#1147

410937

A Preliminary Report of [redacted] (Flathead)
ROP-97 23 July 1956
Issued as 5540-JFE

THIS DOCUMENT CONSISTS OF 99 PAGES!ST
NO 1 OF 1 COPIES, SERIES MC
R250

DOE HQS., Document Search: March 1983
COLLECTION: Los Alamos Records Center
Group Box 1 Loc: C2-D-80

RG 326 US ATOMIC ENERGY COMMISSION
Location LANL
Collection Records Center
Folder Preliminary Report (Flathead) ROP-97 7/23/56

LIMITED DISTRIBUTION ONLY

~~SECRET~~
~~RESTRICTED DATA~~
This document contains restricted data as defined in the Atomic Energy Act of 1954. Disclosure of its contents in any manner to an unau-

BEST COPY AVAILABLE

CLASSIFICATION CANCELLED
WITH DELETIONS
BY AUTHORITY OF DOE/OC
REVIEWED BY [signature] DATE 1/20/87
DNA 3/31/82
J Diaz 2/2/87

61947

1

Flathead

July 28, 1956

Project 18.4 section, pages 94, 95 and 96.
Issued as separate report.

Distribution:
Copy 1A - Stewart
2A, 3A - Hoerlin

Flathead

Project 10.1, pages 68 & 69 issued as a separate report (JO-242)

Distribution:
Copies 1&2A - Hoerlin

RG 326 US ATOMIC ENERGY COMMISSION
Location [redacted]
Collection J-DIV
Folder Prelim. Rpt. (Flathead)
ROP-97 7/23/56

CLASSIFICATION CANCELLED
WITH DELETIONS
BY AUTHORITY OF DOE/OC
[signature] 1/26/87
REVIEWED BY DATE
* DNA ltr 3/31/82
J Diaz 2/2/87

COPIED/DOE
LANL RC

12

Flathead

July 28, 1956

Project 18.3 section, page 93.
Issued as separate report.

Distribution:
Copy 1A - Hoerlin
2A - Stewart

W

Flathead

Project 18.3, page 93 issued as a separate report (JO-243)

Distribution:
Copies 1&2A - Hoerlin

Flathead

Project 18.4, pages 94 thru 96 issued as a separate report (JO-244)

Distribution:
Copy 1A - Hoerlin

[redacted]

OPERATION REDWING

A PRELIMINARY REPORT

OF

[redacted] (FLATHEAD)

Submitted by Task Group 7.1

5540JFE

23 July 1956

[redacted]

CONTENTS

PAGE NO.

[redacted]

INTRODUCTION

This is a preliminary report, and therefore, does not give either complete or final results of the work of the various projects. No information on the construction of the device is included, in order that the classification may be kept to Secret Restricted Data.

DELETED

It was detonated as the Flathead Shot on a barge off Yurochi Island, Bikini Atoll at 0626.001 June 12, 1956.

[redacted]

[redacted] Results of the various experiments are given in the following pages.

PART I

GENERAL INFORMATION

[redacted] (FLATHEAD)

DELETED

BIKINI OBSERVED WEATHER FOR 12 JUNE 1956
AT DETONATION TIME 0626M

Sea Level Pressure	1012.9 mb
Free Air Surface Temperature	82.0°F
Dew Point Temperature	76.0°F
Relative Humidity	82.0%
Surface Wind	050° at 10 knots
Visibility	10 miles

CLOUDS:

4/10 stratocumulus and cumulus; bases estimated at 2000 ft.

10/10 cirrostratus; bases estimated at 30,000 feet.

WEATHER:

No shower activity reported.

BIKINI UPPER AIR SOUNDING (111900Z)

Pressure (Millibars)	Height (Feet)	Temperature (°C)	Dew Point (°C)
1011	110	27.8	24.5
1000	380	26.8	23.5
947	1,903	22.2	19.5
850	5,020	17.2	11.8
770	7,759	14.2	01.5
735	9,022	10.8	-02.2
700	10,380	08.5	-02.4
666	11,713	06.8	-02.5
640	12,705	05.2	-08.8
611	14,042	02.8	-06.2
560	16,327	-02.8	-10.2
543	17,126	-04.8	-20.5
525	17,995	-04.2	-19.2
500	19,250	-08.2	-11.8
400	24,840	-19.2	-30.5
356	27,592	-25.2	-37.5
300	31,670	-32.3	M
250	35,800	-42.3	M
200	40,630	-54.4	M
150	46,450	-69.9	M
122	50,393	-80.0	M
116	51,345	-79.0	M
112	52,001	-81.0	M
100	54,090	-78.0	M
88	56,430	-76.0	M
68	61,548	-65.0	M
58	64,711	-61.0	M

FOR ED/DOE
LAWRENCE

[redacted]

WINDS ALOFT (111940Z)

Height (Feet)	Direction (Degrees)	Speed (Knots)	Height (Feet)	Direction (Degrees)	Speed (Knots)
1,000	070	20	18,000	150	12
2,000	080	17	20,000	160	11
3,000	090	13	22,000	150	10
4,000	100	11	24,000	160	13
5,000	100	11	26,000	170	15
6,000	100	12	28,000	170	16
7,000	090	12	30,000	200	18
8,000	090	09	32,000	220	17
9,000	100	07	34,000	240	14
10,000	100	06	36,000	260	19
12,000	090	04	38,000	260	29
14,000	130	05	40,000	230	18
16,000	160	09	45,000	240	17
			50,000	360	13
			55,000	100	17

[redacted]

