMA DOSIMETRY BY FILM-BADGE
TECHNIQUES

Issuance Date: July 17, 1959.

CIVIL EFFECTS TEST GROUP

RESTRICTED DATA

This document contains restricted data as defined in the Atomic Energy Act of 1946. Its transmission or the disclosure of its contents in any manner to an unauthorized person is prohibited.

SECRET

EXCLUDED FROM AUTOMATIC
REGRADING; DOD DIR 5200.10
DOES NOT APPLY

AD NO. 339487L

DDC FILE COPY

339487L



TA
ET

When no longer required, this document may be destroyed in accordance with applicable security regulations.

DO NOT RETURN THIS DOCUMENT

SECRET
RESTRICTED DATA

③ 22-600 ④ NA

Report to the Test Director

⑥ NA

⑦ **GAMMA DOSIMETRY BY FILM-BADGE
TECHNIQUES S.R.D. (8)**

⑧ NA

By

The Nucleonics Department

⑩ NA

⑪

17 Jul 59,

Approved by: **R. L. CORSBIE**

Director, Program 39

Director, Civil Effects Test Group

⑫

103 p.

⑬ NA

HNA

⑮-17 NA

"This document contains information affecting the National Defense of the United States within the meaning of the Espionage Laws, Title 18, U.S.C., Sections 793 and 794, the transmission or the revelation of its contents in any manner to an unauthorized person is prohibited by law."

Raytheon, Germeshausen & Grif, Inc.
December 1958

DDASA / WT 1/1/60
RESTRICTED DATA

This document contains restricted data as defined in the Atomic Energy Act of 1954. Its transmittal or the disclosure of its contents in any manner to an unauthorized person is prohibited.

⑲
⑳

3-4
SECRET

~~RESTRICTED DATA~~
~~SECRET~~

ABSTRACT

Physical measurements of gamma-radiation dose, as a function of distance from the point of detonation, were made on 15 shots of Operation Plumbbob.

Standard-Du-Pont and Eastman dental film packs housed in film-badge holders designed by Edgeton, Garmeshausen & Grier, Inc., were used to make the measurements.

The results of measurements taken in various shelters and in experimental structures are also presented. The data are arranged in tabular form by project number and shot name.

X

RESTRICTED DATA

SECRET

~~RESTRICTED DATA~~
~~SECRET~~

ABSTRACT



Physical measurements of gamma-radiation dose, as a function of distance from the point of detonation, were made on 15 shots of Operation Plumbbob.

Standard De-Pest and Eastman dental film packs housed in film-badge holders designed by Edgerton, Germeshausen & Grier, Inc., were used to make the measurements.

The results of measurements taken in various shelters and in experimental structures are also presented. The data are arranged in tabular form by project number and shot name.

~~RESTRICTED DATA~~

SECRET

ACKNOWLEDGMENTS

The various participants in Project 39.1a wish to express their gratitude to R. L. Corable, L. J. Deal, and all the members of the Civil Effects Test Group Projects 39.1 and 39.1b for their substantial contributions to this project.

The project participants are highly indebted to the personnel of the Edgerton, Germershausen & Grier, Inc., photography department, who operated the film-processing trailer and assisted in recovery work during Operation Plumbbob, and to the members of the Los Alamos Scientific Laboratory H-4 Group for the gamma calibration of film badges.

We are also indebted to those persons in the Nucleonics Department who did not participate directly in the operation but who performed innumerable supporting functions.

CONTENTS

| | |
|---|----|
| ABSTRACT | 5 |
| ACKNOWLEDGMENTS | 6 |
| CHAPTER 1 INTRODUCTION | 11 |
| 1.1 Objective | 11 |
| 1.2 Background | 11 |
| CHAPTER 2 PROCEDURE | 12 |
| 2.1 Shot Participation | 12 |
| 2.2 Calibration | 12 |
| 2.3 Film-badge Handling | 13 |
| 2.4 Film Processing | 13 |
| 2.5 Analysis | 13 |
| CHAPTER 3 DATA | 14 |
| 3.1 Franklin | 14 |
| 3.2 Wilson | 15 |
| 3.3 Priscilla | 15 |
| 3.4 Hood | 16 |
| 3.5 Diablo | 16 |
| 3.6 Kepler | 16 |
| 3.7 Stokes | 16 |
| 3.8 Shasta | 16 |
| 3.9 Doppler | 17 |
| 3.10 Franklin Prime | 17 |
| 3.11 Smoky | 17 |
| 3.12 Galileo | 19 |
| 3.13 La Place | 19 |
| 3.14 Fizeau | 19 |
| 3.15 Whitney | 20 |
| CHAPTER 4 RECOMMENDATIONS | 88 |
| CHAPTER 5 FUTURE ACTIVITIES | 89 |
| APPENDIX DATA FOR DISTRIBUTED FILM BADGES | 90 |

ILLUSTRATIONS

CHAPTER 3 DATA

| | | |
|------|--|----|
| 3.1 | Franklin, North Line, RD ² vs. D | 21 |
| 3.2 | Franklin, South Line, RD ² vs. D | 22 |
| 3.3 | Los Alamos Gamma Calibration, Type 502 Film | 23 |
| 3.4 | Los Alamos Gamma Calibration, Type 510 Film | 24 |
| 3.5 | Los Alamos Gamma Calibration, Type 608 Film | 25 |
| 3.6 | Los Alamos Gamma Calibration, Type SO-1112 Film | 26 |
| 3.7 | EG&G Calibrations, Useful Portions of All Films | 27 |
| 3.8 | Wilson, Southeast Goal-post Line, RD ² vs. D | 28 |
| 3.9 | Priscilla, Stake Line, RD ² vs. D | 29 |
| 3.10 | Priscilla, Film-badge Locations | 30 |
| 3.11 | Priscilla, Underground Garage (Project 30.2) | 31 |
| 3.12 | Priscilla, Family Shelter No. 1 (Project 30.3) | 32 |
| 3.13 | Priscilla, Family Shelter No. 2 (Project 30.3) | 33 |
| 3.14 | Priscilla, Family Shelter No. 3 (Project 30.3) | 34 |
| 3.15 | Priscilla, Test Dome No. 1 (Project 30.1) | 35 |
| 3.16 | Priscilla, Test Dome No. 3 (Project 30.1) | 36 |
| 3.17 | Priscilla, Blast Door (Project 30.1) | 37 |
| 3.18 | Priscilla, Mosler Vault (Project 30.4) | 38 |
| 3.19 | Hood, East Goal-post Line, RD ² vs. D | 39 |
| 3.20 | Diablo, North Goal-post Line, RD ² vs. D | 40 |
| 3.21 | Diablo, Project 32.3 Manned Shelter | 41 |
| 3.22 | Kepler, Project 33.1 Animal Shelter | 42 |
| 3.23 | Kepler, North Goal-post Line, RD ² vs. D | 43 |
| 3.24 | Stokes, Goal-post Line, RD ² vs. D | 44 |
| 3.25 | Shasta, North Goal-post Line, RD ² vs. D | 45 |
| 3.26 | Shasta, Project 32.3 Manned Shelter | 46 |
| 3.27 | Doppler, Goal-post Line, RD ² vs. D | 47 |
| 3.28 | Franklin Prime, Goal-post Line, RD ² vs. D | 48 |
| 3.29 | Smoky, Shelter Layout with Respect to GZ and Preshot Estimated Psi Levels | 49 |
| 3.30 | Smoky, French Shelter II-1 | 50 |
| 3.31 | Smoky, French Shelter II-2 | 51 |
| 3.32 | Smoky, French Shelter II-3 | 52 |
| 3.33 | Smoky, French Shelter II-4 | 53 |
| 3.34 | Smoky, French Shelter II-5 | 54 |
| 3.35 | Smoky, German Shelter RA-a | 55 |
| 3.36 | Smoky, German Shelter RA-b | 56 |
| 3.37 | Smoky, German Shelter RA-c | 57 |
| 3.38 | Smoky, German Shelter RA-d | 58 |
| 3.39 | Smoky, German Shelter CA-a | 59 |
| 3.40 | Smoky, German Shelter CA-b | 60 |
| 3.41 | Smoky, German Shelter BC-a | 61 |
| 3.42 | Smoky, German Shelter BC-b | 62 |
| 3.43 | Smoky, German Shelter BC-c | 63 |
| 3.44 | Smoky, Holmes & Narver Shelters 1 and 2 | 64 |
| 3.45 | Smoky, North-line Elevation | 65 |
| 3.46 | Smoky, East-line Elevation | 66 |
| 3.47 | Galileo, Southeast Stake Line, RD ² vs. D | 67 |
| 3.48 | Galileo, Project 33.1 Animal Shelter | 68 |
| 3.49 | La Place, Goal-post Line, RD ² vs. D | 69 |

ILLUSTRATIONS (Continued)

| | |
|--|----|
| 3.50 Fizeau, Goal-post Line, RD^2 vs. D | 70 |
| 3.51 Whitney, Goal-post line, RD^2 vs. D | 71 |

TABLES

CHAPTER 3 DATA

| | |
|--|----|
| 3.1 Franklin, North Stake Line and Goal Post | 72 |
| 3.2 Franklin, South Stake Line and Goal Post | 73 |
| 3.3 Wilson, Southeast Goal-post Line | 74 |
| 3.4 Priscilla, Stake Line | 74 |
| 3.5 Hood, Goal-post Line | 75 |
| 3.6 Diablo, Goal-post Line | 75 |
| 3.7 Kepler, Goal-post Line | 76 |
| 3.8 Stokes, Goal-post Line | 76 |
| 3.9 Shasta, Goal-post Line | 76 |
| 3.10 Doppler, Goal-post Line | 77 |
| 3.11 Franklin Prime, Goal-post Line | 77 |
| 3.12 Smoky, French and EG&G Dosimetry Comparison | 78 |
| 3.13 Smoky, Slant-range Calculation, North Line | 79 |
| 3.14 Smoky, North Goal-post Line | 79 |
| 3.15 Smoky, Slant-range Calculation, East Line | 80 |
| 3.16 Smoky, East Goal-post Line | 80 |
| 3.17 Smoky, Iron-pipe Container Data | 81 |
| 3.18 Smoky, Slant-range Calculation, South Line | 82 |
| 3.19 Smoky, South Goal-post Line | 82 |
| 3.20 Galileo, Goal-post Line | 82 |
| 3.21 La Place, Goal-post Line | 83 |
| 3.22 Fizeau, Goal-post Line | 84 |
| 3.23 Special Studies (Project 39.6a) | 84 |
| 3.24 Project 39.6a, Barro Shelters | 85 |
| 3.25 Whitney, Goal-post Line | 87 |

APPENDIX DATA FOR DISTRIBUTED FILM BADGES

| | |
|--|----|
| A.1 Fallout Badge Study (Program 37) | 90 |
| A.2 Fallout Badge Study (Program 37) | 93 |
| A.3 Project Terry-2 (Program 37) | 94 |
| A.4 Project Terry-3 (Program 37) | 94 |
| A.5 Project Terry-4 (Program 37) | 95 |
| A.6 Project Terry-5 (Program 37) | 95 |
| A.7 Project Terry-6 (Program 37) | 96 |
| A.8 Project Terry-7 (Program 37) | 96 |
| A.9 Project Terry-8 (Program 37) | 96 |
| A.10 Project Terry-9 (Program 37) | 97 |
| A.11 Project Terry-10 (Program 37) | 97 |
| A.12 Whirligig (Program 35) | 97 |
| A.13 Project 35.1 | 98 |
| A.14 AFSWP-DOD Badges (Project 2.10) | 98 |

SECRET

Chapter 1

INTRODUCTION

1.1 OBJECTIVE

The objective of Project 39.1a was to ensure that the various Civil Effects Test Group (CETG) projects were able to obtain and document in an economical manner adequate radiation measurements to accomplish their goals. This objective was accomplished by measuring the integrated gamma dose at points along the ground and at various locations in selected structures. In addition, fallout measurements and other special data (found in the Appendix) were supplied to some non-CETG projects.

1.2 BACKGROUND

The film-taping technique designed and used by Edgerton, Germeshausen & Grier, Inc., (EG&G) on Operation Teapot was employed again during Operation Plumbbob. With this technique individual pieces of film are taped together to form a convenient reel equivalent to 35-mm motion-picture film. Some advantages of this system include ease of processing, analysis, and storage.

The sensitometric analysis methods employed on Operation Teapot were also used. A description of the methods can be found in Report WT-1174 (see also Operation Greenhouse Report WT-81).

Chapter 2

PROCEDURE

2.1 SHOT PARTICIPATION

On Operation Plumbbob the film-badge dosimetry measurements were made primarily for CETG projects. Instrumentation was located in the field to determine dose vs. distance (RD^2 vs. D) for a given shot. Total integrated measurements were also made in shelters and in various experimental structures.

2.2 CALIBRATION

A Co^{60} gamma calibration system was arranged so that three sets of 10 badge assemblies were consecutively exposed to doses ranging progressively from 0.05 to 5×10^3 r. An extension of the high-range curve based on a calibration made at Los Alamos Scientific Laboratory (LASL) was used to increase the maximum readable dose to 5×10^4 r. The calibration source (7 curies) was placed in a cradle at one end of a calibration table oriented so that the center of the source beam passed through the center of the badges.

Badge distances were determined with a 25-r Victoreen chamber that had been recently calibrated by the National Bureau of Standards (NBS). Exposures were timed to obtain mid-scale readings for greatest accuracy. It is believed that an over-all reproducibility of better than 5 per cent was maintained on administered doses.

Actual shot calibrations were made the morning of D-day, using film badges that were assembled and handled with the field badges. Shot badges were placed in the field the afternoon before the shot and were recovered when Rad-Safe opened the area. The film badges were not allowed to remain in the field more than three days before a shot. All badges were developed together, with sensitometric scales spaced at intervals throughout the reel. Ranges covered by the dosimeter films were:

| | |
|-----------------|--------------------------|
| Du Pont 502 | 0.1 to 10 r |
| Du Pont 510 | 8 to 300 r |
| Du Pont 606 | 200 to 600 r |
| Eastman SO-1112 | 300 to 5×10^4 r |

Film irradiated in the field tends to darken beyond the density obtainable with gamma calibration alone when it is processed to a gamma of 1.3. Several theories have been proposed by various groups and individuals as to the exact physics or mechanics of this process. Some of the causes proposed are (1) differential rate sensitivities between laboratory and field conditions, (2) neutron effects at distances close to Ground Zero (GZ), (3) thermal effects,

(4) overdarkening due to activation irradiation, (5) a mechanical factor brought out by the low-gamma processing, and (6) the possibility of visible or low-energy X-ray fluorescence.

It is the intent of EG&G to resolve this discrepancy, whether it is due to the above listed anomalies or to some other factor or combination of factors, before the next field participation.

2.3 FILM-BADGE HANDLING

After recovery of the film badges from the field, the film packets were arranged in numerical order in a special dispenser and individually fastened together in the EG&G-designed edge-taping machine. After being taped on this machine, approximately 200 complete badges, or 800 pieces of film, could be assembled on a single reel and processed together in the same manner as standard 35-mm motion-picture film.

When the processing operation had been completed, the density of each film was measured on a densitometer. The equivalent roentgen exposures were determined from the density readings with the curves that were made from the calibration badges. The equivalent dose was calculated according to the proper film-badge number and were transferred to the data sheets for analysis.

2.4 FILM PROCESSING

Owing to high-range restrictions and errors inherent in reading high doses from the plateau area of the calibration curve, which would be noticed in Eastman SO-1112 film under normal development procedures, the badges were processed to a wide-latitude gamma of 1.3. This wide-latitude gamma easily extends the range of the SO-1112 film to approximately 5×10^4 r and yields a slope compatible with reasonably accurate differential dose measurements. Although more control is required in the actual developing phase when development is not carried to completion, the advantage outlined above seemed to warrant this procedure.

Included with the cobalt calibration badges were several SO-1112 white-light standards. All badges were run through the taping machine and were developed as follows:

Emulsion type MF, No. 1112; MCS 5000; N.D. 1.3
Developer: D-76, No. 4
Temperature: 70°F
Time: 2 min 39 sec; 10 double-squeegee wipers used at a speed of 8 $\frac{1}{2}$ ft, min
Gamma: 1.30

2.5 ANALYSIS

The reels of processed badges were mounted on rewinds and wound across the reading surface of an Ansco-Macbeth color densitometer (model 12). Central readings were made and recorded for each film. After the completion of a series of readings, usually involving one set of calibration films and a large number of unknowns, the calibration films were plotted as density vs. dose curves. The unknowns were then evaluated. In most cases each reel, for control purposes, was supplied with several sensitometric scales throughout its length, along with the proper gamma calibration films. After evaluation, reels of badges were placed in 35-mm canisters and properly labeled for storage.

Chapter 3

DATA

No attempts have been made to correct the data presented in this report for neutron sensitivity, thermal sensitivity, and film "lot" reproducibility. The following limitations are brought to the reader's attention:

One occurrence that does have a pronounced effect on film dose measurements in the field is the difference in saturation density between the laboratory exposures and field exposures. On a density vs. log exposure curve, the straight-line portion of the curve is longer for field exposures than for laboratory exposures, and the saturation density is higher for field exposures than for laboratory exposures. This difference appears to be related to differential rate sensitivities between laboratory and field conditions. Since we have no quantitative data on this effect, our procedure has been to ignore, or at least to use skeptically, all measurements above a specifically selected straight-line portion of the curve. All data reported have been extracted from calibration curves where dose does not exceed this point on the straight-line portion of the curve.

The neutron sensitivities of the several types of films used in the EG&G film badge are reported to vary by a factor of 2 from the least sensitive to the most sensitive. Film sensitivity varies from batch to batch and also with the type of packaging. In view of these uncertainties and in view of the fact that the film type is seldom listed in weapons test reports, we are suggesting an average value for film neutron sensitivity in making corrections to film-badge gamma measurements. The values that have been used by the Air Force Special Weapons Center are 3.4 per cent of the high-energy neutron rep dose (measured by Hurst fission-foil detectors) plus a response to thermal neutrons of 3.6×10^8 thermal neutrons/cm (measured by gold foils) for a film response of 1 r. These two corrections are additive. In general, the maximum correction for neutron sensitivity is about 10 to 30 per cent of the gamma dose; thus the errors introduced by using average sensitivity values are not important.

An experiment was conducted under controlled conditions in an attempt to evaluate the effects of environmental desensitization of the film. The scant data collected suggest that there was desensitization, but insufficient data are available to yield adequate correction factors.

A least-squares analysis was performed on all the distance-dose measurements in an attempt to better appreciate the validity of the collected data. However, it was soon realized that, because no corrections were made for the fast-neutron, thermal-neutron, and differential rate sensitivities of the film, this manipulation was somewhat meaningless.

A total of 2958 film badges was issued by EG&G for use by CETG on Operation Plumbbob.

3.1 FRANKLIN

EG&G placed two stake lines from 500 to 1500 yd, at 100-yd intervals, to the north; and 525 to 1525 yd, at 100-yd intervals, to the south of GZ. Badges were also supplied to CETG for

placement on paralleling "goal posts" in Project 39.5, Oak Ridge National Laboratory (ORNL), blast containers ("beer-mug" containers).

The RD^2 vs. D curves are given in Figs. 3.1 and 3.2, and the data are given in Tables 3.1 and 3.2.

The badges remained in the field for two days before the shot and were recovered on the afternoon of D-day. Since EG&G's calibration system was not yet completed, a series of badges calibrated by LASL and processed with the EG&G shot badges was used for evaluation of the Franklin data.

A representative series of calibrations is included with the Franklin data in Figs. 3.3 to 3.6. Subsequent intercomparison of EG&G and LASL calibrations produced curves that were almost identical. Limitations imposed by the small EG&G source made necessary a range extension by use of some LASL calibration points. Since a major portion of the two curves was superimposable, the calibration extension was considered valid.

Figure 3.7 indicates the useful portion of the calibration curves (solid lines).

3.2 WILSON

One film badge per point was placed from 400 to 2000 yd on the southeast 204" goal-post line by Project 39.1b/39.5 in ORNL beer-mug containers.

The RD^2 vs. D curve for these data is given in Fig. 3.8, and the RD^2 vs. D computations are given in Table 3.3.

The badges were placed in the field the night before the shot, but they remained outside a day and a half after the shot before they were processed. EG&G calibration badges, for processing with the shot film, were handled in the same manner, and their curves were used for interpretation.

3.3 PRISCILLA

The calibration curve of the Priscilla film badges was based on the extended LASL calibration and an extrapolation to estimate extremely high doses. This extrapolation was based on previous experimentation that indicated the general shape of the calibration curve from 5×10^4 to 5×10^5 r.

"Extremely high" doses were those for which it was not possible to obtain densities by Co^{60} irradiation alone in the standard EG&G holder. Indications were that fast and thermal neutrons first overshadow the gamma radiation at about 2×10^4 r and continue to darken the film beyond the maximum densities obtainable by Co^{60} calibration. This continued darkening was opposed to film reversal or lightening after about 4×10^4 r of gamma radiation alone when processed to a gamma of 1.3.

These results indicate that proper analysis of high-dose mixed irradiation fields will necessitate adequate neutron calibration and application of corrective factors.

Figure 3.9 shows the RD^2 vs. D slope for the stake line, and the data are given in Table 3.4.

The shelter drawings (Figs. 3.10 to 3.18) indicate film-badge locations in the various Priscilla structures. Figure 3.10 shows the positions of the structures relative to GZ and to each other.

In general, two film badges were placed at each location designated by "+": one badge at 3 ft from the floor and another at 5 ft. To indicate which dose was received by a specific badge, a line was drawn from the + and the dose that was recorded by the badge placed at 5 ft was written above the line; the dose received by the badge placed at 3 ft was written below the line.

3.4 HOOD

The goal posts placed by EG&G for Hood shot were from 750 to 2000 yd east of GZ. Instrumentation at the 750- and 2000-yd positions was not recovered.

In addition to the EG&G badges in hangers, the same types of film were placed in thermal-neutron-shielding lithium cans mounted in bear-mug type containers on the goal posts. A special calibration indicated that the badges in the lithium cans did not differ widely (dose vs. density) from those placed in the standard EG&G container. The RD^2 vs. D curves for these measurements are shown in Fig. 3.19, and the data are given in Table 3.5.

The badges were placed in the field three days before the shot, and they were recovered on zero morning.

3.5 DIABLO

A goal-post line was run from 500 to 1600 yd north of GZ (goal posts were placed at each 100 yd) to the Project 32.3 manned shelter. The RD^2 vs. D curves for the film badges and film in lithium cans are shown in Fig. 3.20, and the data for these curves are given in Table 3.6.

The exterior and entranceway to the shelter were monitored with EG&G film badges; the doses received are shown in Fig. 3.21. Twenty stakes were driven into the ground blanketing the surface of the shelter. The film badges were taped to the stakes at a 3-ft height and were wrapped in the thermal-protective aluminum foil.

Special-study badges were placed on a stake line paralleling the goal posts.

The goal-post and shelter badges were placed in the field three days prior to the detonation and were recovered the afternoon of D-day. Calibration curves used in data interpretation of Diablo badges were handled in a manner similar to those for the shot badges. All calibrated badges were irradiated the morning of the shot and were processed with the field badges, as were all EG&G shot calibrations.

3.6 KEPLER

The main study on Kepler shot was the instrumentation of an animal shelter (Project 33.1) located approximately 340 yd from GZ. Forty-five points within the shelter were monitored. The dose interpretation of these badges is given in Fig. 3.22.

Three goal posts were placed at 500, 1000, and 1500 yd from GZ to obtain an approximate dose vs. distance (RD^2 vs. D) curve (Fig. 3.23 and Table 3.7) for the initial gamma measurements. Film badges in EG&G hangers and in lithium cans, as well as CETG chemical dosimeters and ORNL neutron detectors, were mounted on these goal posts.

The goal-post badges were placed in the field two days prior to, and were recovered the morning of, the shot.

3.7 STOKES

For Stokes shot EG&G film badges were placed on goal posts at 250-yd intervals from 750 to 2000 yd from GZ. Lithium cans containing films were placed at 750, 1000, 1250, and 1500 yd from GZ. The RD^2 vs. D curve is shown in Fig. 3.24, and the data are given in Table 3.8.

3.8 SHASTA

Four film badges were placed on each goal post at 750, 1000, 1250, and 1500 yd from Shasta GZ. The RD^2 vs. D curve for Shasta is shown in Fig. 3.25, and the data are given in Table 3.9.

In addition, the Project 32.3 manned shelter was again monitored with EG&G film badges, as was done for the Diablo shot. A drawing of the shelter used for Shasta, with dose interpretation, is shown in Fig. 3.26.

No calibration was made for this shot; the Stokes calibration was used because of identical processing controls.

3.9 DOPPLER

EG&G film badges were placed on goal posts at 250-yd intervals from 750 to 2000 yd from GZ. Lithium cans were located at points from 750 to 1500 yd from GZ. A comparison of the two types of dosimeters is shown in Fig. 3.27 and in Table 3.10.

The dosimeters were placed in the field the day before the shot and were recovered during the morning of the shot. As in Shasta, the Stokes calibration was used owing to the similarity of processing controls.

3.10 FRANKLIN PRIME

Film badges in EG&G hangers were placed on goal posts at 250-yd intervals from 500 to 1750 yd from GZ. Lithium cans and other special-purpose badge containers were used at points from 500 to 1250 yd. The RD^2 vs. D curves for film badges and film placed in lithium cans are shown in Fig. 3.28, and the data are given in Table 3.11.

Franklin Prime dosimeters were placed in the field the day before the shot and were recovered the morning of the shot.

3.11 SMOKY

Out of a total of 16 shelters on Smoky shot, an arrangement of 14 shelters designed in France (Project 30.6) and Germany (Project 30.7) was tested as part of the CETG structures program. This cooperative program was originated with the intent of strengthening NATO civil-defense relations as well as providing specific indoctrination and orientation into weapons effects.

A hill and dale dosimetry program was conducted to produce data on the effect of geographical terrain on prompt-gamma-radiation doses.

Heavy instrumentation of the 16 underground shelters, i.e., five French, nine German, and two Holmes and Narver (H&N) shelters, was accomplished by the use of EG&G film packs, which were placed in the shelters to measure prompt-gamma-radiation doses at various locations within the shelters. Recovery was made in all shelters. Project 39.1b:39.5 neutron detectors were used to supplement this gamma information.

The data are presented in tabular form and in drawings of the shelters. The sketches show the dose received as a function of badge location. Data from the neutron detectors are also presented on some of the plan drawings to facilitate gamma vs. neutron comparison.

In the shelter drawings the following information is given:

Figure 3.29 is a layout showing distances with respect to GZ of French and H&N shelters to the left, and German to the right, of the blast line. The preshot estimated psi levels are also given.

Figures 3.30 to 3.44 are plans of the French, German, and H&N shelters, indicating points of instrumentation and respective results. Doses in roentgens for American film badges are shown, for all the shelters, above the line drawn to the film-badge symbol for badges 5 ft from the floor and below the same line for badges 3 ft from the floor.

Sulfur and gold neutron-flux detector readings are presented in Figs. 3.31 and 3.32 for the French shelters and in Figs. 3.37 and 3.40 for the German shelters. Readings, which are given above the line for sulfur and below the line for the gold-cadmium difference, are in neutrons per square centimeter.

Positions only are noted for germanium detectors (Project 37.4).

To compare French and American dosimetry techniques, French film plates and EG&G badges were placed together in the five French shelters used on Smoky. Each French plate consisted of eight film packs of various types taped to a piece of Plexiglas and wrapped in packing material covered with a dust-tight plastic bag. The EG&G pack consisted of four types of film in a polyethylene case mounted in a lead and tin box.

French film types used were as follows:

| Type | Range, r (accurate portion of curve) | |
|---|---|---------------------------------|
| | American process (approximate) | French process (approximate) |
| Kodak Periapical (K-P) | | |
| a | 2-200 | 0-2 |
| b | 2-200 | 100 |
| Chassende Baroz 600 R (CB-600 R) | | |
| a | 20-500 | 150 |
| b | 20-1,000 | 600 |
| Chassende Baroz 50,000 R (CB-50,000 R) | | |
| a | 100-10,000 | 1,000 |
| b | 200-40,000 | 10,000 |
| c | 5,000-70,000 | 40,000 |

Film types used by EG&G were:

| Type | Range, r (accurate portion of curve) |
|------------------------------------|---|
| Da Pont Film Pack, Type 553 | |
| Type 502 | 5-12 |
| Type 510 | 8-250 |
| Type 608 | 200-600 |
| Eastman SO-1112 | 300-50,000 |

Two film packs on each French plate had a cadmium strip covering part of the packet. Table 3.12 gives French (cadmium readings) and EG&G dosimetry comparisons.

All French films were processed with the American dosimeters to a gamma of approximately 1.3.

French control films placed in standard EG&G badges were irradiated and developed to furnish calibration curves for the dose interpretation of the plates. It was thought that some of the French control film had been calibrated, but, since no means of identification could be found, these badges could not be distinguished from fresh film. Therefore a random series of K-P and CB-600 R badges was cut in half and made lighttight. One series of these half-badges was then irradiated and processed with the other, nonirradiated (control), half. The results indicated that the Kodak badges chosen were all originally fresh film, and, since the controls showed no darkening above normal, a good calibration curve was obtained. Since some discrepancies appeared on the CB-600 R films, it was necessary to run two calibrations to obtain a curve. The CB-50,000 R film calibration looked very satisfactory, and the doses interpreted from the plates in the shelters indicated these doses to be in fair agreement with the American dosimeters.

A set of the remaining French badges was calibrated for processing in France to compare French and American processing techniques. Kodak Periapical calibration packs were placed in EG&G containers and were irradiated from 0.01 to 500 r on the EG&G Co⁶⁰ calibration range, and the administered dose was written on the packs; the remaining Kodak packs that were returned were not irradiated.

Also included for return to France were nonirradiated controls plus irradiated CB-600 R films (with doses from 0.5 to 500 r irradiated in the same manner as the Kodak film) and CB-50,000 R films (with doses from 100 to 5×10^3 r).

As a final step in preparing film plates for return, all processed French films were mounted on clear plastic sheets, labeled, and bound in book form with a table of contents, thus making it possible to reread film densities directly from the pages without removing the films.

A study was made in an attempt to better understand the part played by the geographical structure of hill and dale terrain on prompt-gamma-radiation doses. Film badges were placed in special containers and attached to a ground cable or mounted on goal posts in various directions from GZ.

Figure 3.45 shows the elevation to the north with respect to the tower, GZ, and point A. Table 3.13 gives the slant-range calculations for the north line, and Table 3.14 gives the RD^2 vs. D data.

Figure 3.46 indicates graphically the elevations to the northeast of GZ. Table 3.15 indicates the slant-range calculations for this line. Table 3.16 contains the RD^2 vs. D information, and Table 3.17 gives the iron-pipe container data.

A blast container made of standard 3-in. iron pipe with a capped end and eyebolt for the cable attachment was used to hold EG&G film badges along the contours of the ground on the northeast line.

Only the ground doses were interpreted from two special iron-pipe calibrations. The doses recorded for the shot were determined from these calibration curves.

Table 3.18 presents the slant-range calculations for the south goal-post line, and Table 3.19 contains the RD^2 vs. D information.

3.12 GALILEO

For the Galileo shot, EG&G film badges and Project 39.1b/39.5 neutron dosimeters were placed on a stake line along the east access road and in an animal shelter (Project 32.1). The stake line ran 1218 to 3400 yd from GZ. The RD^2 vs. D graph for stake-line badges is given in Fig. 3.47, and the data are given in Table 3.20.

The animal shelter was located approximately 300 yd south of GZ. Readings for these shelter film-badge dosimeters are given in Fig. 3.48.

All instrumentation was placed the night before the shot and was recovered the morning of the shot.

3.13 LA PLACE

EG&G film badges were placed on goal posts at 250-yd intervals from 500 to 1500 yd beside the main access road leading to La Place GZ. All instrumentation was set up the day prior to the shot and was recovered the morning of the shot. The RD^2 vs. D curves for the lithium cans and EG&G containers are shown in Fig. 3.49, and the data are given in Table 3.21.

3.14 FIZEAU

EG&G film badges on goal posts at 200-yd intervals from 800 to 1600 yd from GZ were the only dosimeters used by EG&G on Fizeau. The RD^2 vs. D curves of this instrumentation are in Fig. 3.50, and the data are in Table 3.22.

The badges were placed in the field the day before the shot and were recovered the morning of the shot. Ideal conditions made this essentially a fresh film test.

Results of measurements made for Project 39.6a are given in Tables 3.23 and 3.24.

3.15 WHITNEY

Whitney film badges were placed at 250-yd intervals on a stake line from 750 to 1750 yd from GZ. The RD^2 vs. D curve for these badges is shown in Fig. 3.51, and the data are given in Table 3.25. Badges were placed in the field two days before shot time and were recovered the morning of the shot.

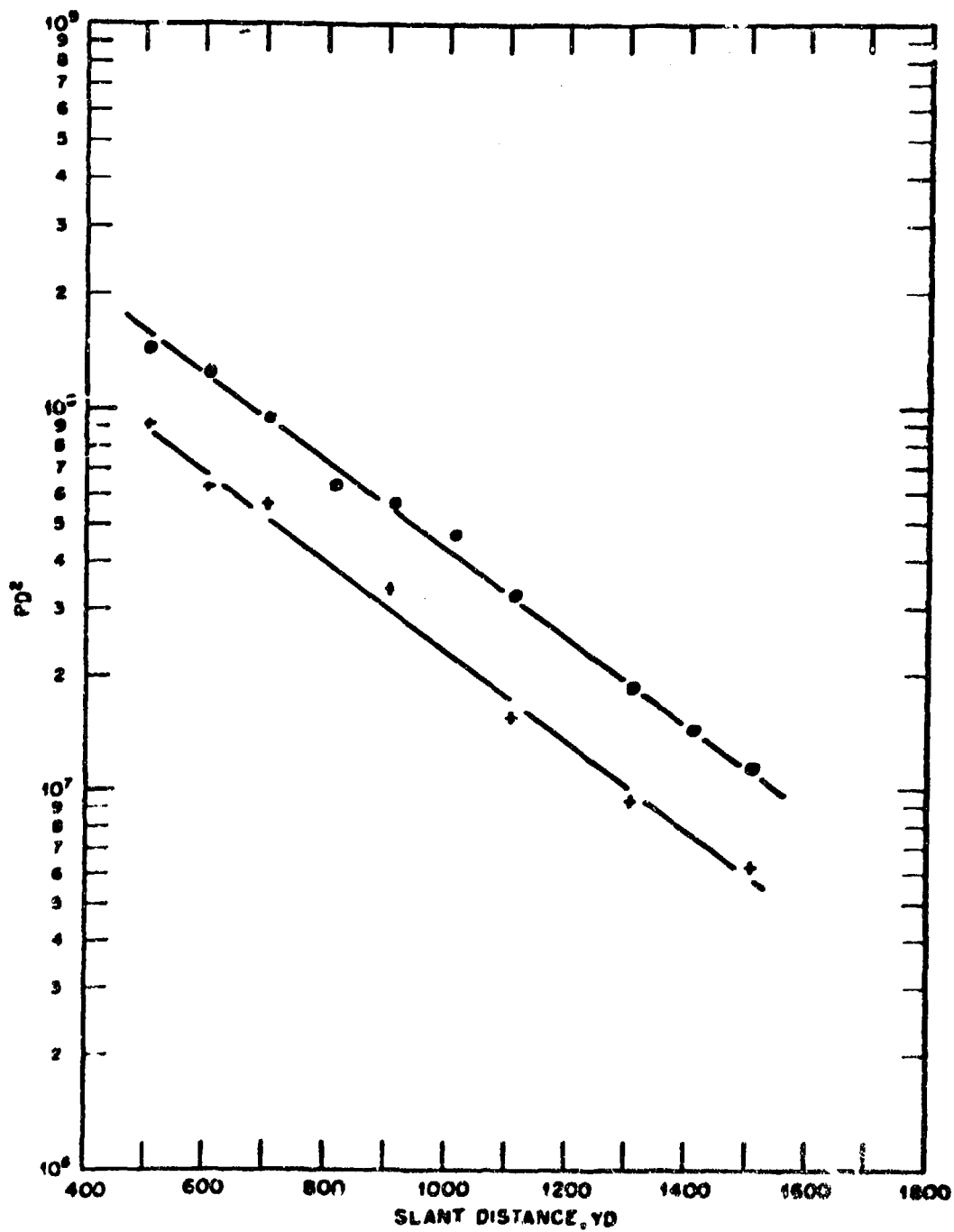


Fig. 3.1 — Franklin, north line, KD^2 vs. D. O, stake-line badges. +, goal-post badges.

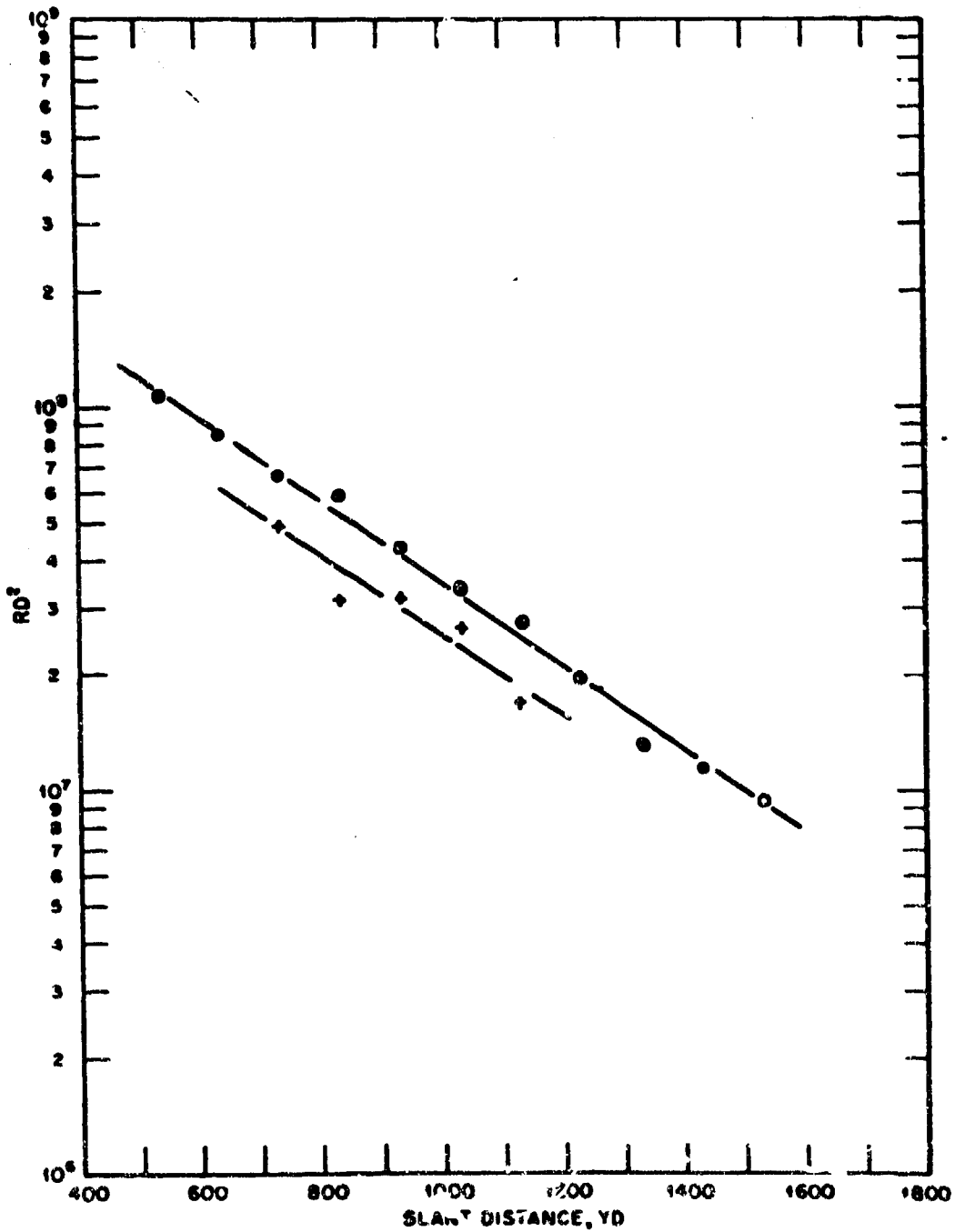


Fig. 3.2—Franklin, south line, RD^2 vs. D. \odot , make-line badges. \times , goal-post badges.

