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DELETED VERSION ONLY

410933

OPERATION REDWING

A PRELIMINARY REPORT

OF

D[redacted] (CHEROKEE)

Submitted by Task Group 7.1

5379JFE

17 JULY 1956

[redacted]

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CONTENTS

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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.

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The [redacted] device was dropped from a B-52B on May 21, 1956, and was detonated at 0550:38.7. The target was near the center of Namu Island on the north side of Bikini Atoll, at an altitude of 5000 feet. The actual burst position was approximately 20,000 feet northeast of the target and actual height of burst was approximately 4450 feet.

Although the error in burst point caused considerable loss in data, it was determined that the device performed satisfactorily [redacted]

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PART I

GENERAL INFORMATION

Observed Weather at Shot Time

Fig. 0-1 - Bikini Atoll North Reef Scientific Stations, Part I

Fig. 0-2 - Bikini Atoll North Reef Scientific Stations, Part II

Fig. 0-3 - Bikini Atoll Map

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BIKINI OBSERVED WEATHER FOR 21 MAY 1956
[redacted] (CHEROKEE). DETONATION TIME 0551M

Sea Level Pressure	1009.0 mb
Temperature	81°F
Dew Point	73°F
Relative Humidity	76%
Surface Wind	140°, 10 kts
Visibility	More than 10 miles

CLOUDS: 2/10 cumulus, bases 1800 ft, tops 2500 ft; 2/10 cirrus at 38,000 ft.

WEATHER: Very widely scattered showers. There were three showers in the vicinity of the atoll at shot time: one very light shower just to the south of Eninman (Tare); one light shower, which was dissipating, near Bokororyuru (Bravo); and a light shower east of Enyu (Nan).

STATE OF SEA: Bikini Lagoon: Average of highest 1/3 of waves; 3.0 ft. at anchorage, 2.5 ft. near Namu. The predominant direction of waves at anchorage was 135°; near Namu, 100°. Open Sea: Average of highest 1/3 of waves; 4.0 ft. The predominant direction of waves in open sea was 100°.

BIKINI SOUNDING

Pressure Millibars	Height Feet	Temperature °C	Dew Point °C
1009	Sfc	27.2	22.2
1000	320	26.5	22.5
916		18.5	17.5
850	4,930	15.5	10.8
835		15.2	09.5
823		13.5	13.5
772		10.5	10.2
716		06.2	02.2
710		07.2	03.5
700	10,230	07.2	03.5
500	19,080	-07.8	-10.2

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Pressure Millibars	Height Feet	Temperature °C	Dew Point °C
453		-10.2	-14.5
400	24,700	-17.2	-20.8
300	31,530	-33.8	-42.2
266		-40.2	-48.8
250	35,630	-43.9	M
200	40,380	-56.1	M
150	46,210	-67.9	M
106		-81.0	M
100	53,910	-80.9	M
080		-80.0	M

BIKINI WINDS ALOFT

Height Feet	Direction Degrees	Speed Knots	Height Feet	Direction Degrees	Speed Knots
Surface	140	10	25,000	150	09
1,000	100	17	30,000	140	06
2,000	090	20	35,000	260	06
3,000	090	20	40,000	230	15
4,000	090	21	45,000	240	26
5,000	090	18	50,000	250	32
6,000	090	14	55,000	210	07
7,000	090	14	60,000	100	17
8,000	090	13	65,000	030	20
9,000	100	11	70,000	100	22
10,000	120	11	75,000	090	47
12,000	120	12	80,000	090	50
14,000	140	14	85,000	080	55
16,000	140	15	90,000	080	61
18,000	130	15	95,000	090	74
20,000	140	18	100,000	090	81

[redacted]

[redacted]