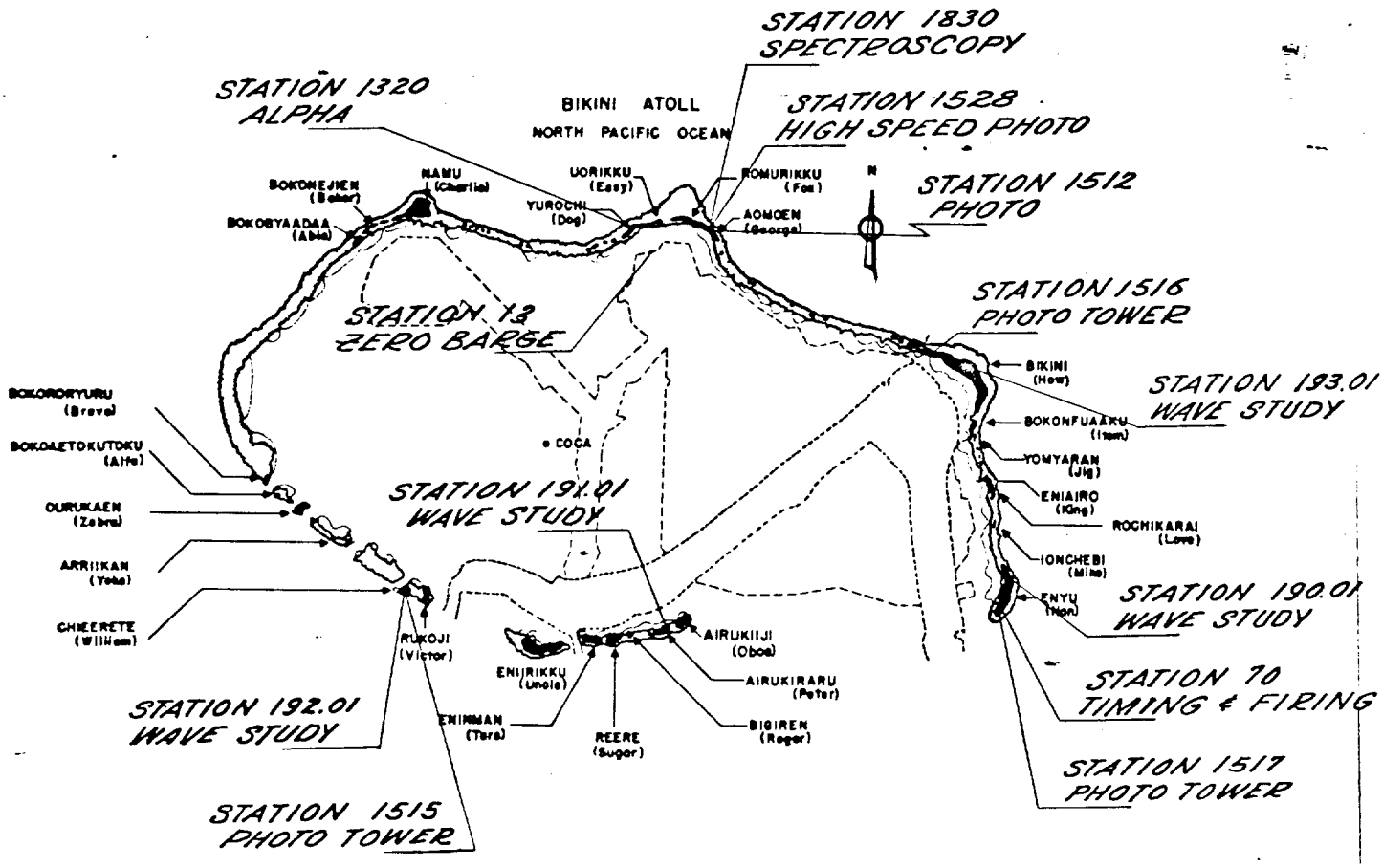


Fig. O-1 - Bikini Atoll Map

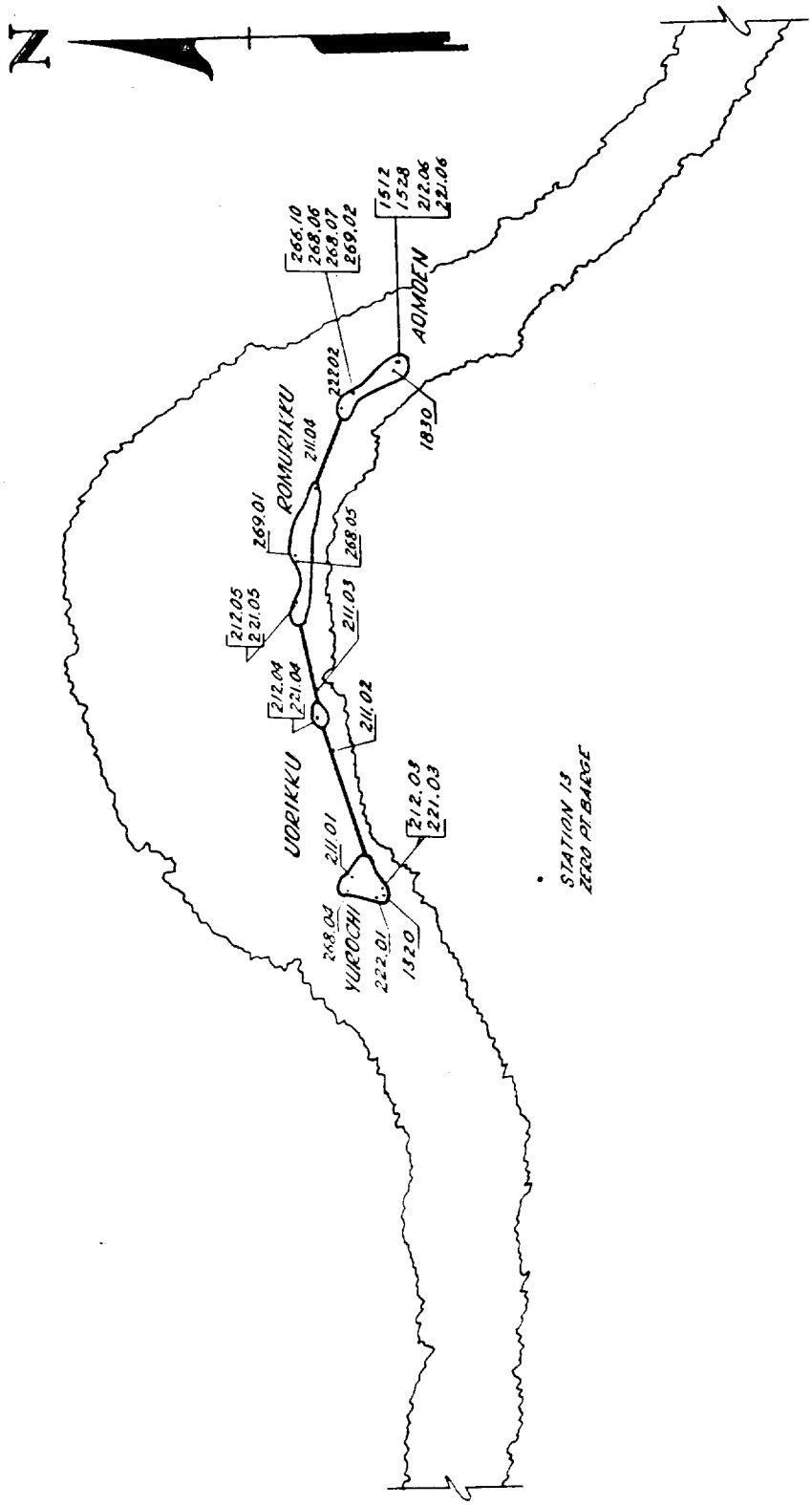


Fig. O-2 - Bikini Area Map, Scientific Stations

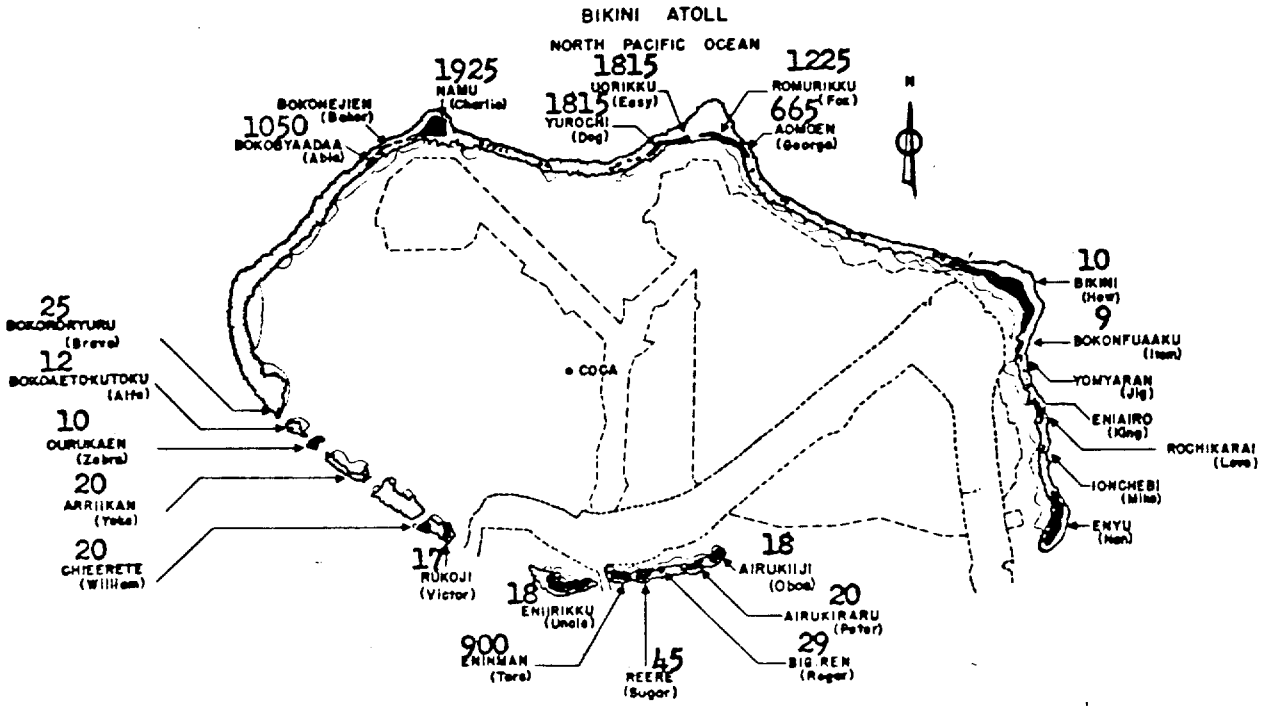


Fig. O-3 - RadSafe Survey, D ⁄ 1

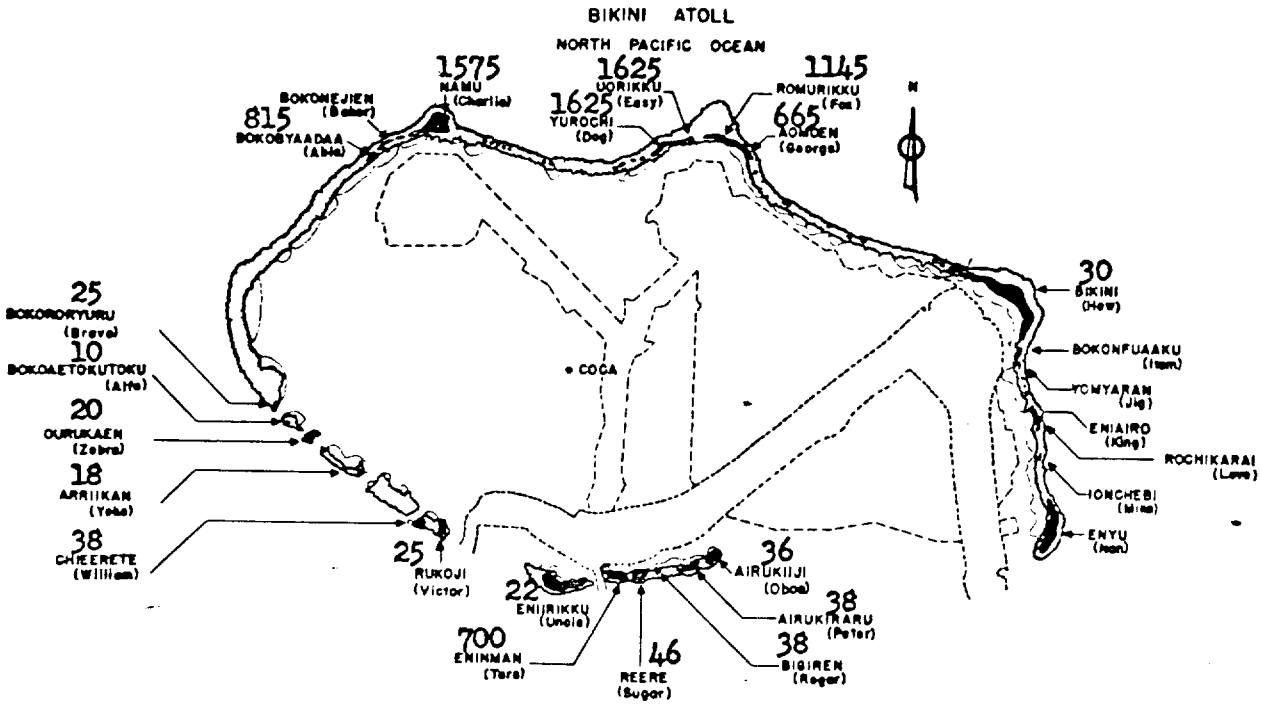


Fig. 0-4 - RadSafe Survey, D ∕ 2

[redacted]

[redacted]

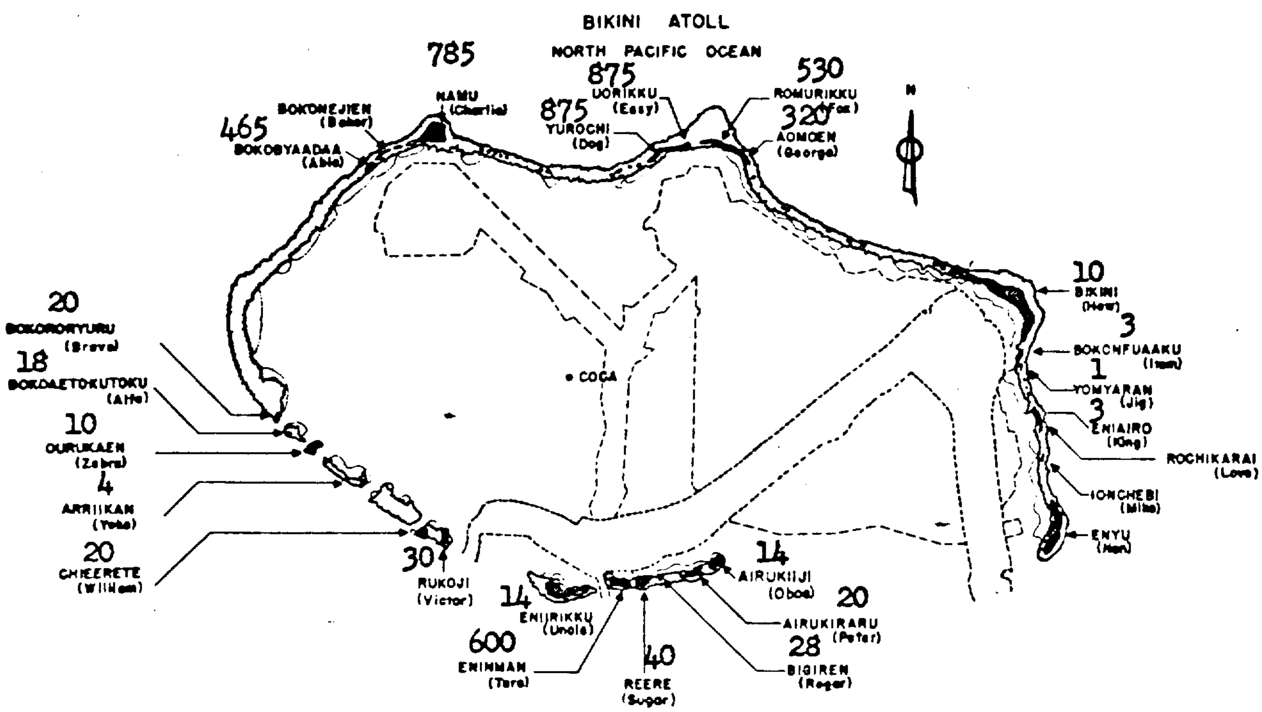


Fig. 0-5 - RadSafe Survey, D + 3

[redacted]

[redacted]

18

[redacted]

PART II

TASK UNIT 3

DOD PROGRAMS

K. D. Coleman

Col. K. D. Coleman
CTU-3

Program 1 - Blast and Shock Measurements	Maj H. T. Bingham
Program 2 - Nuclear Radiation and Effects	CDR D. C. Campbell
Program 5 - Aircraft Structures	CDR M. R. Dahl
Program 6 - Tests of Service Equipment and Materials	Lt Col C. W. Bankes
Program 8 - Thermal Radiation and Effects	CDR A. H. Higgs Maj W. C. Linton
Program 9 - General Support	Lt Col J. G. James

[redacted]

[redacted]

[redacted] (FLATHEAD)

Project 1.9 - Water Wave Studies - L. W. Kidd

OBJECTIVES AND INSTRUMENTATION

Instrumentation was activated to measure water waves resulting from the [redacted] (FLATHEAD). A total of ten stations were utilized in the Bikini Lagoon Area to document wave action from this event. Six of these stations yielded useful data. They were the four shore recording installations, one turtle station (197.04) and one skiff station (196.03). The turtle and skiff station were at ranges 2400 yards and 11,800 yards respectively from ground zero. Two long period wave recorders were active at Ailinginae and Eniwetok Atolls to document any long period waves in the open sea resulting from the [redacted] (FLATHEAD). An inundation survey of islands in the Bikini Atoll to determine the extent of water up-rush and flooding was completed on F + 2.

In addition, the distant stations on Wake and Johnson Islands were active.

RESULTS

Approximate maximum deep water amplitudes (trough to crest) at the shore recording stations in Bikini Lagoon were as follows:

Enyu	- 2 ft.
Bikini	- 1¼ ft.
Airukiiji	- 2¼ ft
Chieerete	- 2¼ ft.

As anticipated, the periods of waves from the [redacted] (FLATHEAD) were considerably less than those from the [redacted] (ZUNI). Periods of waves ranged from 1½ min to 25 sec. Wave energy dissipation along the

[redacted]

Aomoen-Bikini reef is apparent in comparisons of the Bikini station data with other lagoon stations. Data from the Long Period recorders has yet to be examined.

Up rush and inundation on Bikini Atoll islands was insignificant except in the Yurochi-Romurikku area. The largest wave of the train approaching this area had a deep water crest height above mean water level of approximately 9 ft. Water crossed the Yurochi-Romurikku causeway and passed to the ocean side of these islands. The short period associated with [redacted] (FLATHEAD) waves prevented a major break through of the causeway and limited the water damage to earth works and structures in that area. Minor up-rush and cross over occurred in the Eninman-Airukiiji complex. Energy levels at this point were insufficient to cause any but minor scouring and erosion. Water flooded a small section of center Enirikku. No errosion or scouring was apparent.

Results of the distant island station are not available at this time.

21

[redacted] (FLATHEAD)

Project 2.1 - Gamma Exposure vs Distance - P. Brown

OBJECTIVES

To determine gamma exposures as a function of distance from the point of detonation of a [redacted] air burst.

To draw conclusions from the data concerning dosage contours and the validity of scaling laws for this type of shot.

DESCRIPTION AND EXPERIMENTAL PROCEDURES

Standard film badges and quartz fiber dosimeters were distributed at various positions throughout Bikini Atoll and on the ships stationed in the predicted fallout area. Some badges were exposed without interruption, while others were exposed in sequence or shielded from fallout by dropping mechanisms activated after blast arrival.

RESULTS

Sufficient data points were obtained from the fallout gamma-exposure stations to permit a good estimate of dosage contours upon detailed analysis.

The initial gamma radiation exposure fits predicted values reasonably well. There are, however, some discrepancies which may be resolved on further analysis coupled with additional information on the makeup of the device.