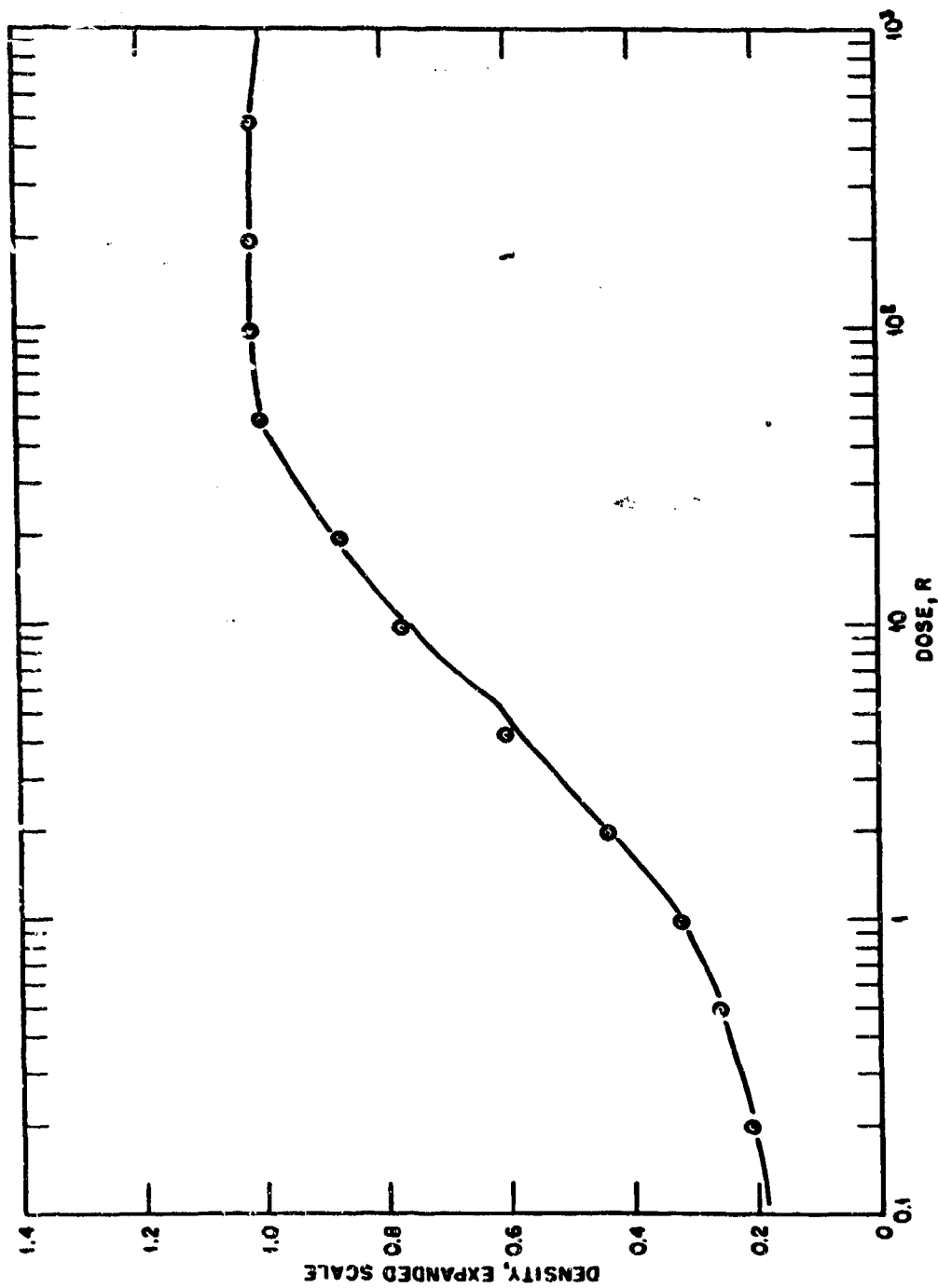


Fig. 3.3—Los Alamos gamma calibration, type 502 film.

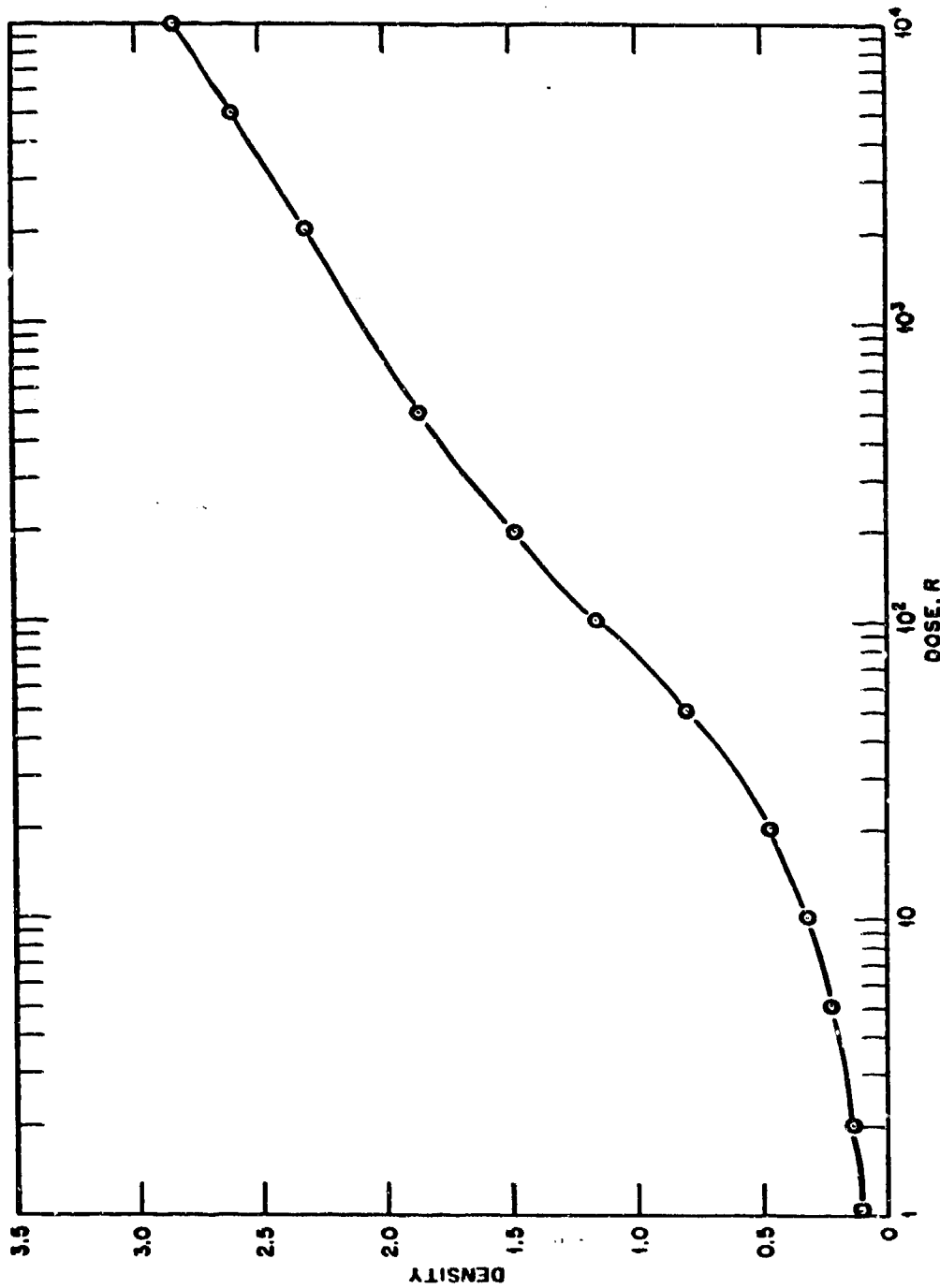


Fig. 3.4—Los Alamos gamma calibration, type 310 film.

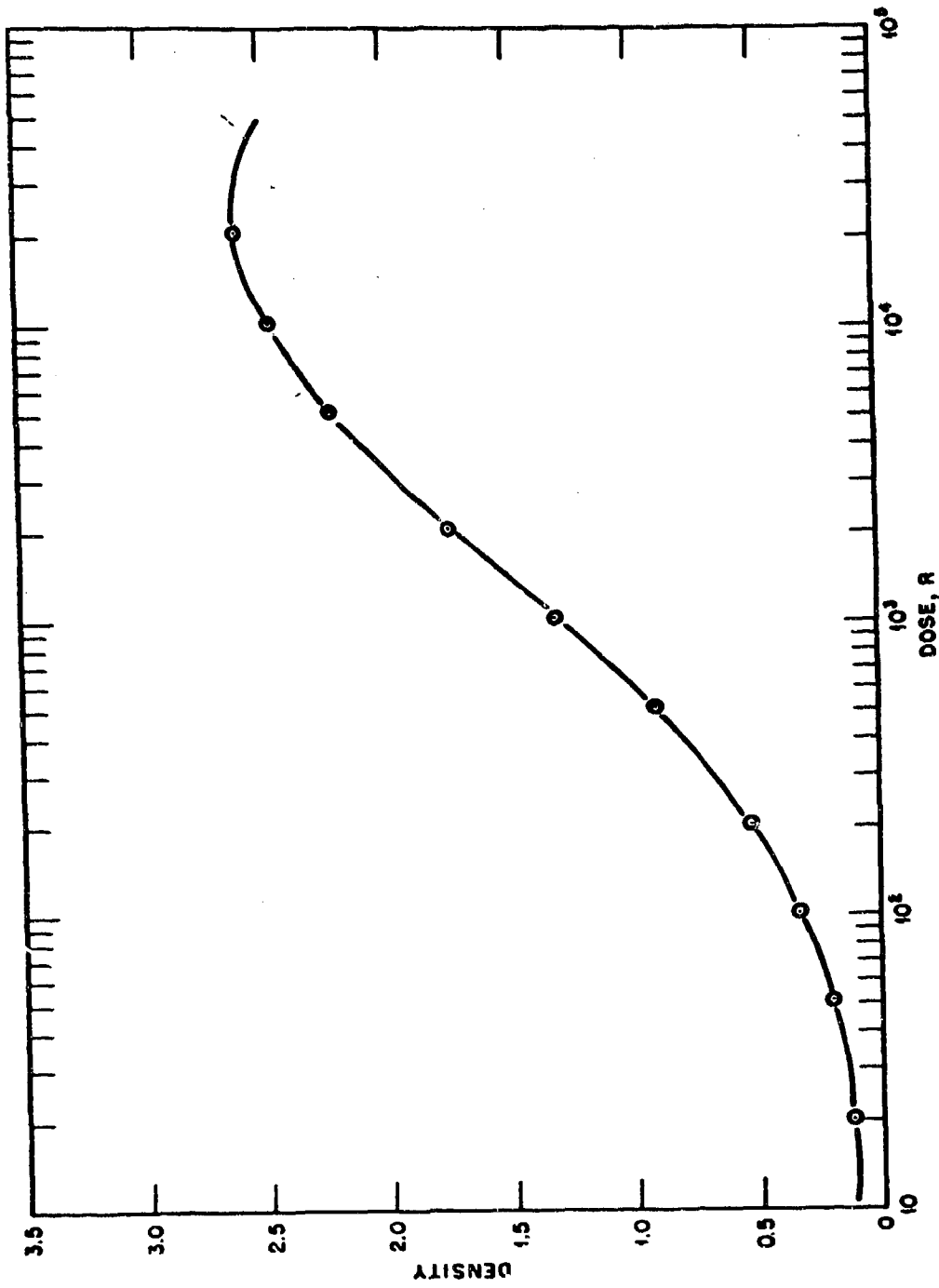


Fig. 3.5—Los Alamos gamma calibration, type 608 film.

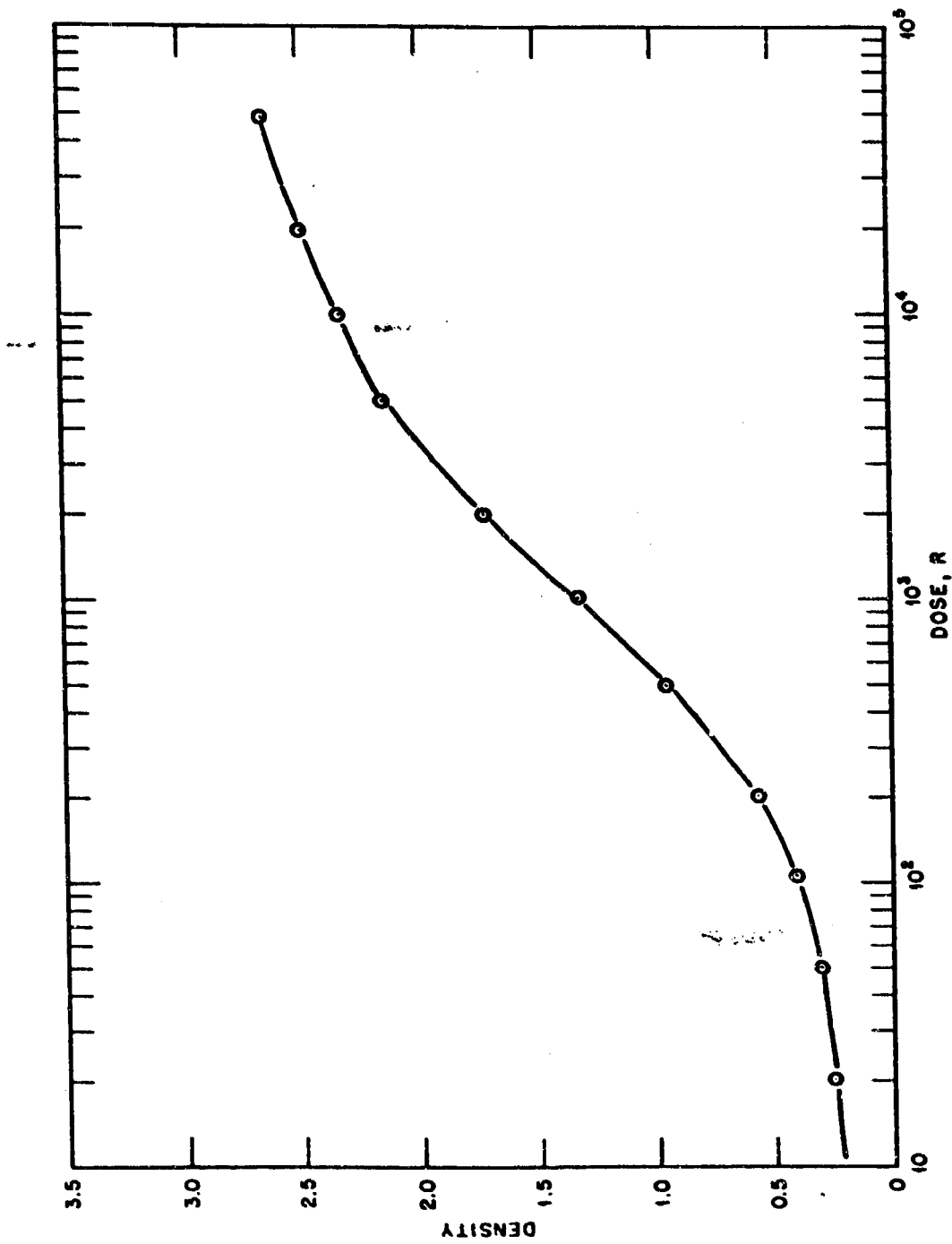


Fig. 3.6—Los Alamos gamma calibration, type SO-1112 film.

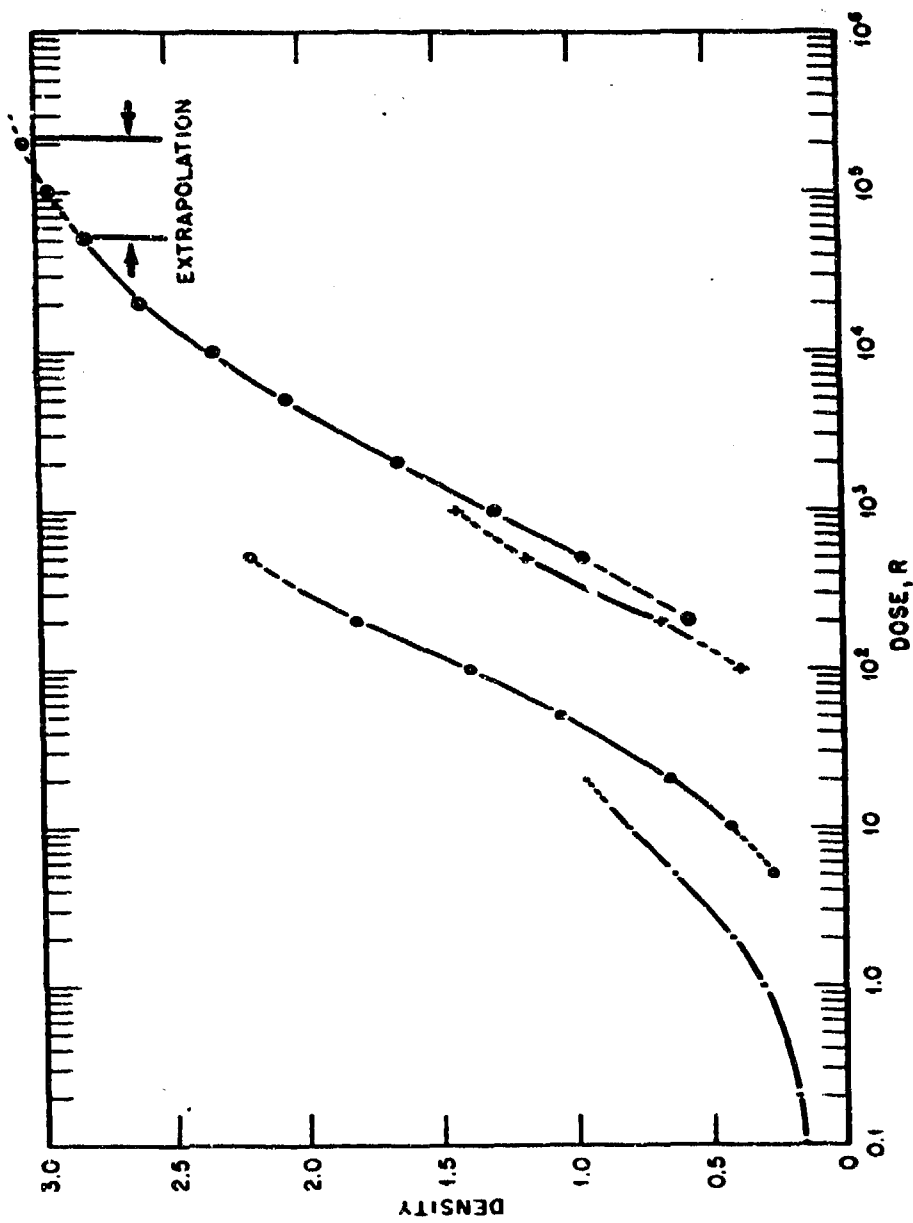


Fig. 3.7—ECGAG calibrations, useful portions of all films, n. 502, O, 610, X, 626, O, 1112.

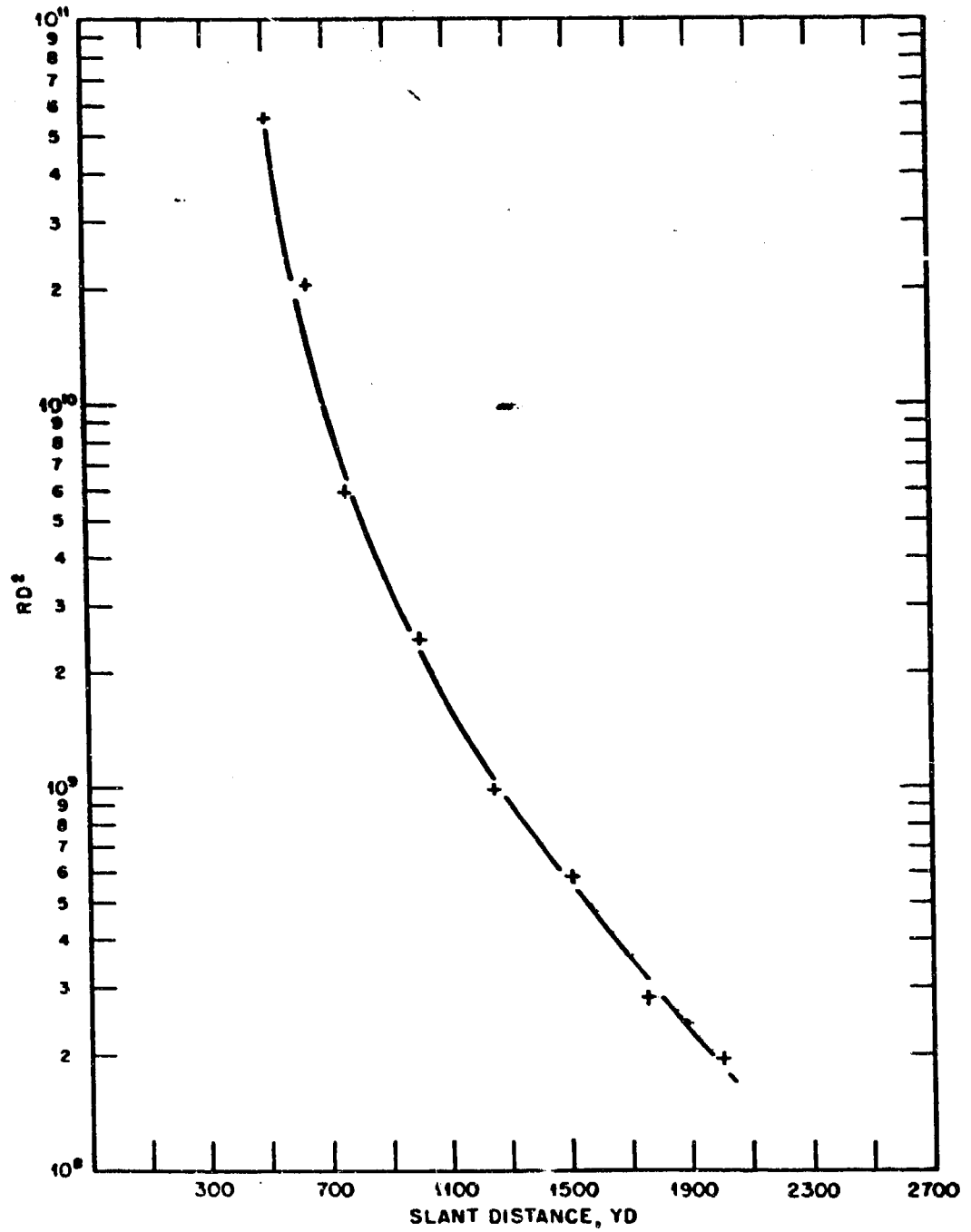


Fig. 3.8—Wilson, southeast goal-post line, RD^2 vs. D.

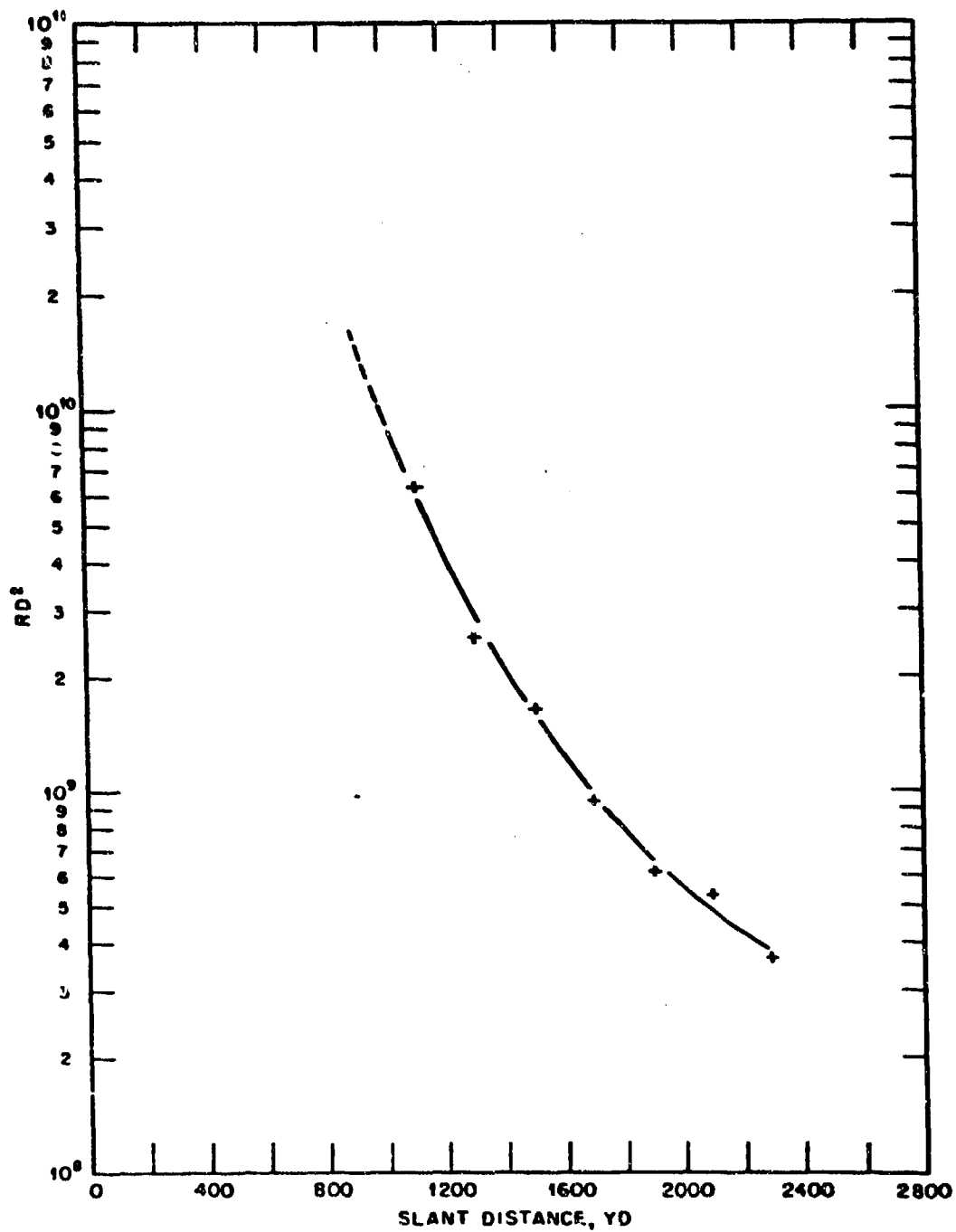


Fig. 3.9—Priscilla, stake line. RD² vs. D.

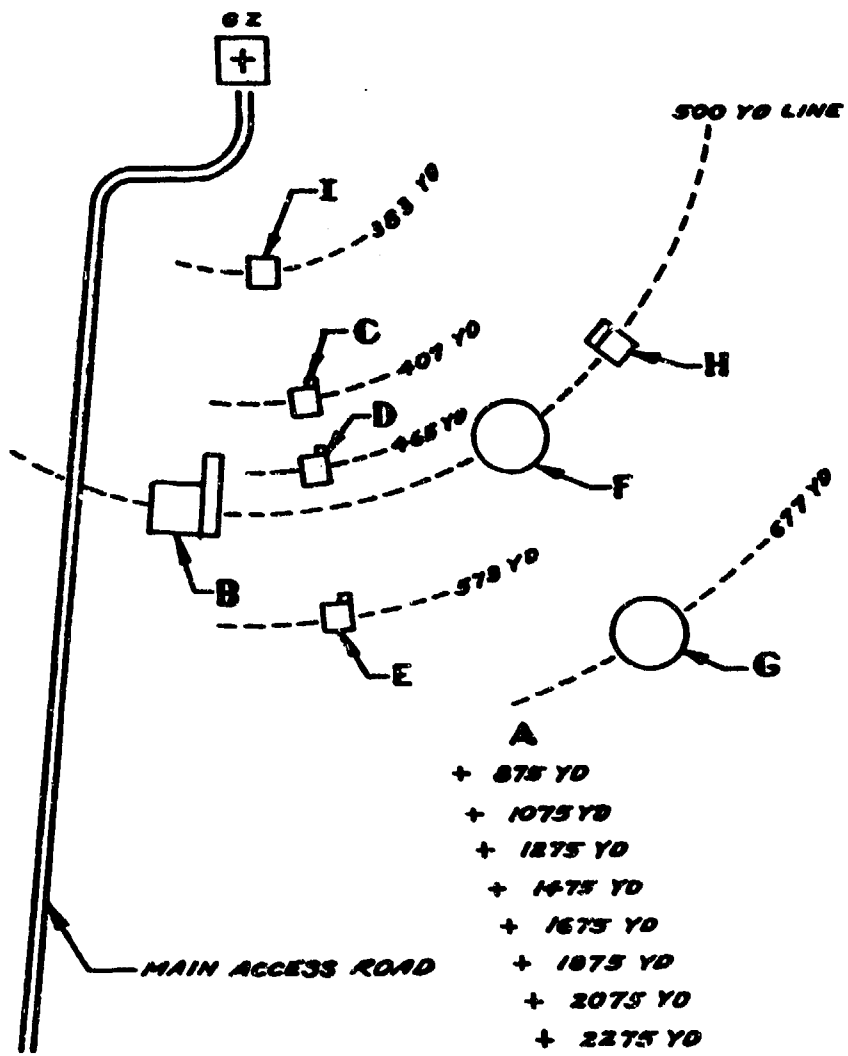


Fig. 3.10—Priscilla, film-badge locations.

- | | |
|--|--|
| A, stake line (Project 30.1) | E, family shelter No. 3 (Project 30.3) |
| B, underground garage (Project 30.2) | F, test dome No. 1 (Project 30.1) |
| C, family shelter No. 1 (Project 30.3) | G, test dome No. 3 (Project 30.1) |
| D, family shelter No. 2 (Project 30.3) | H, blast door (Project 30.1) |
| I, Mosler safe (Project 30.4) | |

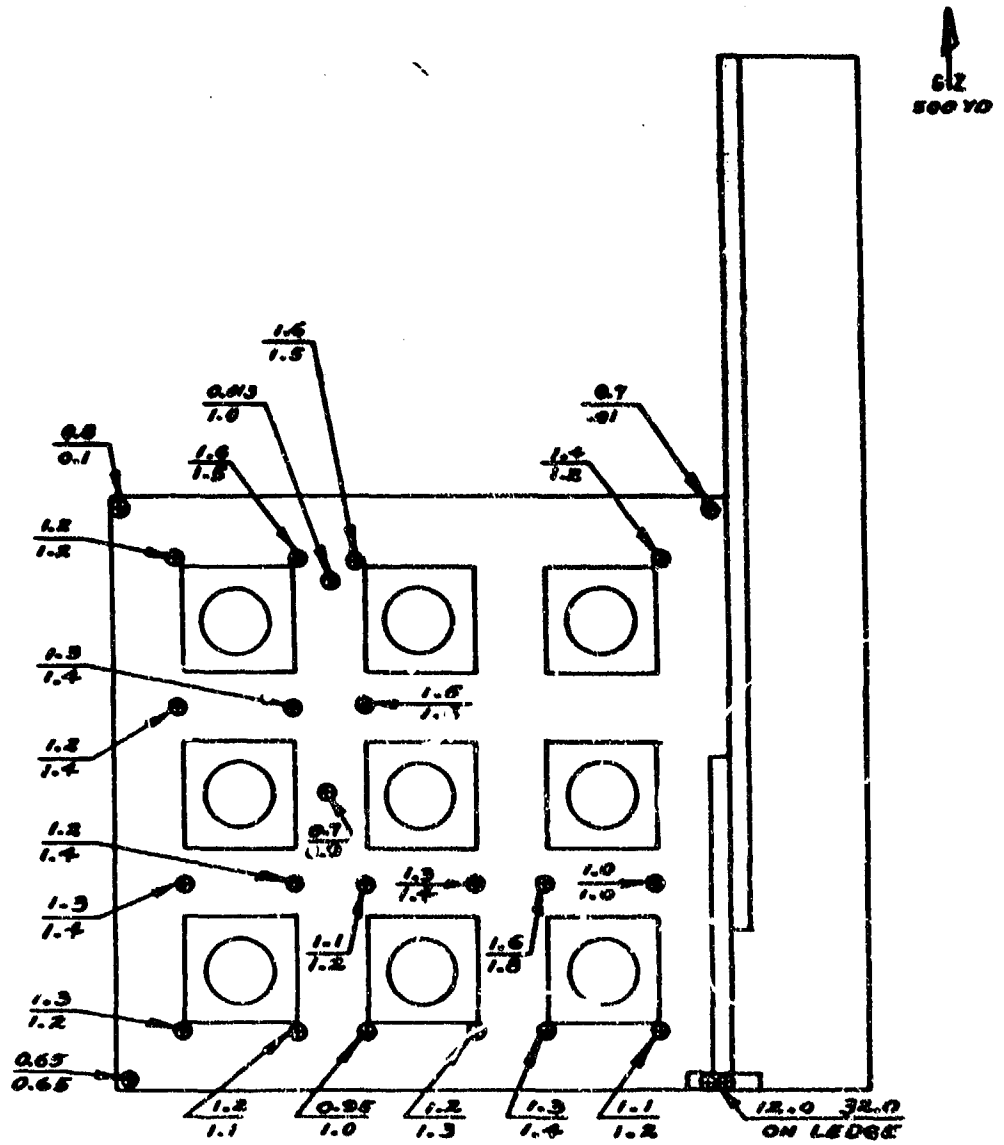


Fig. 3.11—Priscilla, underground garage (Project 30.2), ⊕, film badge locations at heights of 3 and 5 ft from the floor. The readings above and below the lines are the doses in roentgens at the 5- and 3-ft heights, respectively.

612
467 YD

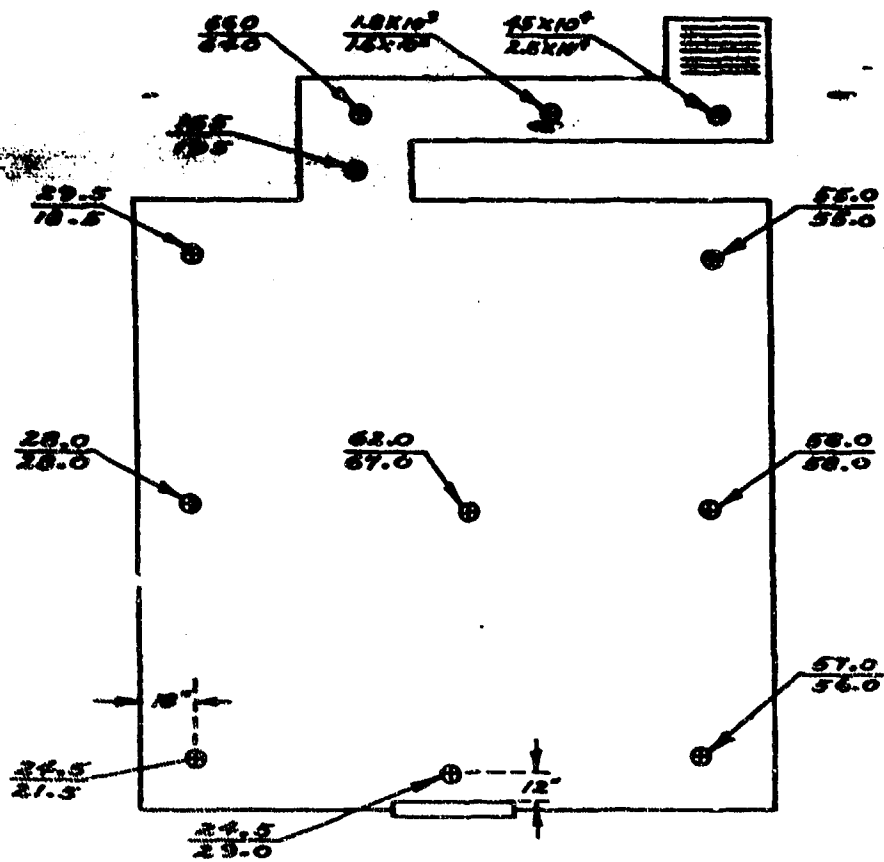


Fig. 3.12—Priscilla, family shelter No. 1 (Project 30.3). ⊙, film-badge locations at heights of 3 and 5 ft from the flow. The readings above and below the lines are the doses in roentgens at the 5- and 3-ft heights, respectively.

