[redacted]

DELETED VERSION ONLY

410935

OPERATION REDWING

A PRELIMINARY REPORT

OF

DEL[redacted] (OSAGE)

Submitted by Task Group 7.1

5585JFE

24 July 1956

[redacted]

CONTENTS

4

[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

The [redacted] is a [redacted] It was detonated at 1313.53 on June 16, 1956, as an air drop over the center of Runit Island, Eniwetok Atoll at an altitude of 680 feet. The actual burst position was about 190 feet southwest of intended GZ.

DELETED

Results of the various experiments are given in the following pages.

PART I

GENERAL INFORMATION

[redacted]

[redacted] (OSAGE)

ENIWETOK OBSERVED WEATHER FOR 16 JUNE 1956

AT DETONATION TIME 1314M

Sea Level Pressure	1008.5 mb
Free Air Surface Temperature	85.9°F
Wet Bulb Temperature	79.0°F
Dew Point Temperature	76.6°F
Relative Humidity	74.0%
Surface Wind	140° - 11 knots
Visibility	10 miles

CLOUDS:

3/10 cumulus; estimated bases at 1800 ft., tops 5-7,000 ft. Towering cumulus in all quadrants.

Less than 1/10 altostratus; estimated at 9,000 ft. (thin).

6/10 cirrostratus; based at 30,000 ft. (very thin and transparent).

AREA WEATHER SUMMARY FROM AIRCRAFT:

5/8 to 6/8 cumulus clouds within 60 miles (all directions) of Eniwetok. Cumulus based at 1600 ft. with 2/3 of tops at 5,000 ft.; remaining 1/3 tops to 10,000 ft. and an occasional top to 20,000 ft. Cirrostratus (5/8) based at 30,000 ft.

RADAR OBSERVATIONS:

Towering cumulus all quadrants within 25 miles of station with tops measured at 10-12,000 ft. Towering cumulus between 25 and 75 miles of station with tops measured at 15-20,000 ft.

STATE OF SEA:

Ocean Side: Wave heights 3.5 ft., period 6 seconds, direction 100°.

Lagoon Side: Less than one foot.

[redacted]

[redacted]

ENIWETOK UPPER AIR SOUNDING (Release time 1230M)

Pressure (Millibars)	Height (Feet)	Temperature (°C)	Dew Point (°C)
1000	280	27.9	23.4
986	689	26.7	22.5
850	4,940	17.8	10.5
700	10,330	09.2	-01.2
630	13,156	04.0	-07.5
600	14,470	02.8	-10.5
558	16,404	00.7	-16.5
504	19,029	-05.5	-22.8
500	19,250	-05.8	M
400	24,910	-15.0	M
300	31,830	-30.8	M
200	[illegible]	-52.2	M
150	[illegible]	-66.2	M
118	51,509	-72.4	M
100	54,660	-73.5	M
98	55,118	-73.8	M
66	62,372	-71.5	M

WINDS ALOFT (Release Time 1230M)