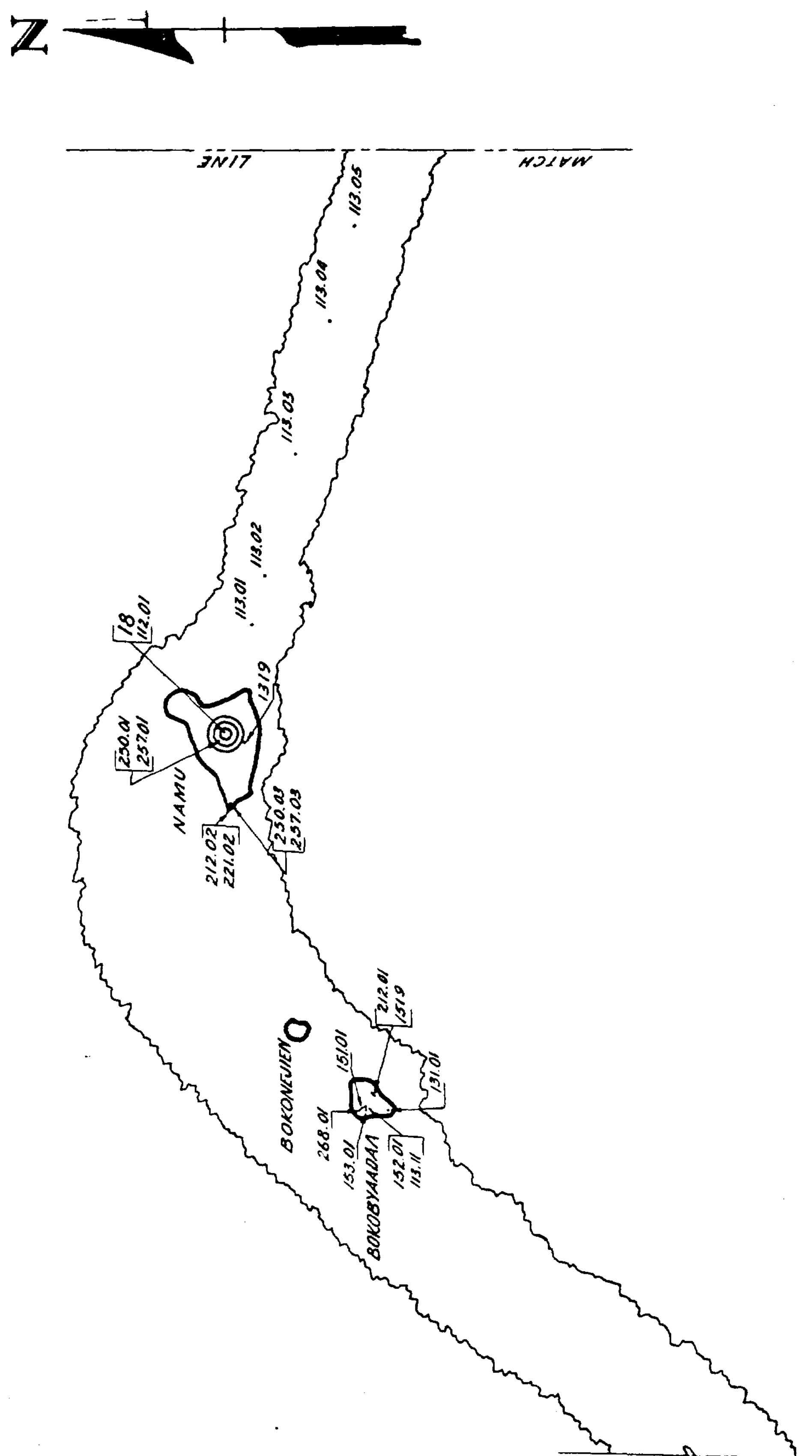

Fig. O-1 - Bikini Atoll North Reef Scientific Stations, Part I

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[redacted]