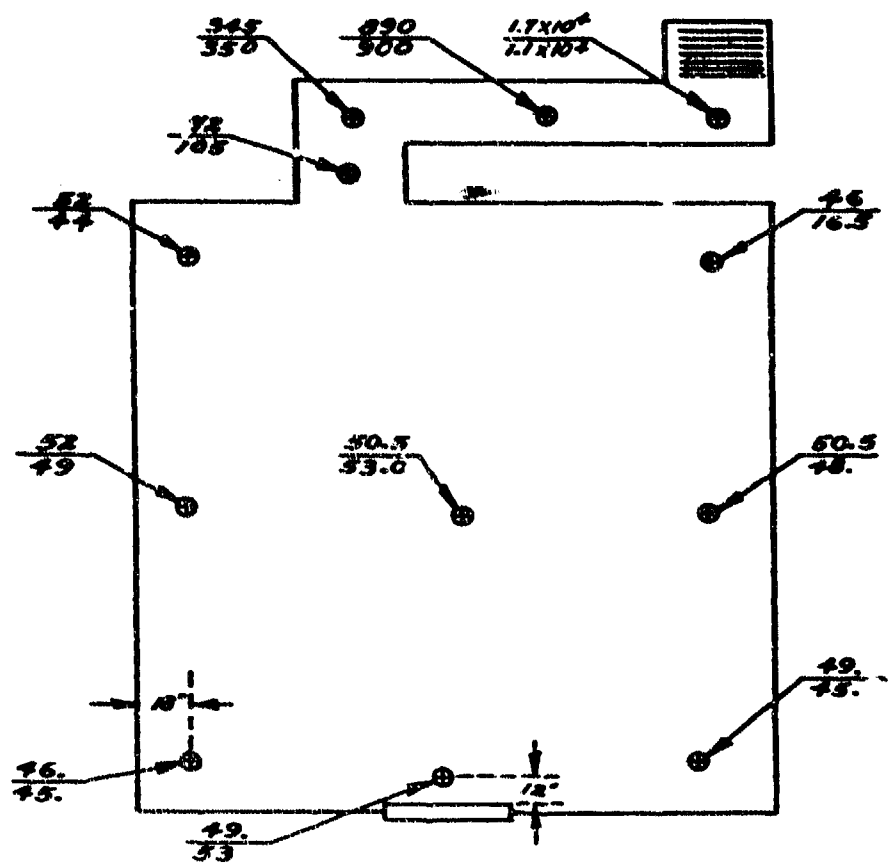


Fig. 5.13—Priscilla, family shelter No. 2 (Project 30.3). ⊙, film-badge locations at heights of 3 and 5 ft from the floor. The readings above and below the lines are the doses to roentgens at the 5- and 3-1/2 heights, respectively.

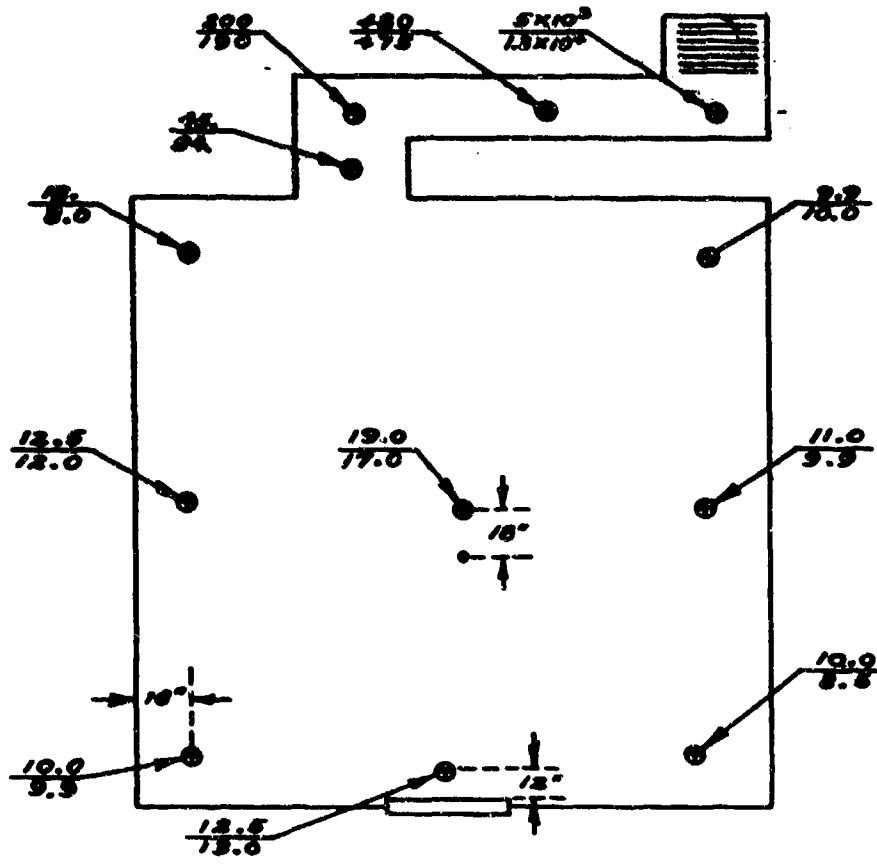


Fig. 3.14—Priscilla, family shelter No. 3 (Project 30.3). ⊙, film-badge locations at heights of 3 and 5 ft from the floor. The readings above and below the lines are the doses in roentgens at the 5- and 3-ft heights, respectively.

612
67710

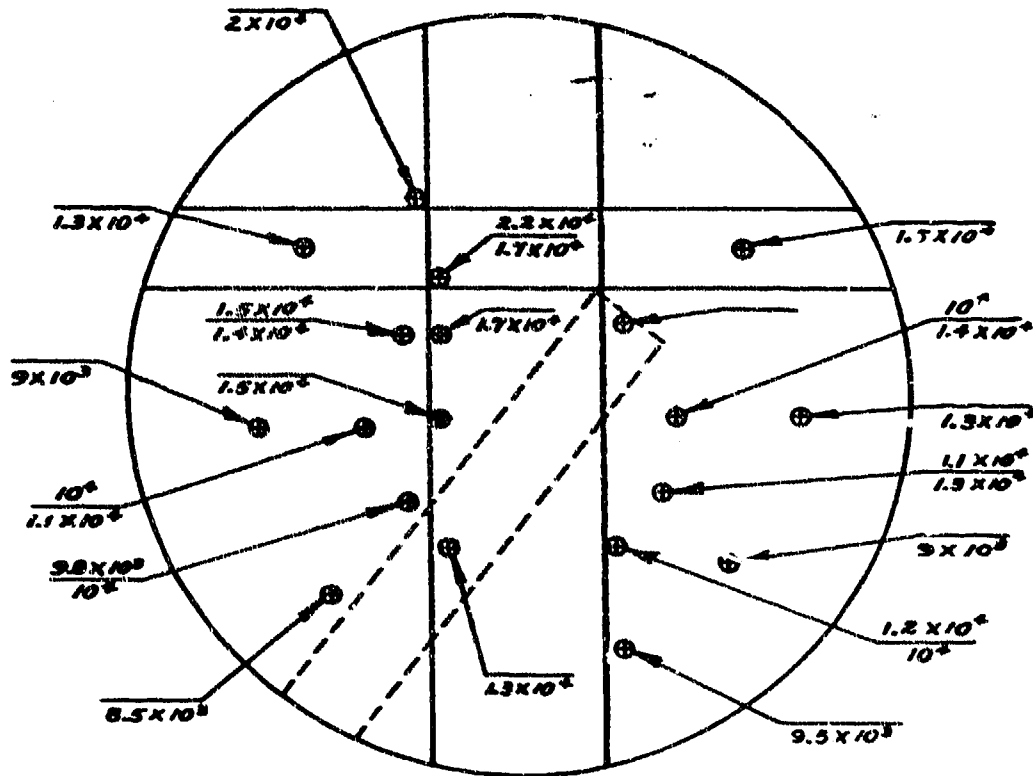


Fig. 3.16—Pracilla, east dome No. 3 (Project 30.1). ⊕. film-badge locations at heights of 3 and 5 ft from the floor. The readings above and below the lines are the doses in roentgens at the 5- and 3-ft heights, respectively.

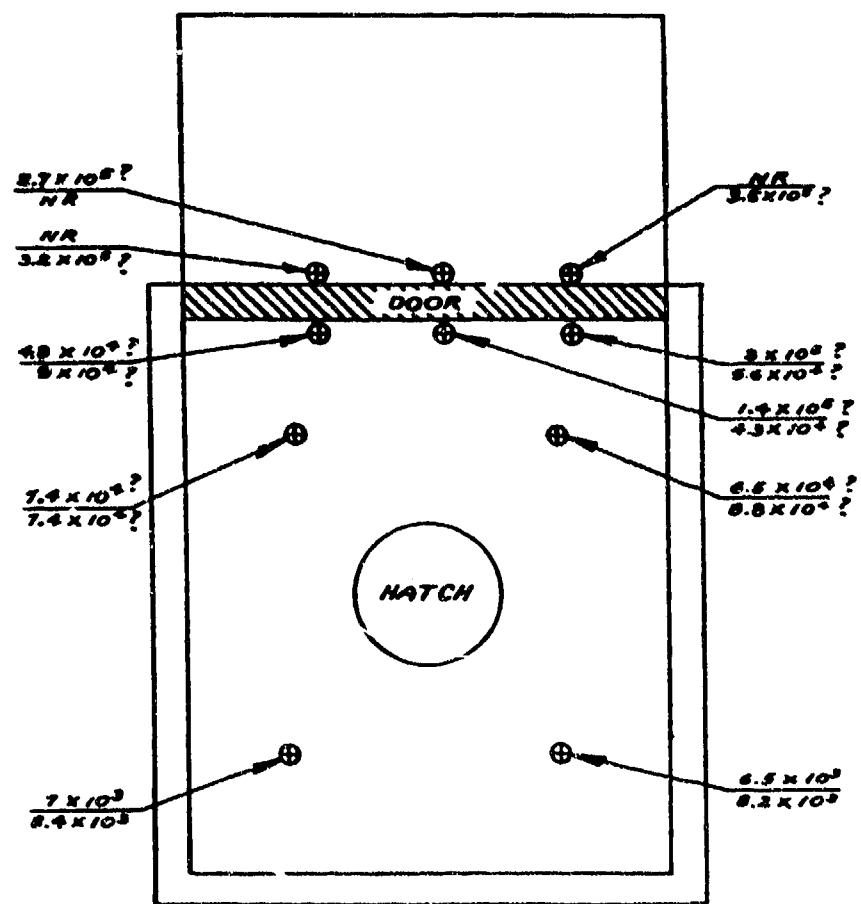


Fig. 3.17—Priscilla, blast door (Project 30.1). ⊕, film-badge locations at heights of 3 and 5 ft from the floor. The readings above and below the lines are the doses in roentgens at the 5- and 3-ft heights, respectively. NR: not recovered.

G12
383 YARDS

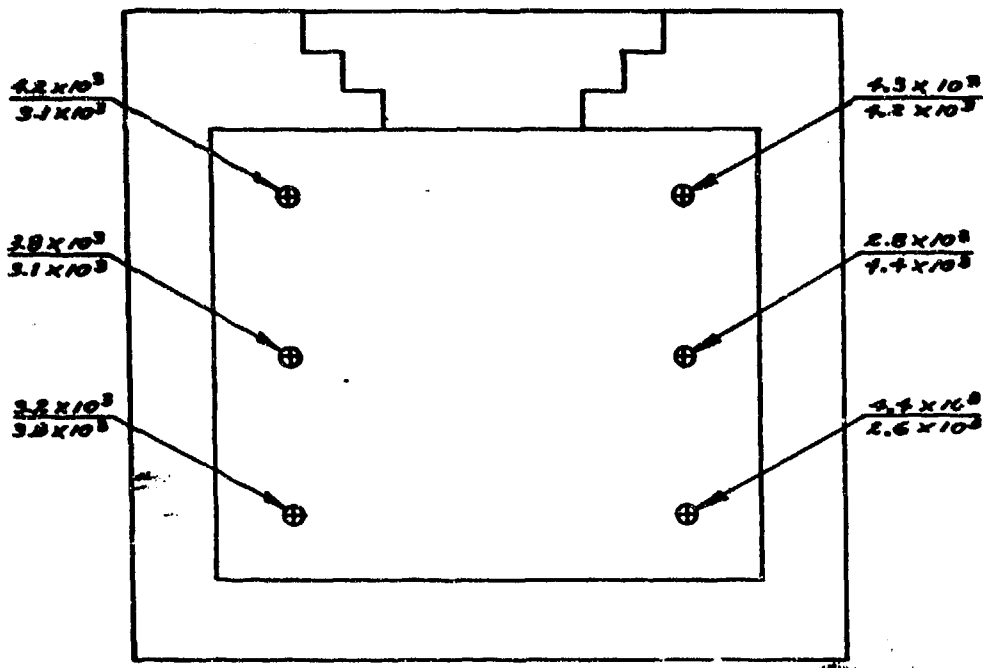


Fig. 3.18—Priscilla, Mosler vault (Project 30.4). ⊕, film-badge locations at heights of 3 and 5 ft from the floor. The readings above and below the lines are the doses in roentgens at the 5- and 3-ft heights, respectively.

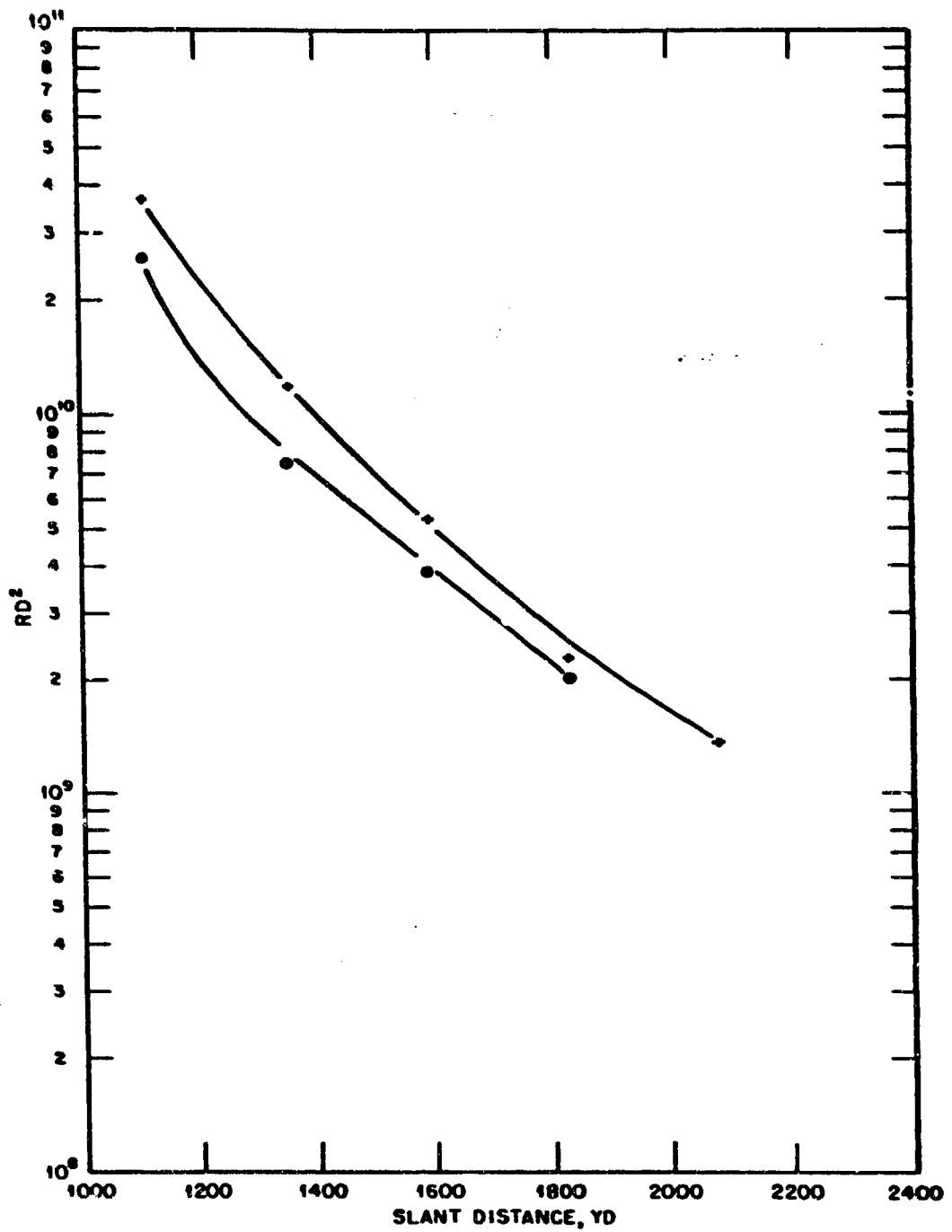


Fig. 3.19—Horizontal goal-post line, RD^2 vs. D. +, EG&G film badges. O, film in lithium can.

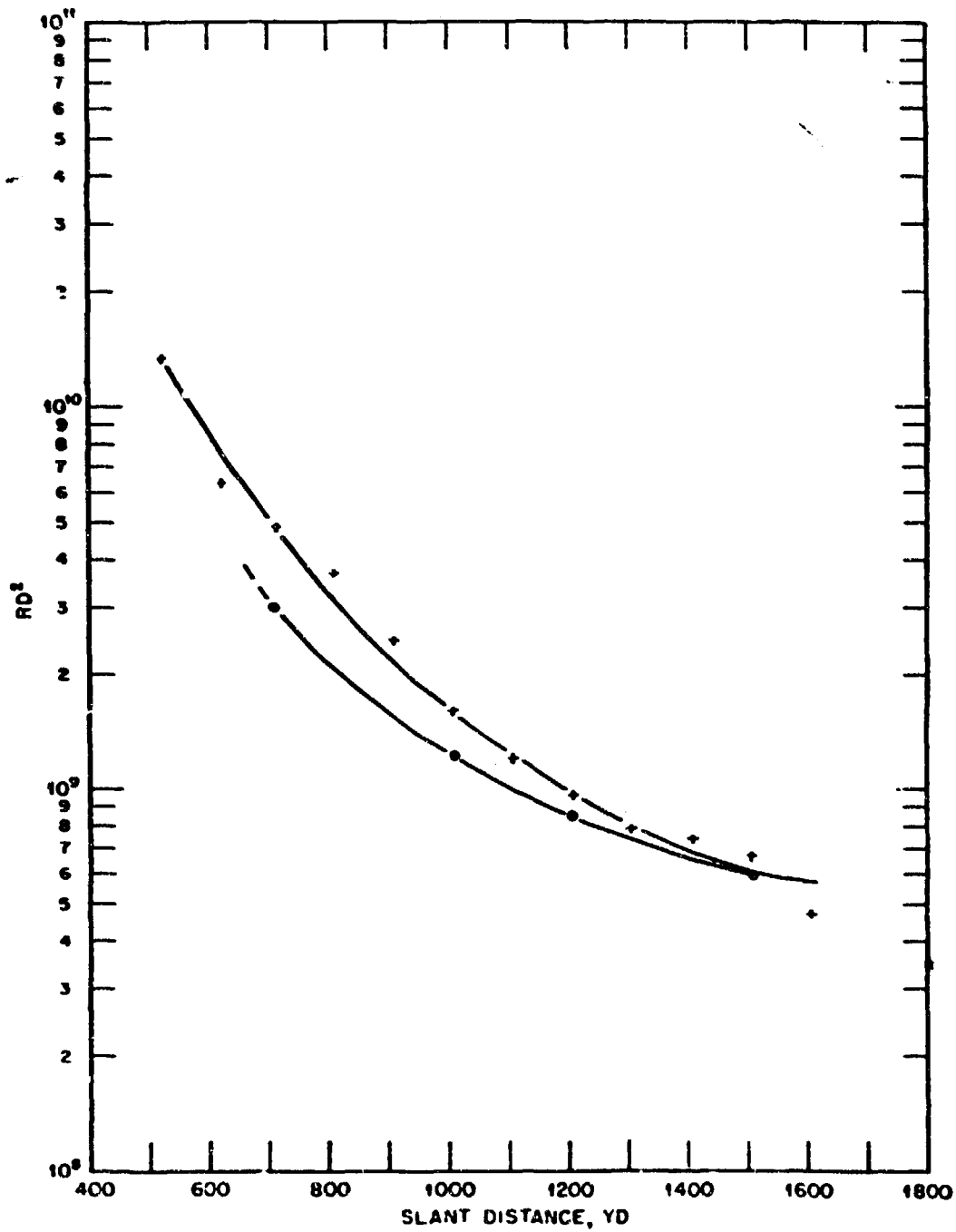


Fig. 3.20—Diablo, north goal-post line, RD^2 vs. D. +, EG&G film badges. O, film in lithium can.

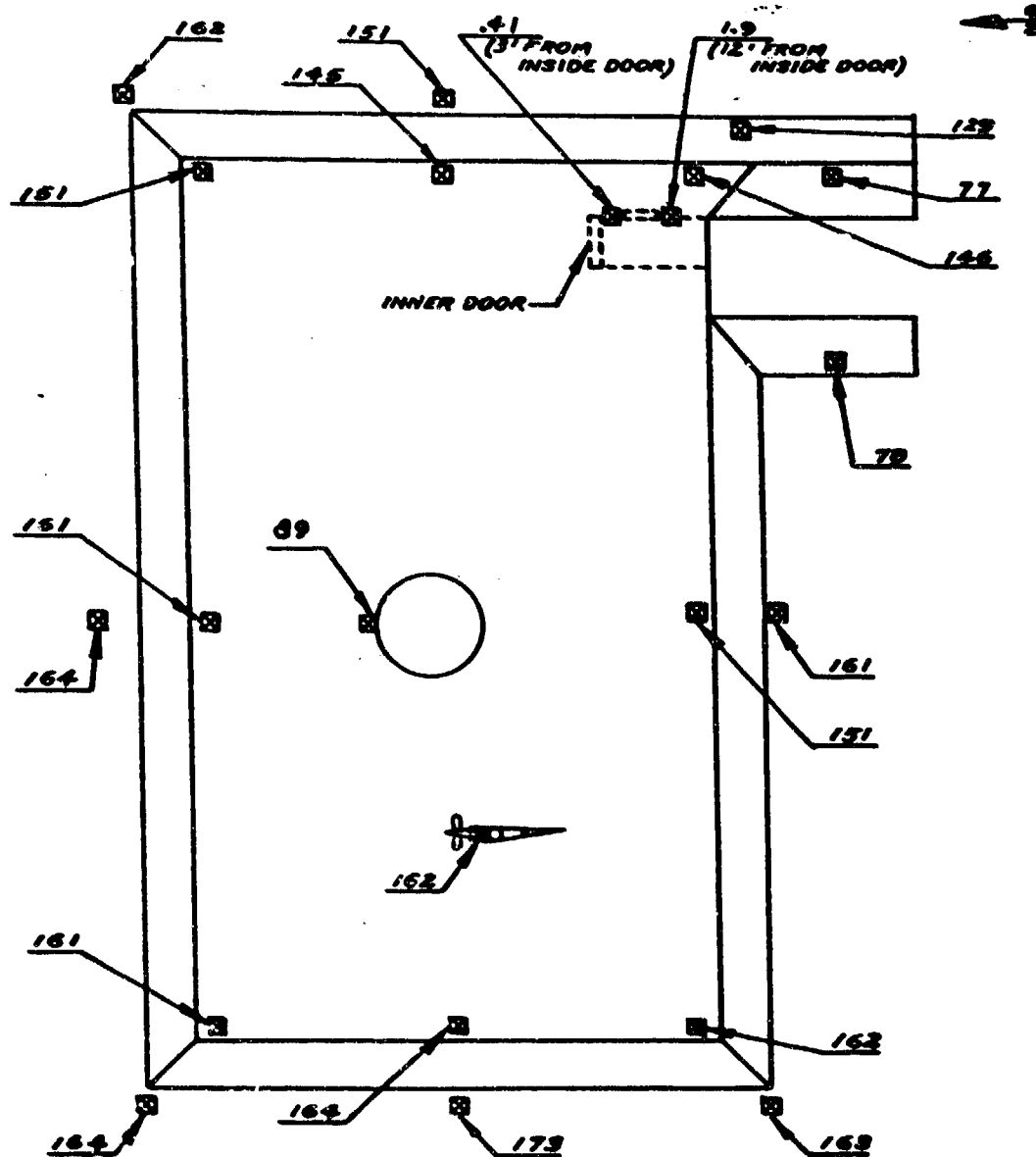


Fig. 3.21—Diablo, Project 32.3 manned shelter. \square , two EG&G badges at a height of 3 ft. Average size of the two is given in emergence. Badges at two positions near the inner door are placed inside the entranceway of the shelter. All readings are for external doors.

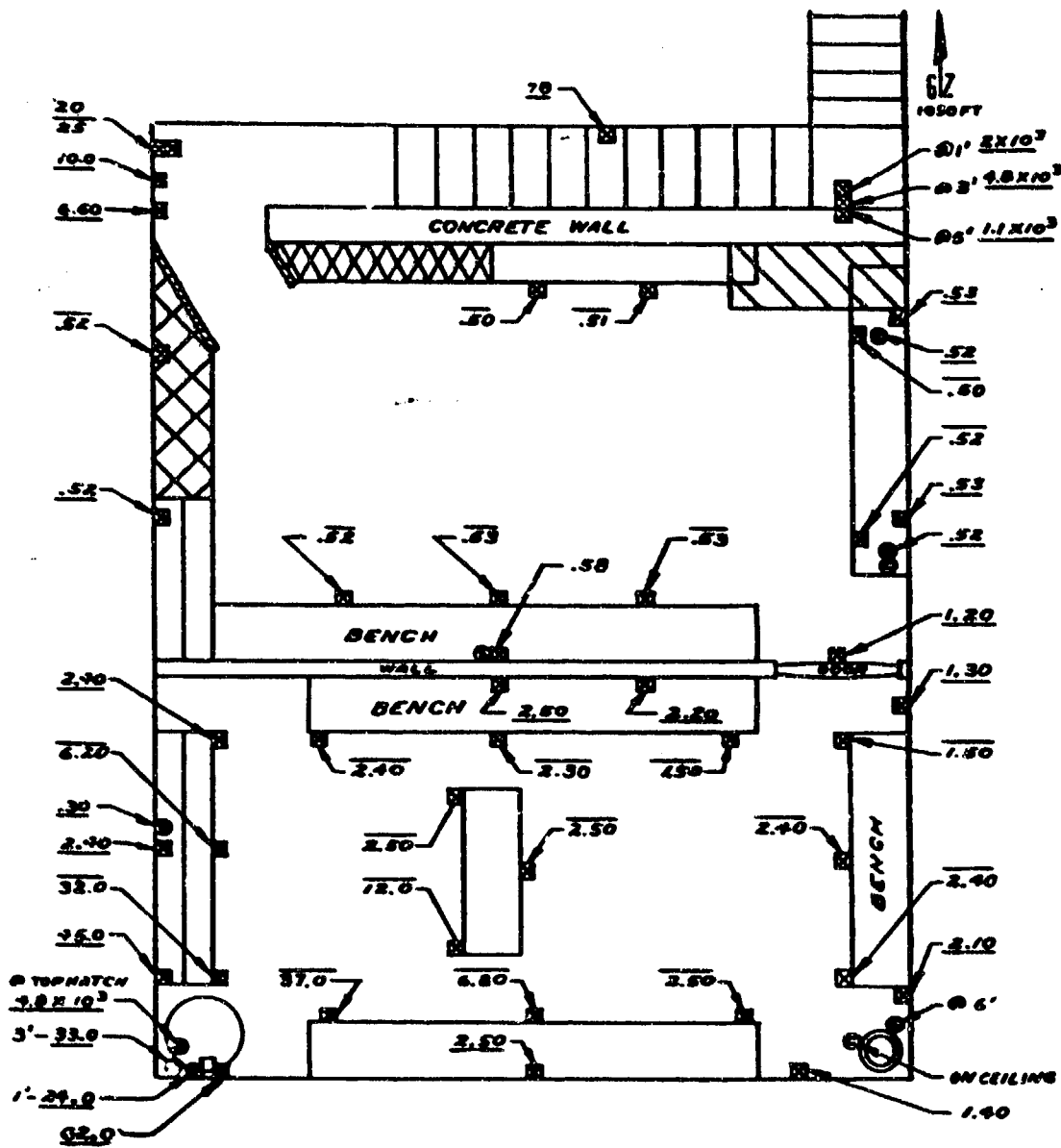


Fig. 3.22—Kepler, Project 33.1 animal shelter. □, EG&G film badge. ○, EG&G film badge in lithium can. S, sulfur detector. P, chemical dosimeter. The readings above the lines are the doses in roentgens at the 5-ft height; the readings below the lines are the doses in roentgens at the 1.5-ft height unless otherwise noted.

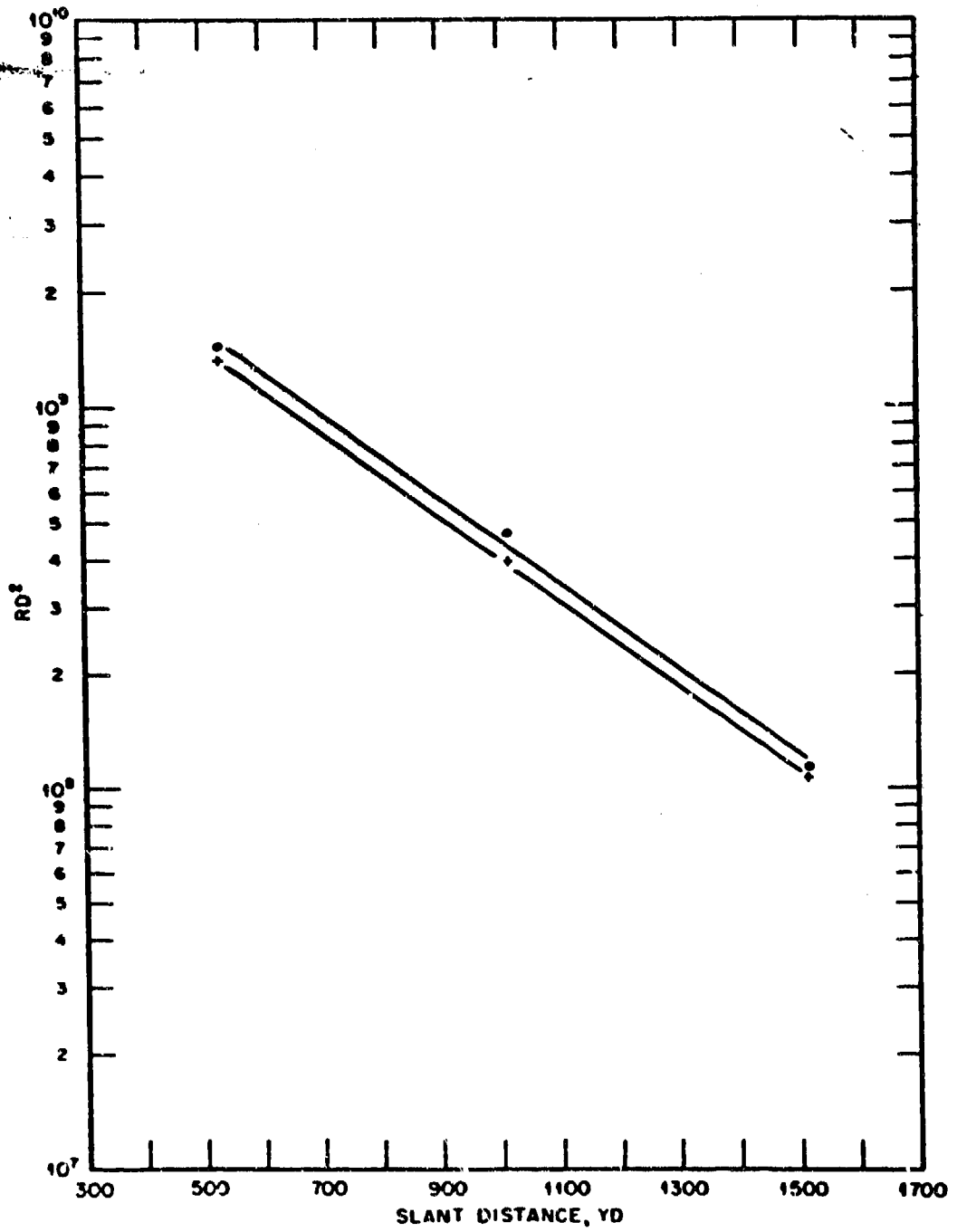


Fig. 3.23--Kepler, north goal-post line, RD^2 vs. D . +, EG&G film badges. O, film in lithium can.

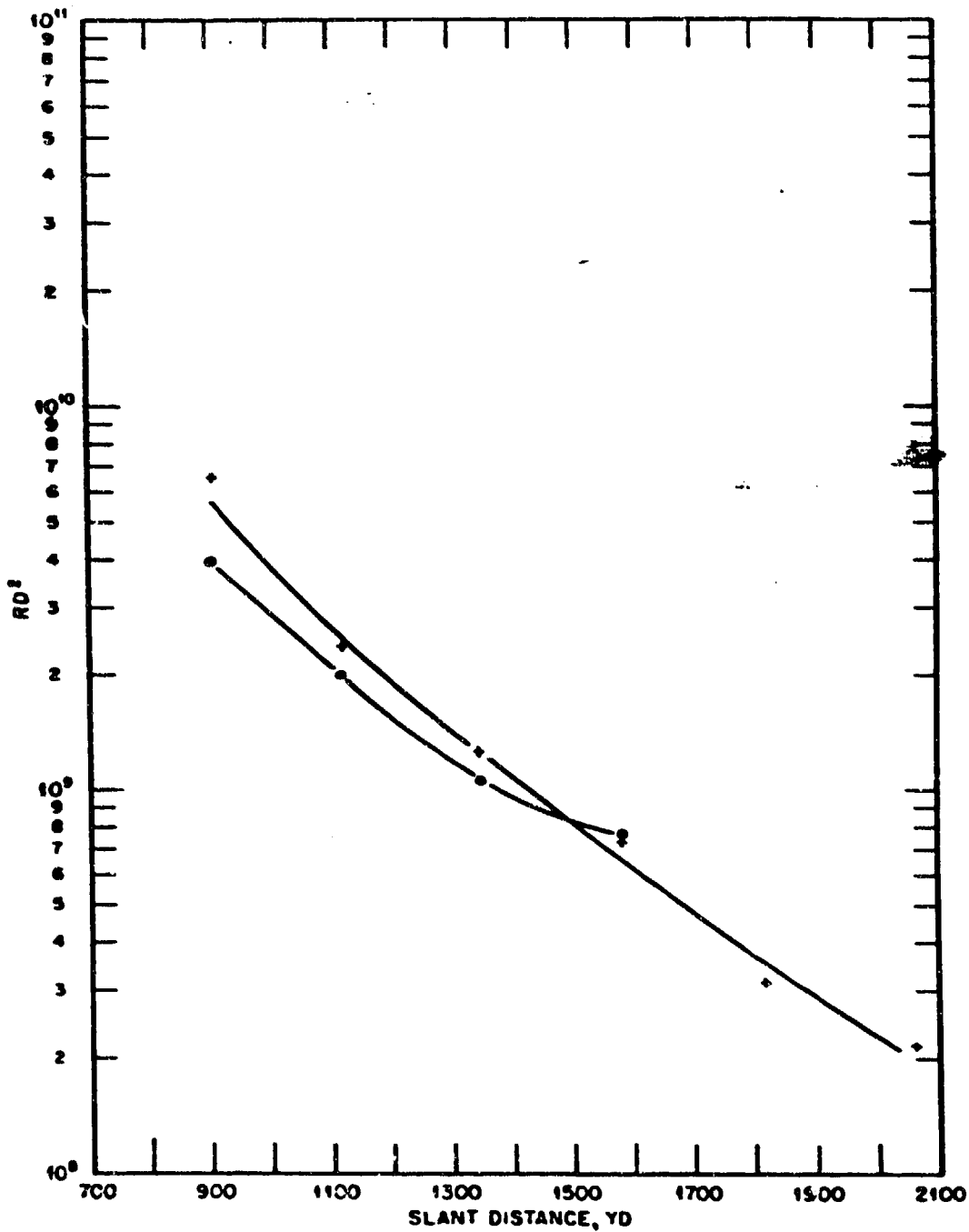


Fig. 3.24—Stokes, goal-post line, RD^2 vs. D. +, EG&G film badges. O, film in lithium can.

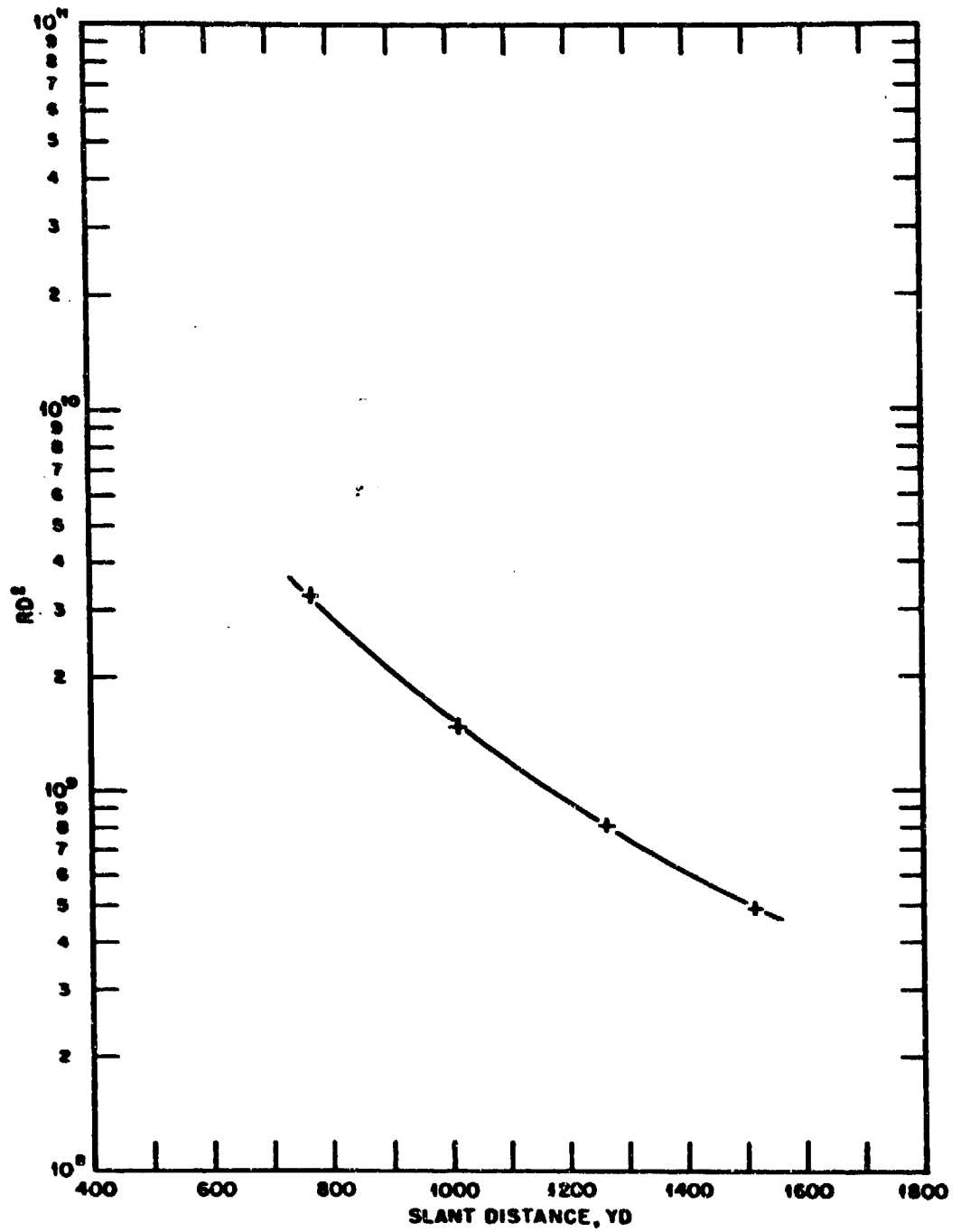


Fig. 3.25—Shasta, north goal-post line, RD^2 vs. D .