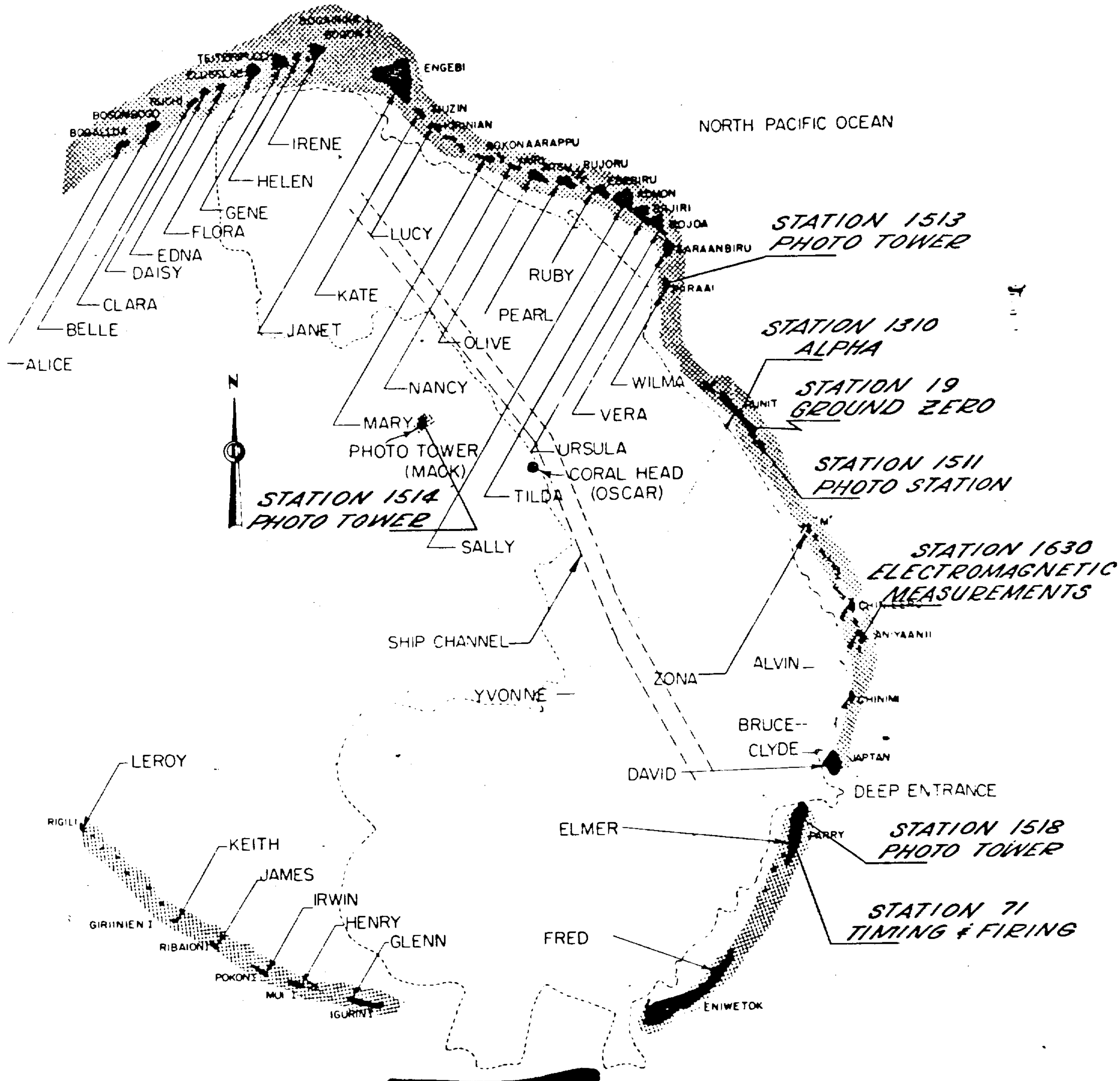
Height (Feet)	Direction (Degrees)	Speed (Knots)	Height (Feet)	Direction (Degrees)	Speed (Knots)
1,000	130	14	26,000	240	4
2,000	130	16	28,000	290	4
3,000	130	16	30,000	020	4
4,000	140	16	32,000	340	8
5,000	150	15	34,000	020	7
6,000	160	14	35,000	030	13
7,000	170	12	36,000	040	17
8,000	[illegible]	[illegible]	38,000	050	21
9,000	170	8	40,000	050	23
10,000	170	10	42,500	080	8
12,000	220	11	45,000	160	6
14,000	230	12	47,500	120	10
16,000	210	13	50,000	110	12
18,000	200	10	52,500	130	5
20,000	200	6	55,000	140	6
22,000	190	8	57,500	140	6
24,000	210	5	60,000	140	6
25,000	230	4	62,000	130	6

[redacted]

4

[redacted]

[redacted]



[redacted]

Fig. 0-1 - Eniwetok Atoll Map

9

[redacted]

[redacted]