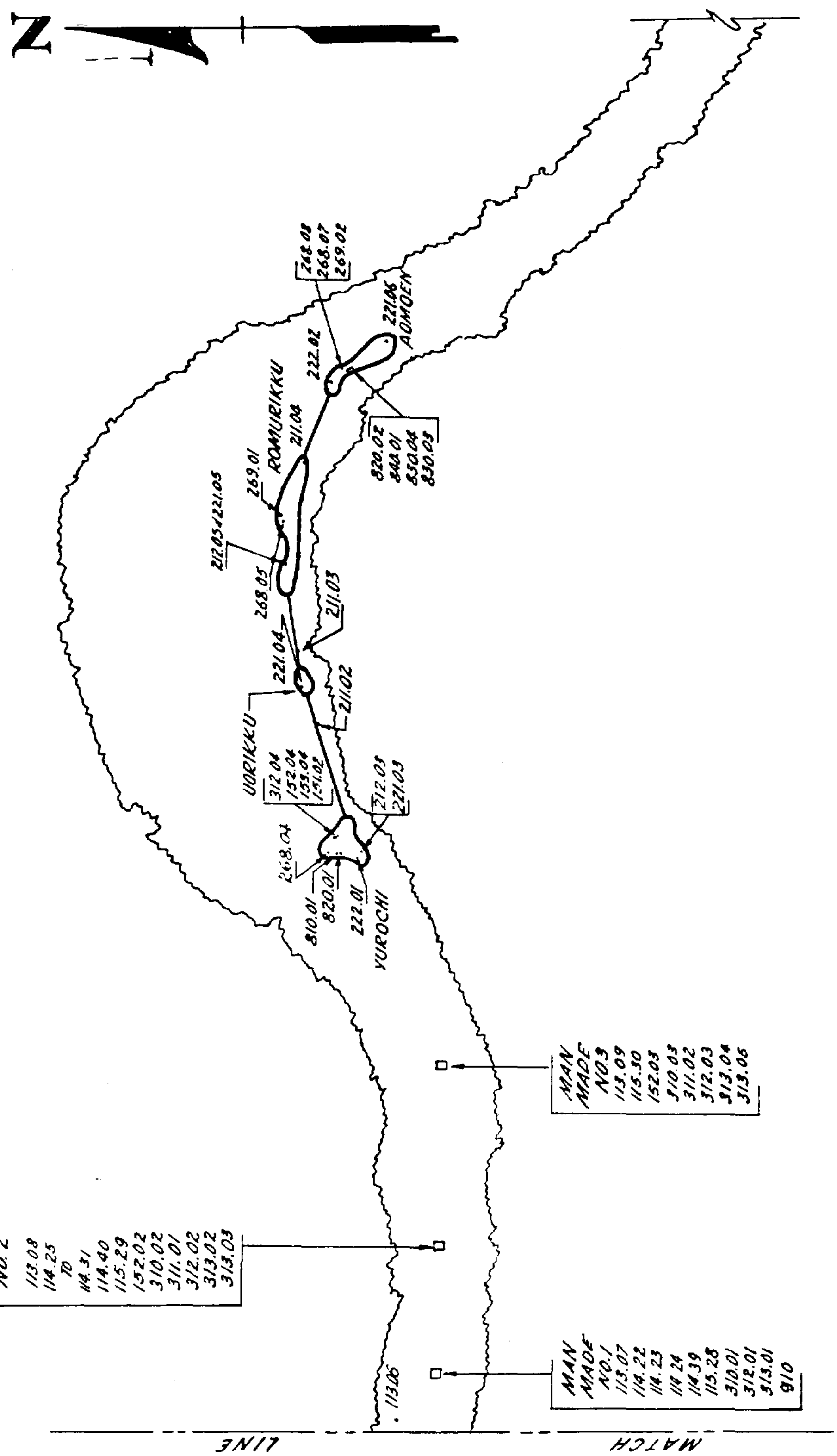

Fig. O-2 - Bikini Atoll North Reef Scientific Stations, Part II

[redacted]

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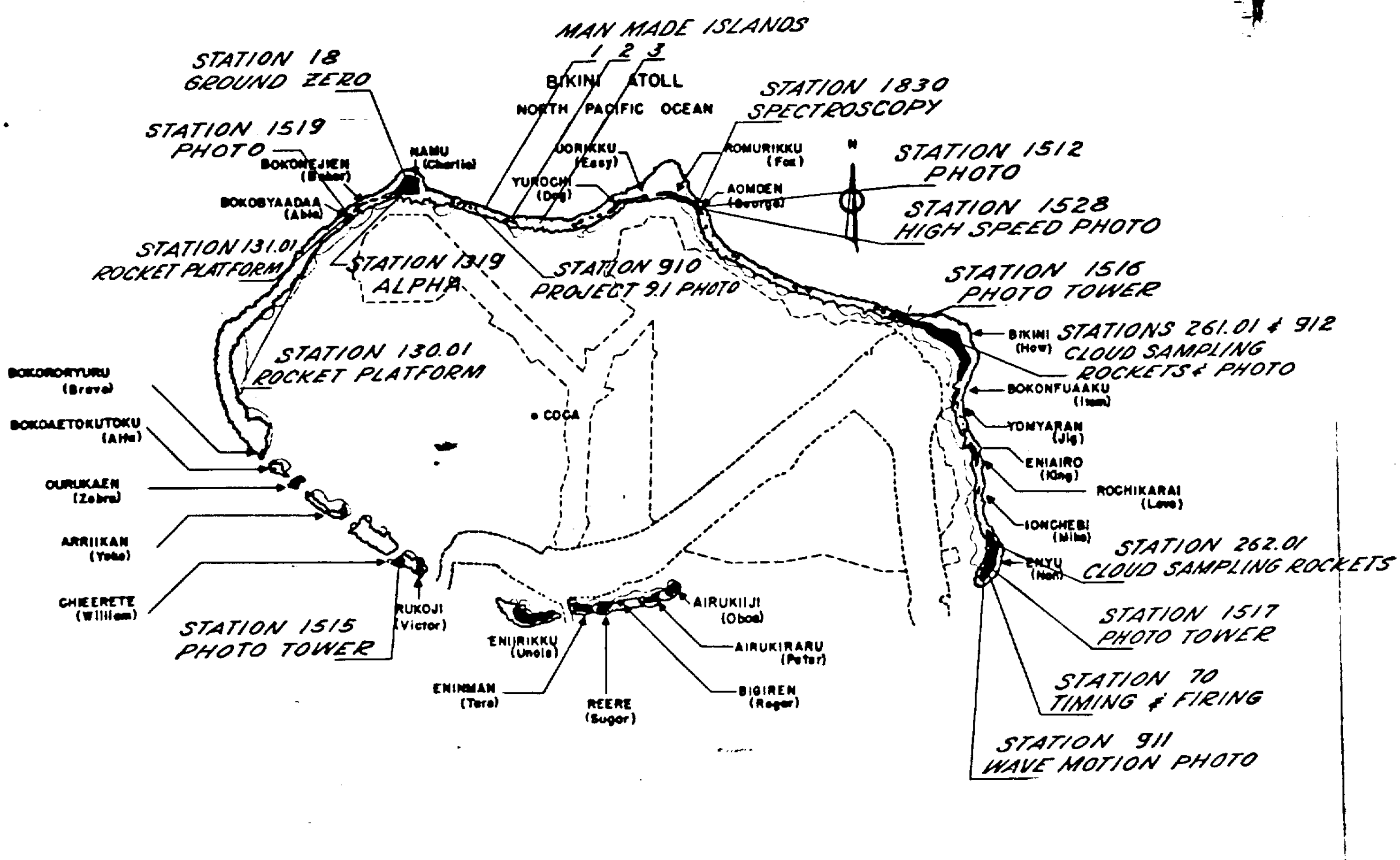