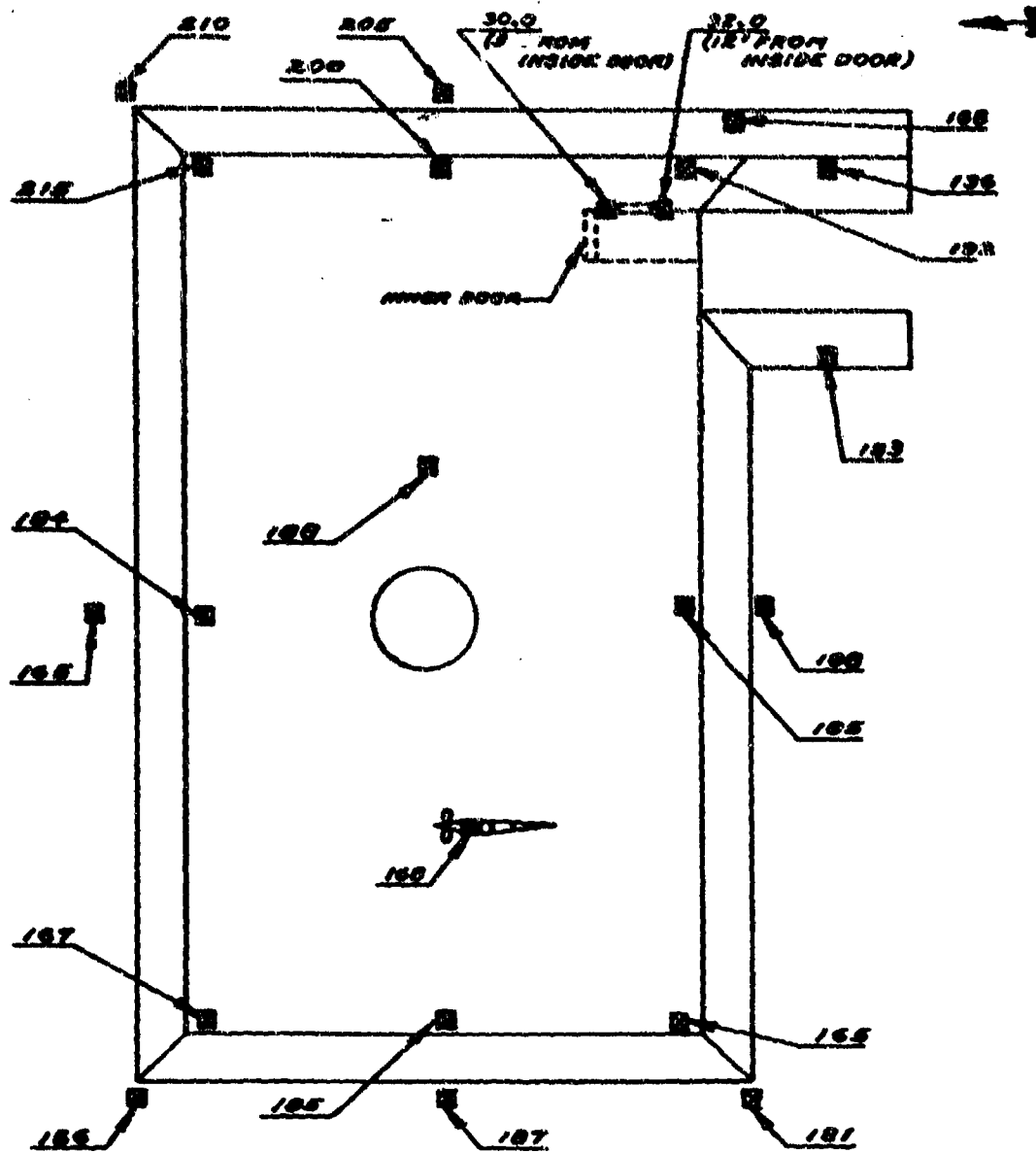


Fig. 3.26—Shasta, Project 32.3 manned shelter. The external door is indicated in roentgens.

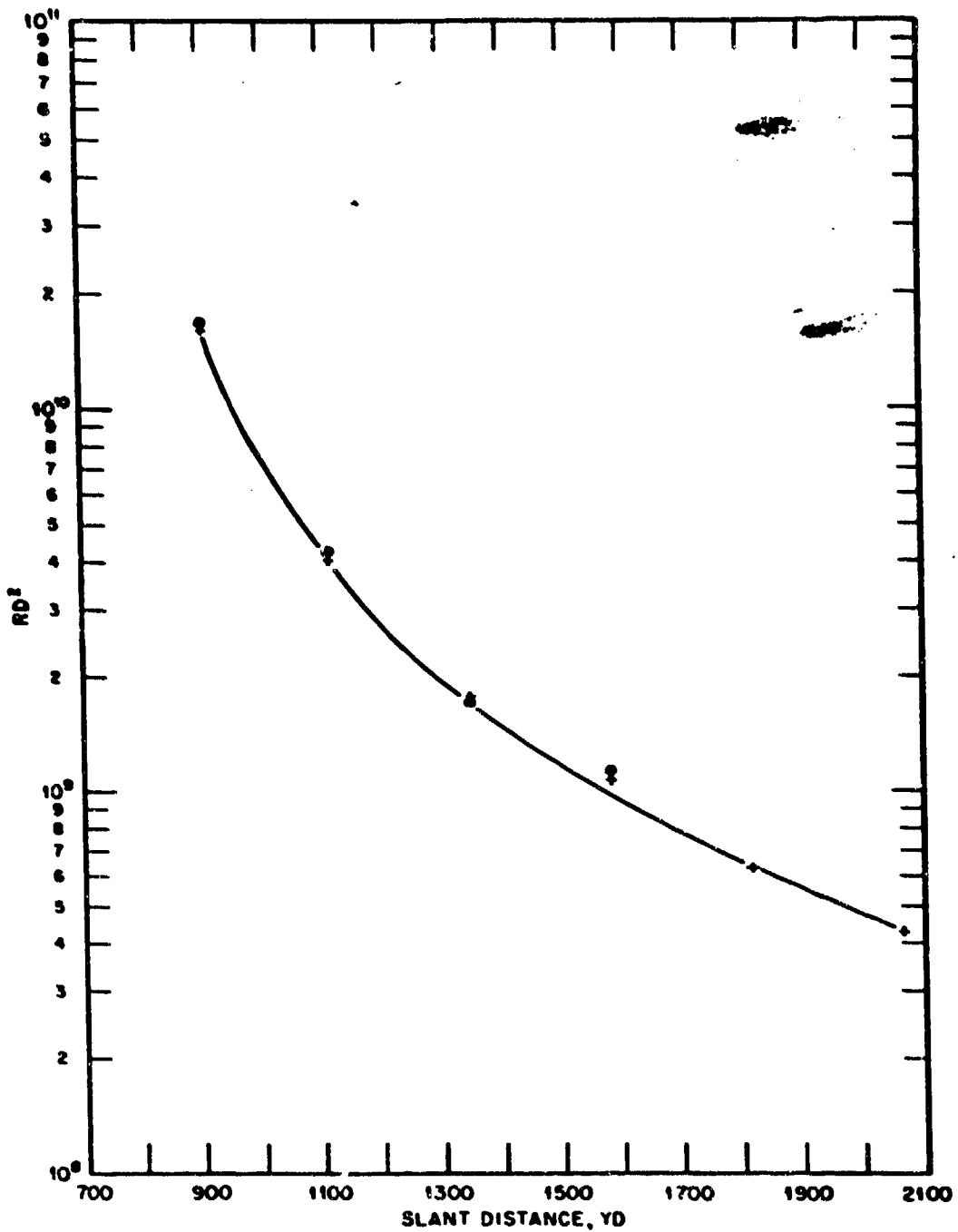


Fig. 3.27—Doppler, goal-post line, RD^2 vs. D. +, EG&G film badges. O, film in lithium can.

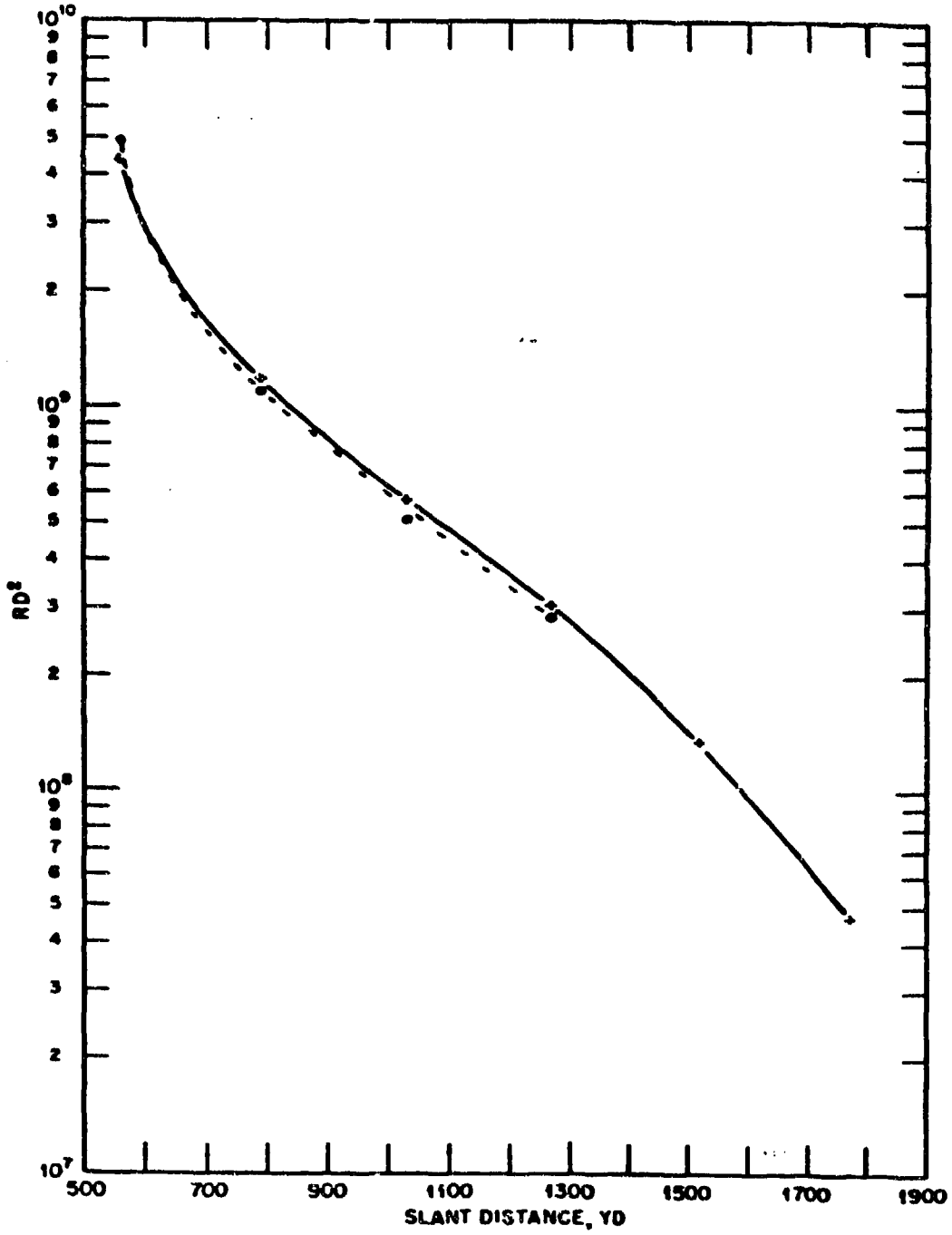


Fig. 3.28—Franklin Prime, goal-post line, RD^2 vs. D. +, EG&G film badges. O, film in lithium can.

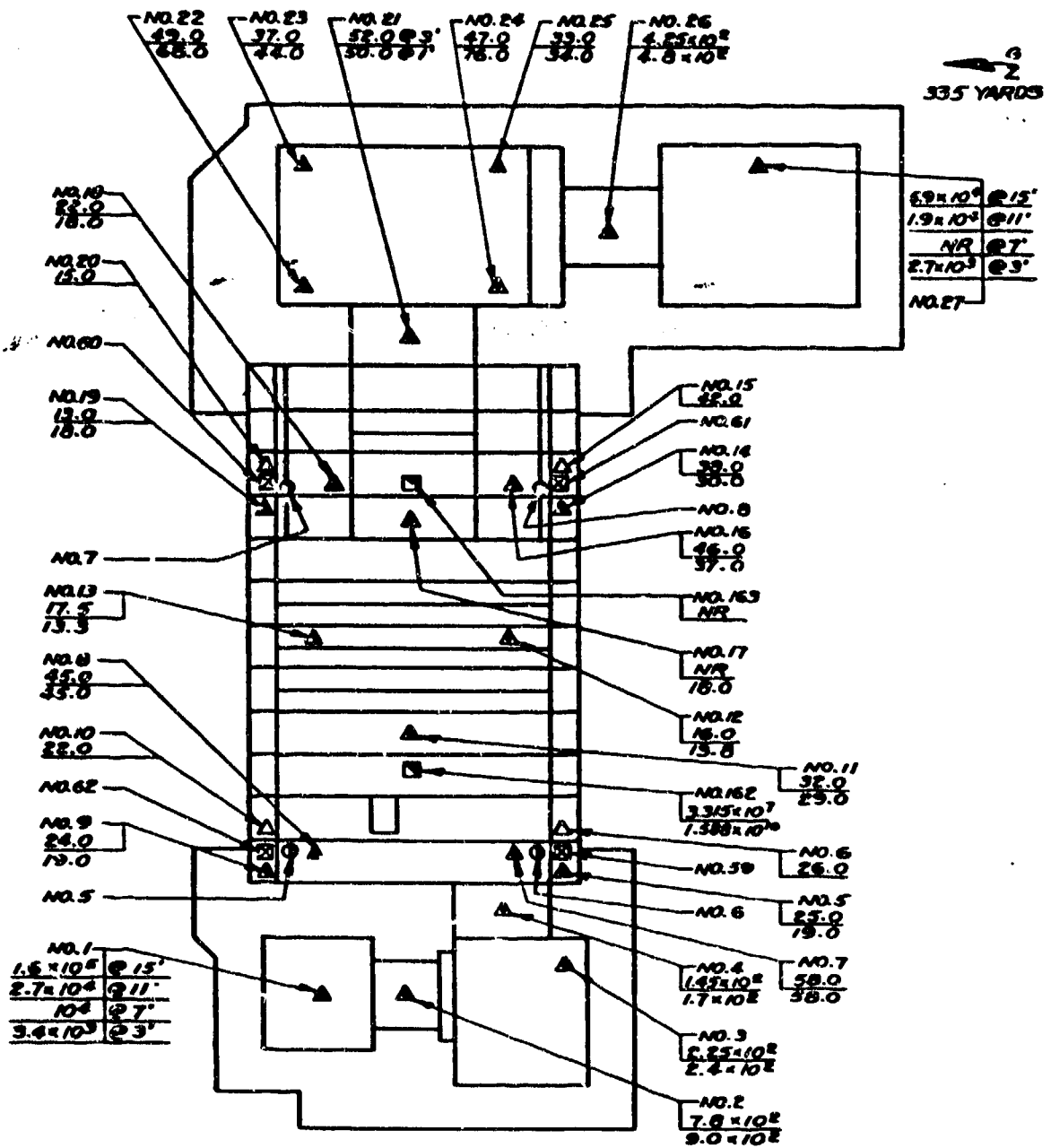


Fig. 3.31—Smoky, French shelter II-2 (type 50; 8-30.6-8092). ■, French film plates. Δ, EG&G film badges at a 5-ft height. Δ, EG&G film badges at 3- and 5-ft heights. ○, germanium detectors. □, sulfur and gold detectors. Δ, EG&G film badges at indicated heights. The badges were placed at 3- and 5-ft heights. The doses in roentgens are given above and below the lines for the badges at the 5- and 3-ft heights, respectively. For the sulfur and gold detectors, the readings in neutrons per square centimeter are given above the lines for sulfur and below the lines for the gold-cadmium difference. NR: not recovered.

↑
0/2
335 YARDS

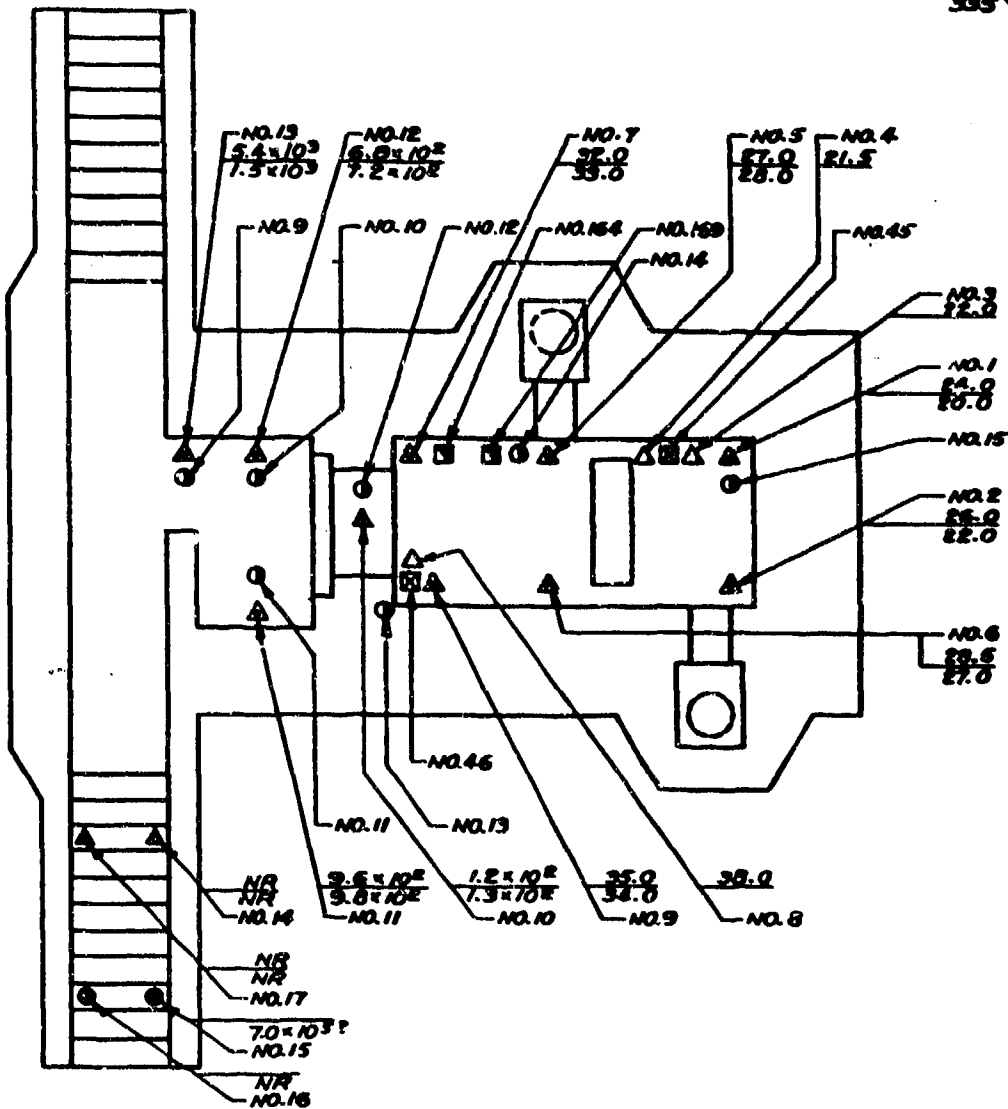


Fig. 3.32—Smoky, French shelter II-3 (type 65; 8-36.6-8004). □, French film plates. ○, EG&C film badges at a 3-ft height. △, EG&C film badges at a 5-ft height. ▲, EG&C film badges at 3- and 5-ft heights. ⊙, germanium detectors. ⊚, sulfur and gold detectors. The badges were placed at 3- and 5-ft heights. The doses in roentgens are given above and below the lines for the badges at the 5- and 3-ft heights, respectively. For the sulfur and gold detectors, the readings in neutrons per square centimeter are given above the lines for sulfur and below the lines for the gold-cadmium difference. NR: not recovered.

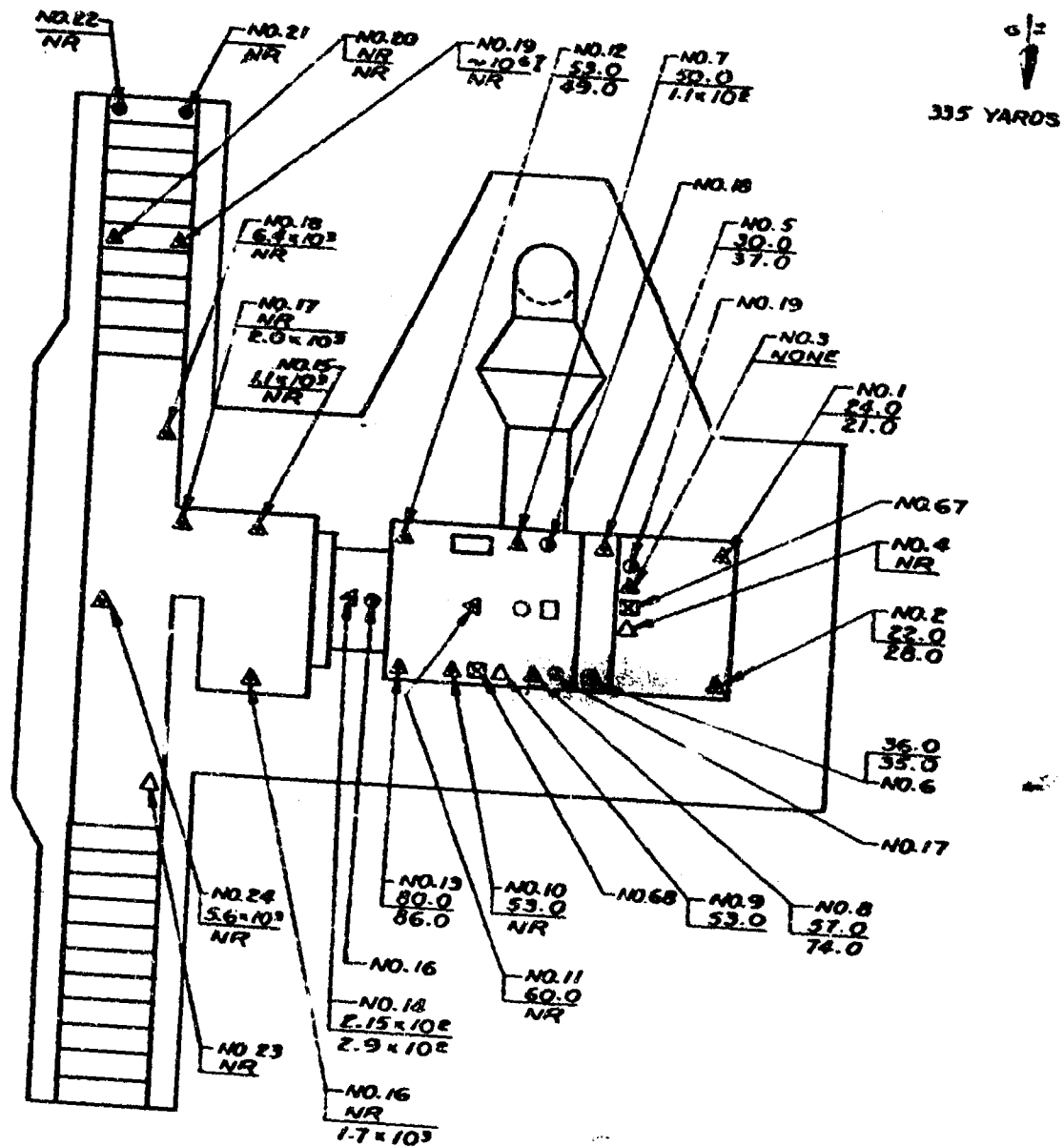


Fig. 3.33—Smoky, French shelter II-4 (type 85: 9-30.6-8005). \square , French film plates. Δ , EG&G film badges at a 5-ft height. \circ , EG&G film badges at a 3-ft height. \square , French film plates. Δ , EG&G film badges at a 3- and 5-ft heights. ∇ , EG&G film badges at indicated heights. \circ , germanium detectors. The badges were placed at 3- and 5-ft heights. The readings above and below the lines are the doses in roentgens at the 5- and 3-ft heights, respectively. NR: not recovered.

$\frac{6}{7}$
 250 YARDS

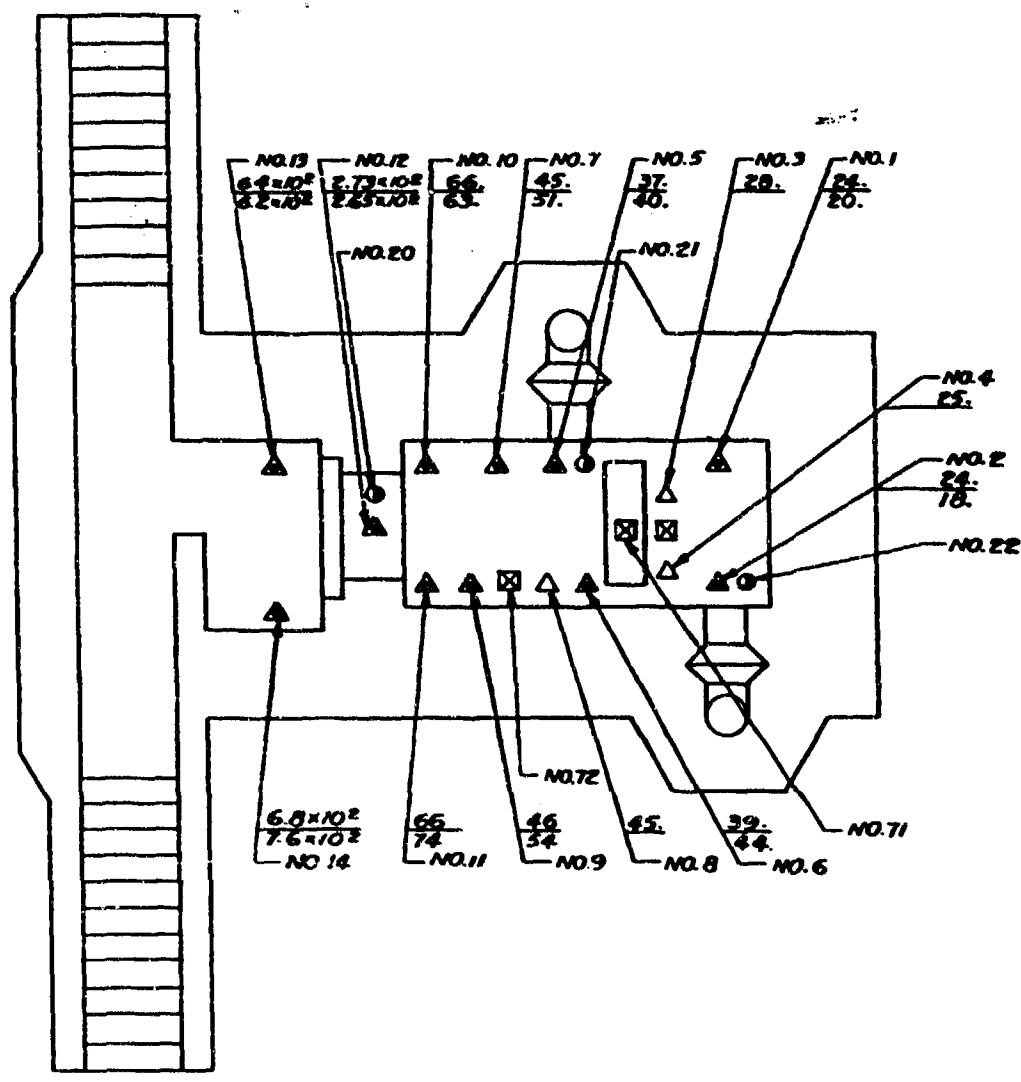


Fig. J.34—Smoky. French shelter II 5 (type 65; 8-30.6-8003). \boxtimes , French film planes. \circ , EG&G film badges at a 3-ft height. Δ , EG&G film badges at a 5-ft height. \triangle , EG&G film badges at 3- and 5-ft heights. \boxtimes , germanium detectors. The badges were placed at 3- and 5-ft heights. The readings above and below the lines are the doses in roentgens at the 5- and 3-ft heights, respectively. NR: not recovered.

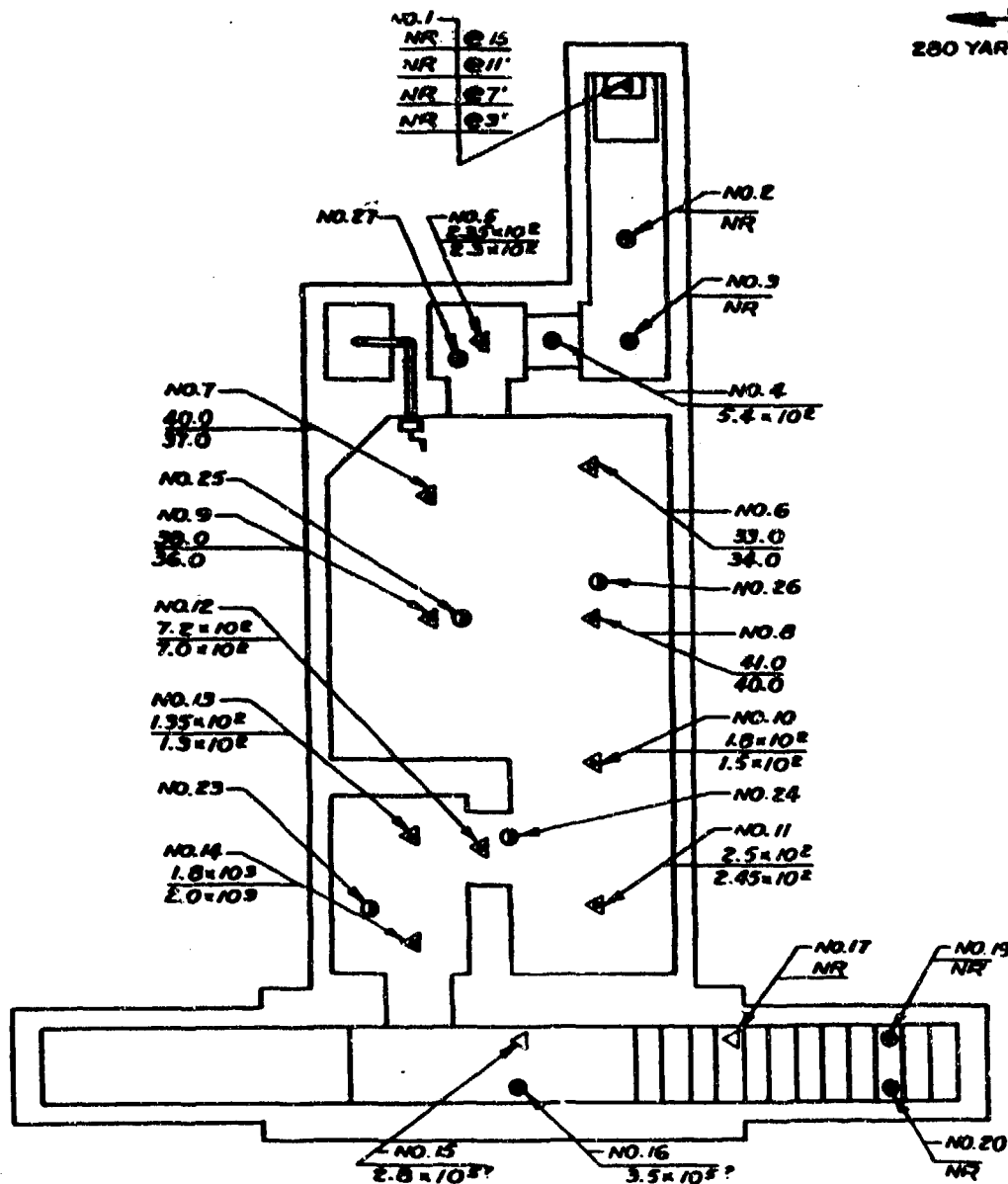


Fig. 3.35—Smoky, German shelter RA-a (rectangular; 8-30.7-8008). ●, EG&G film badges at a 3-ft height. ▲, EG&G film badges at a 5-ft height. △, EG&G film badges at 3- and 5-ft heights. ▴, EG&G film badges at indicated heights. ○, germanium detectors. The badges were placed at 3- and 5-ft heights. The readings above and below the lines are the doses in roentgens at the 5- and 3-ft heights, respectively. NR, not recovered.

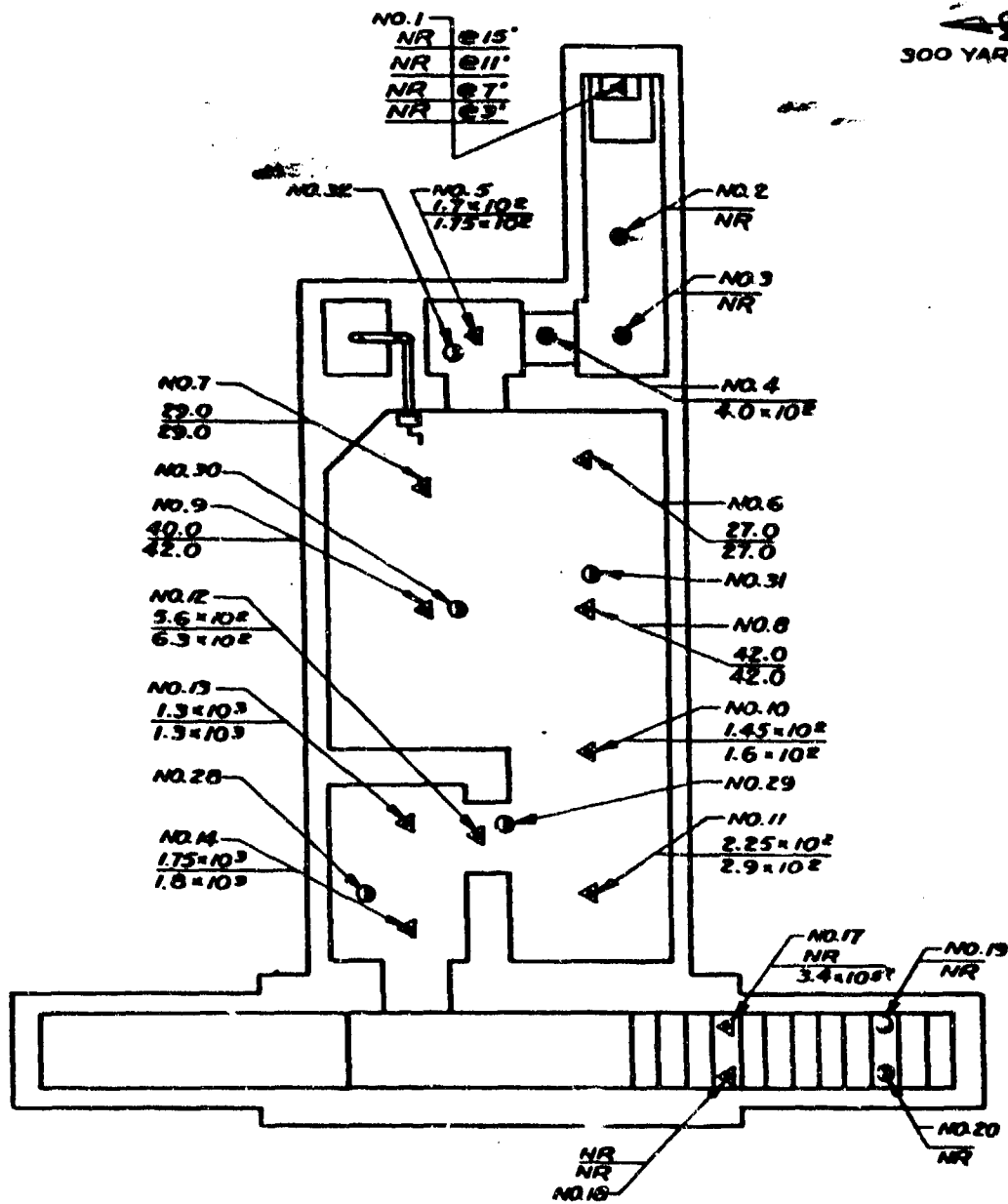


Fig. 3.36—Smoky, German shelter RA-b (rectangular; 8-30.7-0010). O, EG&G film badges at a 3-ft height. A, EG&G film badges at 3- and 5-ft heights. Δ, EG&G film badges at indicated heights. □, germanium detectors. The badges were placed at 3- and 5-ft heights. The readings above and below the lines are the doses in roentgens at the 5- and 3-ft heights, respectively. NR: not recovered.