[redacted] (FLATHEAD)

Project 2.2 - Gamma Dose Rate vs Time - P. Brown

OBJECTIVE

To measure residual gamma radiation intensity as a function of time at land fallout stations, and to measure the initial gamma intensity vs time for a [redacted] air burst.

INSTRUMENTATION

Fallout gamma radiation intensity was measured using ionization chamber detectors, associated electronics and time intensity recorders.

The initial gamma radiation rate was measured using plastic scintillators with photomultiplier and phototube instruments. The gamma rate is recorded in the form of a log scale and has a time resolution of 0.01 second with a total recording time of 5 minutes. Gamma rates from 10^9r/h to 10^3r/h are capable of being recorded by this system.

RESULTS

The fallout gamma radiation appears to agree reasonably well with the Project 2.1 data. This is based on preliminary uncorrected data.

The gamma rate versus time initial radiation data has been evaluated at only one point at the time of writing this report. This data point is in good agreement with the Project 2.1 data. Additional initial gamma radiation data should be available upon readout of magnetic tape recordings.

[redacted] (FLATHEAD)

Project 2.4 - Decontamination and Protection - J. C. Maloney

OBJECTIVES

To study the contamination of various types of building surfaces exposed at various orientations to the fallout.

To study the effectiveness of various decontamination procedures, and thus obtain data on the radiological recovery of military installations constructed from the tested types of material.

INSTRUMENTATION

Panels of the various types of building materials were mounted on a structure so as to present various orientations to the fallout. The structures were mounted on the forward portion of YAG 39 and YAG 40. Evaluation was to be carried out at Parry, where various decontamination methods were to be used on the panels. The effectiveness of decontamination was to be assessed by survey and some radiochemical and radio physical investigations of the panels and decontamination wastes.

Due to insufficient contamination from the [redacted] (FLATHEAD), it was decided to leave the panel assembly on the YAG-39. On the YAG-40, only the panels on the front face received enough contamination to warrant experimentation.

Due to the difficulty in manipulating the canvas covers protecting the panels on the two structures, it was decided to forego the pre- and post-shot surface covering.

Due to the apparent low decontamination efficiency of low and high pressure water hosing, it was decided to forego these techniques.

[redacted]

[redacted]

RESULTS

The following data is from decontamination of the front panels of the YAG-40. Residual percentages shown in the table below are based on panel contamination levels as measured in the project area. Readings are in milliroentgens/hr. Investigations will be made to determine the amount of original fallout contamination which was washed or blown off the panels before they were taken off the YAG-40.

It must be pointed out that the given data is of a gross character and is not to be interpreted as being final results for the [redacted](FLATHEAD).

DELE[redacted]

Vertical Panel Type	Reading before Decon. in mr./hr.	% Residual water scrub	% Residual "Tide" scrub	% Residual Versene & Igapal Scrub
Poured Concrete Control	95	52	61	45
Wood Siding Alkyd	31	23	10	3
Concrete Block Control	46	70	67	59
Brick Control	81	83	78	74
Brick Luminall	34	47	38	26
Concrete Block Luminall	27	52	37	30
Stucco Luminall, 1 coat	43	51	37	28
Poured Concrete, Cement Paint	78	51	38	26
Asbestos Shingle, Control	33	67	55	39
Wood Siding, Control	57	68	53	37
Asbestos Shingle, MPP	24	42	17	8
Phenolic Plywood, control	27	74	67	56
Sheet Metal, Alkyd	9	33	11	4
Wood Siding, MPP	18	44	11	2
Sheet Metal, Epon	11	18	8	6
Wood Siding, Lead & Oil	36	61	28	23

[redacted]

[redacted] (FLATHEAD)

Project 2.62 - Fallout Studies by Oceanography Methods - F. D. Jennings

OBJECTIVES

The objectives of Project 2.62 were to: measure the fallout radioactivity and its chemical nature in the water from a surface water burst and calculate the equivalent land fallout pattern; study the nature of the transport and dilution of radioactive fallout material in the ocean to permit future surveys to acquire a complete fallout picture from the fewest possible measurements; and study the oceanography of Bikini Lagoon as it involves the circulation of contaminated waters, particularly the effluent thereof and the occurrence of rapid transients of circulation which may result in sudden redistribution of activity.

DESCRIPTION AND EXPERIMENTAL PROCEDURE

The Bikini Lagoon was investigated using an instrumented trailer aboard a Navy LCU.

The project installed and maintained sixteen deep-moored skiff stations in the fallout area between 10 and 30 miles from ground zero. Recording instruments were installed on these skiffs to measure the radioactivity as a function of time at depth intervals of 20 meters down to 100 meters. A time of arrival starting pulse was supplied by Project 2.63.

Two high speed vessels were outfitted with devices for measuring radioactivity as a function of depth and in the air. These two vessels were stationed outside the fallout area during the shot and then proceeded to survey the fallout area making measurements out to about 300 miles from GZ. Approximately twenty-five surface samples and a number

of samples from depths were taken for Project 2.63.

RESULTS

Preliminary examination of the fallout data gathered by survey ships indicate that the fallout area extended approximately 150 miles along an axis of about 330 degrees True. The east and north boundaries were remarkably sharp and gave a pattern of about 90 miles between the axis and the eastern boundary. The west boundary was so diffuse that it could not actually be distinguished but merely appeared to be scattered extensively westward.

Results of the postshot lagoon survey and the moored-skiff instrument recovery await further examination.

CONCLUSIONS

Specific conclusions await further data reduction. Intercomparison of the measurements made by various instruments on the different survey vessels of various projects show good correlation and the partially assembled data gives a coherent fallout picture. This correlation was carried out by Program 2.

[redacted] (FLATHEAD)

Project 2.63 - Collection and characterization of Fallout with Time -

T. Triffet

Objectives

To collect samples of fallout and measure radiation field intensities with time at various distances from [redacted] land, water and air thermonuclear detonations. To study these samples from early times with respect to gamma and beta activity, to analyze them for chemical and radiochemical composition and to determine certain of their physical properties, including distributions of particle sizes.

Instrumentation

Instrumentation for the [redacted] (FLATHEAD) was similar to that for the [redacted] (CHEROKEE).

YAG-39 was located approximately 30 miles, YAG-40 approximately 40 miles and LST-611 approximately 50 miles from ground zero; all, however, were at different azimuth angles.

Results

Approximately 95 percent of all project instrumentation functioned properly and no damage to any station from blast or thermal effects was observed. Within the Bikini complex the Chieerete station received no fallout, the Bikini station only very light fallout, the YFNB-29 moderate fallout, and the YFNB-13 and Aomoen station relatively heavy fallout. Additionally, Raft S and Skiffs AA, BB, and CC received small quantities. Collected samples averaged 400 mr/hr surface reading at 1400 on F-day, with some as high as 1.8 r/hr at the same time; the time of arrival at the YFNB-29 was about 1 hour and 20 minutes after detonation.

With the exception of the probe mounted on the boom of the YAG-40 all instruments aboard the three project ships were operated over the entire fallout period. Each ship received fallout, the approximate times of arrival being H + 4½ hours for the YAG-39, H + 7 hours for the LST-611, and

H + 8 hours for the YAG-40. The highest activity level observed was approximately 230 mr/hr at about H + 16½ hours on the deck of the YAG-40. This portion of the deck was not washed down, however, it is believed that a maximum activity level of about 350 mr/hr at H + 9 hours would have been measured on the deck of the LST-611 had it not been washed down. Readings between different instruments on the same ship were in general consistent and overall documentation of the event at each of the three ship locations was good. Samples were obtained in the shielded laboratory aboard the YAG-40 by means of the Special Incremental Collector and were analyzed from early times as planned. Activity measurements, decays, gamma spectra measurements and physical observation were performed. For the most part these data are currently being reduced and will be reported when available; with regard to physical observations, however, it appears that the great majority of the fallout arrived in slurry droplet form. These droplets averaged between 100 and 200 microns in diameter and possessed an NaCl content ordinarily in excess of 80 percent. Preliminary analyses indicate the primary activity to be associated with even smaller particulate contained in these droplets. As before, the wind structure in the region varied considerably during the fallout period, causing the final fallout pattern to be much distorted from its predicted shape.

The data obtained are being examined further and additional analyses are being performed at NRDL; these results will be included in the Preliminary Report.

[redacted] (FLATHEAD)

Project 2.64 - Fallout Location and Delineation by Aerial Survey - R. Graveson

Objectives

To survey the gamma radiation from fallout contaminated ocean areas using an aircraft borne detector. To make air absorption measurements to correlate the aircraft data with the intensities measured at the surface of the sea.

Description and Experimental Procedures

Three P2V-5 aircraft were equipped with gamma radiation detectors to record the dose rate arriving through the thin aircraft skin from a water surface below.

Two aircraft flew over the fallout area simultaneously and observed the radioactivity and altitude (operating altitude 200-400 feet). The information on radiation dose rate and altitude was to be continuously recorded and telemetered to the Program Two Control Center aboard the USS ESTES.

Results

On D day both aircraft became contaminated due to insufficient data on the time of cessation of fallout. Fallout extending some 40 miles west of Bikini was located before the aircraft became contaminated.

On D + 1 day two aircraft surveyed an area bounded by 163°40'E to 166°00'E and 11°00'N to 13°20'N. The contaminated area was located and delineated within this area.

There was apparently some fallout still occurring approximately 60 to 100 miles north and northwest of Bikini. Both aircraft became contaminated in this region.

On D + 2 one aircraft was used but due to its residual contamination careful study of the charts from the aircraft must be made to obtain definitive data. This analysis is being made.

Project 2.65 - Analysis of Fallout and Base Surge - M. Morgenthau

Objectives

The general objectives of project 2.65 participation in REDWING were to: (1) obtain fallout samples on land and to perform radiophysical and radiochemical measurements on the samples; (2) prepare dose rate contours of the atoll area from information gathered by this project, other projects, and Rad-Safe; and (3) evaluate the role of the base surge in transport of radioactive material.

Description and Experimental Procedures:

Stations at Eniwetok Atoll were equipped with a Gross Fallout Collector (GFC).

On D-Day, D ∕ 1, and D ∕ 2, an aerial survey of residual radiation was made over the respective atolls by helicopter. The measurements were taken by means of a probe on a long cable suspended below the hovering helicopter. The position of the probe was determined by comparison with maps and aerial photographs.

Results

Aerial survey readings taken on three successive days were corrected for meter calibration and corrected to H ∕ 1 hour and H ∕ 12 hour values as shown in Table 2.65-1 by using the decay exponent of -1.0. The field readings taken on three successive days were plotted as a function of time for seven representative islands. The average decay exponent for the period H ∕ 8 to H ∕ 55 hours was found to be -1.015.

Analysis of intermittent fallout collector data, particle size data, and radiochemical data is in progress. Very little liquid fallout was collected.

TABLE A-65-1

Corrected Aerial Survey Readings - Flathead
(Field Gamma Decay Factor: -1.0)

Island	Day	Time	Corrected Reading (mr/hr)	Time After Shot (hrs)	H/1	Dose Rates (r/hr) Average H/1	H/12
Bokobyaadaa	F	1543	8800	9.28	79.3	87.3	7.3
	F/1	1442	2800	33.27	93.2		
	F/2	1421	1600	55.93	89.5		
Namu (Station)	F	1525	18000	9.00	162	163	13.6
	F/1	1430	5000	33.07	165		
	F/2	1414	2900	55.8	162		
Namu (GZ)	F	1533	18000	9.12	164	162	13.5
	F/1	1431	5200	33.1	172		
	F/2	1415	2700	55.82	151		
Yurochi	F	1516	19000	8.83	168	176	14.7
	F/1	1420	5600	32.9	184		
	F/2	1406	3200	55.67	178		
Uorikku	F	1513	16000	8.75	140	147	12.3
	F/1	1418	5000	32.86	165		
	F/2	1403	2500	55.61	138		
Romurikku	F	1510	12000	8.7	104	92.8	7.7
	F/1	1412	2700	31.75	85.6		
	F/2	1400	1600	55.56	89		
Aomoen	F	1507	6500	8.6	56	58.6	4.8
	F/1	1405	2000	31.6	63.2		
	F/2	1358	800	55.5	44.4*		

* Not used in computation.

[redacted] (FLATHEAD)

Project 2.66 - Early Cloud Penetration - Col. E. A. Pinson

Objectives

To collect and evaluate data relating to radiation dose rate vs time in radioactive clouds from thermonuclear weapons.

To measure and evaluate the radiation hazards associated with the residual contamination on aircraft which have flown through thermonuclear clouds at early times after detonation.

To measure the turbulence in a thermonuclear cloud at early times after detonation.

Radiation dose rate inside the cloud vs time after detonation.

The extent and quality of the residual contamination on the aircraft after landing.

Instrumentation and Techniques

Three B-57 aircraft penetrated the cloud. The first one a "Nip" penetration at ∠49 minutes at an altitude of 45,000 ft. The pilot flew almost through the cloud before turning 180° and flying back out again. Time in cloud was 128 sec. The second aircraft made a "bore-through" penetration at ∠58 minutes at an altitude of 45,000 ft. Time in cloud was 92 sec. The third aircraft carried out two "bore-through" penetrations at ∠67 and 76 minutes. Altitudes were 47,000 ft and 34,000 ft while the times in the cloud were 76 and 66 sec. respectively.