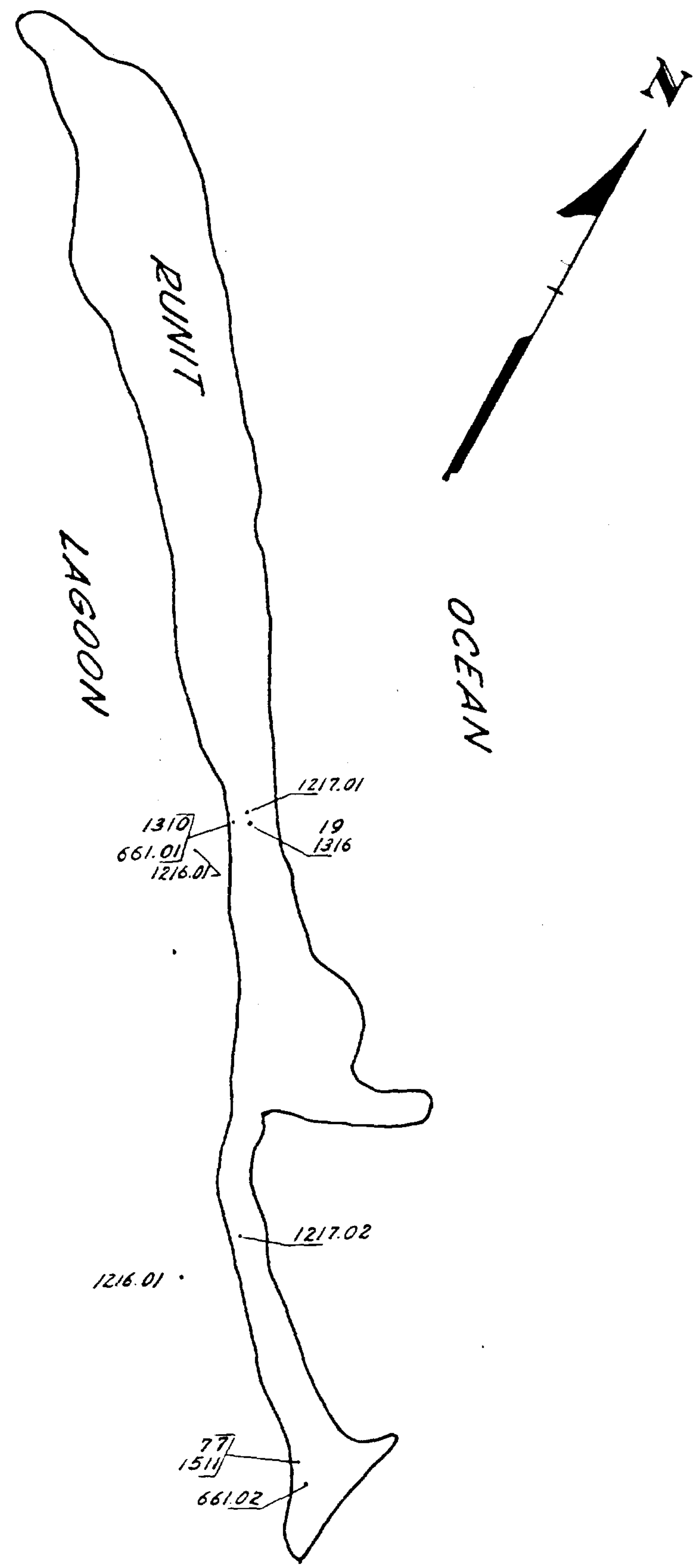
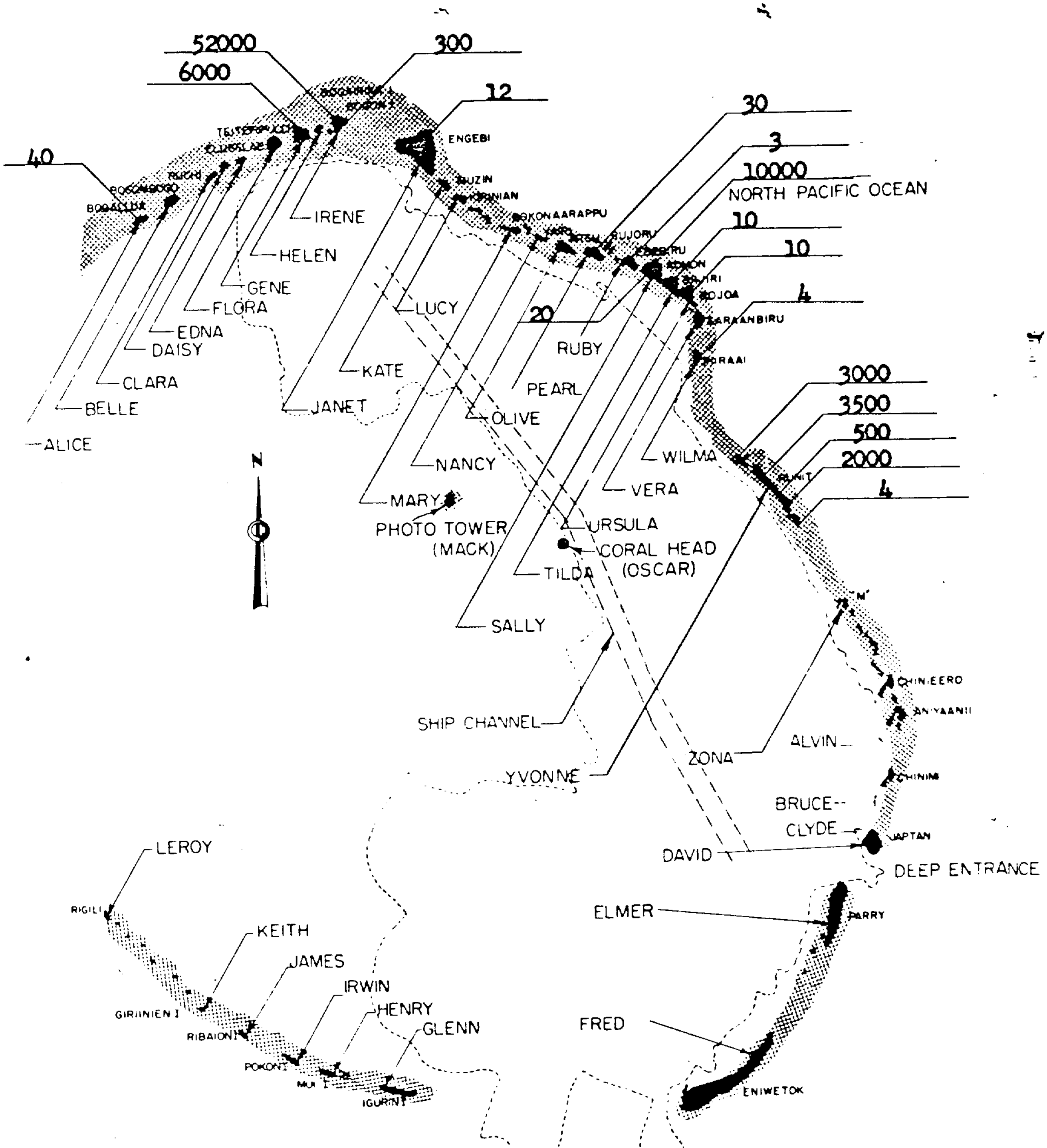


Fig. 0-2 - Runit Island Map with Scientific Stations

[redacted]