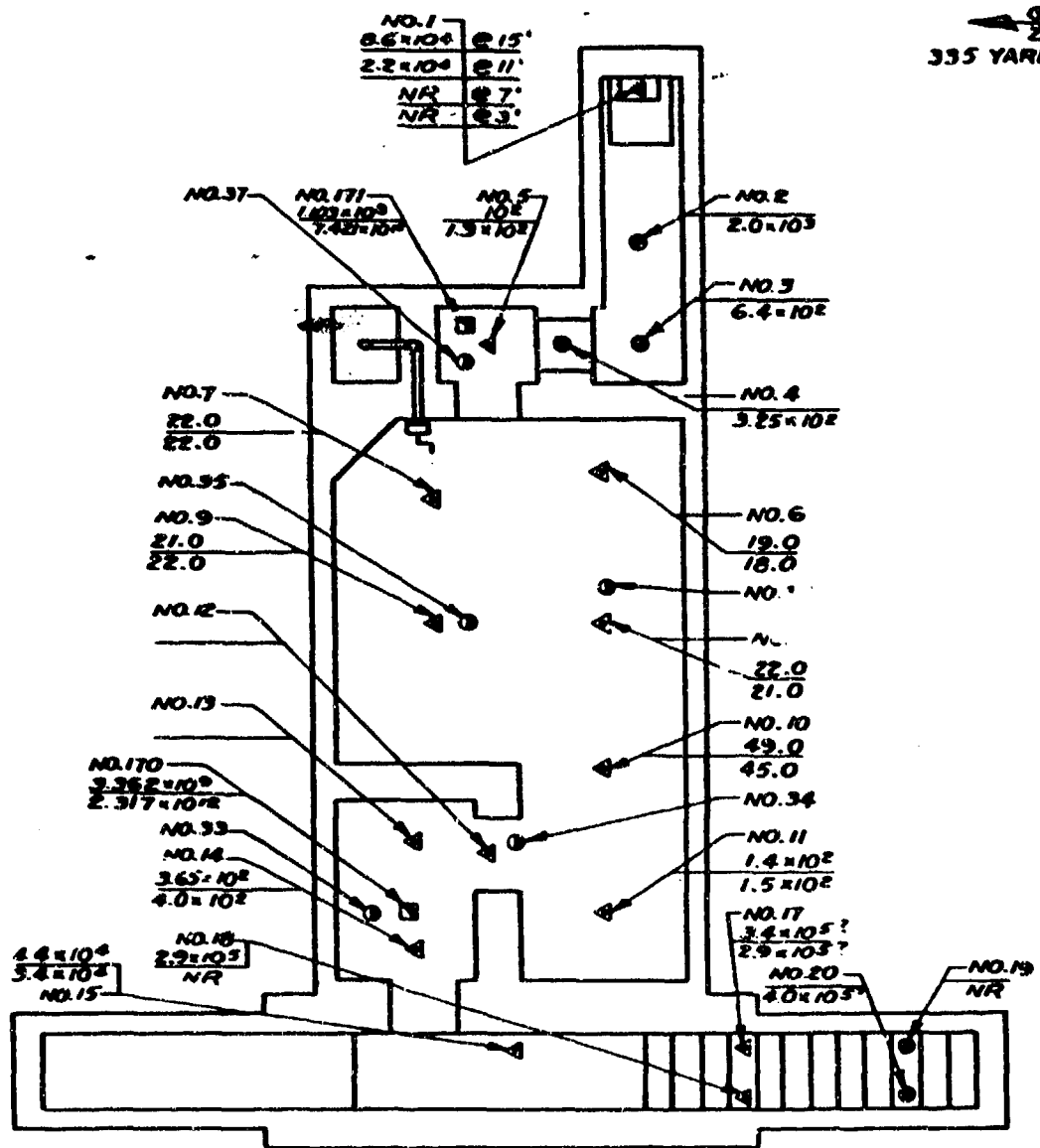


Fig. 3.37—Smoky, German shelter RA-c (circular; B-30.7-8011). ●, EG&G film badges at a 3-ft height. ▲, EG&G film badges at 3- and 5-ft heights. △, EG&G film badges at indicated heights. □, germanium detectors. ⊕, sulfur and gold detectors. The badges were placed at 3- and 5-ft heights. The doses in roentgens are given above and below the lines for the badges at the 5- and 3-ft heights, respectively. For the sulfur and gold detectors, the readings in neutrons per square centimeter are given above the lines for sulfur and below the lines for the gold-cadmium difference. NR: not recovered.

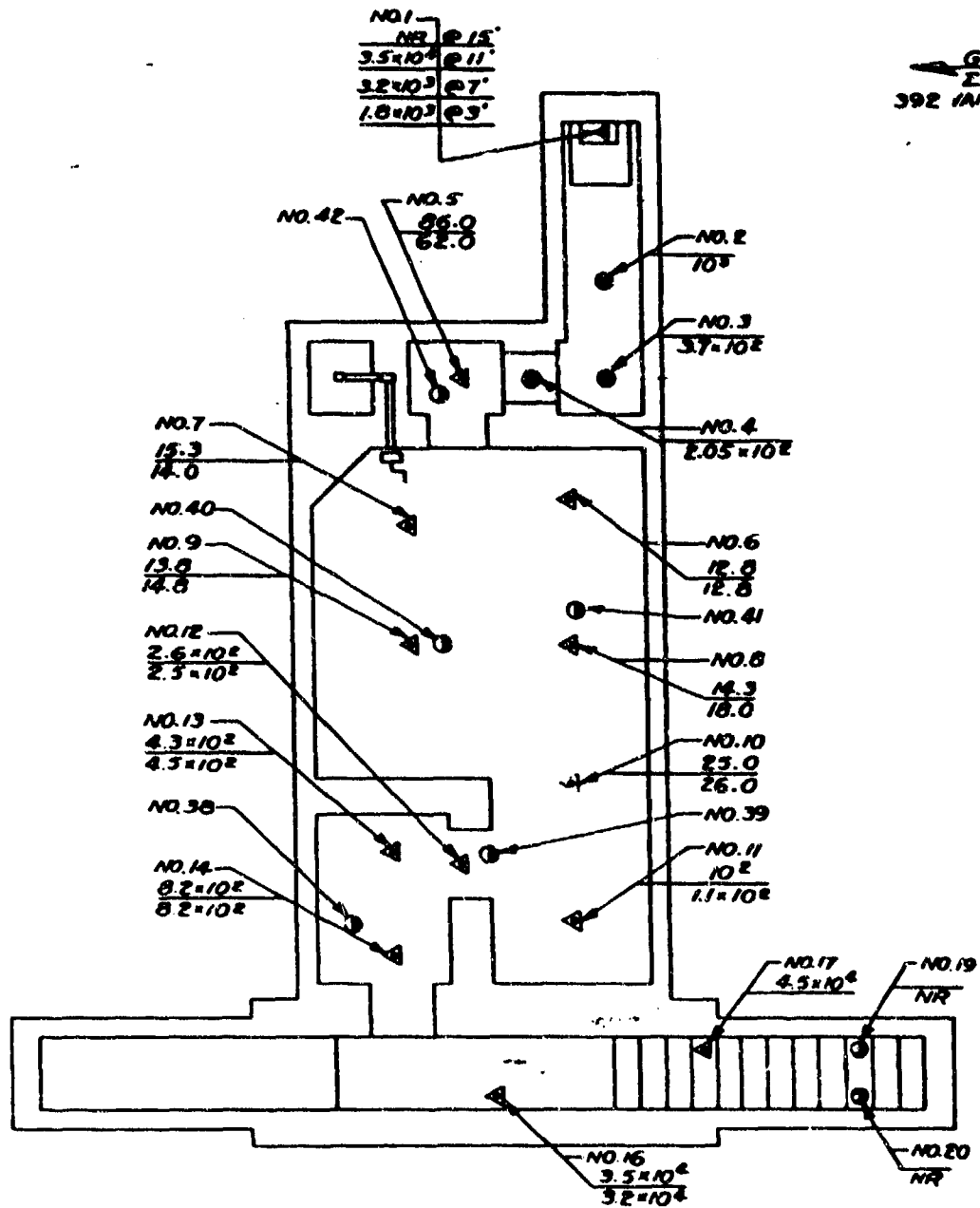


Fig. 3.38—Smoky, German shelter RA-4 (rectangular; B-30,7-8013). ●, EG&G film badges at a 3-ft height. ▲, EG&G film badges at 3- and 5-ft heights. △, EG&G film badges at indicated heights. ⊙, germanium detectors. The badges were placed at 3- and 5-ft heights. The readings above and below the lines are the doses in roentgens at the 5- and 3-ft heights, respectively. NR: not recovered.

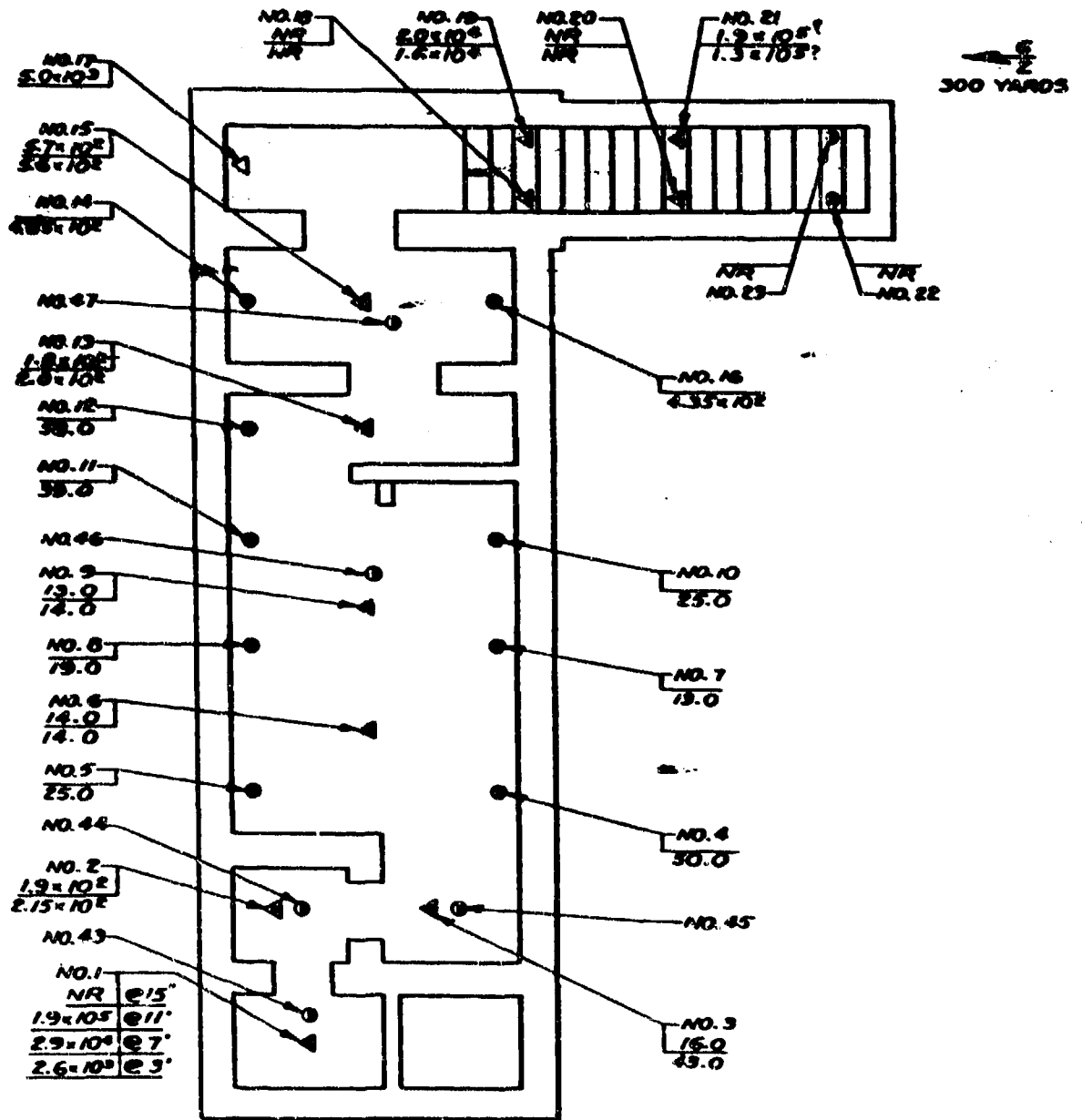


Fig. 3.39—Smoky, German shelter CA-a (circular; 8-30.7-8000). Δ , EG&G film badges at a 5-ft height. \odot , EG&G film badges at a 3-ft height. \triangle , EG&G film badges at 3- and 5-ft heights. \blacktriangle , EG&G film badges at indicated heights. \ominus , germanium detectors. The badges were placed at 3- and 5-ft heights. The readings above and below the lines are the doses in roentgens at the 5- and 3-ft heights, respectively. NR: not recovered.

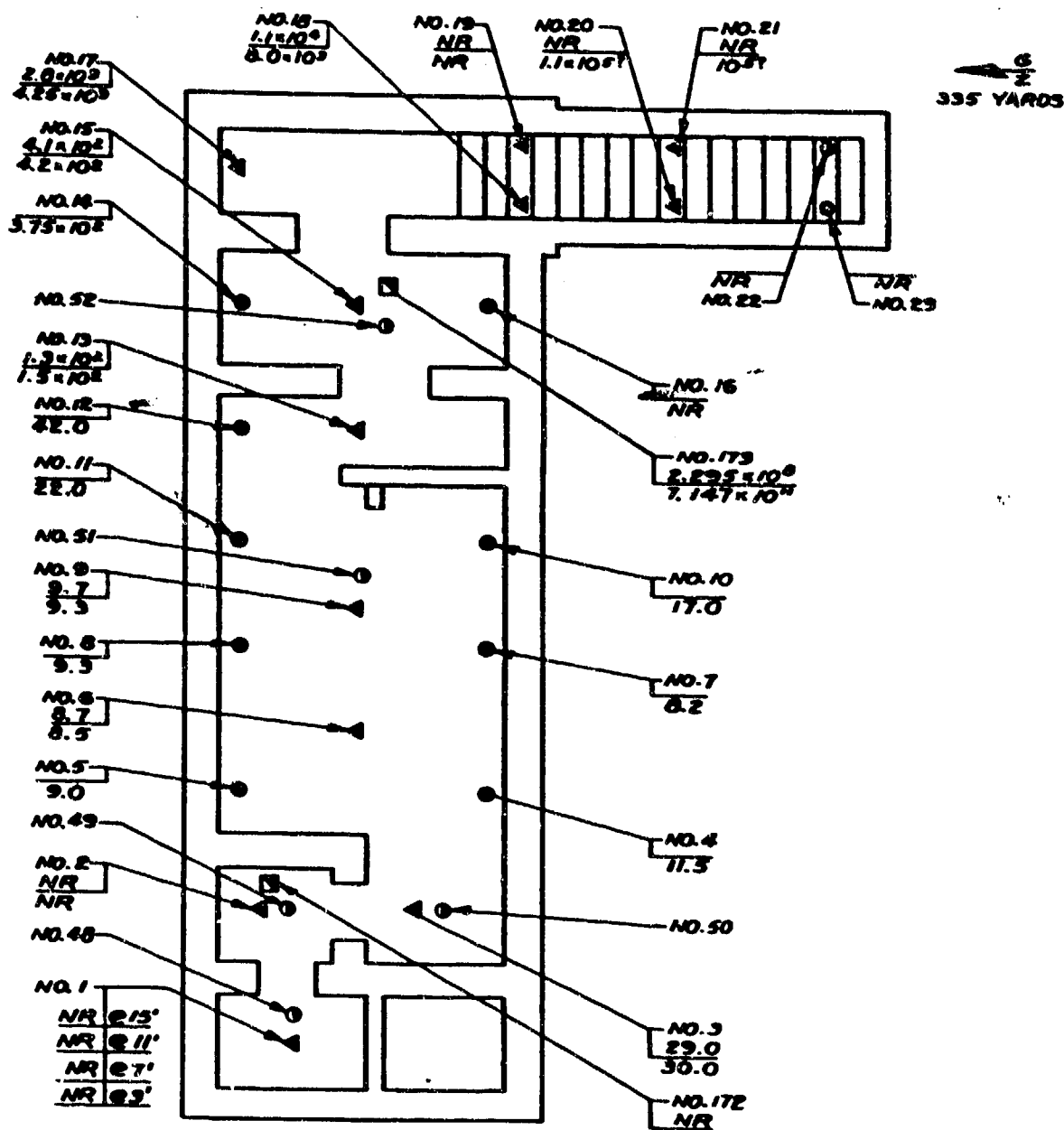


Fig. 3.40—Smoky, German shelter CA-b (circular; 8-30.7-8012). ●, EG&G film badges at a 3-ft height. ▲, EG&G film badges at 3- and 5-ft heights. △, EG&G film badges at indicated heights. ⊙, germanium detectors. ⊞, sulfur and gold detectors. The badges were placed at 3- and 5-ft heights. The dots in roentgens are given above and below the lines for the badges at the 5- and 3-ft heights, respectively. For the sulfur and gold detectors, the readings in neutrons per square centimeter are given above the lines for sulfur and below the lines for the gold-cadmium difference. NR: not recovered.

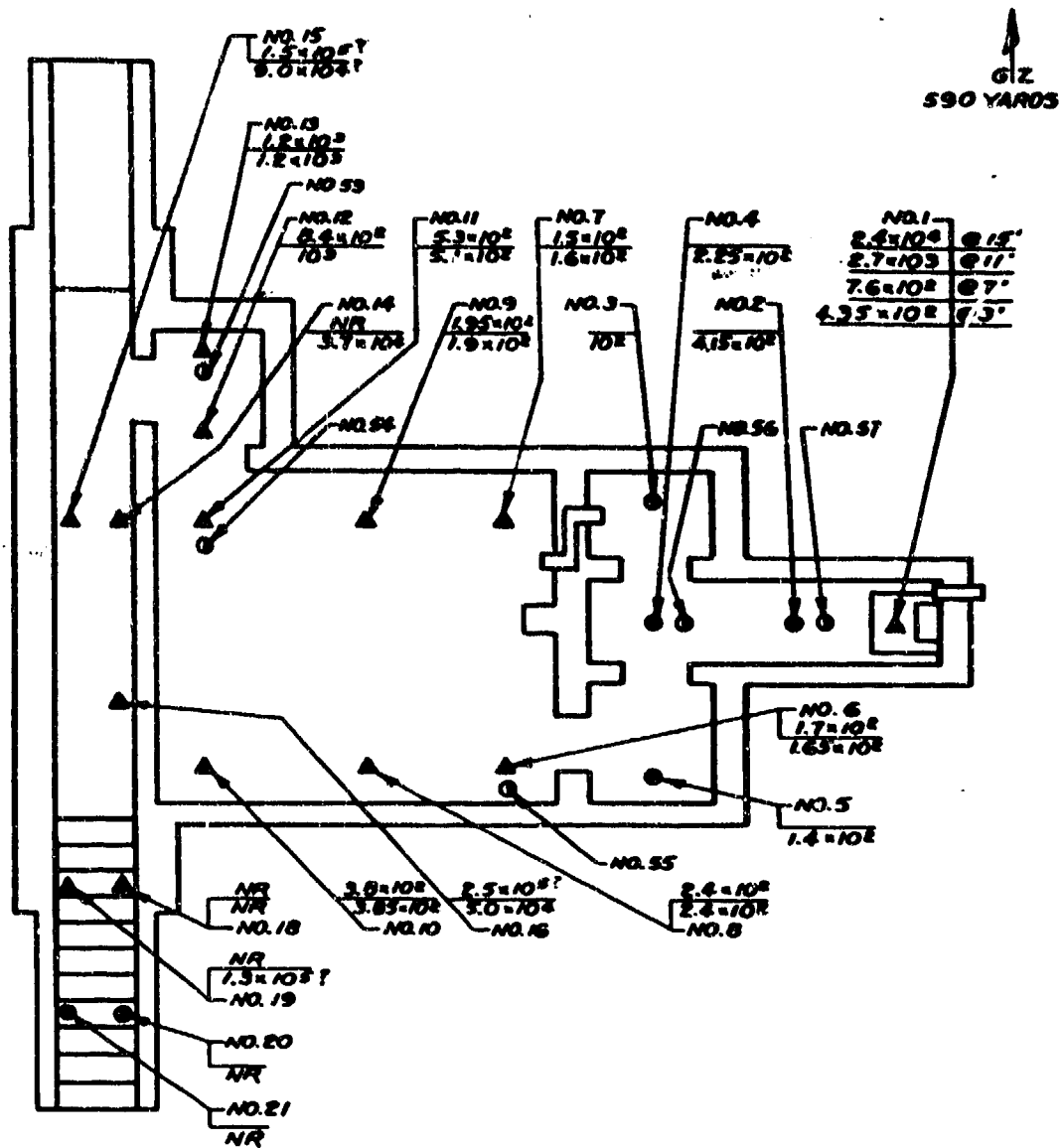


Fig. 3.41—Smoky, German shelter RC-a (rectangular; B-30.7-8014). \odot , EG&G film badges at a 3-ft height. Δ , EG&G film badges at 3- and 5-ft heights. \triangle , EG&G film badges at indicated heights. \ominus , germanium detectors. The badges were placed at 3- and 5-ft heights. The readings above and below the lines are the doses in roentgens at the 5- and 3-ft heights, respectively. NR: not recovered.

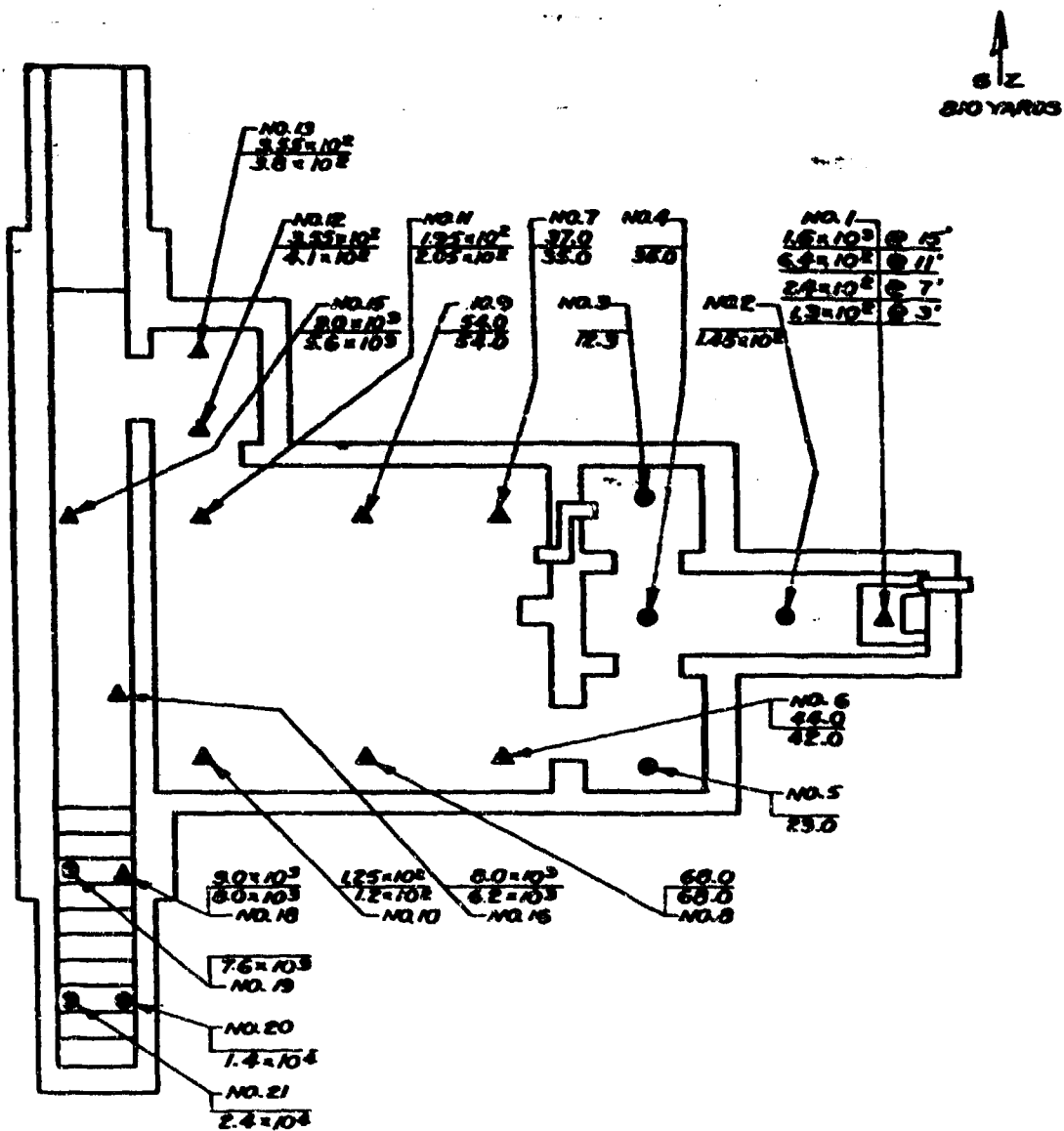


Fig. 3.42—Smokey, German shelter RC-b (rectangular; 8-30,7-8015). O, EG&G film badges at a 3-ft height, A, EG&G film badges at 3- and 5-ft heights, A, EG&G film badges at indicated heights. The badges were placed at 3- and 5-ft heights. The readings above and below the lines are the doses in roentgens at the 3- and 5-ft heights, respectively.

GIZ
1440 YARDS

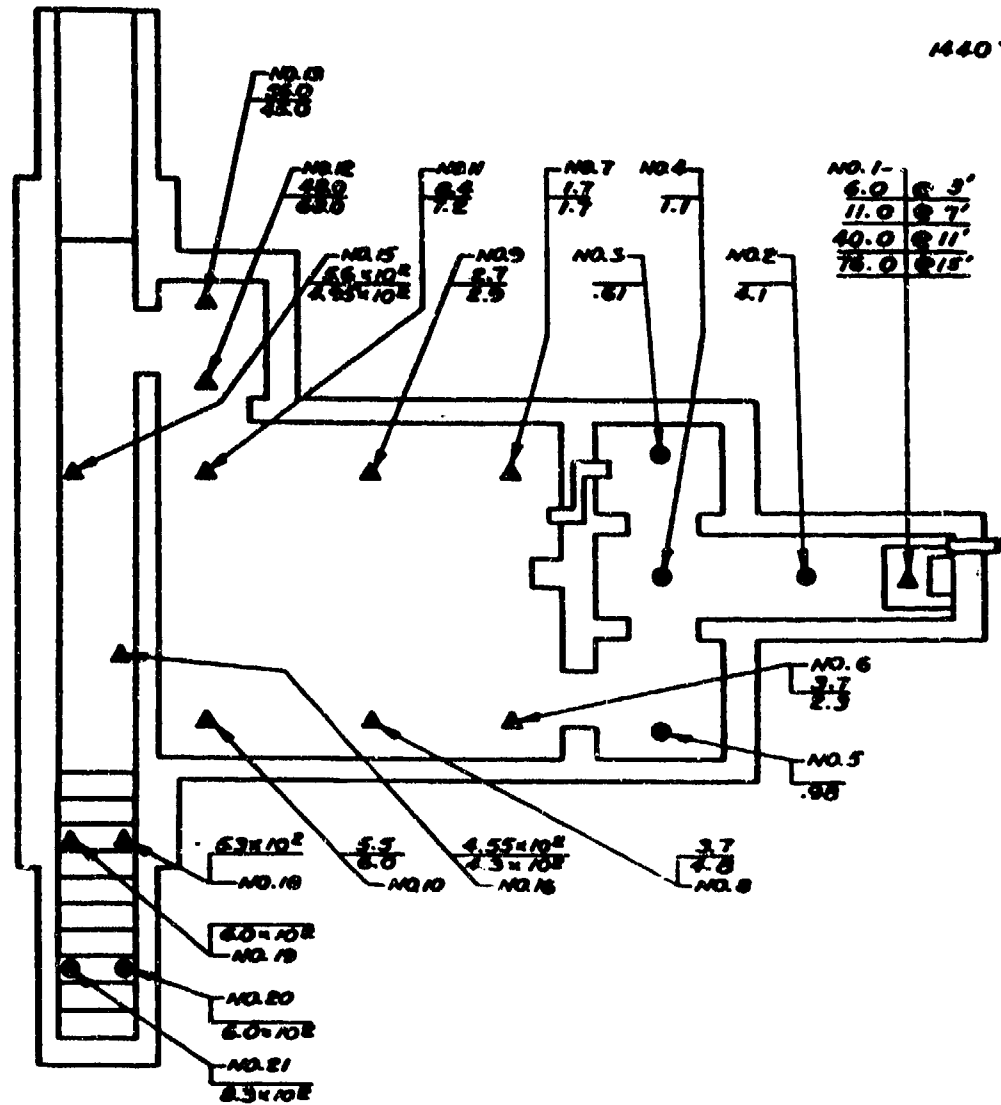


Fig. 3.43—Smoky. German shelter BC-c (rectangular; S-30.7-8016). Q, EG&G film badges at a 3-ft height. A, EG&G film badges at 3- and 5-ft heights. A, EG&G film badges at indicated heights. The badges were placed at 3- and 5-ft heights. The readings above and below the lines are the doses in roentgens at the 5- and 3-ft heights, respectively.

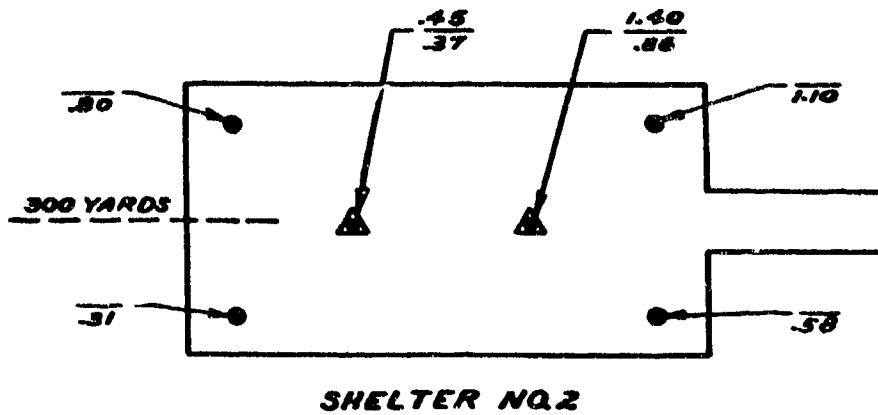
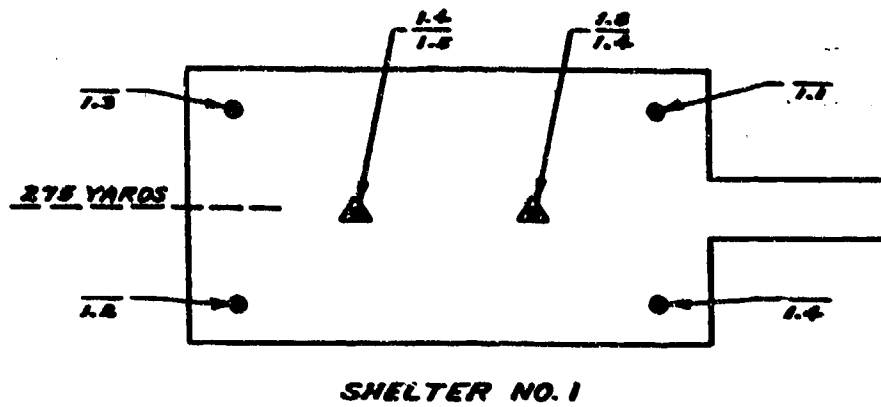


Fig. 3.44—Smoky, Holmes and Narver shelters 1 and 2. \odot , EG&G film badges at a 3-ft height. \triangle , EG&G film badges at 3- and 5-ft heights. The badges were placed at 3- and 5-ft heights. The readings above and below the lines are the doses in roentgens at the 5- and 3-ft heights, respectively. These badges were recovered approximately $1\frac{1}{2}$ months later than those from other shelters.

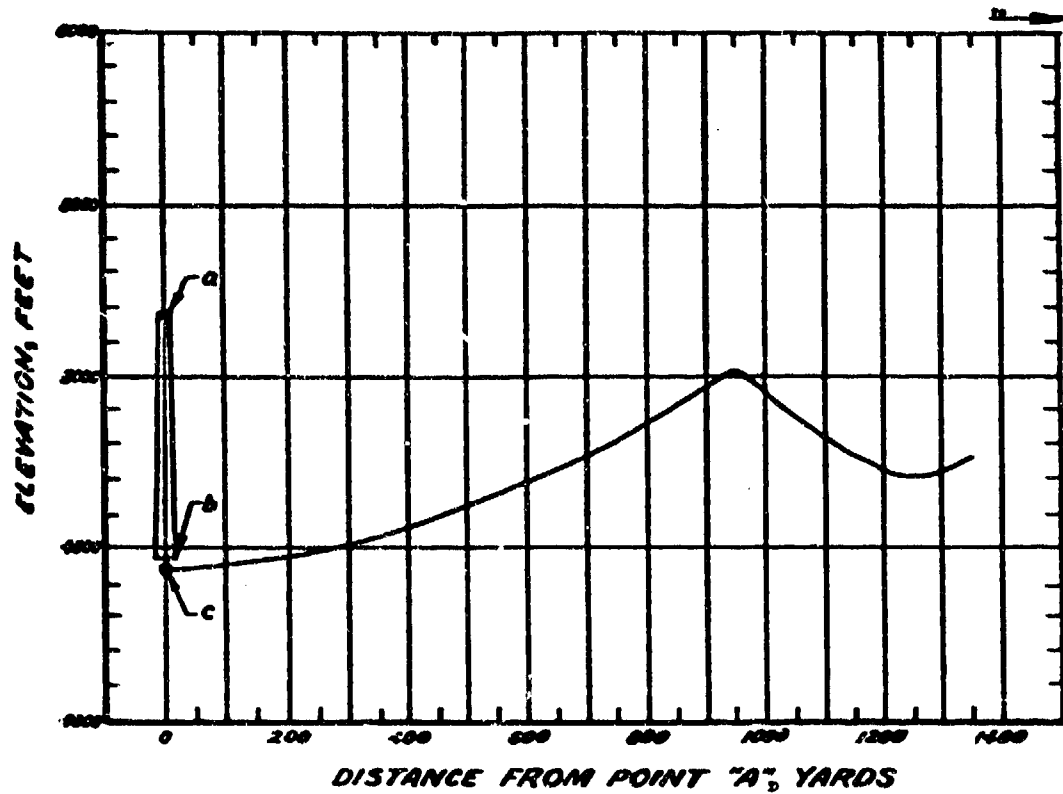


Fig. 3.45—Smoky, north-line elevation. a, top of tower. b, base of tower. c, point A (not GZ).

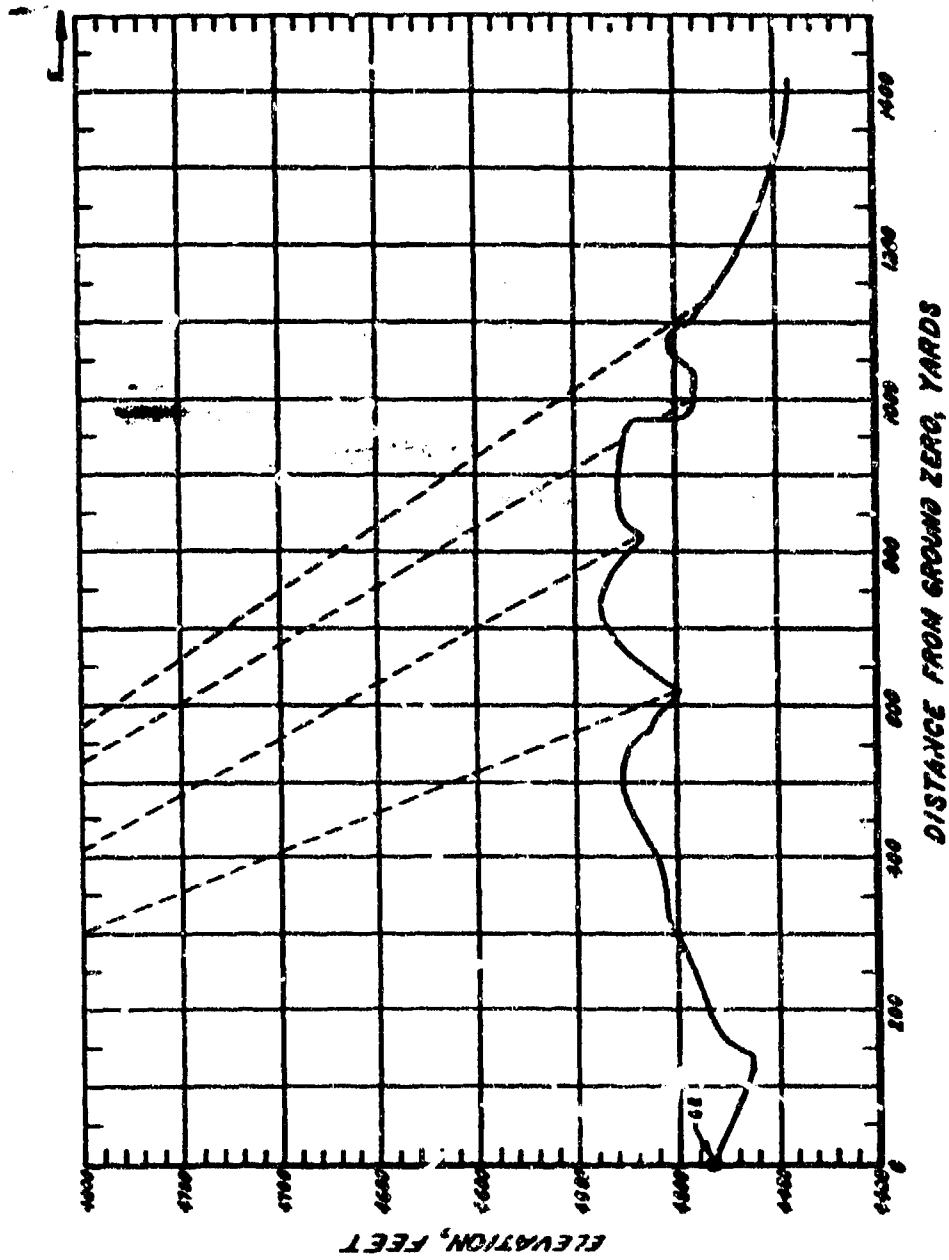


Fig. 3.46 — Smoky, east-line elevation.