The dose rate and integrated dose in the cloud and on the return flight due to residual contamination on the aircraft are measured by a dose rate instrument and integrated dose meter. The readings of these instruments are recorded by a Photo Panel. The Photo Panel includes a "G" meter to determine turbulance in the cloud, a clock to give time in the cloud and an altimeter to show altitude of penetration.

A self-recording dose rate instrument is also installed in the aircraft which is equipped with timing markers to show cloud entry and exit. It automatically starts recording when the radiation field reaches 1-r/hr.

The aircraft were equipped also with Bendix dosimeters, NBS film packs and film badges to indicate total dose received on the mission.

The contamination studies consisted of surveying the aircraft with both gamma and beta survey instruments for the purpose of obtaining the general contamination level on and in the immediate vicinity of the aircraft. Based on these data individual film were placed at selected points on the aircraft. The exposure time for the films is determined from the instrument survey. These exposures give an autograph of the particle distribution, the general background and a measure of the beta dose from the particulate material. Comparing these values with the gamma survey is one of the methods for determining the β/γ ratios. In addition film stacks are exposed to the aircraft to permit a study of the energy distribution of the beta spectrum and to determine the β/γ ratio.

Results

The dose rates in the cloud and total dose received on the mission were = to or less than the predicted values. The pilot of the aircraft which penetrated at ∠49 minutes received a total dose of 3.3R as measured by a Rad-Safe film badge. The maximum dose rate in the cloud was about 300R/Hr with the average dose rate being about 120R/Hr. The "Contamination Factor" on the aircraft was computed to be .75%/min in the cloud.

The pilot of the aircraft penetrating at ∠58 minutes received a total dose of 3.06R as measured by a Rad-Safe film badge. The average rate in the cloud was about 100R/Hr. The "Contamination Factor" on the aircraft was 1.5%/Minute.

The third aircraft planned to penetrate at 50M ft at ∠65 minutes.

[redacted]

However, at this time and altitude the cloud above 48M ft apparently had sheared off to the south and west and was separated from the rest of the cloud. The pilot decreased his altitude to 48M ft and penetrated the cloud at 467 minutes. He continued down to 34M ft and again penetrated the cloud at 476 minutes. The total dose received on the mission was 1.48R. The "Contamination Factor" on the aircraft was computed to be .9%/Minute.

The "come-home" dose to the crew was measured to be from 25% to 33% of the total dose. The pilots reported from none to slight turbulence in the cloud and the "G" meter in the photopanel showed a maximum of.5G during the penetration runs.

Adequate data was obtained from the contamination study. Preliminary analysis indicates that the results will agree with those of Operation TEAPOT.

[redacted]

[redacted]

[redacted] (FLATHEAD)

Project 2.71 - Relative importance of the Various Radiation Sources to the Ship Shielding Problem - H. R. Rinnert

OBJECTIVES

To determine the relative radiation dose rates contributed by contamination of the air envelope, water envelope, and the ship's weather surfaces.

To determine the time dependent gamma ray combined absorption and scattering coefficients of steel to be used in future calculations of shielding effectiveness.

To field test new and improved detector systems.

To obtain gamma radiation measurements at various points on and in the ship as a function of time for the following purposes:

Check points for future shielding calculations.

Determination of the radiological situation at various locations aboard ship for Projects 2.63 and 2.10, to be used for operational control of the test ships.

INSTRUMENTATION

Relative gamma radiation dose rates as a function of time from contamination resulting from [redacted] (FLATHEAD) contributed by the air envelope, water envelope, and ships weather surfaces were to be estimated by means of recording ionization chamber radiation detectors. Detectors were located at several points on and inside of the YAG's 39 and 40.

Time dependent gamma radiation combined absorption and scattering coefficients for steel were to be determined by means of recording detectors inside steel pipes having wall thicknesses ranging from

[redacted]

0.25 to 6.0 inches. Each detector consisted of 3 packaged ionization chambers. The pipes with detectors and an unshielded detector were enclosed in a thin aluminum dome so that the geometry of radiation sources would be identical.

A field test was to be made of a prototype detector-recording system as a part of the laboratory's long range development.

Miscellaneous gamma radiation measurements were to be made by means of unshielded recording radiation detectors located on the kingpost sampling platform, in the bridge, in the fireroom, in the recorder room, and in Number 2 hold.

RESULTS

The radiation levels encountered by the two YAGs were too low to supply data adequate for the satisfaction of all objectives.

The instrumentation performed satisfactorily, however many radiation detectors were operating near their lower limits of sensitivity. Where feasible, for subsequent participation, more sensitive detectors were installed in place of the highest range detectors.

Relative Gamma Radiation Fields Contributed by Various Radiation Sources

Fig. 2.71-1 shows a rather rough estimate of the air contribution to the radiation field on the deck of YAG 40. It should serve to indicate the duration of fallout.

The accuracy of the preliminary analysis of the relative contributions by the various radiation sources does not warrant a presentation of quantitative results at this time.

Interaction of Gamma Radiation with Steel

Gamma fields inside steel cylinders of various thicknesses

[redacted]

were compared as a function of cylinder thickness and time. Combined absorption and multiple scattering coefficients for steel were calculated from the attenuation data and are presented in Fig. 2.71-2. The low radiation levels aboard the two YAGs prevented calculations for later times than those shown.

The values obtained from the two YAGs agreed well. It will require a statistical analysis to determine whether the values are significantly different from those obtained at Operation CASTLE. No conclusion can be drawn at this time.

Participation in the [redacted] Shot (FLATHEAD) supplied only limited data and did not permit adequate satisfaction of project objectives.

[redacted]

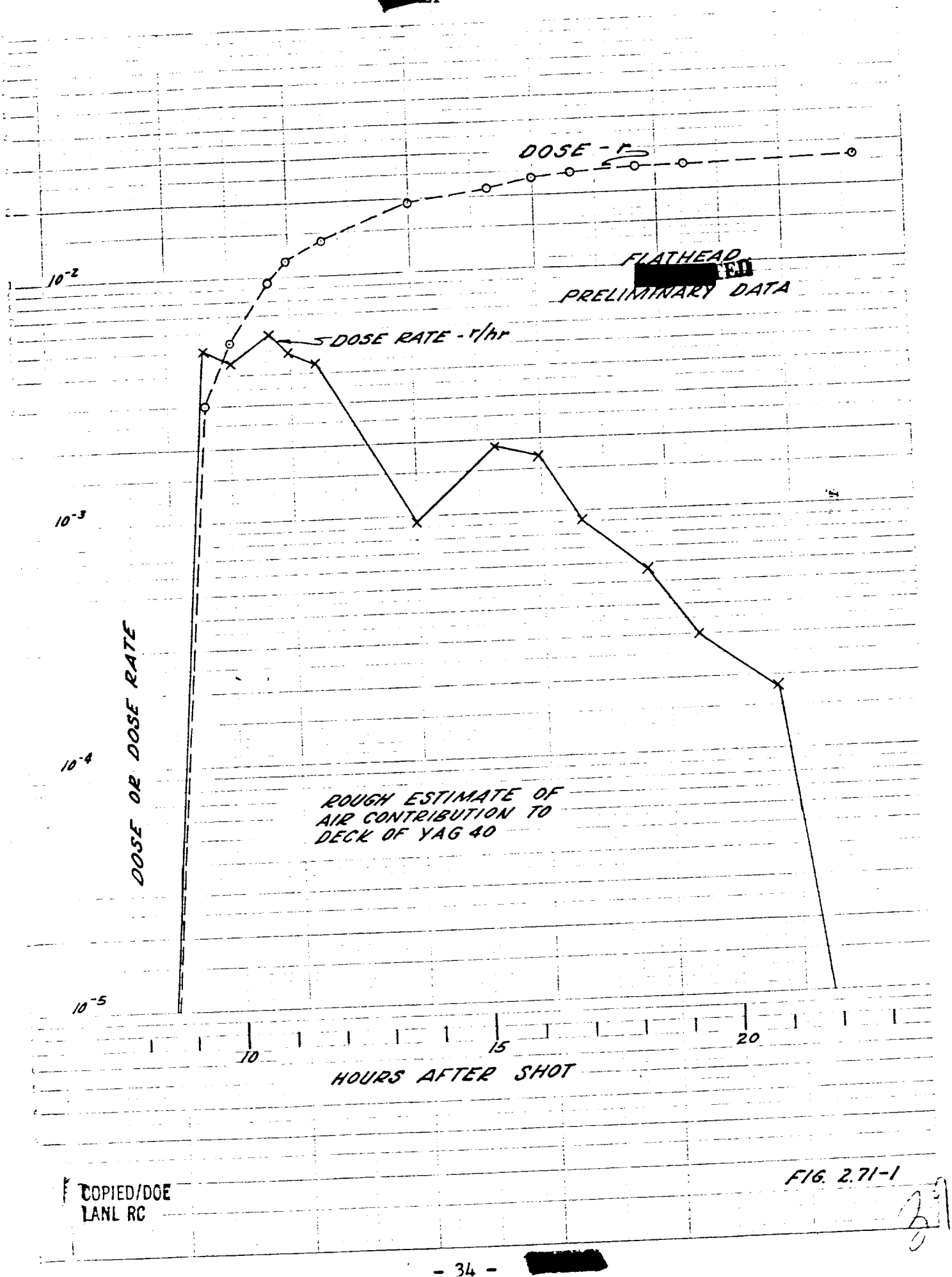


FIG. 2.71-1

[redacted]

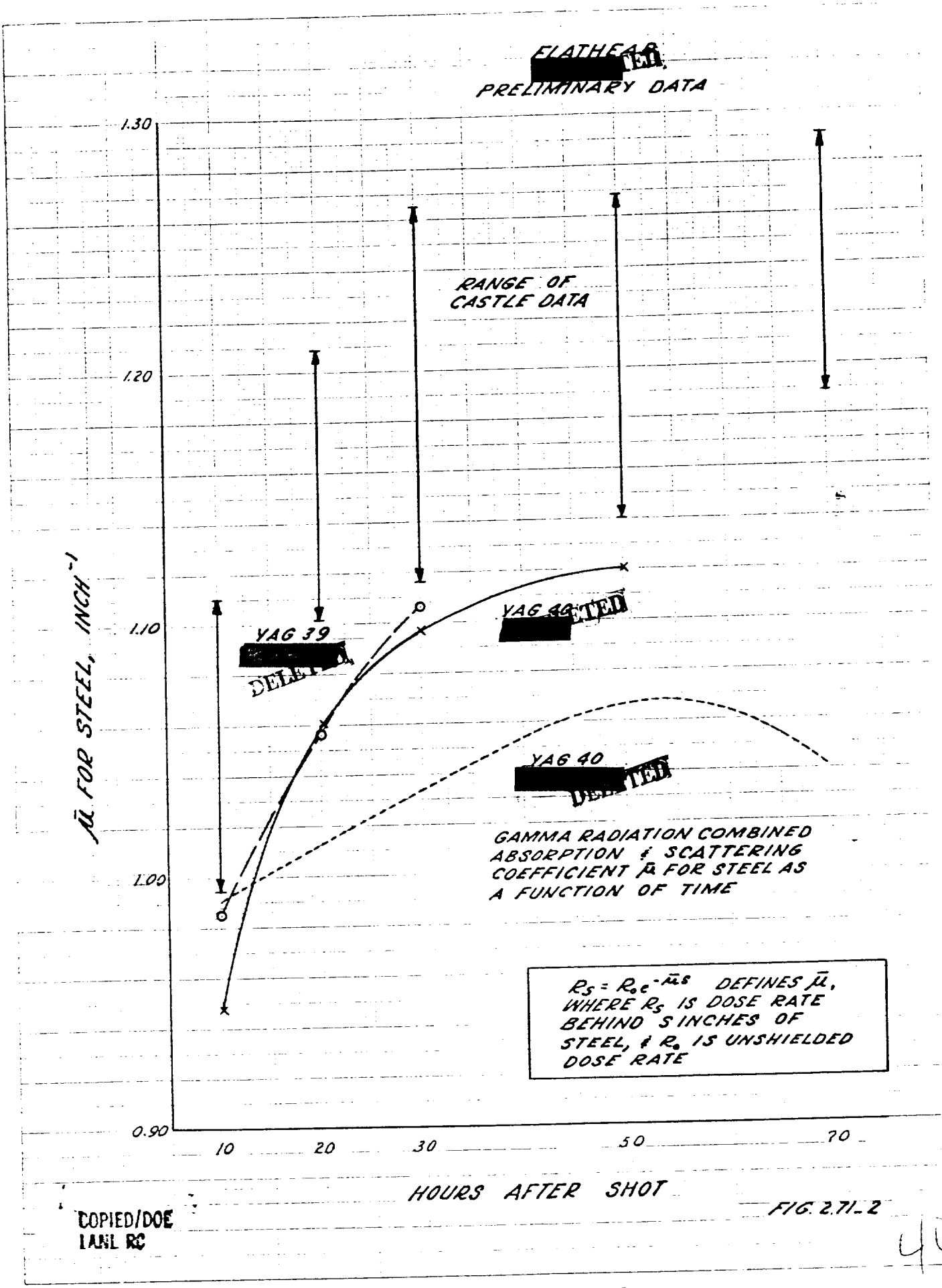


FIG. 2.71-2

40

[redacted] (FLATHEAD)

Project 2.8 - Shipboard Countermeasures Methods Studies - R. H. Heiskell

Objective

To determine the relative effectiveness of various proposed ship and personnel protection and reclamation methods.