[redacted]

[redacted]



[redacted]

Fig. 0-3 - RadSafe Survey, D + 1

[redacted]

[redacted]

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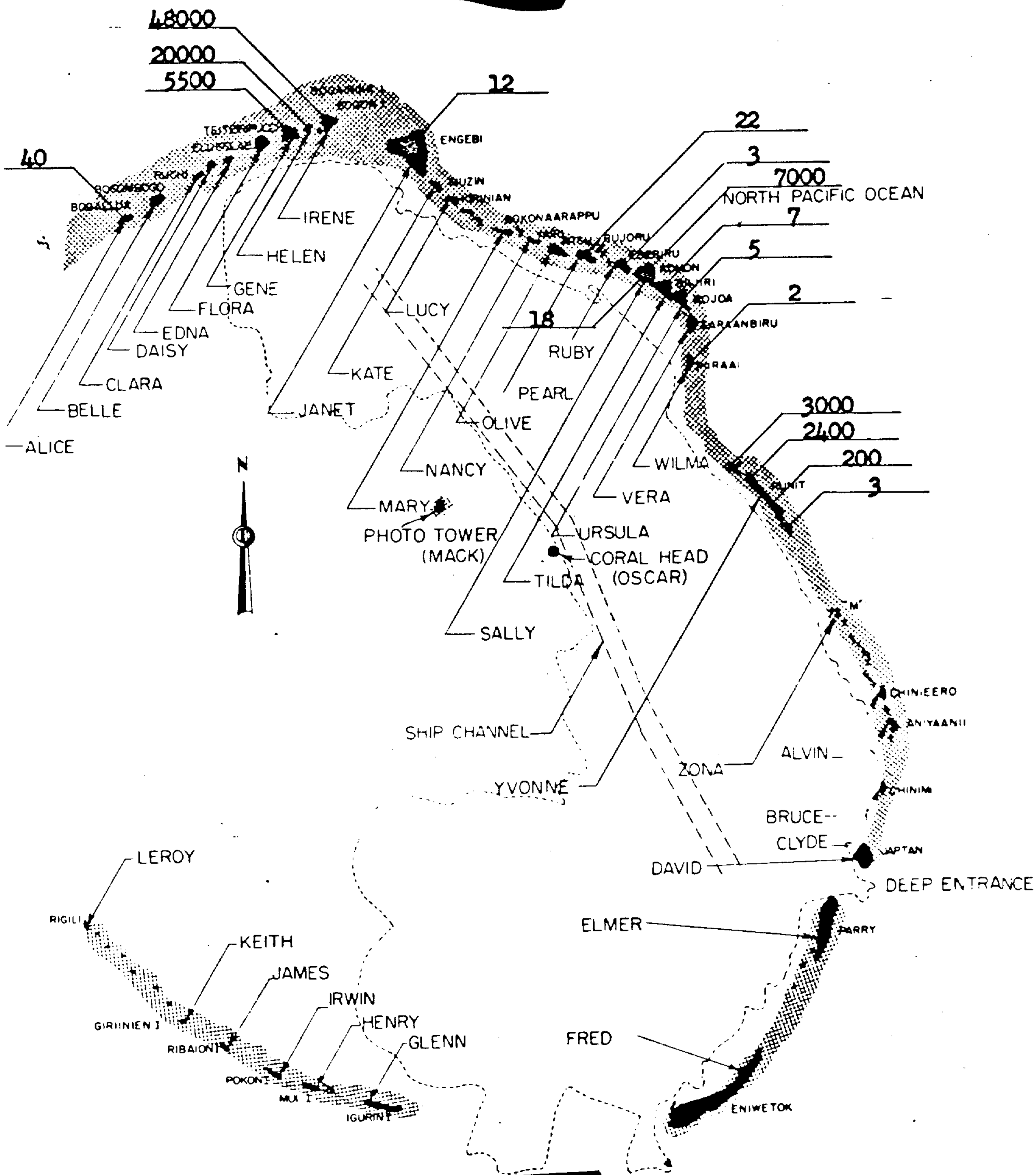

Fig. 0-4 - RadSafe Survey, D + 2

[redacted]