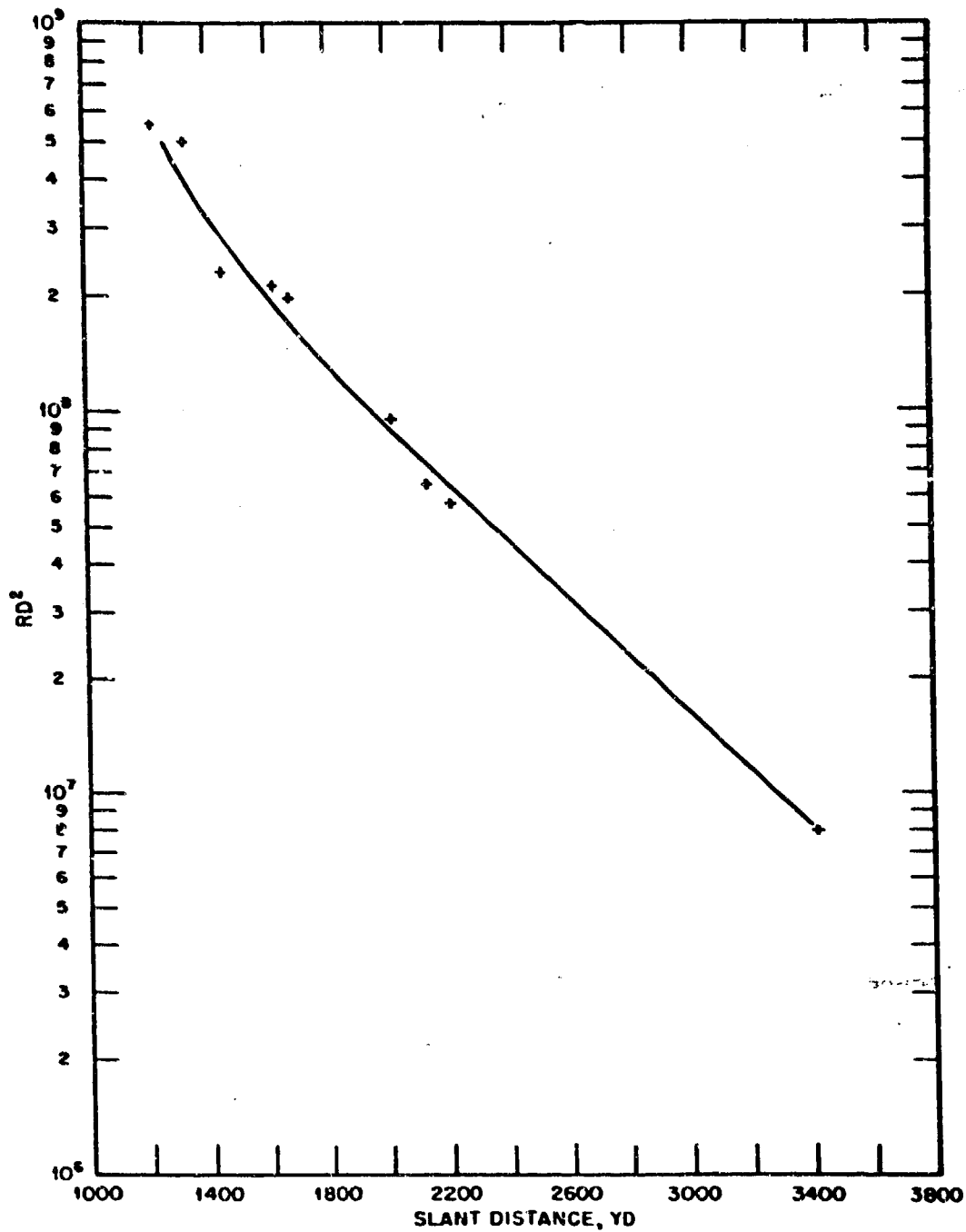


Fig. 3.47—Galileo, southeast stake line, RD² vs. D.

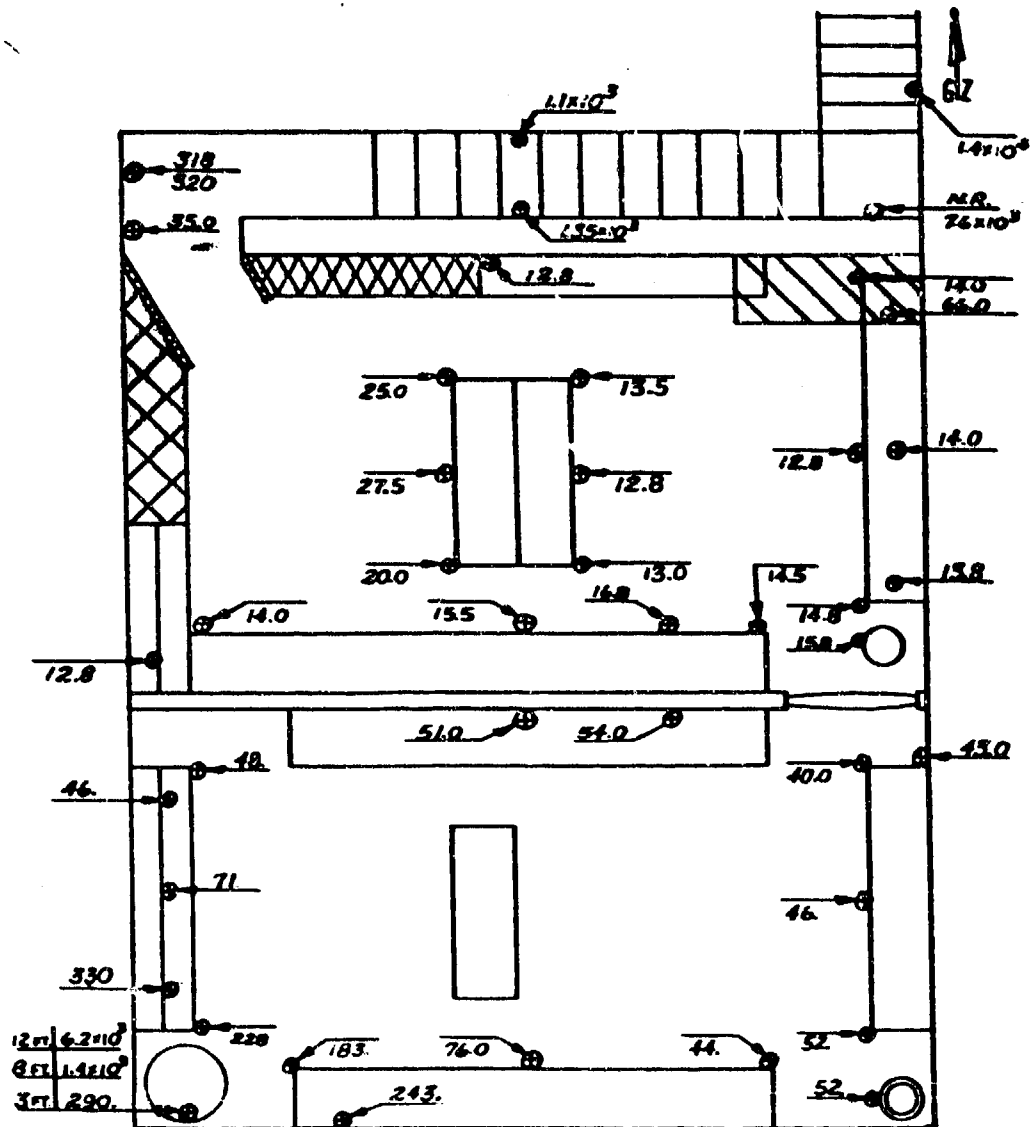


Fig. 3.48—Galileo, Project 35.1 animal shelter. The readings above the lines are the doses in roentgens at the 5-ft height; the readings below the lines are the doses in roentgens at the 1.5-ft height unless otherwise noted.

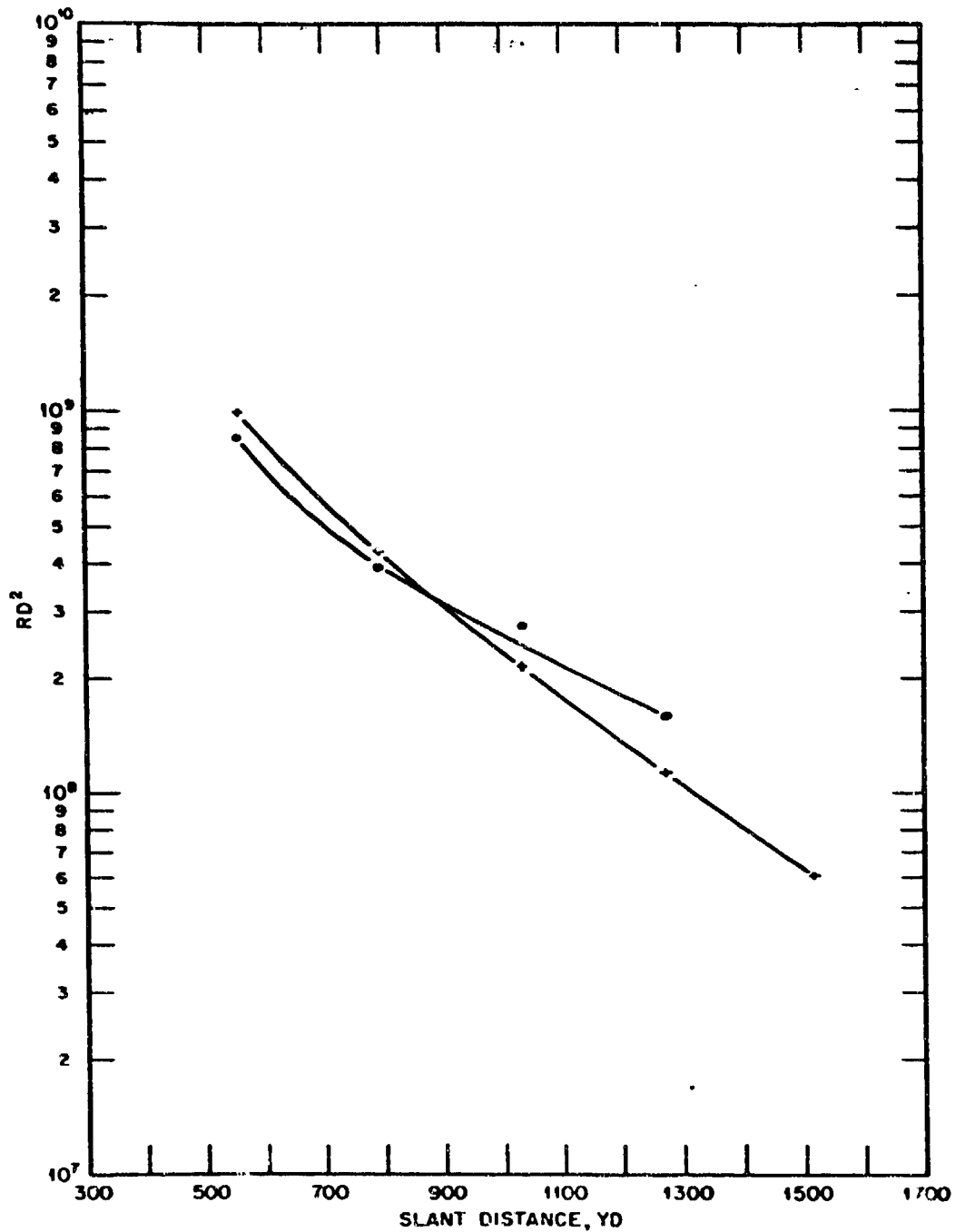


Fig. 3.49—La Place, goal-post line, RD^2 vs. D. +, EG&G film badges. ⊙, film in lithium can.

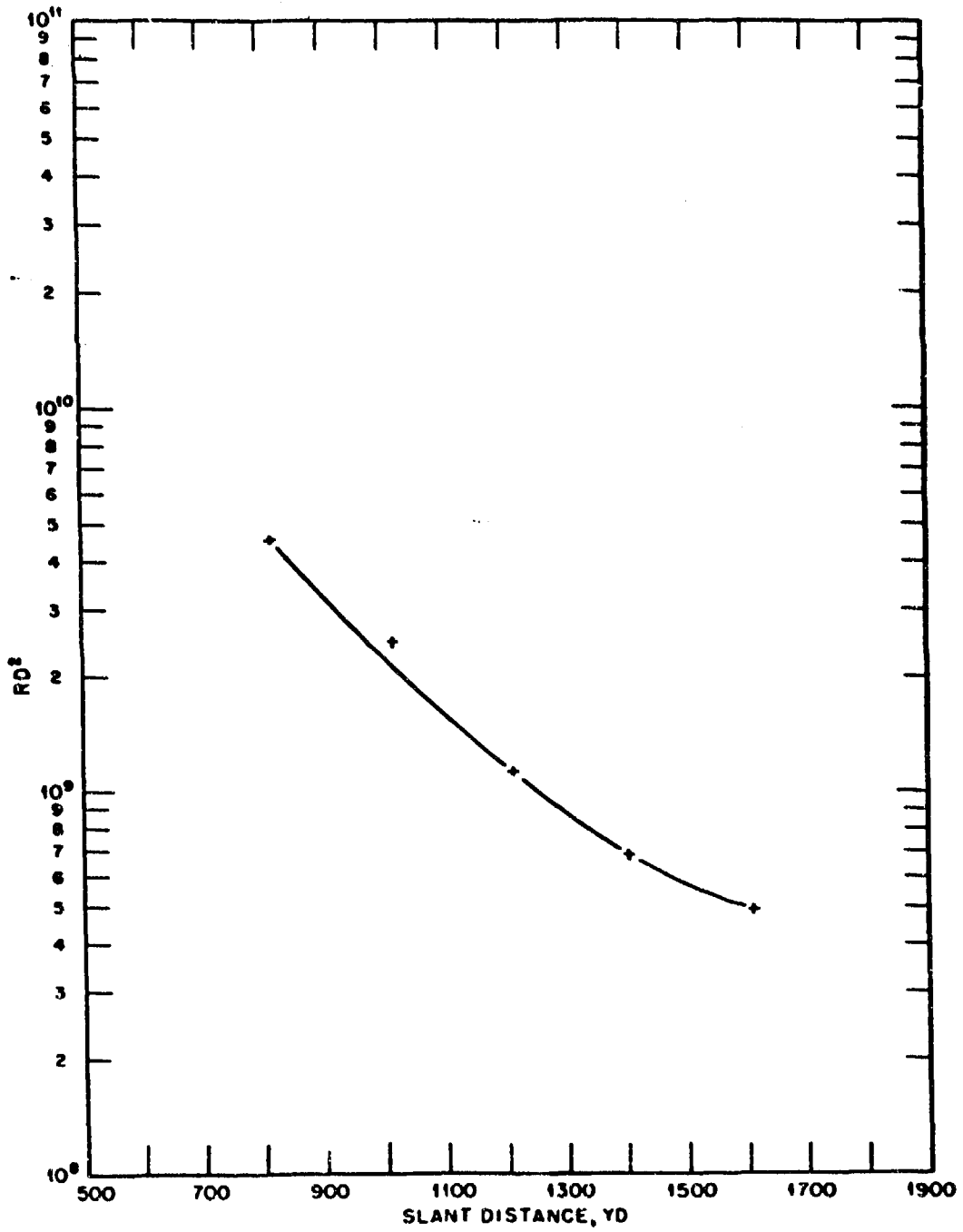


Fig. 3.50—Fizeau, goal-post line, RD^2 vs. D .

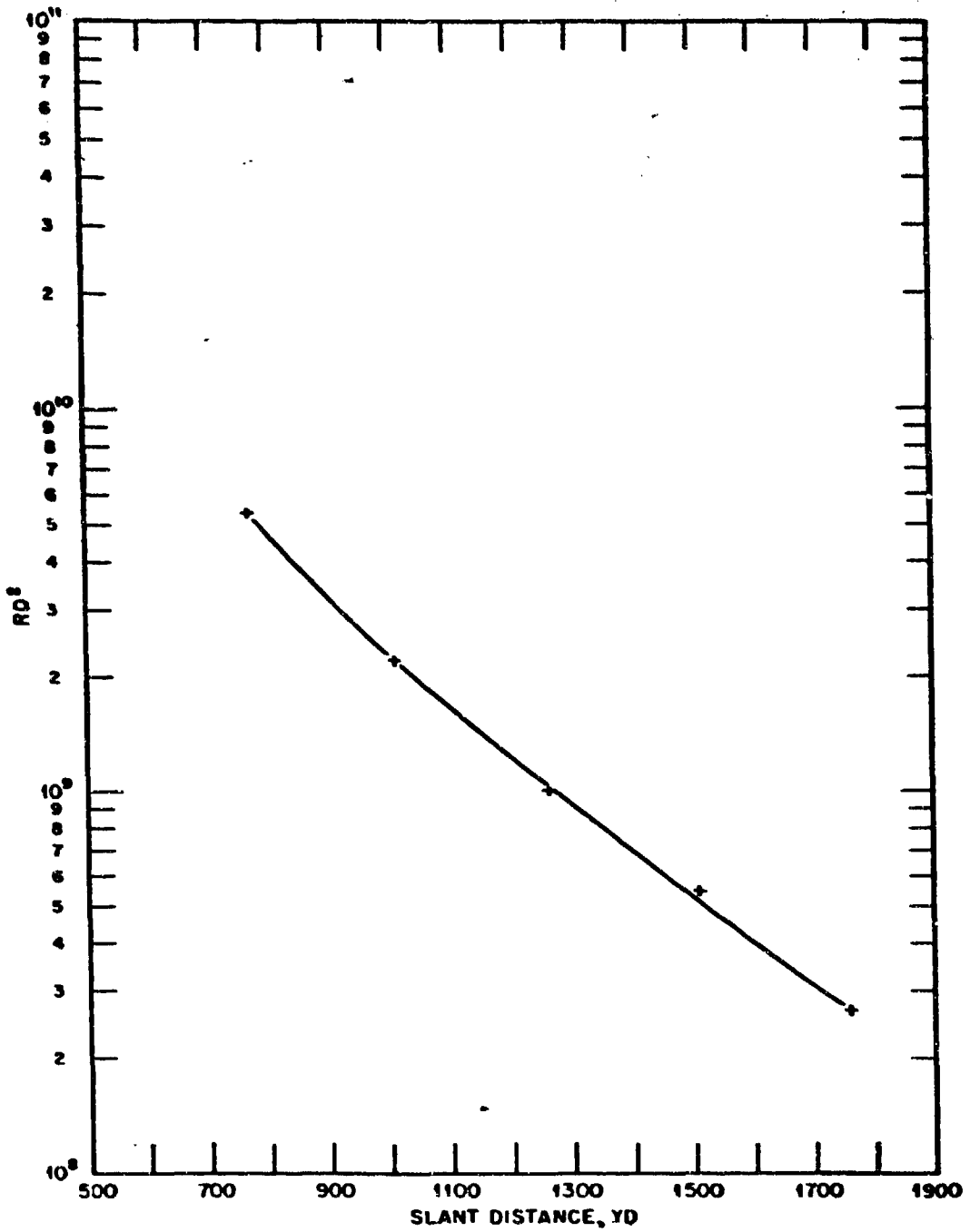


Fig. 3.51—Whitney, goal-post line, RD^2 vs. D. -----

TABLE 3.1—FRANKLIN, NORTH STAKE LINE AND GOAL POST*

| Slant distance (D), yd | D ² | Dose in EG&G container, r | RD ² | No. of EG&G badges per point | Maximum deviation per point, % | Film types read |
|------------------------|------------------------|---------------------------|------------------------|------------------------------|--------------------------------|-----------------|
| North Stake Line | | | | | | |
| 510 | 2.6 × 10 ⁵ | 557.5 | 1.45 × 10 ⁸ | 2 | 1.35 | 1112; 606 |
| 609 | 3.7 × 10 ⁵ | 337.5 | 1.25 × 10 ⁸ | 2 | 9.63 | 1112; 606 |
| 707 | 5.0 × 10 ⁵ | 189.3 | 9.42 × 10 ⁷ | 2 | 6.21 | 1112; 606; 510 |
| 806 | 6.5 × 10 ⁵ | 99.0 | 6.37 × 10 ⁷ | 2 | 4.08 | 510 |
| 905 | 8.2 × 10 ⁵ | 69.5 | 5.7 × 10 ⁷ | 2 | 0.72 | 510 |
| 1005 | 1.01 × 10 ⁶ | 46.0 | 4.65 × 10 ⁷ | 2 | 0.0 | 510 |
| 1104 | 1.22 × 10 ⁶ | 26.8 | 3.51 × 10 ⁷ | 2 | 3.58 | 510 |
| 1204 | 1.45 × 10 ⁶ | † | | | | |
| 1303 | 1.70 × 10 ⁶ | 11.1 | 1.89 × 10 ⁷ | 2 | 8.11 | 502; 510 |
| 1403 | 1.97 × 10 ⁶ | 7.3 | 1.44 × 10 ⁷ | 2 | 2.85 | 502 |
| 1503 | 2.26 × 10 ⁶ | 4.98 | 1.12 × 10 ⁷ | 2 | 5.05 | 502 |
| Goal Post | | | | | | |
| 510 | 2.6 × 10 ⁵ | 360.0 | 9.36 × 10 ⁷ | 1 | | 1112 |
| 609 | 3.7 × 10 ⁵ | 179.0 | 6.29 × 10 ⁷ | 1 | | 510; 606 |
| 707 | 5.0 × 10 ⁵ | 114.0 | 5.7 × 10 ⁷ | 1 | | 510; 606 |
| 806 | 6.5 × 10 ⁵ | † | | | | |
| 905 | 8.2 × 10 ⁵ | 42.0 | 3.44 × 10 ⁷ | 1 | | 510 |
| 1004 | 1.01 × 10 ⁶ | † | | | | |
| 1104 | 1.22 × 10 ⁶ | 13.0 | 1.59 × 10 ⁷ | 1 | | 502 |
| 1303 | 1.7 × 10 ⁶ | 5.6 | 9.52 × 10 ⁶ | 1 | | 502 |
| 1503 | 2.26 × 10 ⁶ | 3.8 | 6.33 × 10 ⁶ | 1 | | 502 |

*Dose vs. distance: RD² vs. D.

†Not recovered.

TABLE 3.1—FRANKLIN, SOUTH STAKE LINE AND GOAL POST*

| Slant distance (D), yd | D ² | Dose in EG&G container, r | RD ² | No. of EG&G badges per point | Maximum deviation per point, % | Film types read |
|------------------------|------------------------|---------------------------|------------------------|------------------------------|--------------------------------|-----------------|
| South Stake Line | | | | | | |
| 835 | 2.86 × 10 ⁵ | 375.5 | 1.07 × 10 ⁸ | 2 | 0.8 | 1112 |
| 633 | 4.01 × 10 ⁵ | 210.0 | 8.42 × 10 ⁷ | 2 | 9.52 | 510; 606 |
| 732 | 5.36 × 10 ⁵ | 125.0 | 6.7 × 10 ⁷ | 2 | 0.0 | 510 |
| 831 | 6.91 × 10 ⁵ | 66.0 | 5.94 × 10 ⁷ | 2 | 0.0 | 510 |
| 930 | 8.65 × 10 ⁵ | 50.5 | 4.37 × 10 ⁷ | 2 | 2.97 | 510 |
| 1029 | 1.06 × 10 ⁶ | 31.3 | 3.31 × 10 ⁷ | 2 | 2.56 | 510 |
| 1131 | 1.26 × 10 ⁶ | 21.3 | 2.73 × 10 ⁷ | 2 | 3.76 | 510 |
| 1229 | 1.51 × 10 ⁶ | 13.1 | 1.98 × 10 ⁷ | 2 | 14.5 | 510; 502 |
| 1330 | 1.77 × 10 ⁶ | 7.35 | 1.3 × 10 ⁷ | 2 | 0.68 | 503 |
| 1428 | 2.04 × 10 ⁶ | 5.60 | 1.14 × 10 ⁷ | 2 | 0.0 | 502 |
| 1530 | 2.34 × 10 ⁶ | 4.0 | 9.36 × 10 ⁶ | 2 | 0.0 | 502 |
| Goal Post | | | | | | |
| 732 | 5.36 × 10 ⁵ | 90.0 | 4.92 × 10 ⁷ | 1 | | 510 |
| 816 | 6.66 × 10 ⁵ | † | | | | |
| 831 | 6.91 × 10 ⁵ | 46.0 | 3.17 × 10 ⁷ | 1 | | 510 |
| 930 | 8.65 × 10 ⁵ | 36.0 | 3.29 × 10 ⁷ | 1 | | 510 |
| 1029 | 1.06 × 10 ⁶ | 25.0 | 2.65 × 10 ⁷ | 1 | | 510 |
| 1127 | 1.27 × 10 ⁶ | 14.0 | 1.87 × 10 ⁷ | 1 | | 510 |

*Dose vs. distance: RD² vs. D.
 †Not recovered.

TABLE 3.3—WILSON, SOUTHEAST GOAL-POST LINE*

| Slant distance (D), yd | D ² | Dose in EG&G container, r | RD ² | No. of EG&G badges per point | Film types read |
|------------------------|------------------------|---------------------------|-------------------------|------------------------------|-----------------|
| 527 | 2.78 × 10 ⁵ | 2.0 × 10 ² | 5.56 × 10 ¹⁰ | 1 | 1112 |
| 647 | 4.19 × 10 ⁵ | 4.0 × 10 ¹ | 2.05 × 10 ¹¹ | 1 | 1112 |
| 768 | 5.9 × 10 ⁵ | 10 ⁰ | 5.90 × 10 ¹¹ | 1 | 1112 |
| 1014 | 1.03 × 10 ⁶ | 2.4 × 10 ² | 2.47 × 10 ¹² | 1 | 1112 |
| 1299 | 1.69 × 10 ⁶ | 620.0 | 9.66 × 10 ¹² | 1 | 1112 |
| 1510 | 2.28 × 10 ⁶ | 255.0 | 5.81 × 10 ¹² | 1 | 606; 1112 |
| 1760 | 3.09 × 10 ⁶ | 91.0 | 2.8 × 10 ¹² | 1 | 510 |
| 2010 | 4.03 × 10 ⁶ | 48.0 | 1.83 × 10 ¹² | 1 | 510 |

*Dose vs. distance: RD² vs. D.

TABLE 3.4—PRISCILLA, STAKE LINE*

| Slant distance (D), yd | D ² | Dose in EG&G container, r | RD ² | No. of EG&G badges per point | Maximum deviation per point, \bar{b} | Film types read |
|------------------------|------------------------|---------------------------|------------------------|------------------------------|--|-----------------|
| 410 | 1.68 × 10 ⁵ | † | | | | |
| 470 | 2.21 × 10 ⁵ | † | | | | |
| 500 | 2.5 × 10 ⁵ | † | | | | |
| 560 | 3.14 × 10 ⁵ | † | | | | |
| 650 | 4.23 × 10 ⁵ | † | | | | |
| 800 | 7.4 × 10 ⁵ | † | | | | |
| 1000 | 1.0 × 10 ⁶ | † | | | | |
| 1104 | 1.22 × 10 ⁶ | 5.2 × 10 ² | 6.34 × 10 ⁹ | 2 | 0.0 | 1112 |
| 1296 | 1.68 × 10 ⁶ | 1.5 × 10 ² | 2.52 × 10 ⁹ | 2 | 0.0 | 1112 |
| 1383 | 1.91 × 10 ⁶ | † | | | | |
| 1477 | 2.18 × 10 ⁶ | † | | | | |
| 1496 | 2.24 × 10 ⁶ | 725.0 | 1.62 × 10 ⁹ | 2 | 0.69 | 1112 |
| 1694 | 2.87 × 10 ⁶ | 327.5 | 9.4 × 10 ⁸ | 2 | 0.76 | 606 |
| 1773 | 3.14 × 10 ⁶ | † | | | | |
| 1892 | 3.58 × 10 ⁶ | 168.5 | 6.03 × 10 ⁸ | 2 | 3.56 | 510 |
| 2090 | 4.37 × 10 ⁶ | 122.5 | 5.35 × 10 ⁸ | 2 | 2.04 | 510 |
| 2289 | 5.24 × 10 ⁶ | 69.0 | 3.61 × 10 ⁸ | 2 | 1.45 | 510 |

*Dose vs. distance: RD² vs. D.

†Not recovered.

TABLE 3.6—HOOD, GOAL-POST LINE*

| Slant distance (D), yd | D ² | Dose in EG&O container, r | Dose in Li can, r _{Li} | RD ² | R _{Li} D ² | No. of EG&O badges per point | Maximum deviation per point, % | No. of Li cans per point | Maximum deviation per point, % | Film types read |
|------------------------|------------------------|---------------------------|---------------------------------|------------------------|--------------------------------|------------------------------|--------------------------------|--------------------------|--------------------------------|-----------------|
| 1117 | 1.25 × 10 ⁶ | 3.95 × 10 ⁴ | 2.0 × 10 ⁴ | 3.56 × 10 ⁶ | 2.5 × 10 ¹⁰ | 4 | 8.3 | 2 | 6.0 | 1112 |
| 1348 | 1.81 × 10 ⁶ | 6.6 × 10 ⁴ | 4.2 × 10 ⁴ | 1.17 × 10 ⁷ | 7.6 × 10 ¹⁰ | 4 | 4.6 | 2 | 7.1 | 1112 |
| 1581 | 2.5 × 10 ⁶ | 2.06 × 10 ⁴ | 1.58 × 10 ⁴ | 5.13 × 10 ⁶ | 3.95 × 10 ¹⁰ | 4 | 2.4 | 2 | 1.9 | 1112 |
| 1818 | 3.31 × 10 ⁶ | 6.85 × 10 ⁴ | 6.0 × 10 ⁴ | 2.27 × 10 ⁷ | 1.99 × 10 ¹⁰ | 4 | 9.73 | 2 | 6.0 | 1112 |
| 2082 | 4.35 × 10 ⁶ | 3.19 × 10 ⁴ | | 1.56 × 10 ⁷ | | 4 | 2.8 | | | 1112 |

*Dose vs. distance: RD² vs. D.

TABLE 3.6—DIABLO, GOAL-POST LINE*

| Slant distance (D), yd | D ² | Dose in EG&O container, r | Dose in Li can, r _{Li} | RD ² | R _{Li} D ² | No. of EG&O badges per point | Maximum deviation per point, % | No. of Li cans per point | Maximum deviation per point, % | Film types read |
|------------------------|------------------------|---------------------------|---------------------------------|------------------------|--------------------------------|------------------------------|--------------------------------|--------------------------|--------------------------------|-----------------|
| 527 | 2.78 × 10 ⁵ | 4.78 × 10 ⁴ | | 1.31 × 10 ⁶ | | 3 | 36.0 | | | 1112 |
| 623 | 3.88 × 10 ⁵ | 1.64 × 10 ⁴ | | 6.36 × 10 ⁵ | | 4 | 22.0 | | | 1112 |
| 719 | 5.18 × 10 ⁵ | 9.5 × 10 ⁴ | 6.0 × 10 ⁴ | 4.92 × 10 ⁶ | 3.11 × 10 ¹⁰ | 4 | 9.47 | 3 | 53.3 | 1112 |
| 817 | 6.67 × 10 ⁵ | 5.85 × 10 ⁴ | | 3.7 × 10 ⁶ | | 4 | 8.11 | | | 1112 |
| 916 | 8.37 × 10 ⁵ | 2.97 × 10 ⁴ | | 2.49 × 10 ⁶ | | 4 | 9.09 | | | 1112 |
| 1014 | 1.03 × 10 ⁶ | 1.64 × 10 ⁴ | 1.2 × 10 ⁴ | 1.61 × 10 ⁶ | 1.24 × 10 ¹⁰ | 4 | 5.77 | 3 | 20.8 | 1112 |
| 1112 | 1.24 × 10 ⁶ | 977.0 | | 1.51 × 10 ⁶ | | 4 | 2.76 | | | 1112 |
| 1212 | 1.47 × 10 ⁶ | 688.0 | 599.0 | 9.82 × 10 ⁵ | 6.83 × 10 ¹⁰ | 4 | 6.29 | 3 | 5.2 | 1112 |
| 1311 | 1.73 × 10 ⁶ | 498.0 | | 8.66 × 10 ⁵ | | 4 | 4.70 | | | 606 |
| 1410 | 1.99 × 10 ⁶ | 378.0 | | 7.5 × 10 ⁵ | | 4 | 2.12 | | | 606 |
| 1509 | 2.28 × 10 ⁶ | 288.0 | 263.0 | 6.79 × 10 ⁵ | 6.0 × 10 ¹⁰ | 4 | 4.03 | 3 | 14.1 | 606 |
| 1608 | 2.59 × 10 ⁶ | 198.0 | | 4.79 × 10 ⁵ | | 4 | 2.7 | | | 510 |

*Dose vs. distance: RD² vs. D.

TABLE 3.7—KEPLER, GOAL-POST LINE*

| Slant distance (D), yd | Dose in EG&G container, r | | Dose in Li can, F _{Li} | RD ³ | R _{Li} D ³ | No. of EG&G badges per point | Maximum deviation per point, % | Maximum deviation per point, % | Film types read |
|------------------------|---------------------------|--------------------|---------------------------------|--------------------|--------------------------------|------------------------------|--------------------------------|--------------------------------|-----------------|
| | D ³ | F _{Li} | | | | | | | |
| 527 | 2.78×10^4 | 4.7×10^3 | 5.2×10^3 | 1.31×10^6 | 1.48×10^6 | 4 | 8.5 | 7.7 | 1112 |
| 1014 | 1.03×10^4 | 3.84×10^3 | 4.48×10^3 | 2.86×10^6 | 4.61×10^6 | 4 | 3.6 | 7.1 | 606; 1112 |
| 1810 | 2.28×10^4 | 46.5 | 49.5 | 1.06×10^6 | 1.13×10^6 | 4 | 1.1 | 1.0 | 510 |

*Dose vs. distance: RD³ vs. D.

TABLE 3.8—STOKES, GOAL-POST LINE*

| Slant distance (D), yd | Dose in EG&G container, r | | Dose in Li can, F _{Li} | RD ³ | R _{Li} D ³ | No. of EG&G badges per point | Maximum deviation per point, % | Maximum deviation per point, % | Film types read |
|------------------------|---------------------------|--------------------|---------------------------------|--------------------|--------------------------------|------------------------------|--------------------------------|--------------------------------|-----------------|
| | D ³ | F _{Li} | | | | | | | |
| 902 | 8.14×10^4 | 6.0×10^3 | 4.7×10^3 | 6.51×10^6 | 3.99×10^6 | 4 | 0.0 | 0.0 | 1112 |
| 1116 | 1.26×10^4 | 2.2×10^3 | 1.6×10^3 | 2.78×10^6 | 2.0×10^6 | 4 | 4.6 | 0.0 | 1112 |
| 1348 | 1.81×10^4 | 7.15×10^3 | 5.8×10^3 | 1.29×10^6 | 1.07×10^6 | 4 | 2.1 | 1.69 | 1112 |
| 1580 | 2.6×10^4 | 2.83×10^3 | 2.05×10^3 | 7.33×10^6 | 7.83×10^6 | 4 | 2.3 | 1.64 | 606 |
| 1818 | 3.31×10^4 | 10^3 | 2.31×10^3 | | | 4 | 0.0 | | 510 |
| 2060 | 4.24×10^4 | 55.0 | 2.33×10^3 | | | 4 | 5.2 | | 510 |

*Dose vs. distance: RD³ vs. D.

TABLE 3.9—SHASTA, GOAL-POST LINE*

| Slant distance (D), yd | D ³ | Dose in EG&G container, r | RD ³ | No. of EG&G badges per point | Maximum deviation per point, % | Film types read |
|------------------------|--------------------|---------------------------|--------------------|------------------------------|--------------------------------|-----------------|
| | | | | | | |
| 1014 | 1.03×10^4 | 1.44×10^3 | 1.48×10^6 | 4 | 4.2 | 1112 |
| 1260 | 1.58×10^4 | 500.7 | 9.06×10^6 | 4 | 0.73 | 606 |
| 1809 | 2.28×10^4 | 214.2 | 4.88×10^6 | 4 | 4.2 | 510; 606 |

*Dose vs. distance: RD³ vs. D.

TABLE 3.10—DOPPLER, GOAL-POST LINE*

| Slant distance (D), yd | D ² | Dose in EG&G counter, F | Dose in Li can, r _{Li} | RD ² | R _{Li} D ² | No. of EG&G badges per point | Maximum deviation per point, % | No. of Li cans per point | Maximum deviation per point, % | Film types read |
|------------------------|------------------------|-------------------------|---------------------------------|------------------------|--------------------------------|------------------------------|--------------------------------|--------------------------|--------------------------------|-----------------|
| 902 | 8.14 × 10 ³ | 1.97 × 10 ⁴ | 2.9 × 10 ³ | 1.6 × 10 ⁶ | 1.63 × 10 ⁶ | 3 | 12.7 | 3 | 6.0 | 1112 |
| 1116 | 1.25 × 10 ⁴ | 3.23 × 10 ⁴ | 3.3 × 10 ³ | 4.0 × 10 ⁶ | 4.13 × 10 ⁶ | 3 | 2.3 | 3 | 5.1 | 1112 |
| 1346 | 1.81 × 10 ⁴ | 973.3 | 869.0 | 1.76 × 10 ⁶ | 1.72 × 10 ⁶ | 3 | 2.7 | 3 | 3.2 | 1112 |
| 1580 | 2.5 × 10 ⁴ | 435.0 | 456.3 | 1.06 × 10 ⁶ | 1.14 × 10 ⁶ | 3 | 2.5 | 3 | 5.3 | 606, 1112 |
| 1818 | 3.31 × 10 ⁴ | 191.7 | | 6.26 × 10 ⁵ | | 3 | 9.5 | | | 606 |
| 2060 | 4.24 × 10 ⁴ | 101.3 | | 4.3 × 10 ⁵ | | 4 | 1.7 | | | 510 |

*Dose vs. distance: RD² vs. D.

TABLE 3.11—FRANKLIN PRIME, GOAL-POST LINE*

| Slant distance (D), yd | D ² | Dose in EG&G counter, F | Dose in Li can, r _{Li} | RD ² | R _{Li} D ² | No. of EG&G badges per point | Maximum deviation per point, % | No. of Li cans per point | Maximum deviation per point, % | Film types read |
|------------------------|------------------------|-------------------------|---------------------------------|------------------------|--------------------------------|------------------------------|--------------------------------|--------------------------|--------------------------------|-----------------|
| 599 | 3.13 × 10 ³ | 1.4 × 10 ⁴ | 1.55 × 10 ³ | 4.38 × 10 ⁵ | 4.55 × 10 ⁵ | 4 | 14.3 | 3 | 5.7 | 1112 |
| 791 | 6.26 × 10 ³ | 1.88 × 10 ⁴ | 1.75 × 10 ³ | 1.16 × 10 ⁶ | 1.09 × 10 ⁶ | 4 | 1.6 | 3 | 11.4 | 1112 |
| 1029 | 1.06 × 10 ⁴ | 539.0 | 497.3 | 5.71 × 10 ⁵ | 5.27 × 10 ⁵ | 4 | 3.9 | 3 | 4.8 | 606, 1112 |
| 1272 | 1.63 × 10 ⁴ | 289.7 | 176.3 | 3.08 × 10 ⁵ | 2.87 × 10 ⁵ | 4 | 7.3 | 3 | 3.5 | 510, 606 |
| 1519 | 2.31 × 10 ⁴ | 58.4 | † | 1.35 × 10 ⁵ | | 4 | .06 | | | 510 |
| 1768 | 3.13 × 10 ⁴ | 14.8 | † | 4.93 × 10 ⁴ | | 4 | 2.9 | | | 502 |

*Dose vs. distance: RD² vs. D.

†No badge was exposed in lithium can.