Description and Experimental Procedures

These studies consisted of 8 problems to be carried out on the YAG-39 and YAG-40 and at the Rad-Safe center on Parry. These eight problems involved the study of the effectiveness of various shipboard protective methods, decontamination methods, hazard assessment methods, personnel protection and decontamination methods, and basic contaminability-decontaminability.

Results and Conclusions

The removability of the RRPC was the same as experienced after the [redacted] (ZUNI). Decontamination effectiveness was superior to that obtained on the [redacted] (ZUNI). In the non-washdown area the RRPC removal left only 3.9% residual as compared to 18 percent residual as for hand and mechanical scrubbing.

Chemical Paint Stripping: No results due to insufficient activity.

Mechanical Scrubbing Methods: Results same as obtained after the [redacted] (ZUNI) shot. The mechanical scrubber was found to be slightly inferior to hand scrubbing. It was, however, far superior to hand scrubbing in reducing fatigue.

Protection and Decontamination of miscellaneous materials, wood decks, and skin: Insufficient activity to obtain useful data.

Monitoring and Hazard Assessment, and Basic Contamination-Decontamination Studies: Data is being processed.

[redacted] (FLATHEAD)

Project 2.9 - Standard Recovery Procedure for Tactical Decontamination of Ships - F. S. Vine

OBJECTIVES

To proof test a ship decontamination procedure consisting of firehosing, handscrubbing with detergent, and a second firehosing, in that order.

To perform an operational decontamination of the YAG 39, YAG 40, and LST 611, as required, to permit participation of these ships in other scheduled shots.

PROCEDURE

The YAGs and LST were positioned in the expected fallout area, as determined by Project 2.63, and served as test platforms for that project. Upon completion of their missions the ships returned to Eniwetok.

No decontamination of the LST-611 was performed because of the negligible contamination received by that ship.

The YAGs 39 and 40 were decontaminated simultaneously on F + 3.

RESULTS

Proof testing of decontamination, as planned aboard the YAG-39, could not be accomplished because of the extremely low initial radiation levels.

On the YAG-40 the average initial level in the non-washdown area forward of the superstructure (exclusive of the flight deck) was 19 mr/hr. By the previously described decontamination procedures this was reduced to 5.6 mr/hr, an effectiveness of 67 percent when corrected for decay.

47

The initial level on the flight deck was 44 mr/hr. Firehosing and hand scrubbing reduced this to 12 mr/hr, an effectiveness of 68 percent when corrected for decay.

In the washdown area, which included the superstructure, the average initial level was 4.9 mr/hr and the final level after decontamination (firehosing only) was 4.4 mr/hr. Since this reduction was equal to that which would have resulted from natural decay according to the $t^{-1.2}$ law, it cannot be demonstrated at this time that the decontamination effort contributed any useful effect.

Twenty men are employed on each ship and a total of 170 man-hours was expended.

The contaminant resulting from the [redacted] (FLATHEAD) was more difficult to remove than that obtained from the [redacted] (Zuni), but was less tenacious than that encountered on some CASTLE shots.

The decontamination procedures, other than the removal of the radiological protective coating, were practicable and effective and agreed closely with the results of similar operation performed in Operation CASTLE.

43

[redacted] (FLATHEAD)

Project 2.10 - Verification of Washdown Effectiveness as a Shipboard Radiological Countermeasure - M. M. Biggers

Objectives

Operation of YAG's and LST to be stationed in fallout area

RadSafe support for NRDL Projects

Washdown evaluation

Procedure and Results - Ship Operations

The project ships, YAG-39, YAG-40, and LST-611, successfully completed their mission on the [redacted] (FLATHEAD) shot. Precise information in ships position and other operational information has been given Project 2.63 for inclusion in their reports.

YAG-39 Operations

YAG-39 encountered fallout at 1030 of D-day (12 June). At 1100, when the gamma radiation intensity had increased by 2 mr/hr, the ship was closed and washdown activated. The radiation level peaked at 1800, D-day, with an intensity of 140 - 150 mr/hr. on the unwashed deck forward, and 10 - 14 mr/hr on the unwashed deck aft. Peak intensity on the bridge was 8.4 mr/hr. Fallout apparently stopped at the same time it peaked (1800). Washdown was secured at 1950, the ship partially opened at 2115 and completely opened at 2400.

YAG-40 Operations:

YAG-40 encountered fallout (i.e. a 2 mr/hr increase in gamma radiation intensity) at about 1415 on D-day. Watch was transferred to the bridge and the ship closed except for several hatches. When the radiation intensity reached 20 to 30 mr/hr at 1600, the engine room hatch was closed and the washdown system was activated. Peak intensity occurred at about

[redacted]

2330 on D-day (H / 17 hours) with readings topside, forward, of 230 to 270 mr/hr. The radiation intensity aft at the same time was 7 mr/hr. The peak intensity on the bridge was 6.4 mr/hr. The following morning at 0607, the washdown was secured and at 0725, the ship opened.

LST-611 Operations

The LST-611 encountered fallout at 1330 on D-day, as indicated by a 5 mr/hr reading on a greased board. The ship was then closed. At 1400, the radiation intensity increased 2 mr/hr. Washdown was activated at 1415. Intensity on the platform peaked at 90 mr/hr at 1530. The intensity on the washed deck was 70 mr/hr. At 0315 on D / 1 the washdown was secured. At 1100 an air sample indicated an activity in the order of 1×10^{-8} μc/cc, and the ship was again closed. The deck and kingpost gave no indication of fallout so, after 5 hours, the ship was opened again.

YAG-39 and YAG-40 received moderate amounts of fallout after the [redacted] (FLATHEAD) and were required to operate their washdown systems. Examination of records from gamma-time stations indicated sufficient reliable data was obtained to attempt an evaluation of the washdown systems effectiveness aboard both ships.

The YAG-39 operated about 25 miles due north of ground zero during the fallout period. Due to light surface winds, the ship held station in a four-mile square by use of a figure-eight maneuver, normal to the surface wind. The surface wind bore from the northeast during the event at speeds varying between 14 and 16 knots.

Peak activity occurred 10 hours after shot time. The activity under the washdown at this time was 12 mr/hr. The maximum accumulated dose was 45 mr. This compared with a rate of 128 mr/hr and dose of 430 mr from the unwashed area gives an effectiveness of 91 and 89 percent.

[redacted]

[redacted]

The YAG-40 was stationed 40 miles due north of ground zero. Fallout arrived shortly after H + 7 hours. The washdown was not activated until a build-up of about 20 mr/hr on deck was reached. This occurred 1 3/4 hours after the first indications of fallout arrival. The fallout ceased at approximately H + 21; the total time that the ship was in the fallout was 13 hours.

The total dose under the washdown was approximately 150 mr, compared with 3½ r in the non-washed area. The relative effectiveness of the washdown for this event is 96 to 97 percent for dose rate and 93 percent for accumulated dose.

Discussion - Washdown

The nature of the fallout material is considerably different from that of the [redacted] (ZUNI) shot, i.e., considerably less mass and averaging smaller size, 30 micron diameter or less, and arriving in liquid droplets of high salt content. The significant difference is that the fallout material consisted of very small, solid radioactive particles of bomb debris in aqueous suspension whereas [redacted] (ZUNI) material was mostly agglomerate material heavy and much larger in size.

[redacted]

4 C

Project 5.1 - In-Flight Participation of B-47 - C. W. Luchsinger

Lt. Robert C. Laumann

Objective

The objective of this project is to measure the blast, gust and thermal effects of a nuclear detonation on an in-flight B-47 aircraft. With the recorded data, the criteria and method used in the B-47 Weapon Delivery Handbook, may be verified or corrected. In addition, the project will provide basic research data for the design criteria of future USAF aircraft.

Instrumentation

301 data channels were available on this shot to record bending, shear and torsion in the wing and horizontal stabilizer, thermal inputs to the aircraft, thermally induced strain, temperature measurements and overpressure. Prior to shot participation 95% of these channels were operating satisfactorily. Since last participation eight new gust information channels had been added at wing station 615.

Aircraft Position in Space

The B-47 was flying at an absolute altitude of 38,000 feet, a speed of Mach 0.75 and on a heading of 300°T at both T_o and shock arrival. At T_o, the horizontal range beyond ground zero was 3,500 feet and at shock arrival it was approximately 38,000 feet.

Results

Thermal: Thermal inputs were negligible since the aircraft was positioned for gust data.[redacted]

DELETED

47

[redacted]

Gust: Gust load at time of shock arrival was 63% allowable limit at wing station 493 and 46% limit at wing station 144.

Overpressure: [redacted]

[redacted]

DELETED

[redacted] (FLATHEAD)

Project 5.2 - In-flight Participation of a B-52 - 1stLt. F. L. Williams

Objective

The objective of this test was to determine the delivery capability of the B-52 aircraft.

Instrumentation

Instrumentation of the B-52 for the [redacted] (FLATHEAD) consisted of approximately 320 oscillograph channels which recorded measurements from strain-gage bridges, accelerometers, thermocouples, pressure transducers, calorimeters, roll and pitch gyros, radiometers, and control position transducers. In addition, 13 cameras recorded instruments, wing deflection, cloud coverage, and fireball rise and growth.

Results

The B-52's participation in the [redacted] (FLATHEAD) shot was unsuccessful. Takeoff was not accomplished until 0510, one hour and 14 minutes later than scheduled. The radar stabilization unit did not have sufficient time to cycle on the ground, and though attempts were made to stabilize it after takeoff, proper operation was not achieved. In view of the necessity of obtaining an exact position in space and the possible error in the BNS due to the non-stabilized condition, it was decided to abort at the latest possible time. Technical considerations preclude the use of manual positioning.

At time zero the aircraft position was approximately 60,000 feet from ground zero on an outbound heading of 135°T.

The instrumentation was "ON" during the test. There were no measurable inputs or responses.

19

[redacted] (FLATHEAD)

Project 5.3 - In-flight Participation of a B-66 - R. W. Bachman

114

Objective

The primary objective of this test was to measure thermal and gust effects of a [redacted] nuclear device on a B-66B aircraft.

Instrumentation

Instrumentation on the B-66 for the [redacted] (FLATHEAD) shot consisted of 306 channels of information on strain, temperature rise, engine information, pressure, acceleration, thermal radiation, and wind and tail deflection. In addition, 32 basic a/c flight instruments on a photo recorder panel and 8 channels of correlation were used.

Aircraft Position in Space

Using the K-5 Radar System the B-66 was positioned at an altitude of 16,000 feet, on a heading of 100 degrees and a horizontal slant range of 17,800 at time zero. At time of shock arrival, the horizontal range was 59,100 feet with the aircraft on the same heading and altitude as before.

Results

Thermal: Total thermal energy measured was DELETED Maximum temperature rise was [redacted] degrees F measured on the .016 white elevator panel, and [redacted] degrees F measured on the nose radome.

Gust: Maximum gust loading at the time of shock arrival was 1.39 g's which is approximately 46.4 percent allowable limit for the B-66. The Dynamic magnification factor was 1.52.

Overpressure: DELETED

Operability: Of 295 total data recording channels, 97 percent were operable.

[redacted]

[redacted] (FLATHEAD)

Project 5.4 - In-Flight Participation of a B-57B- 1stLt. Harold M. Wells, Jr.

Objective

The objective of this test was to measure the effects of a nuclear detonation on an in-flight B-57B aircraft weapon system.

Instrumentation

Out of 220 channels being recorded, 9 data channels were lost for various reasons. They have been repaired, or replaced by spares.

Aircraft Position in Space

The JB-57B was flying at an absolute altitude of 25,630 feet, on a 119° T heading in a 10° nose right position at H ≠ 0. Horizontal range to ground zero at H ≠ 0 was 13,466 feet (aircraft traveling at 800 ft/sec). Aircraft position at time of shock arrival (H ≠ 42.28 sec) was 44,659 feet beyond ground zero. Heading same as H ≠ 0, altitude 25,930 feet, speed 758 ft/sec.

Results

Thermal: Total thermal energy measured was [redacted] normal to a horizontal receiver. (60% ≠ 10% of allowable limit.)

Gust: Total gust load at time of shock arrival was 50% ≠ 10% of allowable limit for the B-57B.