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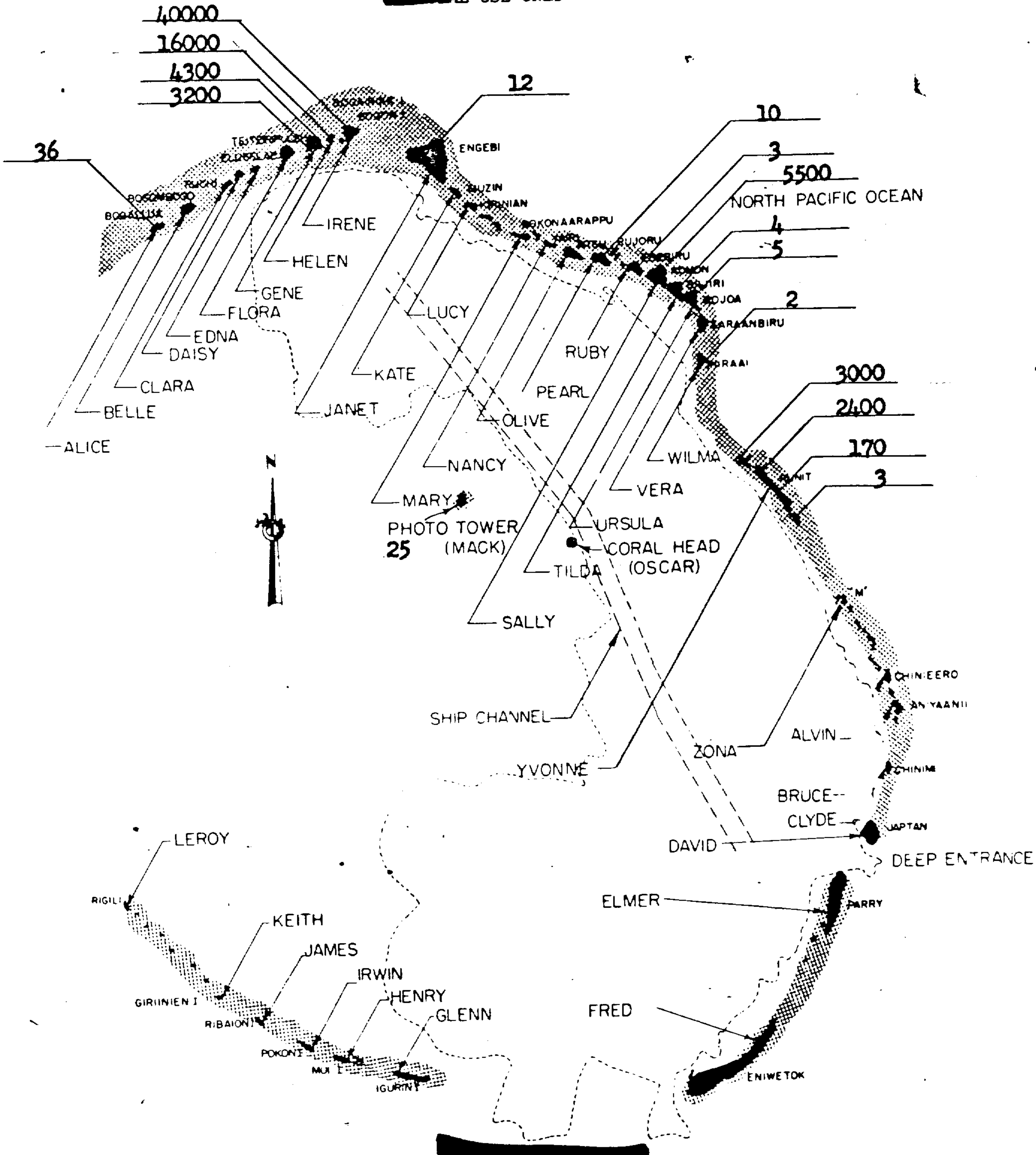

[redacted]

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

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LANL RC

[redacted]

[redacted]

PART II

TASK UNIT 3

DOD PROGRAMS

Col. K. D. Coleman
CTU-3

Program 6 - Tests of Service Equipment and Materials	Lt Col C. W. Bankes

[redacted]

[redacted]

[redacted] (OSAGE)

Project 6.1 - Accurate Location of Electromagnetic Pulse Source -

Dr. 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 being tested. One system known as the short base line or Narol System operates a net in the Hawaiian Islands and another net in California. Each net consists of one master station with slave stations connected with microwave link 30 to 60 miles on either side. The slave stations receive and automatically transmit the bomb pulse to the master station where pulse shape and time differences are analyzed. The California net has the master station located at Woodland and slave stations near Pittsburgh and Marysville. The Hawaiian net has the master station located at Kona Hawaii and the slave stations at Red Hill, Maui; and Papa, Hawaii. Each net will attempt to determine one hyperbolic line or a line of position and will not attempt an exact fix or exact location of ground zero.

[redacted]

The second system known as the long base line system has one net of stations in the Hawaiian area and another in the Continental U.S. Each long base line net requires a synchronizing transmitter and receiving station located not more than 1500 miles from the transmitter. For the Hawaiian net the transmitter is located at Haiku, Oahu and receiver sites at Midway Island, Lahaina, Maui and Palmyra Island. For the Stateside net the transmitter is located at Carolina Beach, North Carolina and receiver sites at Harlingen AFB Texas, Kinross AFB Michigan, Blytheville AFB Arkansas, and Forestport, New York. Each receiver station will determine exact time of receipt of bomb pulse. From this information lines of position will be drawn and definite fixes or exact location of ground zero will be determined for each net.

Results

Delays and short notification of rescheduled time made it impossible to notify stations of exact shot time. No information was obtained by Project 6.1 for OSAGE detonation.

[redacted]

DE[redacted] (OSAGE)

Project 6.3 - Fffects of Atomic Explosion 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 plane based at Eniwetok Island.

RESULTS

Stations at Rongerik and Kusaie operated successfully during this test. The C-97 did not participate. There were no noticeable effects on the ionosphere from this test.