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Fig. 0-3 - Bikini Atoll Map

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PART II

TASK UNIT 3

DOD PROGRAMS

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 3	Structures and Equipment	Maj. H.T. Bingham
Program 4	Biomedical Effects	Lt Col C.W. Bankes
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

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Project 1.1 - Basic Blast Measurements - J. J. Meszaros

OBJECTIVES

The primary objective of Project 1.1 was to measure and record the blast pressure at various distances from a high yield air burst in the megaton range.

Secondary objectives were the measuring of dynamic pressure vs time at the same ground distances with the exception of the station located at the intended GZ point. Also Project 1.1 was requested to make measurements of the diffraction of the shock wave over the man-made islands and around the Project 3.1 structures.

INSTRUMENTATION

The Ballistics Research Laboratories (BRL) self-recording pressure gages were the basic instrumentation used for measuring air blast pressures. The gage is activated from the flash of the detonation. A back-up method for triggering the gage is a thermal link that disengages when heat is applied.

The gage used to measure dynamic pressure is also a self recording gage designed at BRL and referred to as a "q" gage.

A total of 11 contractor installed stations were instrumented with one 3 foot "q" gage and three pressure-time gages. The project installed sixteen stations which included 14 pressure-time gages and three 10 foot "q" gages. A total of 47 pressure-time gages and 14 "q" gages were installed for DELETED [redacted] (CHEROKEE).

RESULTS

Out of a total of 47 pressure-time gages 9 recorded peak

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pressure only. This was because of a failure in the photo initiation circuit or the thermal link causing the gage to start before shot time.

A total of three "q" gages out of 14 also ran before shot time from the same reasons mentioned in the previous paragraph.

Of the 38 pressure-time gage records 6 are considered not reliable for plotting pressure vs distance curves because of the small amplitude of the records, extreme oscillations or a slow rise time caused by the clogging of the pressure inlet hole.

The "q" gage records are almost a complete loss because the orientation of the detonation caused the shock wave to strike the gages at odd angles, some from the rear, some from broadside and some from the front at large angles.

No explanation is offered at present for the variation of the pressure along the reef stations from those measured on the land stations. Whether this is a true phenomenon or a function of the gage mount will have to be determined at a later date.

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Project 1.3 - Shock Photography - J. Petes

OBJECTIVES

To measure free air peak shock overpressure as a function of distance in a horizontal direction at burst height and vertically above the burst.

To determine the blast yield.

To study the effect of the nonhomogeneous atmosphere on shock transmission.

To study the effect of the surface and heating of the air near the surface on shock transmission.

INSTRUMENTATION

The instrumentation for this shot was smoke rocket photography.

The rockets, both Deacon and 5.0", were fired from two stations. One was on the south end of Bokobyaadaa (Able) and the other was on the reef 12,000' SW of Bokobyaadaa (Able). The cameras were located on Aomoen (George).

RESULTS

The rocket instrumentation and the cameras functioned properly but as a result of the bombing error the films obtained for the project are probably of no value.

All other films obtained by EG&G that might be of use to the project were inspected. Four films were found that may be of limited value. Through two of these films a limited amount of pressure distance data at burst height may be obtained. The other two films may be of some value for a study of surface effects.

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Project 1.4 - Free Air Pressure Measurements at Altitudes - Lt. Col. J.A. Fava

OBJECTIVE

The objective of Project 1.4 was to obtain basic free air peak overpressure measurements vertically above an air burst megaton weapon. Information was sought covering the range of 20 psi to 1 psi. This data was needed to further the study of the effect of altitude on the propagation of the shock wave so that safe ranges for delivery aircraft could be specified more accurately.

INSTRUMENTATION

Twelve parachute-borne pressure-instrumented telemetering canisters were deployed in a vertical array above intended ground zero. The range of altitudes at burst time was 930 feet to 33,560 feet. The large horizontal bombing error precluded the canisters being in the range of primary interest.

RESULTS

All twelve canisters telemetered useful data. Ten of the twelve were in the "free air" (regular reflection) region, and two were in the mach reflection region below the triple point path. The assumption [redacted] gives optimum agreement between measured and computed peak overpressures, and with this assumption the r.m.s. percentage deviation between measured and computed values is 7%, which is considered highly satisfactory for measurements of this type. However, if lower estimates of the actual yield obtained by other methods are confirmed, the higher apparent yield obtained from these blast pressure measurements will indicate a need for revision of current methods of calculating the effects of altitude on blast overpressures. Measurements of the amplitude and time of arrival of the reflected shock were obtained, but because of the large

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offset of the burst point these added little to the information obtained on previous tests.