Overpressure: [redacted]

[redacted]

Project 5.5 - In-Flight Participation of F-84F Aircraft - 1st Lt. R. F. Mitchell

Objective

Waiter (Capabilities F-48F) - This participation was an attempt to determine the capability of the F-84F aircraft by subjecting it to both thermal and symmetric blast loads.

Barley (Sideloads F-84F) - The objective of this participation was to study the dynamic response of fighter structures to anti-symmetric blast loads.

Instrumentation

Waiter - 100 data channels were available to record moment, shear, and torsion loads; thermal strain; temperature rise; overpressure; accelerations; and aircraft altitude. Of these channels, there were 2 channels that failed. In addition, a flap camera and an NRDL camera were inoperative.

Barley - Out of the 100 data channels available to record essentially the same information as above, there were 3 channels that failed.

Aircraft Position in Space

Waiter - At time zero, the aircraft was flying at an absolute altitude of 21,000 feet on an inbound heading of 125°. The horizontal range was -740 feet with zero offset. The shock arrival position (at H/18.99 sec) was 21,000 feet altitude and 10,900 feet horizontal range. The true airspeed was maintained at 800 ft/sec.

Barley - At time zero, the aircraft was flying at an absolute altitude of 18,000 feet on an inbound heading of 097°. The horizontal range and offset were -22,400 feet and 34,400 feet respectively. At shock arrival

[redacted]

(H/28.54 sec) the aircraft was at 18,000 feet altitude; zero horizontal range; and 34,400 feet offset. The true airspeed was maintained at 800 ft/sec.

In both of the above cases, the actual positions of the aircraft were very close to the intended positions.

Results

Waiter

Thermal - [redacted] temperature rise in the wing flap (0.025 al. skin)

Gust - 35% design limit in wing bending

Overpressure - [redacted]

Barley

Thermal - negligible

Gust - 60% design limit in side fuselage bending

Overpressure - [redacted]

[redacted]

[redacted] (FLATHEAD)

Project 5.6 - In-Flight Participation of an F-101A - Capt. H. M. Lewin

Objective

The objective of Project 5.6 was to determine the responses of an in-flight F-101A aircraft to the thermal, blast and gust effects of a nuclear detonation.

INSTRUMENTATION

The aircraft was instrumented with radiometers, calorimeters and pressure transducers to measure the thermal and blast inputs and with strain gages, thermocouples and various other instruments to measure the aircraft responses to the inputs. For the [redacted] (FLATHEAD) shot, the aircraft was positioned theoretically to undergo a temperature rise [redacted] on the .020 skin covered honeycomb surfaces of the aircraft based on the positioning yield and the on time position. A small honeycomb test panel was painted black to receive a ΔT of [redacted] on the same basis. At this position, the aircraft would receive 62 percent design limit torque on the stabilizer.

Aircraft Position in Space

The aircraft was to fly at 28,000 feet absolute on an inbound heading of 124° at a ground speed of 800 fps. It was planned that the aircraft would be over ground zero at T_0 with shock arriving 26 seconds later at a horizontal range of 20,800 feet. Actual shot day position was 385 feet short and 120 feet to the right of ground zero at T_0 with shock arriving 27.58 seconds later at a horizontal range of 22,585 feet.

Results

Damage: There was no apparent damage to the aircraft.

Instrumentation: There was no apparent damage to the instrumentation.

54

1147

Of the 49 oscillograph recorded parameters, 45 produced usable data. The photopanel camera recording 26 parameters functioned properly and produced good data. It again vibrated at shock arrival but no data was lost.

Gust Data: DELETED Gust response was about 25 percent of design limit for bending and shear and 40 percent for torque.

Thermal Data: The highest temperature rise to date was recorded on this shot, but was again considerably less than expected due to the low yield. A ΔT of about [redacted] was experienced on the unpainted and about [redacted] on the black painted honeycomb.

Nuclear Radiation: There was no indication of any nuclear radiation on the pilot's film badge.

General: The participation was again successful although disappointing due to the disparity between the positioning yield and the actual yield estimates. Although the temperatures received were the highest to date, they were considerably lower than expected.

[redacted]

[redacted] (FLATHEAD)

Project 5.7 - Thermal Flux and Albedo Measurements from Aircraft -

Capt. R. L. Dresser

OBJECTIVE

The objective of Project 5.7 participation on this shot was to obtain thermal flux and albedo information of a nuclear detonation with airborne calorimeters, radiometers, and sixteen millimeter motion picture cameras.

INSTRUMENTATION

Instrumentation within the purview of Project 5.7 which was installed in the B-47 included nineteen NRDL calorimeters and two NRDL radiometers for measuring the direct and surface reflected thermal radiation. Six calorimeters were utilized to measure thermal radiation which was back-scattered toward the cockpit. Seven GSAP N-9 cameras were utilized to obtain photographic coverage of the fireball, the earth's surface, and of clouds beneath the aircraft, and also of any reflecting surface such as a cloud which could contribute to the back-scattered radiation.

Project 5.7 instrumentation on the B-52 included the twenty one basic instruments for thermal radiation measurements, but only an additional two instruments were utilized for back-scatter measurements. Eight GSAP cameras were installed for photographic coverage.

Project 5.7 instrumentation on the B-57 consisted of the basic twenty one instruments and six cameras.

Project 5.7 instrumentation on the B-66 consisted of the basic twenty one instruments and twelve cameras.

Neither tactical bomber (B-66, B-57) was instrumented for measuring back-scattered thermal radiation. The twenty one basic thermal

[redacted]

instruments possessed various fields of view and were suitably filtered to obtain qualitative spectral distribution information. All channels were recorded on Consolidated Recorders except the six back-scatter channels in the B-47 which were recorded on magnetic tape. The cameras were equipped with red and blue filters to obtain information at each end of the visible region of the spectrum. Several cameras were equipped with spectroscopic attachments to obtain continuous spectra in the visible region. Two of these spectrographs were operated at the EG&G Chieerete photo tower.

AIRCRAFT POSITION IN SPACE

Information of the position in space of each aircraft is contained in the post shot reports of the following projects:

Project 5.1 - B-47 Project 5.3 - B-66

Project 5.2 - B-52 Project 5.4 - B-57

RESULTS

Thermal

The preliminary value of total thermal input to the aircraft obtained by Project 5.7 instrumentation is included in the post shot report of the appropriate project indicated above.

Back-scatter Measurements on the B-47

Readable inputs were obtained on all six back-scatter instruments. These signals would correspond to a rough uncorrected value of thermal inputs of about 0.050 cal/cm^2.

Photographic Data

A total of thirty five cameras were operated by Project 5.7 on this event. Thirty three of these were airborne in four aircraft. Of

57

[redacted]

these, five failed to operate properly. It is expected that little information of value will be obtained from the six cameras which operated on the B-52 because of the abort of the B-52. A report on the operation of the two cameras in the Chiecrete "William" photo tower has not as yet been received. Best estimate, at present, is that twenty four magazines should have obtained records suitable for analysis. Verification of this estimate is not possible until these films have been developed.

[redacted]

Project 5.8 - In-Flight Participation of an A3D-1 Aircraft -

LCdr. P. S. Harward

Objective

The objective of this test was to investigate the A3D-1 aircraft capability for the delivery of high yield nuclear weapons by the measurement and correlation of the In-flight effects of a nuclear detonation.

Instrumentation

Instrumentation of the A3D-1 aircraft consisted of 96 oscillograph recording channels, one photo recorder, four GSAP cameras, and three dosimeters. The data recorded included temperature rise, thermal input, rate of thermal input, overpressure, gust loading, aircraft response, engine response, and gamma radiation.

Aircraft Position in Space

The A3D-1 aircraft was flying at an absolute altitude of 14,050 feet, heading 124°T in a tail-on position at H ≠ 0. Slant range to Ground Zero at H ≠ 0 was 18,425 feet, (Aircraft TAS 768 ft/sec) aircraft position at time of shock arrival (H ≠ 27.2 sec.) was 35,300 feet slant range on a heading of 124°T at 14,050 feet absolute altitude.

Results

Thermal:

Total thermal energy measured was [redacted]

Temperature rise on critical aircraft structure was [redacted]

Gust:

Total gust load at time of shock arrival was 0.85 g's at C.G. (61 per-cent allowable load factor).

59

[redacted]

Overpressure:

Peak overpressure measured was [redacted] DELETED

Gamma:

Approximately 0.025 roentgens of radiation was received in the cockpit of the A3D-1 aircraft.

[redacted]

[redacted] (FLATHEAD)

Project 6.1 - Accurate Location of an Electromagnetic Pulse Source -

E. A. Lewis

Objective

To utilize the electromagnetic signal originating from nuclear weapon detonations to determine ground zero of detonation. Secondarily to obtain the yield data that is available in the bomb pulse.

Procedure

Location of Ground Zero is made by use of an inverse Loran principle. The exact time the bomb pulse is received at various stations is recorded. The exact time difference in receipt of the electromagnetic pulse between two stations will be used to determine a hyperbolic curve which runs through ground zero. The point of intersection of two or more curves determines ground zero.

There are two systems. One of the systems is know as the long base line system and the other, the short base line system. Each system has two sets of stations. The long base line has one set of stations located in the Hawaiian Islands (Midway, Palmyra and Maui) with synchronizing antenna station at Haiku, Maui, and the other set of stations in the States (Harlingen,Texas; Blytheville, Arkansas; Kinross,Michigan and Rome, New York) with synchronizing antenna station at Cape Fear, North Carolina. The short base lines have one set of stations located in the Hawaiian area (Kona, Hawaii; Papa, Hawaii; and Red Hill, Maui) the other set in California (Pittsburgh, Woodland, and Maryville).

Results

All stations of both Long and Short base lines received and recorded the electromagnetic pulse emanating from the bomb detonation.

Short Base Line:

California - All stations in the Woodland net received and recorded the electromagnetic pulse emanating from bomb detonation. Line of Position error 2 nautical miles. Maximum field strength 0.5 volts per meter.

Hawaii - All stations in the Kona net received and recorded the electromagnetic pulse emanating from bomb detonation. Line of position error 2 nautical miles. Maximum field strength 0.8 volts per meter.

Long Base Line:

Hawaii - All stations in the Lahaina net received and recorded the electromagnetic pulse emanating from bomb detonation. Fix error was 2.75 nautical miles.

Stateside - All stations in the Harlingen net received and recorded electromagnetic pulse emanating from bomb detonation.

Griffiss AFB equipment was operating at shot time.

Conclusions

No conclusions can be made until further information is received from data reduction and interpretation.

The above line of position errors may change considerably during further examination of the data.

[redacted] (FLATHEAD)

Project 6.3 - Effect of Atomic Explosions on the Ionosphere - M. Hawn

Objective

The objective of Project 6.3 is to obtain data on the effects of high yield nuclear explosions on the Ionosphere. Principally, to investigate the area of absorption, probably due to the high altitude radioactive particles, and to study the effects of orientation relative to the earth's magnetic field on F2 layer effects.

Instrumentation

The system comprises:

Two Ionosphere recorders, type C-2, operating on pulse transmission, installed in 6 ton trailer vans, one located at Rongerik Atoll and one located at Kusaie in the Caroline Islands.

One Ionosphere recorder, Type C-3, operating on pulse transmission, installed in a C-97 airplane. This station operated on the ground at Kwajalein.

Preliminary Results:

All stations operated successfully during this test.

C-97:

The C-97 was grounded on Kwajalein while a new engine was being installed. Ground records were taken. The only apparent effects occurred between plus twenty and plus forty minutes, during which time part of the F layer shifted in height, and new reflections appeared.

Kusaie:

At F + 33 minutes a slight effect was observed in the F region, similar to that observed during [redacted] (CHEROKEE) and [redacted] (ZUNI). This effect lasted for approximately 20 minutes.

[redacted]

During this period there was an abnormal increase in the critical freqency of the F2 layer of approximately 1.3 Mc. There was no apparent effect upon the height of the layer and no effects due to increased absorption.

Rongerik:

The only significant effect was a slight stratification at the critical frequency of the F2 layer. This effect occurred at F + 18 min. and lasted for about 5 minutes.

[redacted] (FLATHEAD)

Project 6.4 - Determination of Characteristics of Airborne Flush Mounted Antennas and Phototubes for Yield Determination at Extended Ground-to-Air Ranges - Allan J. Waters

Objectives

To determine the effectiveness of flush mounted airborne antennas and phototubes at various ground-to-air ranges in detecting characteristic low frequency electromagnetic radiation and visible radiation, respectively.

To determine the temporal and amplitude characteristics of the low frequency electromagnetic radiation at various ground-to-air ranges.

To determine the temporal and intensity characteristics of visible radiation at various ground-to-air ranges.

To determine the effects of ambient conditions upon the satisfactory measurement of the parameters specified in 1 and 2 above.

Instrumentation

2 fiducial antennas

1 sychronizer

1 scope camera

1 DuMont scope

Technique

Signal is received by antenna fed through an amplifier and then to the scope. The signal is then photographed. Photohead output is let directly to the recorder. The distance was approximately 187 miles.