[redacted]

Project 6.4 - Determination of Characteristics of Airborne Flush Mounted Antennas and Photo Tubes 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 items 1 and 2 above.

Instrumentation

2 fiducial antennas	2 scope cameras
1 whip antenna	1 sequence camera
1 synchronizer	1 recorder
2 photoheads	

2 DuMont Scopes (1 a dual beam, 1 a single beam)

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 sequence camera photographs the blast directly for use in correlation of previous data. Distance was approximately 12 miles.

Results in OSAGE

Equipment reinstalled in aircraft. However, aircraft did not take off so recording was done on ground.

No signal traces were seen on the oscilloscope. Cameras did not record any either.

Photohead data was recorded and gave excellent results.

19

DELETED [redacted] (OSAGE)

Project 6.5 - Analysis of Electromagnetic Pulse Produced by a 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 waveforms 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 a separate output connected to each of the three oscilloscopes. Mounted on each oscilloscope is a Polaroid Land Camera for recording the transient display.

RESULTS

Station A - Parry Island

Positive results obtained on fast and medium sweep speed oscilloscopes. The signals obtained were of good quality. The slow sweep speed oscilloscope did not trigger and no data were recorded.

The predicted field strength was 50 volts per meter and the measured field strength was 26 volts per meter.

Station B - Kwajalein

The shot time for th[redacted] DELETED (Osage) was delayed and it was impossible to relay this information to Kwajalein in time for this event.

[redacted]

DELETED [redacted] (OSAGE)

Project 6.6 - Electromagnetic Attenuation Measurements - T. D. Hanscome

OBJECTIVE

To make electromagnetic attenuation measurements as a function of time at S-band (2160 MC) and X-band (9400 MC).

PROCEDURE

Installation on Runit (Yvonne) consisted of the repaired [redacted] DELETED (Blackfoot) installation (3500 feet from GZ) plus a transmitter and antenna on top of the bunker at ground zero. Both transmitters were on a line to the receiver in a tower on Parry. Both receivers were used to measure attenuation. The transmitter frequencies were separated enough to prevent image interference. Each receiver output was displayed on scopes with scope sweep speeds of 5 microseconds per centimeter and 100 microseconds per centimeter. In addition the Brush recorder was used on the receiver tuned to the transmitter at ground zero.

RESULTS

All equipment operated successfully. The record from the 3500' transmitter is complete and detailed. It confirms and extends the results of the DELETED [redacted] shot (Blackfoot).

The delay introduced in the received signal in order to show the transmitted signal level existing two microseconds before time zero was not sufficient for the signal from the ground zero station. However, the recovery rate can be observed, and by the end of one millisecond the signal had recovered to within 20 db of full signal strength. Island power was turned off before signal recovery could show up in the Brush recorder.

PART III

TASK UNIT 1

LASL PROGRAMS

Keith Boyer

Keith Boyer
Advisory Group

Program 10	Thermal Radiation and Hydrodynamics	H. Hoerlin
Program 11	Radiochemistry	G. Cowan
Program 12	External Neutron Measurement and High Energy Gamma Measurement	R. L. Aamodt
Program 13	Fission Reaction Measurements	J. S. Malik
Program 15	Photo-Physics	G. L. Felt
Program 16	Physics & Electronics & Reaction History	B. E. Watt

[redacted] (OSAGE)

Project 10.1 - Fireball Hydrodynamics - J. F. Mullaney

L. N. Blumberg & J. F. Mullaney

DELETED

The hydrodynamic yield of the [redacted] shot (Osage) was determined on the basis of diameter - time data from four Eastman films as:

DELETED

[redacted]

The data consisted of one film from each of stations Mack (35828), Parry (35821), Runit (35811) and Piiraai (35834). The scatter of yields computed from each of the films individually was about ± 4.7%; the consistency of yield among the frames of a given film was extremely good, varying from ± 0.26% to ± 0.05%.

Results of computation using the differential method and the Mach number scaling method are presented in Table 10.1-1. The Bethe-Fuchs mass treatment was employed using [redacted] pounds as the weight of vaporized materials in the fireball.

DELETED

Louis Gatt and Chester Kazek from group T-1 performed the major part of the computation.

[redacted]

TABLE 10.1-1

Weight of Vaporized Material (Pound)	Yield (Kilotons)		
	Integral Method	Differential Method	Mach Scaling Method
[redacted]	[redacted]	[redacted]	
[redacted]	[redacted]	[redacted]	[redacted]

DELETED DELETED DELETED DELETED

TABLE 10.1-2

Radius (meters)	Time (milliseconds)

DELETED

[redacted]

DELETED [redacted] (OSAGE)

Project 10.2 - Time of Arrival - J. F. Mullaney

L. N. Blumberg

Atmospheric conditions of interest, provided by Weather Central (ENIWETOK) at shot time, are:

Pressure:	1007.6 mb
Temperature:	29.94°C
Wind:	11 Knots from 140°
Dew Point:	24.78°C

From these data, a sound speed of 1151.6 fps was calculated. The results of the time-of-arrival calculation are presented in Table 10.2-1.