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Project 1.5 - Drag Characteristics of Various Shapes - J.J. Meszaros

OBJECTIVES

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The primary objectives of Project 1.5 on Shot [redacted] (CHEROKEE) were the investigation of aerodynamic drag characteristics of actual and idealized shapes when exposed to transient loading conditions resulting from a high yield nuclear detonation.

The actual shapes consisted of wide flange I beams and angle beams. The idealized shapes consisted of 3 inch and 10 inch diameter spheres.

INSTRUMENTATION

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Project 1.5 had four stations on Shot [redacted] (CHEROKEE). They were located on Bokobyaadaa (Able), man made islands one and two, and on Yurochi (Dog). At Bokobyaadaa (Able) and Yurochi (Dog), there were I beam, angle iron and sphere stations. The other two locations had only beam stations.

The sphere stations consisted of two 3 inch gages and one 10 inch gage. These gages measure the drag forces in three directions: axial, lateral, and vertical, both positive and negative phases. Each component was measured by a four arm strain gage bridge. Each bridge is pre-stressed and any imbalance is recorded.

The I beam was instrumented as a "simply supported" beam. A sensor was used to support each end of the beam. These sensors were instrumented with strain gages. The strain gage bridge was so wired that any bending moment would be cancelled. A ball and socket joint was put on each end of the sensor to nullify torsion. As a result the only strain recorded was compression. The records were resolved into a drag force versus time curve.

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The angle beam was instrumented similar to the I beam except for an additional pair of sensors to record lift as well as drag.

RESULTS AND CONCLUSIONS

Structural Members

Due to the bombing error on this shot, the records obtained are rather inconclusive insofar as yielding comprehensive drag data.

In order to compute drag coefficients, dynamic pressure is necessary. All dynamic pressure gages are uni-directional and were oriented facing expected GZ. The dynamic pressure records are meaningless at the present time because of the above fact.

The only data recorded by the structural members which is valid is drag force or rather some undefined component of this force.

Spherical Drag Gages

The beauty of this type gage is the fact that rather than being uni-directional it is omni-directional. Orientation is not a critical factor as with the other type gages. Actual drag force was recorded by the spheres. Although no valid dynamic pressure records were obtained, drag coefficients may be computed using dynamic pressures computed from known side-on pressures.

These records have not been reduced as yet, due to other shot commitments.

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

OBJECTIVES AND INSTRUMENTATION

Studies of water wave action generated by the detonation of large yield (greater than 1 MT) nuclear devices are made at relatively close ranges and at several distant island stations by Project 1.9. Four shore recording wave measuring stations (of the Mark VIII type) were active in Bikini Lagoon for [redacted] Cherokee). In addition, Project 1.9 constructed and installed four new type long period wave recorders on Eniwetok, Ailinginae, Wake, and Johnston Islands. These recorders are designed to document long period, low amplitude deep ocean waves of the tsunami type. The recorders operate continuously but only receive significant signals from the large shots at Bikini. In addition to the above instrumentation, a tide gage was active at Ailinginae Atoll, and Sandia Corporation microbarographic stations were operated by Project 1.9 at Wake and Johnston.

RESULTS AND DISCUSSION

The tide gage record has not yet been recovered from Ailinginae. All other stations yielded excellent data. The Bikini Lagoon stations indicate there was no significant wave action in the lagoon. Detailed analysis may show the presence of a background-level wave entering the lagoon through the Enyu (Nan) channel or possibly the presence of an air-coupled water wave disturbance within the lagoon. All shore recording stations in the Bikini area yielded data on overpressure.

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The results obtained at the farther stations are tabulated below.

Station	Approximate Range (mi.)	Largest Wave Height (cm)	Period (sec)	No. of Waves
Ailinginae	40	1.9	375	3
Eniwetok	200	6.1	350	5
Wake	500	3 *	320	7
Johnston	1500	Undetectable above high background		

* Results by TWX subject to later correction

In addition, two or three very long period (85 minute) waves about 1 cm high were observed on the Cherokee record from Eniwetok, where the background was very low.

Microbarographic records were obtained at both Wake and Johnston Islands. The water wave arrivals reported above are much larger than those reported during CASTLE. This increase is attributed to the factor of ten increase in sensitivity of the present instrument over that used for CASTLE.

It is significant that Ailinginae at 40 miles range received smaller waves than Eniwetok (200 miles). This result agrees with the microbarograph records analyzed for CASTLE, in which the "shadow zone" for net integrated air pressure impulse was shown to extend at least 30 miles from the shot. It also indicates that these long waves are generated by barometric impulses and not by energy directly transmitted to the water. The wave generation process seems to be independent of the source conditions (surface or air burst).

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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 high yield 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 the fallout by dropping mechanisms activated after blast arrival.

RESULTS

All dosimeters were recovered following the shot. Incomplete analysis indicates approximately 1-r dose received by instruments on the reef stations between Namu (Charlie) and Yurochi (Dog), and on the Yurochi (Dog) complex. This is in the expected dose range for the yield and distance involved. The shot point error precluded obtaining useful data from most stations.