Results

Equipment was set up on the ground at Parry Island. Antennas were

[redacted]

[redacted]

directed to pick up signal from [redacted] (BLACKFOOT). As the antennas were directional, and blasts were detonated at the same, only the signal from [redacted] (BLACKFOOT) was received.

[redacted]

Project 6.5 - Analysis of Electromagnetic Pulse Produced by Nuclear Explosion - C. J. Ong

Objective

The objective of Project 6.5 is to obtain waveforms of the electromagnetic radiation for all the detonations during Operation REDWING. This data is to be used in connection with a continuing study relating the waveform parameters to the height and yield of the detonation.

Instrumentation

Two identical stations are used to record data, one at Eniwetok and one at Kwajalein.

The instrumentation consists of a wide-band receiver with separate outputs connected to each of the three oscilloscopes. Mounted on each oscilloscope is a Polaroid Land Camera for recording the transient display.

The wide-band receiver consists of one primary and four secondary cathode follower amplifiers. An antenna, frequency insensitive in the range of interest is fed directly into the primary cathode follower. The primary cathode follower is then connected to four individual cathode followers by a 50-ohm coaxial cable. Only three secondary cathode followers are utilized, the fourth serving as a spare.

The number one and two cathode followers feed oscilloscopes with sweep speeds of approximately 30 micro-seconds per centimeter and 10 microseconds/centimeter respectively. The number three cathode follower is connected to the third oscilloscope through a 2 micro-second delay line. The third oscilloscope has a sweep speed of 1.0 micro-seconds/centimeter. All oscilloscopes were triggered simultaneously by the DC

trigger device located in the primary cathode follower and connected directly to the receiving antenna. The 2 micro-second delay line was added to permit the leading edge of the waveform to be recorded.

In order to establish a definite time relationship between the reception of the signal and the triggering of a given device such as a counter or transmitter, a time marker pip, generated by the delay trigger from one of the oscilloscopes, is fed through the 2 micro-second delay line and superimposed on the initial portion of the received waveform.

Procedure

All oscilloscopes are calibrated against a known frequency standard for sweep linearity.

The cathode follower triggering system is set to trigger approximately 6 db. above the noise level. The vertical deflector of the oscilloscopes are set to receive the predicted field strength.

Results

Station A - Parry Island

Waveform traces were obtained on two oscilloscope photos and the third oscilloscope failed to function properly. The predicted field strength was 43.0 volts per meter and the measured field strength was 17.0 volts per meter. The waveform traces are of good quality.

Station B - Kwajalein

Waveform traces were obtained on two oscilloscope photos and the third failed to trigger. The predicted field strength was 25.0 volts per meter and the measured field strength was 6.8 volts per meter.

68

[redacted] (FLATHEAD)

Project 8.5 - Airborne High Resolution Spectral Analysis - R. Zirkind

Objective

To determine the radiant power of a [redacted] surface burst as a function of wavelength and the fireball color temperature as seen from an airborne station. These objectives were to be accomplished by determining the atmospheric attenuation by an independent measurement and correcting the power received at the instrument station aboard the aircraft.

Instrumentation

The spectral distribution of the radiant power is obtained from a medium quartz Hilger spectrometer. The spectrum is sampled in narrow bands by photocells in the visible region and PbS cells in the infra-red. The electrical signal is then recorded on an Ampex 814 tape recorder, with a resolution time of 150 μsec. The transmission measurement is accomplished by beaming a pulsed light signal of known output and spectral distribution from a fixed point on the ground towards the aircraft. The attenuated beam is received by a detector in the aircraft and recorded on a Heiland recorder. The detector consists of two filtered photo-multiplier tubes sampling two spectral regions, (1) .3-.55 microns and (2) .6-1.05 microns. In addition, a quartz filtered calorimeter, 22 degrees field of view, is utilized to measure the approximate radiant exposure received at the spectrometer.

Results

The aircraft was approximately 1950 feet beyond intended location at time zero. Planned position was on an out-bound heading of 287°T having a

[redacted]

horizontal range of 40,000 feet. The relatively large error is attributable to insufficient time to make a suitable number of positioning runs prior to zero time resulting from a late decision to proceed with the shot.

The spectrometer operated well and data was obtained on from 6 to 10 channels.

The calorimeter functioned and satisfactory data was obtained.

The light source functioned properly; however, due to a postponement in shot time, the transmissometer was saturated by sunlight.

[redacted] (FLATHEAD)

Project 9.1 - Technical Photography - Lt Col Jack G. James

All three Carter aircraft participated on this event. Carter III was repositioned to 50 nautical miles West of GZ. Carter I was positioned at 70 nautical miles East of GZ and Carter II 70 nautical miles South of GZ. Due to heavy cloud cover in vicinity of Carter I orbit this aircraft started his first racetrack pattern at 26,000 feet altitude. Carter II and III flew the mission at 20,000 feet. High cirrus at approximately 40,000 feet obstructed view of the cloud for all three aircraft. Photography from both East and West positions was satisfactory for only the first three to four minutes. Carter II in the South orbit accomplished two 15 minute patterns with good results on early rate of rise and probable data on height of the cloud base at 15 minutes plus tip to tip spread of the cloud at plus 30 minutes.

PART III

TASK UNIT 1

LASL PROGRAMS

Keith Boyer
Advisory Group

Program 10 - Thermal Radiation and Hydrodynamics	H. Hoerlin
Program 11 - Radiochemistry	G. Cowan
Program 13 - Fission Reaction Measurements	J. S. Malik
Program 15 - Photo-Physics	G. L. Felt
Program 16 - Physics & Electronics & Reaction History	B. E. Watt
Program 18 - Thermal Radiation	H. Hoerlin

72

F

[redacted] (FLATHEAD)

Project 10.1 - Fireball Hydrodynamic Yield - J. F. Mullaney

L. N. Blumberg & J. F. Mullaney

A preliminary value for the hydrodynamic yield of Flathead is:

[redacted]

This number is based on the integral method with Bethe-Fuchs mass treatment.

The films used to get this number were 34811 (Aomoen), 34828 (Chieerete), and 34820 and 34821 (Enyu). The radius-time data which were given only for the region 40 to 80 milliseconds, showed little scatter (roughly 1% spread) so that the spread in yield values due to data scatter is only about 5%. The radius-time data presented as Table 10.1-1 were obtained by drawing a curve through points representing the average of the four films.

Yields obtained using the integral method are presented in Table 10.1-2 for the several mass distributions considered. The smallest distribution includes only the upper structure of the barge; the next considers in addition, the remainder of the barge, one-half of the ballast sand, and six inches of surface water out to 60 meters radius; the largest includes the remaining ballast sand, and one foot of surface water to 60 meters radius. In this latter case, the water considered weighed 6,200,000 pounds. At least for the integral method, it looks as though addition of mass relatively far from the center of the explosion does not change greatly the yield number given by the method. The integral method was used at each of twelve radii ranging from 335 to 391 meters for each mass distribution. Judging from

[redacted]

[redacted]

scatter of yield about the average, a large amount of mass with weight of the order of millions of pounds was involved. When radius-time data for early time become available, a better estimate of the mass involved, using also the differential method, can be made.

TABLE 10.1-1

Time (milliseconds)	Radius (meters)
[redacted]	[redacted]

TABLE 10.1-2

Mass (pounds)	Yield Integral Method (kilotons)	Mass included
[redacted]	[redacted]	[redacted]

[redacted]

[redacted] (FLATHEAD)

Project 11.1 - Radiochemical Analysis - G. Cowan

DELETED

15

[redacted]

[redacted]

[redacted] (FLATHEAD)

Project 11.2 - Sampling - H. F. Plank

(P. F. Moore)

EQUIPMENT

Seven aircraft equipped for cloud sampling as described in the [redacted] Report were used on this mission: "A" flight, Tiger Red One (F-84); "B" flight, Tiger Red Two (F-84); "C" flight, Hotshot One (B-57); "D" flight, Hotshot Two (B-57); "E" flight, Hotshot Three (B-57); "F" flight, Hotshot Four (B-57); and the control aircraft, Cassidy One (B-57).

WEATHER

At sampling altitudes for this shot there was a thick cirrus layer from 37,000 to 42,000 feet, and considerable haze above this, necessitating instrument flight by the aircraft at least part of the time. Wind shears at sampling altitudes were considerable, with winds at adjacent levels differing as much as 90 degrees in direction and 10 to 15 knots in velocity.

CLOUD DESCRIPTION

The bomb cloud rose through the thick cirrus layer between 37,000 and 42,000 feet and into considerable haze above that. There was the usual experience with thick cloud cover that the natural clouds tend to be carried up and consolidated with the bomb cloud, obscuring even the high layers to visual penetration. The bomb cloud appeared to have very little color in the layers above 40,000 feet; which increased the confusion of the bomb cloud with natural clouds.

SAMPLING MISSION

The dual shot, (firing simultaneously with [redacted] required that all sampling aircraft be in the air as primary available samplers or as control aircraft. The back up for the [redacted] control aircraft was a B-50 held in

[redacted]

readiness on the ground.

DELETED

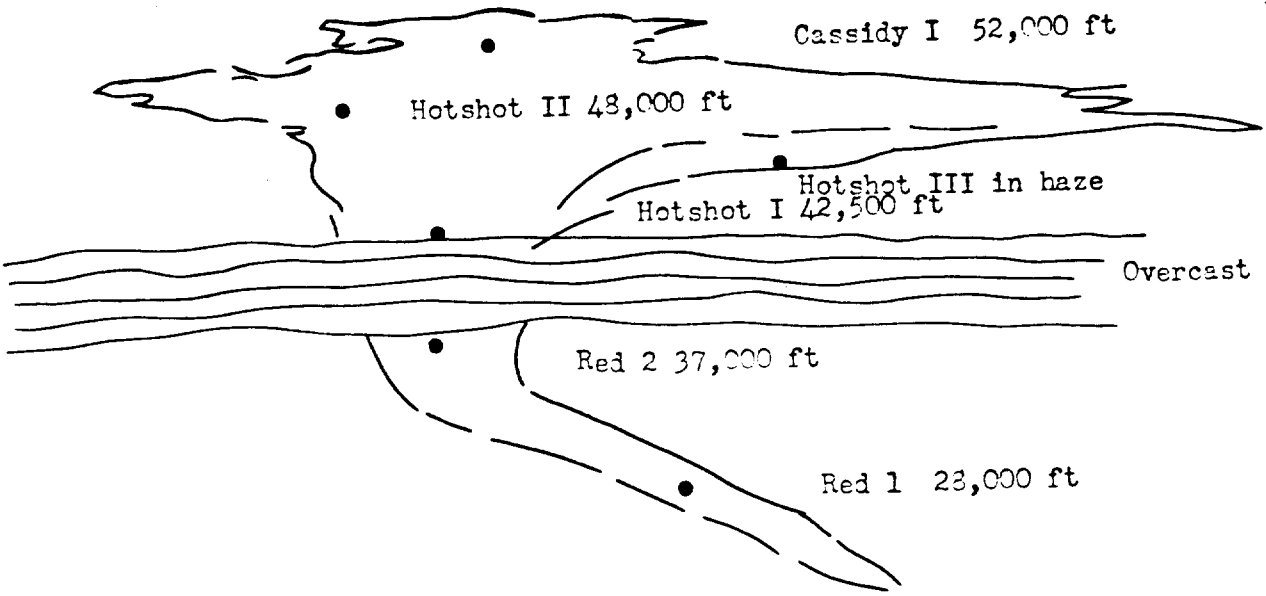
DELETED

Red One was directed into the tail of the cloud at 28,000 feet and plus 105 minutes after burst and collected a very good sample. A half hour of in-cloud flight time was required due to low cloud intensities. Red Two was directed to the portion of the cloud directly below the overcast at 37,000 feet about 10 minutes later and observed expected cloud intensity. Hotshot One was directed into the cloud at 42,000 feet and plus 2 hours just above the overcast and collected a good sample despite poor visibility and low cloud intensities. Hotshot Two was put into the cloud at 48,000 feet, 2½ hours after burst time and found cloud intensities holding up to the prediction curve. Hotshot Three was unable to reach his assigned altitude of 52,000 feet and in view of the rapidly changing weather and cloud conditions at altitudes below this he was unable to fly on instruments into any portion of the cloud and collect an appreciable sample. Hotshot Four aborted and Cassidy One, therefore, went on in the cloud at 52,000 feet at plus 3 hours and, with the fuel capacity remaining, was able to collect a sample only slightly below the size scheduled for Hotshot Four. While at 52,000 feet, Cassidy estimated the cloud top at 53,000 feet.

[redacted]

NUMBER RATIOS

Number of fissions measured in these samples by radio-chemistry at Los Alamos averaged about 91% of the number predicted at PPG from observation of radiation levels of the sample papers after they were removed from the aircraft.



View of [redacted] cloud during sampling operations looking South.