TABLE 10.2-1

STATION	RANGE (ft)	BEARING	RANGE, WIND - CORRECTED	TIME INTERVAL (Seconds)	YIELD (KT)
Sta. 71, Parry	49,648.1	172° 35'	50,416	[redacted]	[redacted]

[redacted]

DELETED [redacted] (OSAGE)

Project 11.1 - Radiochemical Analysis - G. Cowan

The fission yields for the [redacted] are as follows:

[redacted] ± 5%

[redacted] ± 10%

Suggested best value for this shot is

[redacted]

Capture to fission ratio is [redacted]

[redacted]

[redacted](OSAGE)

Project 11.2 - Sampling - H. F. Plank

(P. F. Moore)

EQUIPMENT

Seven aircraft equipped for cloud sampling as described in the VIPER 2 Report were used on this mission: "A" flight, Tiger Red One (F-84); "B" flight, Tiger Red Two (F-84); "C" flight, Tiger White One and Two (2-F-84's); "D" flight, Tiger Blue One and Two (2-F-84's); and control aircraft, Cassidy (B-57).

WEATHER

The cloud cover was quite extensive at low levels with occasional cumulus reaching up to 25,000 feet, but so positioned that none of them threatened to engulf the small bomb cloud. Wind structure was on the whole favorable with light velocities compensating for the directional changes in wind of about 10 degrees for each 2,000 feet change in altitude.

CLOUD DESCRIPTION

The bomb went off under the edge of a small cumulus cloud and the bomb cloud carried quite a bit of natural cloud material up with it so that in the early stages there was high turbulence within the cloud and practically no color. After about 20 minutes of this slow churning rise the bomb cloud stablized with the top at 21,000 feet, about 8,000 feet higher than predicted on the original yield prediction. The cloud then spread out widely under the influence of the variable winds and the fleecy color disappeared completely, leaving only transparent brown stains against the sky at sampling time. This transparent cloud was almost impossible to see without the aid of the special brown glasses or helmet visors, which were invaluable in keeping the target in sight.

The cloud separated into three layers before plus 1 hour; a very puny layer at 21,000 feet; a middle layer at 19,000 to 20,000 feet which seemed to contain the majority of visible bomb material, although quite thin; and a lower layer at 16,000 feet which was very thin and wide spread and quite difficult to see at all. It was found that all of these thin pieces of cloud could be seen best by breaking off about 20 miles and then flying straight in watching radiation instruments to pick out the activity, as the clouds almost disappeared to the eye, when approached closely or penetrated.

SAMPLING MISSION

Red One was brought out a little early, because of the meagre appearance of the cloud, and at plus 38 minutes was put in the top; Red Two at plus 70 minutes was put in the middle; White Flight at plus 84 minutes was put in the bottom; Blue Flight at plus 91 minutes was put in the middle; and Cassidy at plus 108 minutes was put in the top. In line with visual appearance, the top cloud was somewhat low in radiation readings, the middle about normal and the bottom very low. Decay of the top between Red Two readings and Cassidy readings (70 and 108 minutes) was over 50%.

The special penetration by Cassidy was an experiment to check cross contamination effects if two separate samples were to be gathered with one aircraft. One sampler pod was opened in the cloud and the other left closed. A run of equal time was then made 10,000 feet above the cloud with the second sampler open and the first closed.

NUMBER RATIOS

The number of fissions measured in the samples by radio-chemistry at Los Alamos averaged 77% of the number predicted at PPG from observation of radiation levels of the sample papers through the shipping pigs after removal from the aircraft. This drop was compensated by increases in pilot dosage based on experience with the previous REDWING shots.

DELETED [redacted] (OSAGE)

Project 12.1 - Threshold Detectors - W. A. Biggers

J-12 participation on Osage consisted of placing gold samples at four stations. Two of these were land stations at approximately ground zero and 700 yards south of ground zero. The samples were placed from surface level to about 20 inches below the surface. Two stations were in the water on the lagoon side of the island, one being about 100 yards west of ground zero and the other about 700 yards south of zero. These samples also were placed from the water surface to a point about 20 inches below the surface.

One of the main items of interest was to find the difference in the water and ground for absorption of thermal neutrons. This is for future calculations of neutron distribution in space where the two medium problem is considered.

[redacted]

[redacted]

[redacted] (OSAGE)

Project 13.1 - MEASUREMENT OF ALPHA - H. Grier

J. Malik

The measurement of the multiplication rate on alpha of the [redacted] made by EG&G (Ward) from Runit, station 1310. Within the range of [redacted] generations, [redacted]

An array of four detectors, one photomultiplier and three photocell detectors, each driving the three scope combination of EG&G 3343, K-1421, and K-1409, all utilizing a common 270 Mc/s Rossi display. All detectors were located at the predicted ground zero; the actual ground zero was 190 feet southwest of the detectors and burst altitude was 680 feet. No collimation was used on this shot.

Data were obtained on only 7 of the 12 indicators; a large amount of hash of unexplained origin made records hard or impossible to read. The photomultiplier gave good data on the EG&G 3343, however, and the high level photocell data were generally good.