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Project 2.2-1 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 high yield air burst.

INSTRUMENTATION

The initial gamma dose rate vs time was to be detected by scintillator-photomultiplier detectors with time response to 10 msec. Residual and fallout gamma intensity vs time was to be measured with ionization chambers and associated electronics. Station locations spread from Bokobyaadaa (Able) through Namu (Charlie) to Enyu (Nan), and on the YAG's and LST 611.

RESULTS

Usable data was not obtained for either initial or residual radiation rates vs time.

[redacted]

[redacted]

[redacted]

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 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 Elmer, 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.

RESULTS

No fallout was received by the YAG's on CHEROKEE.

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Project 2.51 - Neutron Flux Measurements and Shielding Studies - C.W. Luke

OBJECTIVES

To measure the neutron flux and energy spectrum as a function of distance from the point of detonation of a Megaton device.

To compare the foil detector method of determing dose in rep with chemical and semi-conductor dosimeter methods.

INSTRUMENTATION

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The location of Project 2.51 stations for [redacted] (CHEROKEE) are shown in Fig. 2.51-1, page 29, Program 2 Consolidated Program Book. The stations consisted of concrete slabs on which were bolted 1½' x 5½' x 1" steel plates. The concrete slabs at the land stations were 12' x 6' x 3' while the reef station was 21' x 6' x 6'. The steel plates were oriented so that they would be perpendicular to a line from the station to the proposed point of burst. In order to facilitate recovery, the neutron foil detectors were mounted on the steel plates by means of specially designed "quick disconnect clamps". The chemical and semiconductor dosimeters were placed in three inch diameter pipe nipples and were clamped to a 3/8" cable stretched between two eyebolts mounted on the concrete slab. The following detectors were placed at each station:

Detector	Type
Gold	Activation
$Plutonium^{239}$	Fission Threshold
Neptunium	Fission Threshold

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Uranium^{238}	Fission Threshold	
Sulfur	Activation Threshold	
Zirconium	Activation Threshold	
Chemical	Dosimeter	- - -
Germanium	Dosimeter	- - -

Counting of all samples was accomplished at the Pacific Proving Grounds.

RESULTS

No neutrons were detected at any of the stations, due to large error in the air drop.

CONCLUSIONS

None.

[redacted]

[redacted]

Project 2.52 - Neutron Induced Soil Radioactivity - T. C. Looney

OBJECTIVE

To determine experimentally the radioactivity in various typical soil samples induced by irradiation in a thermonuclear detonation. Interpretation of the data will have as its objective the prediction of soil radioactivity for a nuclear explosion at any location.

EXPERIMENTAL PROCEDURE

Samples used were representative of several soils from the continental U.S., including Nevada Test Site soil, and from Puerto Rico, Hawaii, and Bikini Atoll. The exposure containers were lengths of steel pipe placed at various ranges from planned ground zero. Interpretation was to be by means of gamma-ray spectroscopy, for induced gamma intensity vs energy and time, and by chemical analysis.

RESULTS

Extended ranges to actual ground zero precluded the activation of any of the samples.

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Project 2.61 - Rocket Determination of the Activity Distribution Within the Stabilized Cloud - R. Soule

OBJECTIVES

To determine the spatial distribution of radioactivity in the cloud of high yield thermonuclear detonations at two early times. The following special objectives are sought:

Relative activity distribution between stem and cloud.

Rate of change of activity at early times.

Performance of atmospheric sounding vehicles (ASP) up to high altitudes in an atomic cloud, and particularly whether information can be telemetered out of the radioactive cloud.

DESCRIPTION AND EXPERIMENTAL PROCEDURE

The radioactivity in the cloud was detected by pressure ion chambers borne by rocket propelled atmospheric sounding vehicles. The data was telemetered back to essentially duplicate receiving-recording stations on Enyu (Nan) and aboard the USS KNUDSEN.

Six rockets each were fired in two salvos at 5 minutes and 15 minutes after detonation. Various trajectories were selected by preshot aiming of the launchers. Highest altitude achieved was about 160,000 ft.

RESULTS

All rockets fired and good signal strength was received on all channels. Radiation fields on the order of 20,000 r/hr at $7\frac{1}{2}$ minutes were measured in the cloud. Rockets aimed at the stem apparently missed it. The blast wave stopped two generators at Bikini (How) causing loss of the rocket launch signals. Failure of automatic readout equipment prior

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to this test will necessitate a tedious manual readout of the tapes.
In spite of the relatively high radiation fields encountered, no serious attenuation of the telemetering transmitter signal was noted.

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

OBJECTIVES

To understand the oceanography of the ocean area where fallout is expected in order to extrapolate the observed fallout pattern back to the equivalent land pattern. To furnish oceanographic assistance to the Task Force.

To measure the fallout radioactivity and its chemical nature in the water from a high air burst, a surface land burst, and surface water bursts. To calculate the equivalent land fallout pattern.

To understand 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 least possible measurements.

To understand 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.