TABLE 3.12—SMOKY, FRENCH AND EG&G DOSIMETRY COMPARISON

| Shelter No. | Inside location | 5-ft French plate | | 5-ft EG&G badge | | 5-ft EG&G badge | | 3-ft EG&G badge | |
|-------------|-----------------|-------------------|---------------------|-----------------|---------------------|-----------------|---------------------|-----------------|-------------------|
| | | No. | Av. dose, r (Cd) | No. | Dose, r | No. | Dose, r | No. | Dose, r |
| II-1 | 24 | 51 | 2.78 | 1979 | 1.5 | | | 1978 | 1.9 |
| II-1 | 20 and 21 | 52 | 3.73 | 1970 | 1.0 | 1971 | 1.7 | 1972 | 2.3 |
| II-1 | 16 | 53 | 24.50 | 1962 | 7.4 | 1963 | 7.4 | | |
| II-1 | 33 | 54 | 3.36 | 2564 | 2.7 | 2565 | 2.7 | 2566 | 2.7 |
| II-1 | 35 and 36 | 55 | 10.60* | 2570 | 8.7 | | | 2569 | 5.4 |
| II-1 | 1 | 56 | 8.9×10^2 * | 1937 | 7.0×10^2 † | 1936 | 1.0×10^2 ‡ | 1935 | 1.0×10^2 |
| II-1 | 39 | 57 | 35. | 2580 | 31.0 | 2579 | 27.0 | 2578 | 31.0 |
| II-2 | 5 and 68 | 59 | 17.88 | 2512 | 26.0 | 2511 | 25.0 | 2510 | 19.0 |
| II-2 | 19 and 20 | 60 | 26.00 | 1918 | 15.0 | 1917 | 12.0 | 1916 | 18.0 |
| II-2 | 14 and 15 | 61 | 23.13 | 1909 | 42.0 | 1908 | 38.0 | 1907 | 30.0 |
| II-2 | 9 and 10 | 62 | 205.50 | 2518 | 24.0 | 2519 | 22.0 | 2517 | 19.0 |
| II-3 | 3 and 4 | 44 and 45 | 19.44 | 2521 | 22.0 | 2522 | 21.5 | | |
| II-3 | 8 and 9 | 46 | 27.50 | 2520 | 30.0 | 2528 | 35.0 | 2527 | 34.0 |
| II-4 | 5 and 6 | 67 | 24.50 | | | | 33.0† | | 36.0** |
| II-4 | 9 and 10 | 68 | 24.38 | 2497 | 53.0 | 2496 | 53.0 | | |
| II-5 | 3 and 4 | 71 | 19.36 | 2478 | 28.0 | 2477 | 25.0 | | |
| II-5 | 8 and 9 | 72 | 34.13 | 2484 | 45.0 | 2486 | 46.0 | 2485 | 54.0 |

*Recovered one month later than the other badges.

†At 11 ft.

‡At 7 ft.

§3 and 4 were not recovered.

¶Average dose at 5 ft for Nos. 2494 and 2496.

**Average dose for Nos. 2493 and 2496.

TABLE 3.13—SMOKY, SLANT-RANGE CALCULATION, NORTH LINE

| Distance from GZ, yd | Elevation above GZ, ft | Slant range, yd |
|-------------------------|---------------------------|--------------------|
| 450 | +60 | 498 |
| 600 | +130 | 629 |
| 700 | +210 | 719 |
| 825 | +360 | 833 |
| 900 | +450 | 903 |
| 930 | +520 | 933 |
| 1000 | +470 | 1003 |
| 1100 | +350 | 1106 |
| 1200 | +260 | 1209 |
| 1300 | +240 | 1309 |

TABLE 3.14—SMOKY, NORTH GOAL-POST LINE*

| Slant distance (D), yd | D ² | Dose in EG&G con- tainer, r | RD ² | No. of EG&G badges per point | Maximum deviation per point, % | Film types read |
|------------------------------|--------------------|-----------------------------------|-----------------------|---------------------------------------|---|-----------------------|
| 498 | 2.49×10^5 | $\sim 10^5?$ | 2.49×10^{11} | 2 | 0 | 1112 |
| 629 | 3.96×10^5 | $9.00 \times 10^5?$ | 3.56×10^{11} | 2 | 11.1 | 1112 |
| 719 | 5.18×10^5 | $2.00 \times 10^5?$ | 1.04×10^{11} | 2 | 20.0 | 1112 |
| 833 | 6.94×10^5 | $6.50 \times 10^4?$ | 4.52×10^{10} | 2 | 10.7 | 1112 |
| 903 | 8.16×10^5 | 2.75×10^4 | 2.24×10^{10} | 2 | 20.0 | 1112 |
| 933 | 8.72×10^5 | 2.45×10^4 | 2.14×10^{10} | 2 | 2.0 | 1112 |
| 1003 | 1.01×10^6 | 2.70×10^3 | 2.73×10^9 | 2 | 7.4 | 1112 |
| 1106 | 1.22×10^6 | 1.70×10^3 | 2.07×10^9 | 2 | 0 | 1112 |
| 1209 | 1.46×10^6 | 0.35 | 5.11×10^8 | 2 | 5.7 | 502 |
| 1309 | 1.71×10^6 | 0.33 | 5.64×10^8 | 2 | 15.1 | 502 |

*Dose vs. distance: RD² vs. D.

TABLE 3.15--SMOKY. SLANT-RANGE CALCULATION, EAST LINE

| Distance from GZ, yd | Elevation above GZ, ft | Slant range, yd |
|-------------------------|---------------------------|--------------------|
| 400 | +30 | 458 |
| 500 | +45 | 545 |
| 565 | +38 | 607 |
| 610 | +21 | 651 |
| 660 | +44 | 691 |
| 725 | +58 | 756 |
| 780 | +16 | 810 |
| 811 | +38 | 841 |
| 880 | +48 | 887 |
| 965 | +41 | 940 |
| 965 | +30 | 990 |
| 975 | +16 | 1001 |
| 1000 | +12 | 1026 |
| 1090 | +21 | 1096 |
| 1140 | +2 | 1164 |
| 1250 | -20 | 1268 |
| 1400 | -38 | 1421 |
| 1600 | -30 | 1618 |
| 1800 | -20 | 1816 |

TABLE 3.16--SMOKY, EAST GOAL-POST LINE*

| Slant distance (D), yd | D ² | Dose EG&G con- tainer, r | RD ² | No. of EG&G badges per point | Maximum deviation per point, % | Film types read |
|------------------------------|------------------------|--------------------------------|-------------------------|---------------------------------------|---|-----------------------|
| 756 | 5.72 × 10 ⁵ | 1.55 × 10 ⁵ ? | 8.88 × 10 ¹⁰ | 2 | 23 | 1112 |
| 810 | 6.56 × 10 ⁵ | 4.70 × 10 ⁴ | 3.08 × 10 ¹⁰ | 2 | 4.3 | 1112 |
| 841 | 7.07 × 10 ⁵ | 2.40 × 10 ⁴ | 1.70 × 10 ¹⁰ | 2 | 0 | 1112 |
| 887 | 7.87 × 10 ⁵ | 3.20 × 10 ⁴ | 2.52 × 10 ¹⁰ | 2 | 6.1 | 1112 |
| 980 | 9.60 × 10 ⁵ | 8.70 × 10 ³ | 8.35 × 10 ⁹ | 2 | 1.1 | 1112 |
| 990 | 9.80 × 10 ⁵ | 4.99 × 10 ⁴ | 4.80 × 10 ¹⁰ | 2 | 10.2 | 1112 |
| 1001 | 1.00 × 10 ⁶ | 4.10 × 10 ³ | 4.10 × 10 ⁹ | 2 | 2.4 | 1112 |
| 1026 | 1.05 × 10 ⁶ | 6.50 × 10 ³ | 6.82 × 10 ⁹ | 2 | 1.5 | 1112 |
| 1098 | 1.21 × 10 ⁶ | 4.05 × 10 ³ | 4.90 × 10 ⁹ | 2 | 13.6 | 1112 |
| 1164 | 1.36 × 10 ⁶ | 2.50 × 10 ³ | 3.40 × 10 ⁹ | 2 | 8.0 | 1112 |
| 1268 | 1.61 × 10 ⁶ | 1.80 × 10 ³ | 2.90 × 10 ⁹ | 2 | 0 | 1112 |
| 1421 | 2.02 × 10 ⁶ | 7.50 × 10 ² | 1.52 × 10 ⁹ | 4 | 6.7 | 1112; 506 |
| 1618 | 2.62 × 10 ⁶ | 4.15 × 10 ² | 1.09 × 10 ⁹ | 4 | 10.8 | 1112; 606 |
| 1816 | 3.30 × 10 ⁶ | 2.18 × 10 ² | 7.20 × 10 ⁸ | 6 | 23.8 | 1112; 606 |

*Dose vs. distance: RD² vs. D.

TABLE 3.17—SMOKY, IRON-PIPE CONTAINER DATA

| Location of iron-pipe container, yd from GZ | Badge No. | Type 502 | | Type 510 | | Type 606 | | Type 1112 | | Interpreted EG&G dose |
|--|--------------|----------|------|----------|-------------------|----------|-------------------|-----------|----------------------|--------------------------|
| | | Density | Dose | Density | Dose | Density | Dose | Density | Dose | |
| 100 | 1741 | 1.76 | | 6.53 | | 4.43 | | 3.37 | $\sim 6 \times 10^3$ | $\sim 6 \times 10^7$ |
| 200 | 1742 | 1.87 | | 5.71 | | 4.37 | | 3.25 | $\sim 2 \times 10^4$ | $\sim 2 \times 10^7$ |
| 300 | 1743 | 1.85 | | 5.61 | | 4.03 | | 3.00 | 2.1×10^4 | 2.1×10^7 |
| 400 | 1744 | 1.94 | | 5.36 | | 3.55 | | 2.74 | 4.6×10^4 | 4.6×10^7 |
| 450 | 1745 | 1.93 | | 5.14 | | 3.26 | | 2.54 | 1.9×10^4 | 1.9×10^7 |
| 450 | 1746 | 1.91 | | 5.11 | | 3.22 | | 2.54 | 1.9×10^4 | 1.9×10^7 |
| 500 | 1747 | 1.92 | | 4.81 | | 2.94 | | 2.38 | 10^4 | 10^7 |
| 600 | 1748 | 1.91 | | 4.13 | | 2.46 | | 2.08 | 3.4×10^3 | 3.4×10^6 |
| 700 | 2179 | 1.81 | | 3.49 | | 1.94 | | 1.72 | 1.7×10^3 | 1.7×10^6 |
| 900 | 2180 | 1.61 | | 2.59 | | 1.19 | | 1.12 | 5.8×10^2 | 5.8×10^5 |
| 900* | 2181 | 1.61 | | 2.53 | | 1.19 | 5.4×10^3 | 1.09 | 4.6×10^2 | 5×10^5 |
| 1100 | 2182 | 1.44 | | 2.03 | 2.2×10^3 | 0.76 | 2.4×10^3 | 0.79 | 2.4×10^2 | 2.4×10^5 |
| 450† | 2183 | 1.03 | 16.0 | 0.88 | 16.0 | 0.11 | 16.0 | 0.26 | | 16 |
| 450‡ | 2184 | 1.19 | 31.0 | 0.75 | 24.0 | 0.15 | 31.0 | 0.26 | | 22.6 |

*Coal; †all others are ground readings.

†H + 1 L + 8 hr.
‡H + 6 L + 36 hr.

TABLE 3.18—SMOKY, SLANT-RANGE CALCULATION, SOUTH LINE

| Distance from GZ, yd | Elevation above GZ, ft | Slant range, yd |
|-------------------------|---------------------------|--------------------|
| 400 | -20 | 466 |
| 600 | -60 | 649 |
| 800 | -80 | 841 |
| 1000 | -95 | 1034 |
| 1200 | -105 | 1229 |
| 1400 | -120 | 1426 |
| 1500 | -120 | 1525 |
| 1600 | -125 | 1623 |
| 1700 | -125 | 1722 |
| 1800 | -130 | 1821 |
| 1900 | -130 | 1920 |
| 2000 | -135 | 2019 |

TABLE 3.19—SMOKY, SOUTH GOAL-POST LINE*

| Slant distance (D), yd | D ² | Dose in EG&G con- tainer, r | RD ² | No. of EG&G badges per point | Maximum deviation per point, % | Film types read |
|------------------------------|------------------------|-----------------------------------|-------------------------|---------------------------------------|---|-----------------------|
| 466 | 2.17 × 10 ⁵ | 7.60 × 10 ³ ? | 1.65 × 10 ¹¹ | 2 | 0 | 1112 |
| 641 | 7.07 × 10 ⁵ | 2.90 × 10 ⁴ | 2.05 × 10 ¹⁰ | 2 | 0 | 1112 |
| 1034 | 1.07 × 10 ⁶ | 4.65 × 10 ⁴ | 4.97 × 10 ⁹ | 2 | 3.2 | 1112 |
| 1229 | 1.51 × 10 ⁶ | 2.13 × 10 ⁴ | 3.22 × 10 ⁹ | 2 | 1.4 | 1112 |
| 1426 | 2.03 × 10 ⁶ | 1.50 × 10 ⁴ | 3.05 × 10 ⁹ | 2 | 6.7 | 1112 |
| 1525 | 2.33 × 10 ⁶ | 1.23 × 10 ⁴ | 2.86 × 10 ⁹ | 2 | 2.4 | 1112 |
| 1623 | 2.63 × 10 ⁶ | 1.13 × 10 ⁴ | 2.97 × 10 ⁹ | 2 | 7.1 | 1112 |
| 1722 | 2.97 × 10 ⁶ | 1.15 × 10 ⁴ | 3.42 × 10 ⁹ | 2 | 4.3 | 1112 |
| 1821 | 3.02 × 10 ⁶ | 1.10 × 10 ⁴ | 3.32 × 10 ⁹ | 2 | 4.5 | 1112 |
| 1920 | 3.69 × 10 ⁶ | 1.05 × 10 ⁴ | 3.87 × 10 ⁹ | 2 | 0 | 1112 |
| 2018 | 4.07 × 10 ⁶ | 9.50 × 10 ³ | 3.86 × 10 ⁹ | 2 | 5.2 | 1112 |
| 2309 | 5.33 × 10 ⁶ | 0.85 | 4.53 × 10 ⁸ | 2 | 11.1 | 502 |

*Dose vs. distance: RD² vs. D.

TABLE 3.20—GALILEO, GOAL-POST LINE*

| Slant distance (D), yd | D ² | Dose in EG&G con- tainer, r | RD ² | No. of EG&G badges per point | Maximum deviation per point, % | Film types read |
|------------------------------|------------------------|-----------------------------------|------------------------|---------------------------------------|---|-----------------------|
| 1228 | 1.51 × 10 ⁶ | 363.8 | 5.49 × 10 ⁸ | 4 | 10.0 | 1112; 606 |
| 1326 | 1.76 × 10 ⁶ | 282.2 | 4.97 × 10 ⁸ | 4 | 7.9 | 1112; 606 |
| 1442 | 2.08 × 10 ⁶ | 108.7 | 2.26 × 10 ⁸ | 4 | 10.4 | 510 |
| 1624 | 2.64 × 10 ⁶ | 79.0 | 2.09 × 10 ⁸ | 2 | 1.3 | 510 |
| 1673 | 2.8 × 10 ⁶ | 69.8 | 1.95 × 10 ⁸ | 4 | 6.0 | 510 |
| 2022 | 4.09 × 10 ⁶ | 23.0 | 9.41 × 10 ⁷ | 4 | 8.7 | 510 |
| 2128 | 4.53 × 10 ⁶ | 14.1 | 6.39 × 10 ⁷ | 1 | 7.8 | 502; 510 |
| 2222 | 4.94 × 10 ⁶ | 11.5 | 5.68 × 10 ⁷ | 2 | 0.0 | 502 |
| 3402 | 1.16 × 10 ⁷ | 0.68 | 7.89 × 10 ⁶ | 2 | 0.0 | 502 |

*Dose vs. distance: RD² vs. D.

TABLE 3.21—LA PLACE, GOAL-POST LINE*

| Slant distance (D), yd | D^2 | Dose in EG&O container, r | Dose in Li can, μ | R_D^2 | $R_D^2 D^2$ | No. of EG&O badges per point | Maximum deviation per point, % | No. of Li cans per point | Maximum deviation per point, % | Film types used |
|------------------------|--------------------|---------------------------|-----------------------|--------------------|--------------------|------------------------------|--------------------------------|--------------------------|--------------------------------|-----------------|
| 659 | 3.58×10^5 | 4.5×10^2 | 2.73×10^2 | 0.92×10^2 | 6.52×10^6 | 4 | 6.9 | 2 | 6.2 | 1112 |
| 791 | 6.26×10^5 | 7.0×10^2 | 6.23×10^2 | 4.26×10^2 | 2.63×10^6 | 4 | 4.4 | 2 | 0.6 | 1112 |
| 1029 | 1.06×10^6 | 2.02×10^2 | 2.6×10^2 | 2.14×10^2 | 2.76×10^6 | 4 | 3.5 | 2 | 0.0 | 510, 608 |
| 1275 | 1.62×10^6 | 70.0 | 10^2 | 1.13×10^2 | 1.8×10^6 | 4 | 1.4 | 2 | 0.0 | 510 |
| 1819 | 3.31×10^6 | 26.1 | | 6.03×10^1 | | 4 | 3.4 | | | 510 |

*Dose vs. distance: R_D^2 vs. D.

TABLE 3.22—FIZEAU, GOAL-POST LINE*

| Slant distance (D), yd | D ² | Dose in EG&G container, r | RD ² | No. of EG&G badges per point | Maximum deviation per point, % | Film types read |
|------------------------|------------------------|---------------------------|------------------------|------------------------------|--------------------------------|-----------------|
| 817 | 6.68 × 10 ⁵ | 6.7 × 10 ³ | 4.48 × 10 ⁹ | 4 | 4.5 | 1112 |
| 1014 | 1.03 × 10 ⁶ | 2.38 × 10 ³ | 2.45 × 10 ⁹ | 4 | 2.9 | 1112 |
| 1212 | 1.47 × 10 ⁶ | 7.63 × 10 ² | 1.12 × 10 ⁹ | 4 | 5.6 | 1112 |
| 1401 | 1.96 × 10 ⁶ | 3.43 × 10 ² | 6.83 × 10 ⁸ | 4 | 5.0 | 606; 1112 |
| 1609 | 2.59 × 10 ⁶ | 1.89 × 10 ² | 4.9 × 10 ⁸ | 4 | 2.1 | 570 |

*Dose vs. distance: RD² vs. D.

TABLE 3.23—SPECIAL STUDIES (Project 39.6a)

| Badge No. | Dose, r | Badge No. | Dose, r |
|-----------|-----------------------|-----------|-----------------------|
| 390 | 0 | 433 | 5 × 10 ² |
| 420 | 5.9 × 10 ² | 434 | 4.7 × 10 ² |
| 421 | 7.5 × 10 ² | 435 | 5.2 × 10 ² |
| 422 | 5.6 × 10 ² | 436 | 5.9 × 10 ² |
| 423 | 5.2 × 10 ² | 437 | 5.5 × 10 ² |
| 424 | 4.9 × 10 ² | 440 | 6 × 10 ² |
| 425 | 5.3 × 10 ² | 441 | 6.4 × 10 ² |
| 430 | 5.1 × 10 ² | 442 | 0 |
| 431 | 5.4 × 10 ² | 443 | 0 |
| 432 | 5.7 × 10 ² | 444 | 0 |

TABLE 3.24—PROJECT 39.6a, BURRO SHELTERS

| Project 39.6a No. | Badge No. | Dose, r | Project 39.6a No. | Badge No. | Dose, r |
|-------------------|-----------|--------------------|-------------------|-----------|--------------------|
| 0293 | 2952 | 2.8×10^2 | 2007 | 3008 | 4.05×10^2 |
| 0276 | 2953 | 3.2×10^2 | | 3009 | 3.75×10^2 |
| 0256 | 2954 | 2.45×10^2 | | 3010 | 4.15×10^2 |
| 0253 | 2955 | 2.6×10^2 | | 3011 | 3.2×10^2 |
| 0299 | 2956 | 3.55×10^2 | | 3012 | 4×10^2 |
| 0272 | 2957 | 3.3×10^2 | 3313 | 3013 | 4.1×10^2 |
| 0258 | 2958 | 2.85×10^2 | | 3014 | 3.9×10^2 |
| 0257 | 2959 | 3.0×10^2 | | 3015 | 4.1×10^2 |
| 0295 | 2960 | 3.2×10^2 | | 3016 | 4.1×10^2 |
| 0278 | 2961 | 2.5×10^2 | | 3017 | 3.7×10^2 |
| 0261 | 2962 | 3×10^2 | | 3018 | 4×10^2 |
| 0259 | 2963 | 2.4×10^2 | | 3019 | 3.8×10^2 |
| 0294 | 2964 | 2.7×10^2 | | 3020 | 4.25×10^2 |
| 0280 | 2965 | 3.5×10^2 | | 3021 | 3.6×10^2 |
| | 2966 | 2.85×10^2 | | 3022 | 3.5×10^2 |
| 0264 | 2967 | 2.5×10^2 | | 3023 | 3.6×10^2 |
| 0296 | 2968 | 3.4×10^2 | 3025 | 3024 | 4.25×10^2 |
| 0286 | 2969 | 3×10^2 | | 3025 | 4.35×10^2 |
| | 2970 | 2.6×10^2 | | 3026 | 4.6×10^2 |
| 0254 | 2971 | 3.1×10^2 | | 3027 | 4.2×10^2 |
| 0297 | 2972 | 3.4×10^2 | | 3832 | 2.3×10^2 |
| 0279 | 2973 | 3.4×10^2 | | 3833 | 2.1×10^2 |
| 0270 | 2974 | 2.85×10^2 | | 3834 | 2.05×10^2 |
| 0260 | 2975 | 3.15×10^2 | | 3835 | 2×10^2 |
| 0298 | 2976 | 2.8×10^2 | | 3836 | 1.95×10^2 |
| 0287 | 2977 | 3.5×10^2 | | 3837 | 2.3×10^2 |
| 0274 | 2978 | 3.6×10^2 | | 3838 | 2.15×10^2 |
| 0262 | 2979 | 3.1×10^2 | | 3839 | 2.4×10^2 |
| 0290 | 2980 | 3.55×10^2 | | 3840 | 2.15×10^2 |
| 0261 | 2981 | 1.75×10^2 | | 3841 | 1.75×10^2 |
| 0273 | 2982 | 3.1×10^2 | | 3842 | 2.1×10^2 |
| 0268 | 2983 | 2.7×10^2 | | 3843 | 1.95×10^2 |
| 0292 | 2984 | 3.45×10^2 | | 3844 | 1.5×10^2 |
| 0285 | 2985 | 3.7×10^2 | | 3845 | 2×10^2 |
| 0285 | 2986 | 3.15×10^2 | | 3846 | 1.7×10^2 |
| 0255 | 2987 | 3.3×10^2 | | 3847 | 2.3×10^2 |
| 0248 | 2988 | 3.4×10^2 | | 3848 | 2.2×10^2 |
| 0283 | 2989 | 2.8×10^2 | | 3849 | 2.2×10^2 |
| 0275 | 2990 | 2.8×10^2 | | 3850 | 2.3×10^2 |
| 0263 | 2991 | 3×10^2 | | 3851 | 2.3×10^2 |
| 0291 | 2992 | 3.1×10^2 | | 3852 | 2×10^2 |
| 0266 | 2993 | 2.75×10^2 | | 3853 | 2.8×10^2 |
| | 2994 | 2.73×10^2 | | 3854 | 2.75×10^2 |
| 0267 | 2995 | 3.3×10^2 | | 3855 | 2.7×10^2 |
| 3099 | 2996 | 3.4×10^2 | | 3856 | 2.65×10^2 |
| 0282 | 2997 | 3.15×10^2 | | 3857 | 2.7×10^2 |
| 0277 | 2998 | 3.55×10^2 | | 3858 | 2.7×10^2 |
| 0265 | 2999 | 2.33×10^2 | | 3859 | 2.4×10^2 |
| 3028 | 3000 | 3.55×10^2 | | 3860 | 1.9×10^2 |
| 3005 | 3001 | 3.55×10^2 | | 3861 | 2.85×10^2 |
| | 3002 | 3.2×10^2 | | 3862 | 2.3×10^2 |
| 3008 | 3003 | 3.0×10^2 | | 3863 | 3.7×10^2 |
| 3006 | 3004 | 3.6×10^2 | | 3864 | 2.2×10^2 |
| | 3005 | 4.05×10^2 | | 3865 | 2.3×10^2 |
| 3003 | 3006 | 3.7×10^2 | | 3866 | 2.3×10^2 |
| 3005 | 3007 | 2.78×10^2 | | 3867 | 3.35×10^2 |

TABLE 3.24—(Continued)

| Project 39.6a No. | Badge No. | Dose, r | Project 39.6a No. | Badge No. | Dose, r |
|-------------------|-----------|--------------------|-------------------|-----------|--------------------|
| | 3868 | 2.3×10^2 | | 4004 | 2.55×10^2 |
| | 3869 | 2.6×10^2 | | 4005 | 1.95×10^2 |
| | 3870 | 2.2×10^2 | | 4006 | 1.9×10^2 |
| | 3871 | 2.9×10^2 | | 4007 | 1.9×10^2 |
| | 3872 | 3.0×10^2 | | 4008 | 2.1×10^2 |
| | 3873 | 3.1×10^2 | | 4009 | 2.15×10^2 |
| | 3874 | 1.9×10^2 | | 4010 | 1.9×10^2 |
| | 3875 | 2.9×10^2 | | 4011 | 1.7×10^2 |
| | 3876 | 2.9×10^2 | | 4012 | 1.55×10^2 |
| | 3877 | 2.8×10^2 | | 4014 | 1.4×10^2 |
| | 3878 | 3.15×10^2 | | 4015 | 1.45×10^2 |
| | 3879 | 3.05×10^2 | | 4016 | 2.65×10^2 |
| | 3880 | 2.55×10^2 | | 4017 | 1.35×10^2 |
| | 3881 | 2.9×10^2 | | 4018 | 2.0×10^2 |
| | 3882 | 3.35×10^2 | | 4019 | 1.8×10^2 |
| | 3883 | 3.1×10^2 | | 4020 | 2.95×10^2 |
| | 3884 | 2.65×10^2 | | 4021 | 1.25×10^2 |
| | 3885 | 3.55×10^2 | | 4022 | 1.15×10^2 |
| | 3886 | 4.1×10^2 | | 4023 | 1.45×10^2 |
| | 3887 | 3.15×10^2 | | 4024 | 1.25×10^2 |
| | 3888 | 4.15×10^2 | | 4025 | 1.3×10^2 |
| | 3889 | 3.65×10^2 | | 4026 | 2.4×10^2 |
| | 3890 | 3.7×10^2 | | 4027 | 1.35×10^2 |
| | 3891 | 3.75×10^2 | | 4028 | 1.7×10^2 |
| | 3892 | 3.4×10^2 | | 4029 | 1.5×10^2 |
| | 3893 | 3.4×10^2 | | 4030 | 1.28×10^2 |
| | 3894 | 3.3×10^2 | | 4031 | 2.8×10^2 |
| | 3895 | 2.9×10^2 | | 4032 | 1.55×10^2 |
| | 3896 | 4.25×10^2 | | 4033 | 2.05×10^2 |
| | 3897 | 3.75×10^2 | | 4034 | 1.75×10^2 |
| | 3898 | 4.65×10^2 | | 4035 | 2.05×10^2 |
| | 3899 | 3.6×10^2 | | 4036 | 1.59×10^2 |
| | 3900 | 4.45×10^2 | | 4037 | 1.4×10^2 |
| | 3901 | 3.6×10^2 | | 4038 | 1.8×10^2 |
| | 3902 | 4.4×10^2 | | 4039 | 1.6×10^2 |
| | 3903 | 4.8×10^2 | | 4040 | 1.55×10^2 |
| | 3904 | 3.1×10^2 | | 4041 | 1.3×10^2 |
| | 3905 | 3.0×10^2 | | 4042 | 1.45×10^2 |
| | 3906 | 3.75×10^2 | | 4043 | 1.7×10^2 |
| | 3907 | 3.9×10^2 | | 4044 | 1.55×10^2 |
| | 3908 | 3.8×10^2 | | 4045 | 1.3×10^2 |
| | 3909 | 3.05×10^2 | | 4046 | 1.2×10^2 |
| | 3910 | 3.0×10^2 | | 4047 | 1.35×10^2 |
| | 3911 | 4.2×10^2 | | 4048 | 1.45×10^2 |
| | 3992 | 3.1×10^2 | | 4049 | 1.5×10^2 |
| | 3993 | 1.7×10^2 | | 4050 | 1.4×10^2 |
| | 3994 | 2.2×10^2 | | 4051 | 1.4×10^2 |
| | 3995 | 1.9×10^2 | | 4052 | 1.65×10^2 |
| | 3996 | 1.95×10^2 | | 4053 | 1.6×10^2 |
| | 3997 | 2.2×10^2 | | 4054 | 1.3×10^2 |
| | 3998 | 1.8×10^2 | | 4055 | 1.8×10^2 |
| | 3999 | 2.35×10^2 | | 4056 | 1.7×10^2 |
| | 4000 | 1.9×10^2 | | 4057 | 1.5×10^2 |
| | 4001 | 1.55×10^2 | | 4058 | 1.40×10^2 |
| | 4002 | 1.9×10^2 | | 4059 | 1.40×10^2 |
| | 4003 | 1.8×10^2 | | 4060 | 1.7×10^2 |

TABLE 3.24—(Continued)

| Project 39.6a No. | Badge No. | Dose, r | Project 39.6a No. | Badge No. | Dose, r |
|-------------------|-----------|--------------------|-------------------|-----------|--------------------|
| | 4061 | 1.6×10^3 | | 4067 | 1.25×10^3 |
| | 4062 | 1.4×10^3 | | 4068 | 1.15×10^3 |
| | 4063 | 1.35×10^3 | | 4069 | 1.2×10^3 |
| | 4064 | 1.4×10^3 | | 4070 | 1.3×10^3 |
| | 4065 | 1.7×10^3 | | 4071 | 1.25×10^3 |
| | 4066 | 1.45×10^3 | | | |

TABLE 3.25—WHITNEY, GOAL-POST LINE*

| Slant distance (D), yd | D ² | Dose in EG&G container, r | RD ² | No. of EG&G badges per point | Maximum deviation per point, % | Film type read |
|------------------------|--------------------|---------------------------|--------------------|------------------------------|--------------------------------|----------------|
| 768 | 5.9×10^5 | 9.13×10^3 | 5.39×10^9 | 4 | 4.1 | 1112 |
| 1011 | 1.02×10^6 | 2.16×10^3 | 2.2×10^9 | 4 | 4.2 | 1112 |
| 1260 | 1.59×10^6 | 6.3×10^3 | 10^9 | 4 | 1.6 | 1112 |
| 1509 | 2.28×10^6 | 2.41×10^3 | 5.49×10^9 | 4 | 4.6 | 698 |
| 1760 | 3.1×10^6 | 87 | 2.7×10^9 | 4 | 10.3 | 510 |

*Dose vs. distance: RD² vs. D.

Chapter 4

RECOMMENDATIONS

In order that the films can be handled more effectively and efficiently after a shot, it is recommended that a crew be permanently stationed on site to place badges on short notice, make the fastest possible recovery, and arrange immediate courier delivery of the dosimeters to Las Vegas for processing. In addition, the films could be placed in the field in the evening, be recovered early in the morning in the event of postponement, and be replaced in a large storage reefer for future use. After the shot and calibration films are received in Las Vegas, a second crew would immediately prepare the films for processing and would read and analyze the results for fast preliminary distribution.

Chapter 5

FUTURE ACTIVITIES

In an attempt to better serve the needs of CFTO, it is anticipated that EG&G will undertake the following research sponsored by the Division of Biology and Medicine before any future operations:

- 1. Design and fabrication of a thermal-neutron-shield system**
- 2. Experimentation to evaluate environmental desensitization parameters**
- 3. Rate vs. response studies**
- 4. Absolute processing reproducibility studies involving large numbers of film badges**

Appendix

DATA FOR DISTRIBUTED FILM BADGES

The data in Tables A.1 to A.14 represent the interpreted doses of EG&G badges issued to various groups by Project 39.1a and returned to EG&G for processing and analysis. Badges exposed in the field were processed simultaneously with control badges receiving known amounts of gamma radiation. Since large numbers of film badges were issued to various agencies because of participation in several events and since these badges were returned to EG&G with no shot name associated, data are reported with the user's identification number and symbols or with EG&G identification numbers.

TABLE A.1—FALLOUT BADGE STUDY (Program 37)

| Badge No. | Dose, r | Badge No. | Dose, r | Badge No. | Dose, r |
|-----------|---------|-----------|---------|-----------|---------|
| 3032 | 7 | 3061 | 2.30 | 3125 | 0 |
| 3033 | 0.48 | 3062 | 2.30 | 3126 | 0 |
| 3035 | 0.65 | 3064 | 1.40 | 3127 | 0 |
| 3036 | 1.90 | 3065 | 1.70 | 3128 | 0 |
| 3037 | 0.03 | 3067 | 0.24 | 3129 | 0 |
| 3038 | ≤0.03 | 3068 | 1.70 | 3130 | 0.04 |
| 3039 | ≤0.03 | 3070 | 1.50 | 3131 | 0 |
| 3040 | ≤0.03 | 3071 | 0.10 | 3132 | 0 |
| 3041 | ≤0.03 | 3073 | 0 | 3133 | 0 |
| 3042 | 0.90 | 3074 | 0 | 3134 | 0 |
| 3043 | 3.90 | 3076 | 0 | 3135 | 0.04 |
| 3044 | ≤0.03 | 3079 | 0 | 3136 | 0 |
| 3045 | 2.10 | 3112 | 0 | 3137 | 0 |
| 3046 | ≤0.03 | 3113 | 0 | 3138 | 0 |
| 3047 | 0.80 | 3114 | 0.04 | 3139 | 0 |
| 3048 | 0.10 | 3115 | 0 | 3140 | 0 |
| 3049 | 0.04 | 3116 | 0.06 | 3141 | 0 |
| 3050 | ≤0.03 | 3117 | 0 | 3142 | 0 |
| 3051 | 2.10 | 3118 | 0 | 3143 | 0 |
| 3052 | ≤0.03 | 3119 | 0.04 | 3144 | 0.04 |
| 3053 | ≤0.04 | 3120 | 0 | 3145 | 0.24 |
| 3055 | 0.08 | 3121 | 0 | 3146 | 0.04 |
| 3056 | ≤0.03 | 3122 | 0 | 3147 | 0 |
| 3058 | ≤0.03 | 3123 | 0 | 3148 | 0.19 |
| 3059 | 1.70 | 3124 | 0 | 3149 | 0 |

TABLE A.1 — (Continued)

| Badge No. | Dose, r | Badge No. | Dose, r | Badge No. | Dose, r |
|-----------|---------|-----------|---------|-----------|---------|
| 3150 | 0.08 | 3207 | 0.04 | 3264 | 0.08 |
| 3151 | 0.24 | 3208 | 0 | 3265 | 0.10 |
| 3152 | 0.24 | 3209 | 0.04 | 3266 | 0.24 |
| 3153 | 0.24 | 3210 | 0.35 | 3267 | 0.24 |
| 3154 | 0.48 | 3211 | 0.24 | 3268 | 0.04 |
| 3155 | 0.19 | 3212 | 0.24 | 3269 | 0 |
| 3156 | 0.48 | 3213 | 0.48 | 3270 | 0.04 |
| 3157 | 0.04 | 3214 | 0.24 | 3271 | 0 |
| 3158 | 0.19 | 3215 | 0.10 | 3272 | 0 |
| 3159 | 0.15 | 3216 | 0.48 | 3273 | 0.19 |
| 3160 | 0.08 | 3217 | 0.40 | 3274 | 0 |
| 3161 | 0.08 | 3218 | 0.10 | 3275 | 12.5 |
| 3162 | 0.08 | 3219 | 0.15 | 3276 | 1.00 |
| 3163 | 0.09 | 3220 | 0.24 | 3277 | 0.20 |
| 3164 | 0.10 | 3221 | 0.24 | 3278 | 0 |
| 3165 | 0.10 | 3222 | 0.35 | 3279 | 3.40 |
| 3166 | 0.15 | 3223 | 0.40 | 3280 | 0.70 |
| 3167 | 0.15 | 3224 | 0.24 | 3281 | 8.00 |
| 3168 | 0.10 | 3225 | 0.40 | 3282 | 0 |
| 3169 | 0.15 | 3226 | 0.35 | 3283 | 0 |
| 3170 | 0.15 | 3227 | 0.24 | 3284 | 1.40 |
| 3171 | 0.19 | 3228 | 0.24 | 3285 | 0 |
| 3172 | 0.10 | 3229 | 0.48 | 3286 | 0 |
| 3173 | 0.10 | 3230 | 0.24 | 3287 | 0 |
| 3174 | 0.10 | 3231 | 0.10 | 3288 | 0 |
| 3175 | 0.10 | 3232 | 0.10 | 3289 | 0 |
| 3176 | 0.08 | 3233 | 0.10 | 3290 | 0 |
| 3177 | 0.10 | 3234 | 0.10 | 3291 | 1.80 |
| 3178 | 0.10 | 3235 | 0.10 | 3292 | 0.24 |
| 3179 | 0.08 | 3236 | 0.19 | 3293 | 0 |
| 3180 | 0.24 | 3237 | 0.15 | 3294 | 1.70 |
| 3181 | 0.27 | 3238 | 0.19 | 3295 | 0 |
| 3182 | 0.24 | 3239 | 0.24 | 3296 | 1.70 |
| 3183 | 0.19 | 3240 | 0 | 3300 | 0 |
| 3184 | 0.15 | 3241 | 0 | 3301 | 0.04 |
| 3185 | 0.90 | 3242 | 0.48 | 3302 | 0 |
| 3186 | 0.24 | 3243 | 0.48 | 3303 | 0.04 |
| 3187 | 0.15 | 3244 | 0 | 3304 | 0.08 |
| 3188 | 0.27 | 3245 | 0 | 3305 | 0 |
| 3189 | 0.70 | 3246 | 0 | 3306 | 1.90 |
| 3190 | 0.24 | 3247 | 0 | 3307 | 1.80 |
| 3191 | 0.24 | 3248 | 0 | 3308 | 0 |
| 3192 | 0.24 | 3249 | 0 | 3309 | 50.0 |
| 3193 | 0.24 | 3250 | 0.10 | 3310 | 0 |
| 3194 | 0.27 | 3251 | 0.09 | 3312 | 0 |
| 3195 | 0.24 | 3252 | 0.08 | 3313 | 0 |
| 3196 | 0.15 | 3253 | 0.08 | 3314 | 0.08 |
| 3197 | 0.10 | 3254 | 0.15 | 3315 | 0 |
| 3198 | 0.15 | 3255 | 0.15 | 3317 | 0.70 |
| 3199 | 0.10 | 3256 | 0.24 | 3318 | 0.70 |
| 3200 | 0 | 3257 | 0.08 | 3319 | 0.48 |
| 3201 | 0 | 3258 | 0.10 | 3320 | 3.50 |
| 3202 | 0.08 | 3259 | 0.10 | 3322 | 0 |
| 3203 | 0 | 3260 | 0.10 | 3323 | 0.10 |
| 3204 | 0 | 3261 | 0.15 | 3324 | 0.54 |
| 3205 | 0.08 | 3262 | 0.19 | 3325 | 1.90 |
| 3206 | 0.08 | 3263 | 0.19 | 3326 | 0.04 |
| | | | | 3327 | 0 |
| | | | | 3328 | 0 |