[redacted]

[redacted] (FLATHEAD)

Project 13.2 - Measurement of Alpha, Boosting and Time Interval -

H. Grier

J. Malik

DELETED

[redacted]

[redacted]

79

[redacted]

DELETED

DELETED

[redacted]

FIGURE 13.2-1 HAS BEEN DELETED ENTIRELY

DELETED

FIGURE 13.2-2 HAS BEEN DELETED ENTIRELY

DELETED

FIGURE 13.2-3 HAS BEEN DELETED ENTIRELY

DELETED

[redacted] (FLATHEAD)

Project 13.3 - ENS Monitoring - D. Henry

J. Malik

DELETED

DELETED

COPIES/DOE
LANL RC

COPIES/DOE
LANL RC

[redacted] (FLATHEAD)

Project 15.1 - EG&G PHOTOGRAPHY - H. Grier

D. J. Barnes

FIREBALL YIELDS

DELETED

BHANGMETERS

DELETED

To reproduce this page use JDO Log # RCE-2975, which is the late fireball negative for Flathead, together with a photo mat layout showing classification top and bottom, Figure # and page number. From this material Graphic Arts can make a composite negative and produce glossy prints.

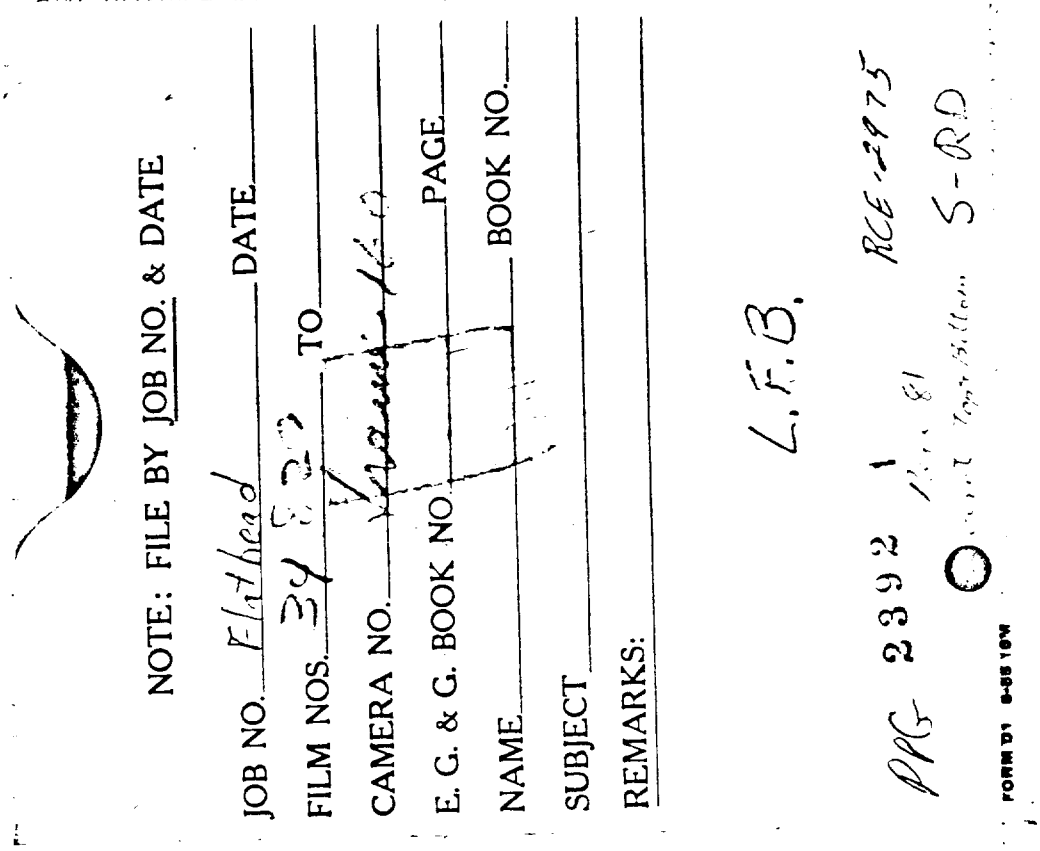


Fig. 15.1-1

To reproduce this page see instructions for page 81 and use JDO Log # RCE-2974, Flathead early fireball.

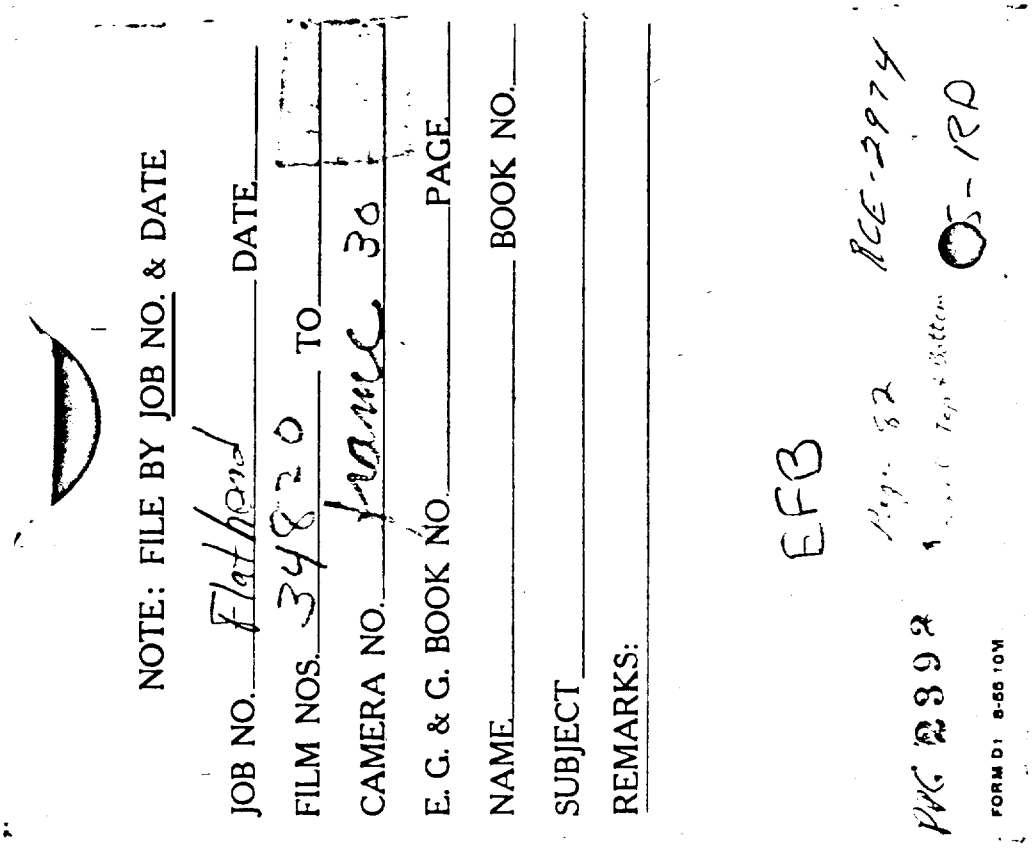


Fig. 15.1-2

To reproduce this page see instructions for page 81 and use JDO Log # RCE-2976, Flathead late cloud negative.

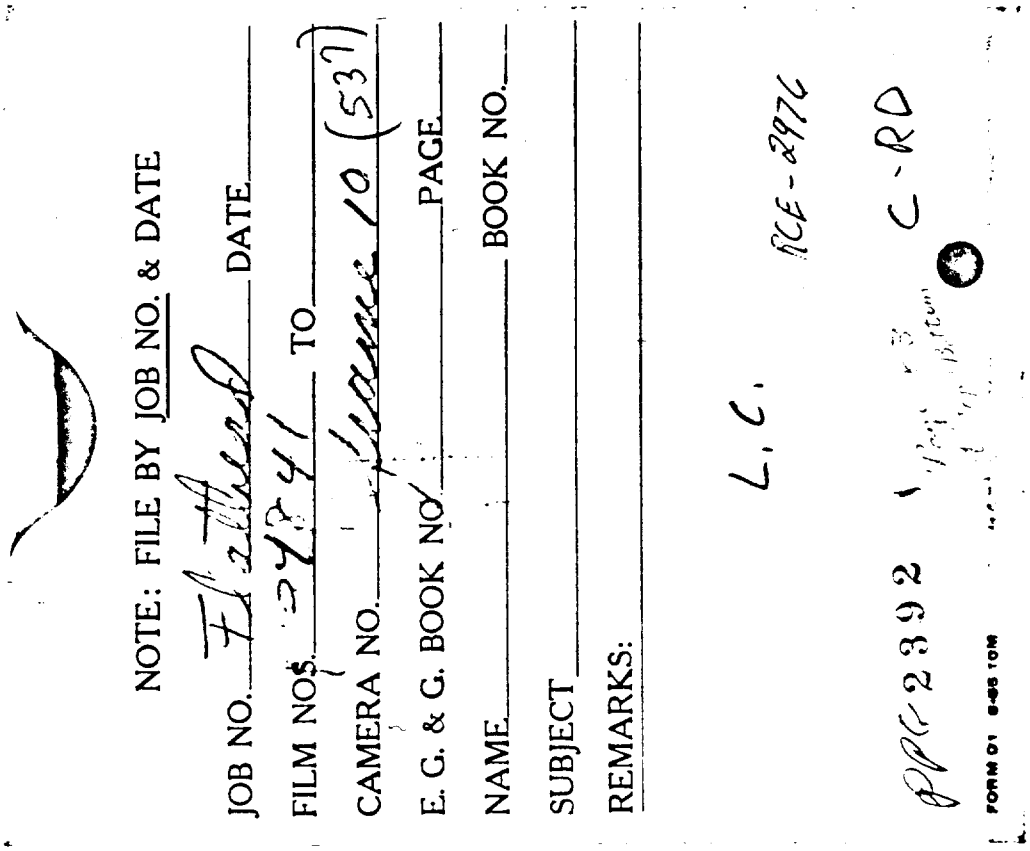


Fig. 15.1-3

[redacted] (FLATHEAD)

Project 15.2 - HIGH SPEED PHOTOGRAPHY - G.L. Felt

EARLY FIREBALL GROWTH, CHORD EXPERIMENT, FLUOR STUDIES

DELETED

DELETED

[redacted]

[redacted]

[redacted]

DELETED

DELETED

DELETED

[redacted]

DELETED

DELETED

[redacted]

To reproduce this page use Graphic Arts

Negative # F000-78

To reproduce this page use Graphic Arts

Negative # F000-77

To reproduce this page use Graphic Arts

Negative # F000-75

To reproduce this page use Graphic Arts

Negative # F000-76

[redacted]

DELETED

COPIED/DOE
LANL RC

96

[redacted] FLATHEAD)

[redacted]

Project 16.3 - Electromagnetic Measurements - R. Partridge

DELETED

[redacted] (FLATHEAD)

Project 18.3 - Spectroscopy - H. Stewart

For purposes of intercomparison all results obtained by Project 18.3 are presented and discussed in the Navajo report where a description of instrumentation is also included.

All equipments operated on the [redacted] (Flathead) giving good exposures except for the Bowen camera which failed to run.

[redacted]

[redacted]

[redacted] (FLATHEAD)

Project 18.4 - Chord Experiment and Time-Interval - H. Hoerlin

Westervelt, Bennet, Day, Hoerlin

DELETED

 boxes.

[redacted]

DELETED

k.

er.

[redacted]

To reproduce this page use Graphic Arts

Negative # F000-79

PART IV

TASK UNIT 4

SC PROGRAMS

E L Jenkins

E. L. Jenkins
CTU-4

Program 31 - Microbarography R. Heppelwhite

[redacted] (FLATHEAD)

Project 31.1 - Microbarograph - W. A. Gustafson

The purpose of this project was to measure winds in ozone layer of the atmosphere. This was accomplished by measuring at several sites the arrival times of the shock wave reflected from the ozone layer. Four sites were operated: Ujelang, Wotho, Rongerik, and Eniwetok. At each site, two stations were operated about one mile apart. The difference in arrival times gives the angle of incidence of the shock and information from several stations may be combined to give the winds.

On [redacted] (FLATHEAD), good shot records were obtained from all stations, except Rongerik, which had high ambient wind noise. However, enough directions are available for the Bikini shot to allow ozonosphere wind and temperature resolution, but this has not yet been accomplished.

[redacted]

[redacted]

DISTRIBUTION:

Copy 1A - CJTF SEVEN (B. H. Hanlon)

2A - DCSM, JTF SEVEN (W. E. Ogle)

3A - CTG 7.1 (G. L. Felt)

4A - D/UCRL, TG 7.1 (G. W. Johnson)

5A - D/DOD, TG 7.1 (L. L. Woodward)

6-7A - DMA, USAEC (A. D. Starbird)

8-9A - Chief AFSWP (A. R. Ludecke)

10-14A - Report Library, LASL

15-19A - UCRL (H. York)

20-24A - Field Command, AFSWP (F. O'Beirns)

25-29A - Sandia Corp (R. A. Bice)

30A - ALOO, USAEC (J. E. Reeves)

[redacted]