[redacted]

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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

Prior to CHEROKEE oceanographic surveys were conducted in the Marshall Island Area and in the Bikini lagoon and a field report "Radioactivity Background and Oceanographic conditions in the Pacific Proving Grounds at the Start of Operation REDWING" was submitted on 10 May 1956.

The post shot fallout survey found only one minor trace of activity in the ocean water at a distance of 260 miles and a bearing of 330^{o} from GZ whose importance is questionable. Further evaluation is necessary to establish the significance of this area.

A postshot survey indicated insignificant radioactivity in the Bikini lagoon.

Radioactive fallout in the skiff area was not of sufficient intensity to trigger the recording instruments.

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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 high yield 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.

DESCRIPTION AND EXPERIMENTAL PROCEDURES

Two YFNB barges and three pontoon rafts were anchored in Bikini Lagoon. YFNB29 carried two Standard Platforms with Major Arrays of instruments and YFNB13 carried one. Each Major Array consisted of four Open-Close Total Collectors, two Always-Open Total Collectors, one Incremental Collector, one Gamma Intensity vs Time Recorder, and one Wind Speed and Direction Recorder. The arrays on the barges were fully automatic. Each pontoon raft carried an Always-Open Total Collector, a Time of Arrival Detector and a film pack to measure total dose.

An array of 16 skiffs was deep-sea anchored by Project 2.62 between 10 and 30 miles from ground zero in the expected fallout area. Each carried a minor array.

YAG 40, YAG 39, and LST 611 were located at 65, 135, and 190 miles from ground zero, respectively. Each was extensively instrumented with a major array supplemented by incremental collectors and high volume filter units.

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Several land stations at Bikini were similarly instrumented.

<u>RESULTS</u> --

Approximately 95% of all project instrumentation functioned properly and no damage to any station from blast or thermal effects was reported other than the destruction of skiff PP resulting from the off-target detonation. As far as could be determined prior to laboratory analyses, no fallout samples above normal background were collected on any of the island, barge, or raft stations; but samples collected from two skiff stations (MM and AA) were slightly above background. No measurable activity was encountered by the LST 611, but both the YAG 40 and the YAG 39 received light fallout. A slight rise above normal background was detected on the YAG 40 at about H ≠ 6 and a few active droplets were collected on Incremental Collector trays between about H ≠ 6 and H ≠ 8. Early time gamma spectra were taken and these results will be reported as soon as they have been properly reduced. A slight rise above background was also detected on the YAG 39 at about H ≠ 12 and one droplet was collected in an Incremental Collector tray on that ship.

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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 informati 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 the shot day flights were accomplished with two aircraft. On C + 1 and C + 4 missions were flown with one aircraft. A large area to the north and west of Bikini Atoll and to a distance of 150 miles was covered during the various flights.

The aircraft-Program 2 Control Center telemeter system did not operate.

The airborne detector equipment operated throughout and indicated no radiation levels detectable at the altitude of the aircraft.

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[redacted]

Project 2.65 - Analysis of Fallout and of 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

Intermittent fallout collectors (IFC) and gross fallout collectors (GFC) were installed on islands in the Bikini Atoll and on the YAG's and LST in the fallout zone. The IFC timing intervals were 5 min or 30 min, depending on location and type of shot. The equipment was installed prior to the shot and was activated by EG&G Blue Boxes. Some of the stations also incorporated a tape fallout monitor. A station at the Rongerik weather station was instrumented with a distant fallout collector and a tape fallout monitor.

RESULTS

No fallout samples were collected at any station. Ground samples picked up in the vicinity of intended ground zero showed insufficient activity for analysis. The planned aerial survey of the atoll was cancelled due to the lack of activity on the islands of the atoll.

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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, instrumented to measure radiation dose rate, integrated dose, and turbulence were flown through portions of the cloud and stem at times of H + 59, 68 and 75 minutes for CHEROKEE at altitudes varying from 38,000 to 46,000 feet. These penetrations were all "Nip" penetrations in which the pilot flies into the cloud, makes a 180 degree turn and flies out of the cloud. The time in the radioactive cloud varied from 2 to 4 minutes.

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 turbulence 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.

Contamination levels on aircraft which penetrated CHEROKEE were in general too low for film studies.

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 beta/gamma 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 beta/gamma ratio. Preliminary analysis of the film data indicates that the particle distribution, beta/gamma ratio and beta contact dose are essentially consistent with that found on Operation TEAPOT.

RESULTS

[redacted]

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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' 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.

DESCRIPTION AND EXPERIMENTAL PROCEDURES

Relative gamma radiation dose rates as a function of time from contamination resulting from CHEROKEE 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]

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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

No data were obtained because the YAG's were not contaminated.

[redacted]

[redacted]

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

In Shot CHEROKEE the YAG's and LST were positioned in the predicted fallout area as test platforms for Program 2. Upon completion of their missions the ships returned to Eniwetok.

Because of the negligible contamination received, no decontamination was performed.

RESULTS

Objectives were not accomplished because of the insignificant fallout received.