TABLE A.1 — (Continued)

| Badge No. | Dose, r | Badge No. | Dose, r | Badge No. | Dose, r |
|-----------|---------|-----------|---------|-----------|---------|
| 3329 | 1.50 | 3919 | 0.075 | 4090 | 0.075 |
| 3331 | 0 | 3922 | 0.075 | 4091 | 2.30 |
| 3332 | 0.54 | 3923 | 0.12 | 4092 | 0.075 |
| 3336 | 0.04 | 3924 | 0.075 | 4093 | 0.04 |
| 3338 | 0.04 | 3927 | 0.04 | 4094 | 0.02 |
| 3341 | 0.03 | 3931 | 0.1 | 4096 | 0.10 |
| 3345 | 0.10 | 3932 | 0.12 | 4096 | 0.075 |
| 3349 | 50.0 | 3933 | 0.1 | 4097 | 0.10 |
| 3629 | 0.56 | 3934 | 0.01 | 4099 | 0.02 |
| 3630 | 0.45 | 3935 | 0.01 | 4099 | 0.02 |
| 3631 | 0.20 | 3938 | 0.12 | 4100 | 0.02 |
| 3632 | 0.40 | 3942 | 0.01 | 4101 | 0.02 |
| 3634 | 0.075 | 3943 | 0.15 | 4109 | 0.20 |
| 3635 | 0.075 | 3944 | 0.01 | 4109 | 0 |
| 3645 | 0.04 | 3945 | 0.04 | 4110 | 0.15 |
| 3646 | 0.04 | 3946 | 0.04 | 4111 | 0 |
| 3647 | 0.075 | 3948 | 0.26 | 4112 | 0.01 |
| 3650 | 0.075 | 3950 | 0.40 | 4113 | 0.175 |
| 3651 | 0.10 | 3952 | 0.26 | 4115 | 0.20 |
| 3652 | 0.10 | 3953 | 0.175 | 4116 | 0 |
| 3653 | 0.075 | 3954 | 0 | 4117 | 0.20 |
| 3658 | 0.075 | 3956 | 0.26 | 4120 | 0.175 |
| 3659 | 0.04 | 3960 | 0 | 4121 | 0.175 |
| 3661 | 0.04 | 3961 | 0.01 | 4122 | 0.12 |
| 3663 | 0.04 | 3962 | 0.26 | 4124 | 0.10 |
| 3664 | 0.075 | 3966 | 0.075 | 4125 | 2.75 |
| 3665 | 0.04 | 3967 | 0.075 | 4126 | 0.70 |
| 3666 | 0.04 | 3968 | 0.1 | 4127 | 0.175 |
| 3667 | 0.04 | 3978 | 0.075 | 4130 | 0.175 |
| 3668 | 0.10 | 4072 | 0.04 | 4139 | 0.04 |
| 3670 | 0 | 4075 | 0.075 | 4141 | 0.075 |
| 3671 | 0.15 | 4076 | 0.04 | 4142 | 0.075 |
| 3912 | 0.075 | 4077 | 0.04 | 4143 | 0.10 |
| 3913 | 0.075 | 4078 | 0.12 | 4144 | 0.10 |
| 3914 | 0.075 | 4079 | 0.12 | 4145 | 0.26 |
| 3915 | 0.075 | 4081 | 0.075 | 4147 | 0.10 |
| 3916 | 0.075 | 4084 | 0.01 | 4148 | 0.075 |
| 3917 | 0.12 | 4085 | 0.075 | 4149 | 0.075 |
| 3918 | 0.075 | 4088 | 0.04 | 4150 | 0.15 |
| | | | | 4151 | 0.075 |

TABLE A.2—FALLOUT BADGE STUDY (Program 37)

| Badge No. | Dose, r | Badge No. | Dose, r |
|-----------|---------|-----------|---------|
| 1661 | 0.07 | 1843 | 0.01 |
| 1662 | 0.09 | 1844 | 0.05 |
| 1663 | 0.09 | 1845 | 0.03 |
| 1664 | 0.03 | 1846 | 0.05 |
| 1665 | 0.03 | 1847 | 0.07 |
| 1667 | 0.05 | 1848 | 0.03 |
| 1668 | 0.03 | 1849 | 0.07 |
| 1671 | 0.03 | 1850 | 0.07 |
| 1672 | 0.05 | 1851 | 0.07 |
| 1673 | 0.07 | 1852 | 0.03 |
| 1675 | 0.05 | 1853 | 0.01 |
| 1676 | 0.05 | 1854 | 0.03 |
| 1677 | 0.05 | 1855 | 0.03 |
| 1678 | 0.05 | 1856 | 0.05 |
| 1679 | 0.09 | 1857 | 0.03 |
| 1680 | 0.05 | 1858 | 0.03 |
| 1683 | 0.05 | 1859 | 0 |
| 1684 | 0.05 | 1870 | 0 |
| 1688 | 0.01 | 1871 | 0 |
| 1691 | 0.03 | 1872 | 0 |
| 1692 | 0.03 | 1873 | 0 |
| 1693 | 0.03 | 1874 | 0 |
| 1821 | 0.01 | 1875 | 0.01 |
| 1822 | 0.01 | 1876 | 0 |
| 1823 | 0.01 | 1877 | 0 |
| 1824 | 0.03 | 1878 | 0 |
| 1825 | 0.03 | 1879 | 0 |
| 1828 | 0 | 1880 | 0 |
| 1829 | 0 | 1881 | 0.03 |
| 1840 | 0.01 | 1882 | 0 |
| 1841 | 0.01 | 1884 | 0.03 |
| 1842 | 0.01 | 1885 | 0.01 |

TABLE A.3—PROJECT TERRY-2 (Program 37)

| Station | Position | Badge No. | Dose, r |
|---------|----------|-----------|---------|
| 0206 | GV | 1684 | 0 |
| 0206 | GH | 1879 | 0 |
| 0206 | 3'V | 1683 | 0.02 |
| 0206 | 3'H | 1873 | 0 |
| 0206 | 3'B | 1874 | 0 |
| 0210 | GV | 1882 | 0 |
| 0210 | GH | 1879 | 0 |
| 0210 | 3'V | 1880 | 0 |
| 0210 | 3'H | 1688 | 0 |
| 0210 | 3'B | 1885 | 0.02 |
| 0214 | GV | 1881 | 0 |
| 0214 | GH | 1876 | 0 |
| 0214 | 3'V | 1884 | 0 |
| 0214 | 3'H | 1875 | 0 |
| 0214 | 3'B | 1977 | 0 |
| 0218 | GV | 1690 | 0.02 |
| 0218 | GH | 1870 | 0 |
| 0218 | 3'V | 1693 | 0 |
| 0218 | 3'H | 1871 | 0 |
| 0218 | 3'B | 1872 | 0 |
| Control | | 1691 | 0 |
| Control | | 1692 | 0 |

TABLE A.4—PROJECT TERRY-3 (Program 37)

| Station | Position | Badge No. | Dose, r |
|---------|-------------|-----------|---------|
| 0306 | GV | 1848 | 0 |
| 0306 | GH | 1855 | 0.02 |
| 0306 | 3'V | 1850 | 0 |
| 0306 | 3'H | 1858 | 0.04 |
| 0306 | 3'B | 1859 | 0 |
| 0310 | GV | 1856 | 0.04 |
| 0310 | GH | 1851 | 0.02 |
| 0310 | 3'V | 1857 | 0 |
| 0310 | 3'H | 1854 | 0.02 |
| 0310 | 3'B | 1852 | 0 |
| 0314 | GV | 1844 | 0.04 |
| 0314 | GH | 1847 | 0.02 |
| 0314 | 3'V | 1849 | 0.06 |
| 0314 | 3'H | 3068 | 1.09 |
| 0314 | 3'B | 3071 | 0.09 |
| 0318 | GV | 1843 | 0.02 |
| 0318 | GH | 1846 | 0.02 |
| 0318 | 3'V | 1845 | 0.02 |
| 0318 | 3'H | 1853 | 0.02 |
| 0318 | 3'B (33277) | | 0.06 |
| Control | | 1840 | 0 |
| Control | | 1841 | 0 |
| Control | | 1842 | 0 |

TABLE A.5—PROJECT TERRY-4 (Program 37)

| Station | Position | Badge No. | Dose, r |
|---------|----------|-----------|---------|
| 0406 | GV | 1824 | 0 |
| 0406 | GH | 1823 | 0 |
| 0406 | 3V | 1821 | 0 |
| 0406 | 3H | 1822 | 0.02 |
| 0406 | 3B | 1825 | 0 |
| 0410 | GV | 1677 | 0.04 |
| 0410 | GH | 1679 | 0.02 |
| 0410 | 3V | 1675 | 0 |
| 0410 | 3H | 1678 | 0.02 |
| 0410 | 3B | 1676 | 0.02 |
| 0414 | GV | 1667 | 0.02 |
| 0414 | GH | 1672 | 0.02 |
| 0414 | 3V | 1668 | 0.04 |
| 0414 | 3H | 1671 | 0.02 |
| 0414 | 3B | 1673 | 0 |
| 0418 | GV | 1664 | 0.02 |
| 0418 | GH | 1662 | 0.02 |
| 0418 | 3V | 1665 | 0 |
| 0418 | 3H | 1663 | 0.04 |
| 0418 | 3B | 1661 | 0.02 |
| Control | | 1828 | 0 |
| Control | | 1829 | 0 |

TABLE A.6—PROJECT TERRY-5 (Program 37)

| Station | Position | Badge No. | Dose, r |
|---------|----------|-----------|---------|
| 0506 | GV | | |
| 0506 | GH | 3048 | 0.10 |
| 0506 | 3V | | |
| 0506 | 3H | 3055 | 0.57 |
| 0506 | 3B | 3073 | 0 |
| 0510 | GV | | |
| 0510 | GH | 3039 | 0 |
| 0510 | 3V | | |
| 0510 | 3H | 3070 | 0.15 |
| 0510 | 3B | 3076 | 0 |
| 0514 | GV | | |
| 0514 | GH | 3290 | 0 |
| 0514 | 3V | | |
| 0514 | 3H | 3044 | 0 |
| 0514 | 3B | 3067 | 0.19 |
| 0518 | GV | 3052 | 0 |
| 0518 | GH | 3326 | 0.10 |
| 0518 | 3V | 3341 | 0.07 |
| 0518 | 3H | 3310 | 0 |
| 0518 | 3B | 3072 | 0 |
| Control | | 3053 | 0 |
| Control | | 3074 | 0 |
| Control | | 3058 | 0 |
| Control | | 3297 | 0 |
| Control | | 3288 | 0 |
| Control | | 3056 | 0 |
| Control | | 3293 | 0 |
| Control | | 3049 | 0 |

TABLE A.7—PROJECT TERRY-6 (Program 37)

| Station | Position | Badge No. | Dose, r |
|---------|----------|-----------|---------|
| 0606 | G | 3064 | 0 |
| 0606 | B | 3224 | 0 |
| 0606 | B | 3276 | 0 |
| 0610 | G | 3042 | 0 |
| 0610 | B | 3318 | 0 |
| 0610 | B | 3286 | 0 |
| 0614 | G | 3059 | 0.15 |
| 0614 | B | 3061 | 0.80 |
| 0614 | B | 3294 | 0 |
| 0618 | G | 3062 | 0.80 |
| 0618 | B | 3351 | 0.50 |
| 0618 | B | 3045 | 0.80 |
| Control | | 3065 | 0 |
| Control | | 3317 | 0 |

TABLE A.8—PROJECT TERRY-7 (Program 37)

| Station | Position | Badge No. | Dose, r |
|---------|----------|-----------|---------|
| 0706 | G | 3277 | 7.4 |
| 0706 | B | 3298 | 6.1 |
| 0706 | B | 3281 | 7.4 |
| 0710 | G | 3275 | 10.4 |
| 0710 | B | 3309 | 30 |
| 0710 | B | 3348 | 35 |
| 0714 | G | 3314 | 5.4 |
| 0714 | B | 3032 | 6.1 |
| 0714 | B | 3279 | 4.6 |
| 0718 | G | 3043 | 3.1 |
| 0718 | B | 3320 | 3.1 |
| 0718 | B | 3329 | 3.4 |
| Control | | 3332 | 0 |
| Control | | 3319 | 0 |

TABLE A.9—PROJECT TERRY-8 (Program 37)

| Station | Position | Badge No. | Dose, r |
|---------|----------|-----------|---------|
| 0806 | G | 3338 | 0 |
| 0806 | B | 3304 | 0 |
| 0806 | B | 3300 | 0 |
| 0810 | G | 3336 | 0 |
| 0810 | B | 3284 | 0 |
| 0810 | B | 3308 | 0 |
| 0814 | G | 3307 | 1.60 |
| 0814 | B | 3325 | 1.80 |
| 0814 | B | 3291 | 1.50 |
| 0818 | G | 3036 | 1.90 |
| 0818 | B | 3306 | 1.60 |
| 0818 | B | 3299 | 1.40 |
| Control | | 3301 | 0 |
| Control | | 3345 | 0 |

TABLE A.10—PROJECT TERRY-9 (Program 37)

| Station | Position | Badge No. | Dose, r |
|---------|----------|-----------|---------|
| 0906 | G | 3280 | 0.57 |
| 0906 | B | 3035 | 0.70 |
| 0906 | B | 3047 | 0.70 |
| 0910 | G | 3273 | 0 |
| 0910 | B | 3292 | 0.06 |
| 0910 | B | 3033 | 0.40 |
| 0914 | G | 3223 | 0 |
| 0914 | B | 3302 | 0 |
| 0914 | B | 3322 | 0 |
| 0918 | G | 3303 | 0 |
| 0918 | B | 3315 | 0 |
| 0918 | B | 3305 | 0 |
| Control | | 3237 | 0 |
| Control | | 3331 | 0 |

TABLE A.11—PROJECT TERRY-10 (Program 37)

| Station | Position | Badge No. | Dose, r |
|---------|----------|-----------|---------|
| 1006 | G | 3312 | 0 |
| 1006 | B | 3313 | 0 |
| 1006 | B | 3328 | 0 |
| 1010 | G | 3046 | 0 |
| 1010 | B | 3271 | 0 |
| 1010 | B | 3272 | 0 |
| 1014 | G | 3278 | 0.02 |
| 1014 | B | 3038 | 0.02 |
| 1014 | B | 3040 | 0 |
| 1018 | G | 3041 | 0 |
| 1018 | B | 3050 | 0 |
| 1018 | B | 3237 | 0 |
| Control | | 3037 | 0 |
| Control | | 3293 | 0 |

TABLE A.12—WHIRLIGIG (Program 35)

| Badge No. | Dose, r | Badge No. | Dose, r |
|-----------|---------|-----------|---------|
| 3289 | 1.0 | 3335 | 1.0 |
| 3311 | 1.25 | 3343 | 1.25 |
| 3316 | 0.95 | 3344 | 1.25 |
| 3321 | 1.0 | 3347 | 1.2 |
| 3330 | 0.95 | 3349 | 1.25 |
| 3333 | 1.1 | 3350 | 1.25 |

TABLE A.13—PROJECT 35.1

| Location | Badge No. | Dose, r |
|--|-----------|---------|
| 3 August 1400: | | |
| 10 ft north of pad | 439 | 200 |
| 10 ft south of pad | 419 | 200 |
| Lower arm of tower, 3-ft elevation | 447 | 157.5 |
| 100 ft west of pad | 446 | 207.5 |
| 100 ft south of pad | 445 | 100 |
| 200 ft west of pad | 413 | 205 |
| 200 ft south of pad | 428 | 207.5 |
| 200 ft east of pad | 448 | 225 |
| 100 ft east of pad | 426 | 207.5 |
| 200 ft north of pad | 409 | 207.5 |
| 100 ft north of pad | 427 | 212.5 |
| 10 ft north, 2 in. deep | 429 | 0 |
| 10 ft south, 2 in. deep | 449 | 0 |
| 7 August 1500: | | |
| Height: 9 ft, lower side arm, 41 in. from tower | 3351 | 140 |
| Height: 9 ft, lower side arm, 27 in. from tower | 3339 | 134 |
| Height: 9 ft, lower side arm, 14 in. from tower | 3342 | 134 |
| Height: 3 ft, lower side arm, 41 in. from tower | 3324 | 150 |
| Height: 3 ft, lower side arm, 27 in. from tower | 3337 | 143 |
| Height: 3 ft, lower side arm, 14 in. from tower | 3340 | 147.5 |

TABLE A.14—AFSWP-DOD BADGES
(Project 2.10)

| Badge No. | Dose, r* | Badge No. | Dose, r* |
|-----------|-------------------|-----------|--------------------|
| 1741 | 9.0×10^3 | 1748 | 2.5×10^3 |
| 1742 | 2.7×10^3 | 2179 | 1.25×10^3 |
| 1743 | 5.0×10^4 | 2180 | 460 |
| 1744 | 1.0×10^4 | 2181 | 450 |
| 1745 | 9.0×10^3 | 2182 | 240 |
| 1746 | 9.0×10^3 | 2183 | 19 |
| 1747 | 5.1×10^3 | 2184 | 31 |

*From the extrapolated portion of the curve.

DISTRIBUTION

Military Distribution Categories 22 and 28

ARMY ACTIVITIES

| | |
|---|-------|
| Deputy Chief of Staff for Military Operations, D/A, Washington 25, D. C. ATTN: Dir. of SW&R | 1 |
| Chief of Research and Development, D/A, Washington 25, D. C. ATTN: Atomic Div. | 2 |
| Assistant Chief of Staff, Intelligence, D/A, Washington 25, D. C. | 3 |
| The Quartermaster General, D/A, Washington 25, D. C. ATTN: Research and Development | 4-5 |
| Chief Chemical Officer, D/A, Washington 25, D. C. | 6-7 |
| Chief of Engineers, D/A, Washington 25, D. C. ATTN: ENGNB | 8 |
| Chief of Engineers, D/A, Washington 25, D. C. ATTN: ENGTB | 9 |
| Office, Chief of Ordnance, D/A, Washington 25, D. C. ATTN: ORDTN | 10-11 |
| Chief Signal Officer, D/A, Comb. Development and Operations Div., Washington 25, D. C. ATTN: SIGCO-4 | 12 |
| Chief of Transportation, D/A, Office of Planning and Intelligence, Washington 25, D. C. | 13 |
| The Surgeon General, D/A, Washington 25, D. C. ATTN: MEDNE | 14-15 |
| Commanding General, U. S. Continental Army Command, Ft. Monroe, Va. | 16-18 |
| Director of Special Weapons Development Office, Headquarters, CONARC, Ft. Bliss, Tex. ATTN: Capt Chester L. Peterson | 19 |
| President, U. S. Army Artillery Board, U. S. Continental Army Command, Ft. Sill, Okla. | 20 |
| President, U. S. Army Infantry Board, Ft. Benning, Ga. | 21 |
| President, U. S. Army Air Defense Board, U. S. Continental Army Command, Ft. Bliss, Tex. | 22 |
| President, U. S. Army Aviation Board, Ft. Rucker, Ala. ATTN: ATBG-DG | 23 |
| Commanding General, First United States Army, Governor's Island, New York 4, N. Y. | 24 |
| Commanding General, Second U. S. Army, Ft. George G. Meade, Md. | 25 |
| Commanding General, Third United States Army, Ft. McPherson, Ga. ATTN: ACofS G-3 | 26 |
| Commanding General, Fourth United States Army, Ft. Sam Houston, Tex. ATTN: G-3 Section | 27 |
| Commanding General, Fifth United States Army, 1660 E. Hyde Park Blvd., Chicago 15, Ill. | 28 |
| Commanding General, Sixth United States Army, Presidio of San Francisco, San Francisco, Calif. ATTN: AMGCT-4 | 29 |
| Commanding General, Military District of Washington, USA, Room 1543, Bldg. T-7, Gravelly Point, Va. | 30 |
| Commandant, U. S. Army Command and General Staff College, Ft. Leavenworth, Kans. ATTN: ARCHIVES | 31 |
| Commandant, U. S. Army Air Defense School, Ft. Bliss, Tex. ATTN: Dept. of Tactics and Combined Arms | 32 |
| Commandant, U. S. Army Armored School, Ft. Knox, Ky. | 33 |
| Commandant, U. S. Army Artillery and Missile School, Ft. Sill, Okla. ATTN: Combat Development Department | 34 |
| Commandant, U. S. Army Aviation School, Ft. Rucker, Ala. | 35 |
| Commandant, U. S. Army Infantry School, Ft. Benning, Ga. ATTN: C.D.S. | 36 |
| The Superintendent, U. S. Military Academy, West Point, N. Y. ATTN: Prof. of Ordnance | 37 |
| Commandant, The Quartermaster School, U. S. Army, Ft. Lee, Va. ATTN: Chief, Quartermaster Library | 38 |

| | |
|--|-------|
| Commandant, U. S. Army Ordnance School, Aberdeen Proving Ground, Md. | 39 |
| Commandant, U. S. Army Ordnance and Guided Missile School, Redstone Arsenal, Ala. | 40 |
| Commanding General, Chemical Corps Training Command, Ft. McClellan, Ala. | 41 |
| Commandant, USA Signal School, Ft. Monmouth, N. J. | 42 |
| Commandant, USA Transport School, Ft. Eustis, Va. ATTN: Security and Information Office | 43 |
| Commanding General, The Engineer Center, Ft. Belvoir, Va. ATTN: Asst. Commandant, Engineer School | 44 |
| Commanding General, Army Medical Service School, Brooks Army Medical Center, Ft. Sam Houston, Tex. | 45 |
| Director, Armed Forces Institute of Pathology, Walter Reed Army Medical Center, 625 16th St., NW, Washington 25, D. C. | 46 |
| Commanding Officer, Army Medical Research Laboratory, Ft. Knox, Ky. | 47 |
| Commandant, Walter Reed Army Institute of Research, Walter Reed Army Medical Center, Washington 25, D. C. | 48 |
| Commanding General, Quartermaster Research and Development Command, Quartermaster Research and Development Center, Natick, Mass. ATTN: CBR Liaison Officer | 49-50 |
| Commanding General, U. S. Army Chemical Corps, Research and Development Command, Washington 25, D. C. | 51-52 |
| Commanding Officer, Chemical Warfare Laboratory, Army Chemical Center, Md. ATTN: Tech. Library | 53-54 |
| Commanding General, Engineer Research and Development Laboratory, Ft. Belvoir, Va. ATTN: Chief, Tech. Support Branch | 55 |
| Director, Waterways Experiment Station, P.O. Box 631, Vicksburg, Miss. ATTN: Library | 56 |
| Commanding Officer, Office of Ordnance Research, Box CM, Duke Station, Durham, N. C. | 57 |
| Commanding Officer, Picatinny Arsenal, Dover, N. J. ATTN: ORDBB-TK | 58 |
| Commanding Officer, Diamond Ordnance Fuze Laboratories, Washington 25, D. C. ATTN: Chief, Nuclear Vulnerability Br. (230) | 59 |
| Commanding General, Aberdeen Proving Grounds, Md. ATTN: Director, Ballistic Research Laboratories | 60-61 |
| Commanding General, Frankford Arsenal, Bridge and Tacony Sts., Philadelphia, Pa. | 62 |
| Commanding Officer, Watervliet Arsenal, Watervliet, N. Y. ATTN: ORDBF-RR | 63-64 |
| Commanding General, U. S. Army Ordnance Missile Command, Redstone Arsenal, Ala. Commander, Army Rocket and Guided Missile Agency, Redstone Arsenal, Ala. ATTN: Tech. Library | 65-66 |
| Commanding General, White Sands Proving Ground, Las Cruces, N. Mex. ATTN: ORDBS-OM | 67 |
| Commander, Army Ballistic Missile Agency, Redstone Arsenal, Ala. ATTN: ORDAB-HT | 68 |
| Commanding Officer, Ordnance Materials Research Office, Watertown Arsenal, Watertown 72, Mass. ATTN: Dr. Foster | 69 |
| Commanding General, Ordnance Tank Automotive Command, Detroit Arsenal, Centerline, Mich. ATTN: ORDMC-RO | 70 |
| Commanding General, Ordnance Ammunition Command, Joliet, Ill. | 71 |
| Commanding Officer, USA Signal Research and Development Laboratory, Ft. Monmouth, N. J. | 72 |
| Commanding General, U. S. Army Electronic Proving Ground, Ft. Huachuca, Ariz. ATTN: Tech. Library | 73 |
| Commanding General, USA Combat Surveillance Agency, 1124 N. Highland St., Arlington, Va. | 74 |
| Commanding Officer, USA Signal Research and Development Laboratory, Ft. Monmouth, N. J. ATTN: Tech. Documents Center, Evans Area | 75 |
| Commanding Officer, USA Transportation Combat Development Group, Ft. Eustis, Va. | 76 |
| Director, Operations Research Office, Johns Hopkins University, 6335 Ailington Rd., Bethesda 14, Md. | 77 |
| Commandant, U. S. Army Chemical Corps CBR Weapons School, Dugway Proving Ground, Dugway, Utah | 78 |
| Commander-in-Chief, U. S. Army Europe, APO 403, New York, N. Y. ATTN: Opot. Div., Weapons Br. | 79 |
| Commanding General, Southern European Task Force, APO 168, New York, N. Y. ATTN: ACofS G-3 | 80 |
| Commanding General, Eighth U. S. Army, APO 301, San Francisco, Calif. ATTN: ACofS G-3 | 81 |
| Commanding General, U. S. Army Alaska, APO 342, Seattle, Wash. | 82 |
| | 83 |

| | |
|--|---------|
| Commanding General, U. S. Army Caribbean, Ft. Amador, Canal Zone. ATTN: Cml. Office | 84 |
| Commander-in-Chief, U. S. Army Pacific, APO 968, San Francisco, Calif. ATTN: Ordnance Officer | 85 |
| Commanding General, USARFANT & SADR, Ft. Brooke, Puerto Rico | 86 |
| Commander-in-Chief, EUCCOM, APO 128, New York, N. Y. | 87 |
| Commanding Officer, 9th Hospital Center, APO 180, New York, N. Y. ATTN: CO, U. S. Army Nuclear Medicine Research Detachment, Europe | 88 |
| NAVY ACTIVITIES | |
| Chief of Naval Operations, D/N, Washington 25, D. C. ATTN: OP-03EG | 89 |
| Chief of Naval Operations, D/N, Washington 25, D. C. ATTN: OP-36 | 90 |
| Chief of Naval Operations, D/N, Washington 25, D. C. ATTN: OP-922G2 | 91 |
| Chief of Naval Personnel, D/N, Washington 25, D. C. | 92 |
| Chief of Naval Research, D/N, Washington 25, D. C. ATTN: Code 811 | 93-94 |
| Chief, Bureau of Aeronautics, D/N, Washington 25, D. C. | 95-96 |
| Chief, Bureau of Medicine and Surgery, D/N, Washington 25, D. C. ATTN: Special Weapons Defense Div. | 97-98 |
| Chief, Bureau of Ordnance, D/N, Washington 25, D. C. | 99 |
| Chief, Bureau of Ordnance, D/N, Washington 25, D. C. ATTN: S.P. | 100 |
| Chief, Bureau of Ships, D/N, Washington 25, D. C. ATTN: Code 423 | 101 |
| Chief, Bureau of Yards and Docks, D/N, Washington 25, D. C. ATTN: D-440 | 102 |
| Director, U. S. Naval Research Laboratory, Washington 25, D. C. ATTN: Mrs. Katherine H. Cam | 103 |
| Commander, U. S. Naval Ordnance Laboratory, White Oak, Silver Spring 19, Md. | 104-105 |
| Director, Material Laboratory (Code 900), New York Naval Shipyard, Brooklyn 1, N. Y. | 106 |
| Commanding Officer and Director, Navy Electronics Laboratory, San Diego 52, Calif. | 107 |
| Commanding Officer, U. S. Naval Radiological Defense Laboratory, San Francisco, Calif. ATTN: Tech. Information Div. | 108-111 |
| Officer-in-Charge, U. S. Naval Civil Engineering Research and Evaluation Laboratory, U. S. Naval Construction Battalion Center, Port Hueneme, Calif. ATTN: Code 753 | 112-114 |
| Superintendent, U. S. Naval Academy, Annapolis, Md. | 115 |
| Commanding Officer, U. S. Naval Schools Command, U. S. Naval Station, Treasure Island, San Francisco, Calif. | 116 |
| Superintendent, U. S. Naval Postgraduate School, Monterey, Calif. | 117 |
| Officer-in-Charge, U. S. Naval School, CEC Officers, U. S. Naval Construction Battalion Center, Port Hueneme, Calif. | 118 |
| Commanding Officer, Nuclear Weapons Training Center, Atlantic, U. S. Naval Base, Norfolk 11, Va. ATTN: Nuclear Warfare Dept. | 119 |
| Commanding Officer, Nuclear Weapons Training Center, Pacific, Naval Station, San Diego, Calif. | 120 |
| Commanding Officer, U. S. Naval Damage Control Training Center, Naval Base, Philadelphia 12, Pa. ATTN: ABC Defense Course | 121 |
| Commanding Officer, Air Development Squadron 5, VX-5, China Lake, Calif. | 122 |
| Commanding Officer, U. S. Naval Air Development Center, Johnsville, Pa. ATTN: NAS, Librarian | 123 |
| Commanding Officer, U. S. Naval Medical Research Institute, National Naval Medical Center, Bethesda, Md. | 124 |
| Commanding Officer and Director, David W. Taylor Model Basin, Washington 7, D. C. ATTN: Library | 125 |
| Officer-in-Charge, U. S. Naval Supply Research and Development Facility, Naval Supply Depot, Bayonne, N. J. | 126 |
| Commander-in-Chief, U. S. Atlantic Fleet, U. S. Naval Base, Norfolk 11, Va. | 127 |
| Commandant, U. S. Marine Corps, Washington 25, D. C. ATTN: Code A03H | 128-131 |
| Commandant, U. S. Coast Guard, 1300 E St., NW, Washington 25, D. C. ATTN: (OIN) | 132 |
| Chief, Bureau of Ships, D/N, Washington 25, D. C. ATTN: Code 372 | 133 |
| Commanding Officer, U. S. Naval CIC School, U. S. Naval Air Station, Glynnco, Brunswick, Ga. | 134 |
| Chief of Naval Operations, Department of the Navy, Washington 25, D. C. ATTN: OP-25 | 135 |
| Commander-in-Chief, Pacific, c/o Fleet Post Office, San Francisco, Calif. | 136 |
| Commander-in-Chief, U. S. Pacific Fleet, Fleet Post Office, San Francisco, Calif. | 137 |

AIR FORCE ACTIVITIES

| | |
|--|---------|
| Assistant for Atomic Energy, Headquarters, USAF, Washington 25, D. C. ATTN: DCS/O | 138 |
| Deputy Chief of Staff, Operations, Headquarters, USAF, Washington 25, D. C. ATTN: AFOOP | 139 |
| Deputy Chief of Staff, Operations, Headquarters, USAF, Washington 25, D. C. ATTN: Operations Analysis | 140 |
| Director of Civil Engineering, Headquarters, USAF, Washington 25, D. C. ATTN: APOCE | 141 |
| Assistant Chief of Staff, Intelligence, Headquarters, USAF, Washington 25, D. C. ATTN: AFCDN-38 | 142-143 |
| Director of Research and Development, DCS/D, Headquarters, USAF, Washington 25, D. C. ATTN: Guidance and Weapons Div. | 144 |
| The Surgeon General, Headquarters, USAF, Washington 25, D. C. ATTN: Bio.-Def. Pro. Med. Division | 145 |
| Commander-in-Chief, Strategic Air Command, Offutt AFB, Nebr. ATTN: OAWS | 146 |
| Commander, Tactical Air Command, Langley AFB, Va. ATTN: Document Security Branch | 147 |
| Commander, Air Defense Command, Ent AFB, Colo. ATTN: Atomic Energy Div., ADLAN-A | 148 |
| Commander, Air Force Ballistic Missile Div., Headquarters, ARDC, Air Force Unit Post Office, Los Angeles 46, Calif. ATTN: WDSOT | 149 |
| Commander, Headquarters, Air Research and Development Command, Andrews AFB, Washington 25, D. C. ATTN: HDRWA | 150 |
| Commander, AF Cambridge Research Center, L. G. Hanscom Field, Bedford, Mass. ATTN: CRQST-2 | 151-152 |
| Commander, Air Force Special Weapons Center, Kirtland AFB, Albuquerque, N. Mex. ATTN: Tech. Information and Intelligence Div. | 153-157 |
| Director, Air University Library, Maxwell AFB, Ala. | 158-159 |
| Commander, Lowry AFB, Denver, Colo. ATTN: Dept. of Special Weapons Training | 160 |
| Commandant, School of Aviation Medicine, USAF, Randolph AFB, Tex. ATTN: Research Secretariat | 161 |
| Commander, 1609th Special Weapons Squadron, Headquarters, USAF, Washington 25, D. C. | 162 |
| Commander, Wright Air Development Center, Wright-Patterson AFB, Dayton, Ohio. ATTN: WCOSEI | 163-165 |
| Director, USAF Project RAND, VIA: USAF Liaison Office, The RAND Corp., 1700 Main St., Santa Monica, Calif. | 166-167 |
| Commander, Air Defense Systems Integration Div., L. G. Hanscom Field, Bedford, Mass. ATTN: SIDE-S | 168 |
| Chief, Ballistic Missile Early Warning Project Office, 220 Church St., New York 13, N. Y. ATTN: Col Leo V. Skinner, USAF | 169 |
| Commander, Air Technical Intelligence Center, USAF, Wright-Patterson AFB, Ohio. ATTN: AFCTN-481a, Library | 170 |
| Assistant Chief of Staff, Intelligence, Headquarters, USAF, APO 633, New York, N. Y. ATTN: Directorate of Air Targets | 171 |
| Commander, Alaskan Air Command, APO 942, Seattle, Wash. ATTN: AAOTN | 172 |
| Commander-in-Chief, Pacific Air Forces, APO 953, San Francisco, Calif. ATTN: PFCIE-MIA, Base Recovery | 173 |
| OTHER DEPARTMENT OF DEFENSE ACTIVITIES | |
| Director of Defense Research and Engineering, Washington 25, D. C. ATTN: Tech. Library | 174 |
| Executive Secretary, Military Liaison Committee, P.O. Box 1814, Washington 25, D. C. | 175 |
| Director, Weapons Systems Evaluation Group, Room 1E568, The Pentagon, Washington 25 D. C. | 176 |
| Commandant, The Industrial College of The Armed Forces, Ft. McNair, Washington 25, D. C. | 177 |
| Commandant, Armed Forces Staff College, Norfolk 11, Va. ATTN: Secretary | 178 |
| Chief, Defense Atomic Support Agency, Washington 25, D. C. | 179-184 |
| Commander, Field Command, DASA, Sandia Base, Albuquerque, N. Mex. | 187 |
| Commander, Field Command, DASA, Sandia Base, Albuquerque, N. Mex. ATTN: FCTG | 188 |
| Commander, Field Command, DASA, Sandia Base, Albuquerque, N. Mex. ATTN: FCWT | 189-193 |
| Commander, JTF-7, Arlington Hall Station, Arlington 12, Va. | 194 |
| Administrator, National Aeronautics and Space Administration, 1520 H St., NW, Washington 25, D. C. ATTN: Mr. R. V. Rhode | 195 |
| U. S. Documents Officer, Office of the United States National Military Representative, SMAPE, APO 55, New York, N. Y. | 196 |

RESTRICTED DATA

SECRET

ATOMIC ENERGY COMMISSION ACTIVITIES

| | |
|--|---------|
| U. S. Atomic Energy Commission, Tech. Library, Washington 25, D. C. ATTN: For DMA | 197-199 |
| Los Alamos Scientific Laboratory, Report Library, P.O. Box 1663, Los Alamos, N. Mex. ATTN: Helen Redman | 200-201 |
| Sandia Corporation, Classified Document Division, Sandia Base, Albuquerque, N. Mex. ATTN: H. J. Smyth, Jr. | 202-206 |
| University of California Lawrence Radiation Laboratory, P.O. Box 508, Livermore, Calif. ATTN: Clovis G. Craig | 207-209 |
| Weapon Data Section, Technical Information Service Extension, Oak Ridge, Tenn. | 210 |
| Technical Information Service Extension, Oak Ridge, Tenn. (Surplus) | 214-285 |

ADDITIONAL DISTRIBUTION

| | |
|---|---------|
| Office of Civil and Defense Mobilization, Security Officer, Operational Headquarters, Battle Creek, Mich. ATTN: Rollin U. Bryan, Jr. | 286-310 |
|---|---------|

103

SECRET
RESTRICTED DATA



Defense Nuclear Agency
6801 Telegraph Road
Alexandria Virginia 22310-3398

ERRATA

ISST

29 March 1996

MEMORANDUM FOR DEFENSE TECHNICAL INFORMATION CENTER
ATTENTION: OGD Mr. Bill Bush

SUBJECT: Declassification of AD-339487L and Withdrawal of AD-A995091

The Defense Nuclear Agency Security Office (OPSSI) has declassified and approved for public release (distribution statement "A") the following report:

AD-339487L (WT-1466).

Since the original report (AD-339487L) is declassified and approved for public release, this office requests the removal of the extracted version (AD-A995091, WT-1466-EX) from the DTIC system. The extracted version (AD-A995091) is now obsolete and should no longer be sold.


JOSEPHINE B. WOOD
Chief, Technical Support

ERRATA
AD-339487L



Defense Nuclear Agency
6801 Telegraph Road
Alexandria, Virginia 22310-3398

ISST

29 March 1996

MEMORANDUM FOR DEFENSE TECHNICAL INFORMATION CENTER
ATTENTION: OCD/Mr. Bill Bush


SUBJECT: Declassification of AD-339487L and Withdrawal of AD-A995091

S-RD

The Defense Nuclear Agency Security Office (OPSSI) has declassified and approved for public release (distribution statement "A") the following report:

AD-339487L (WT-1466).

Since the original report (AD-339487L) is declassified and approved for public release, this office requests the removal of the extracted version (AD-A995091, WT-1466-EX) from the DTIC system. The extracted version (AD-A995091) is now obsolete and should no longer be sold.


-JOSEPHINE B. WOOD
Chief, Technical Support