DELETED [redacted] (OSAGE)

Project 15.1 - EG&G PHOTOGRAPHY - H. Grier

D. J. Barnes

BURST POSITION

The position of burst was determined by triangulation utilizing four phototheodolite plates, two each from Piiarii (WILMA) and Mack photo stations. Ground Zero was:

N 102851 ± 50

E 126647 ± 50

Ground Zero is therefore about 190 feet at an Azimuth of 224° 21' from intended Ground Zero.

Burst altitude was 680 ± 35 feet.

TIME OF FALL

Time of fall was determined to be 32.185 seconds.

FIREBALL YIELDS

Fireball yields have been determined from four films, one each from Parry (ELMER), Mack, Piiarii (WILMA), and Runit (YVONNE), with the following results:

Parry

Mack

Piiarii DELETED

Runit

Therefore, the fireball yield is [redacted] Preliminary measurements indicate an alpha of [redacted] DELETED

BHANGMETERS

Four Bhangmeters at the control point gave time-to-minimum [redacted] DELETED

[redacted]

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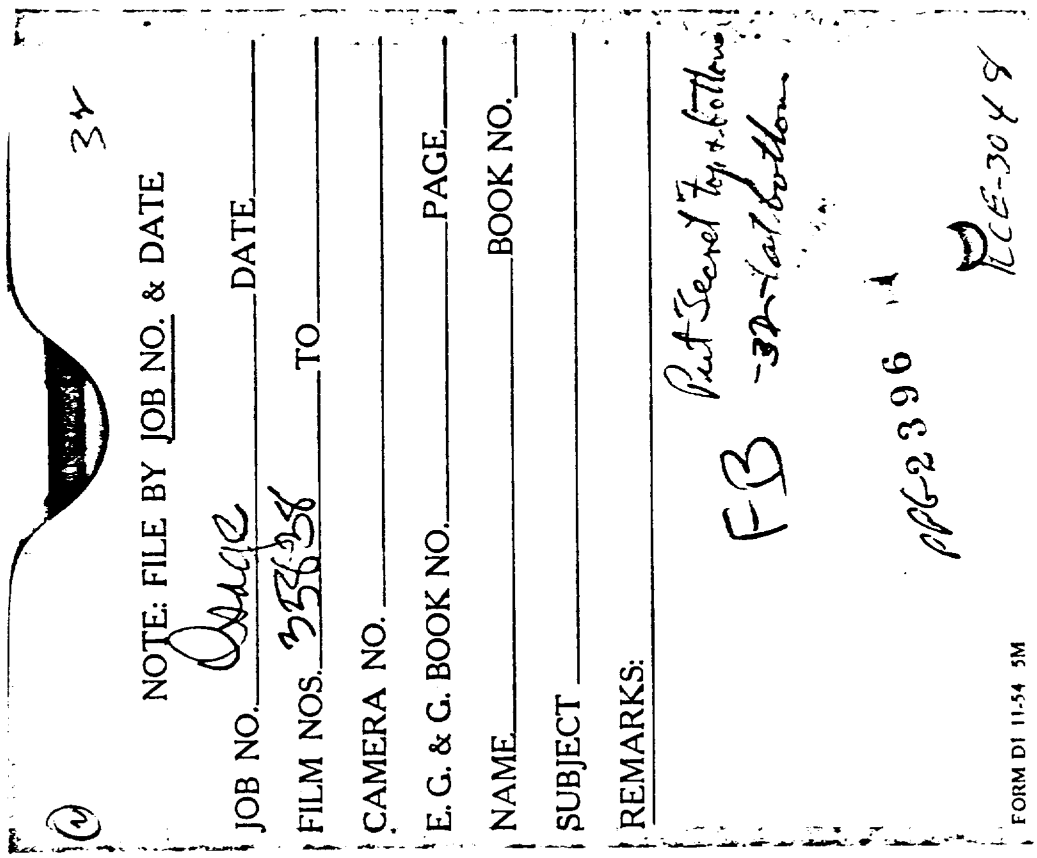
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FORM DI 11-54 5M

[redacted]

[redacted] (OSAGE)

DELETED

Project 16.3 - Electromagnetic Measurements - R. Partridge

DELETED

DELETED Project 16.3 measures the time interval between the [redacted] reactions in [redacted] devices by direct oscilloscopic recording of the electromagnetic radiation in the radio-frequency range. In addition, methods of obtaining other diagnostic information from this signal are investigated.

The air-dropped [redacted] (OSAGE) furnished an excellent opportunity to check some predictions which had been made concerning the reduction in field strength to be expected from air drops. The signal strength was about six times that predicted.

An alpha system was in operation, but the traces are unrecognizable. It has not yet been determined whether this was due to radio interference or whether the radiated signal had a strange shape. There is some evidence that it took the form of a rapidly or growing oscillation.

[redacted]

PART IV

TASK UNIT 4

SC PROGRAMS

E L Jenkins

E. L. Jenkins
CTU-4

Program 31 - Microbarography R. Heppelwhite

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. Five sites were operated: Ujelang, Wotho, Rongerik, Bikini, 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.

One recorder did not operate properly at Wotho on Osage, and at Rongerik no distinguishable signal was received because of high ambient wind noise, so ozonosphere data probably cannot be obtained from the records.

[redacted]

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