[redacted]

[redacted]

[redacted]

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 PROCEDURE

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.

In view of the lack of contamination on CHEROKEE, a detailed description of the problems and experimental procedure will be deferred until the ZUNI summary is published.

RESULTS

The YAG's did not intercept a significant fallout, and thus project results are negative.

[redacted]

[redacted]

[redacted]

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

Rad Safe support for NRDL Projects

Washdown evaluation

DESCRIPTION AND EXPERIMENTAL PROCEDURES

This project will document the procedures involved with the deployment and turn-about operations of the YAG's and LST. It will also report on the effectiveness of the washdown system.

Ship Operations - Results

The project ships, YAG-39, YAG-40 and LST-611, successfully completed their mission at shot CHEROKEE. The ships operated in Area 5, roughly N and NNW from Bikini Atoll at ranges as follows:

YAG- 40	-	40 miles
YAG- 39	-	70 miles
LST-611	-	100 miles

YAG's 39 and 40 encountered small amounts of fallout measuring about 0.15 to 0.20 mr/hr on the deck. LST-611 received no measurable fallout. The ships were not closed nor was the washdown system activated.

The YAG's 39 and 40 returned to Eniwetok Atoll on C ≠ 1 and the LST-611 on C ≠ 2. The ships were radiologically clean and no experimental or operational decontamination was performed.

During the sortie, no major casualties of ships propulsion, auxiliaries, navigational, communications or control equipment were experienced.

[redacted]

Additional details regarding location radiation intensities will be found in the Project 2.63 report.

Rad Safe Support-Results

Project 2.10b (Rad Safe Support) supplied monitors to the ships and to recovery operations in the Bikini Area. No Rad Safe problems were encountered on the project ships. The non-existence of fallout in the Bikini area eliminated the requirement for Rad Safe support.

CONCLUSIONS

The ship operations and Radiological Safety missions were successfully accomplished. The absence of significant fallout prevented the washdown evaluation.

[redacted]

Project 3.1— Difference in Effect of Short and Long Duration Blast Loading on the Response of Structures - Capt R.E. Grubaugh

The objective of this project was to investigate experimentally the effect of the positive phase duration on damage to full scale industrial type structures.

Three drag-type and three semi-drag type structures were exposed [redacted] Measurements were made to determine the response of the structures and the blast parameters in the vicinity of each structure. The measurements consisted of deflection of roof system, acceleration, strain in column, side-on overpressure, and dynamic pressure.

It was intended that the results of this experiment be compared with the results of Operation TEAPOT for the necessary comparison of duration effects. The results from the two operations are listed in the accompanying table 3.1-1.

It has been concluded that for a drag-type structure, there is a significant bonus effect from a long duration blast wave if peak pressure is considered the criterion in producing structural damage. Thus, as positive phase duration is increased, the peak pressure required to produce a given level of damage, say collapse, is reduced.

No conclusion can be drawn for the semi-drag type structure at this time.

[redacted]

TABLE 3.1-1

Table of Preliminary Results

Operation	Structure	Measured Peak Over Pressure (psi)	Computed Peak Dynamic Pressure (psi)	Angle of Incidence (degrees)	Duration of Positive Phase (sec)	Measured Maximum Deflection (In.)
Teapot	A-1	6.5	1.1	0	0.88	22
Teapot	A-2	4.7	0.58	0	0.89	9.5
Redwing	A-1	8.3	1.55	58	3.92	Collapse
Redwing	A-2	7.3	1.21	50	4.18	Collapse
Redwing	A-3	5.8	0.77	42	4.65	Collapse
Teapot	B-1	3.4	0.31	0	0.95	13.2
Teapot	B-2	2.7	0.20	0	1.01	6.8
Redwing	B-1	7.3	1.21	50	4.18	Collapse
Redwing	B-2	5.8	0.77	42	4.65	Collapse
Redwing	B-3	4.6	0.49	32	5.08	Collapse

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Project ~~4.1~~ - Biomedical Effects - Flash Blindness and Chorioretinal Burns - Col. R. S. Fixott

OBJECTIVES

To gain information regarding the behavior of lid reflexes under the high illuminations produced by atomic devices; to further evaluate the blink reflexes as a protective mechanism against chorioretinal burns.

To gain information on shutter and filter mechanisms for eye protection against chorioretinal burns caused by atomic weapons of various types and yields.

INSTRUMENTATION

The experimental arrangement for this project required the exposure of animal eyes to the weapon detonation at distances which produced retinal lesions in a similar test series during UPSHOT-KNOTHOLE. Rabbits and monkeys were the animals of choice; the former because of ready availability and limited motility of the eye, the latter because of close resemblance to the human eye. Exposure racks were constructed to render nearly complete protection of the animal from whole body effects, when such protection was indicated. Direct exposure was limited to one eye of subject rabbits. The monkeys had both eyes exposed, being used solely for determining the protection offered by the blink reflex.

Staggered shutters of two types were used. The simple closure shutters were open at time zero and closed at varying intervals after, up to 1 second. The closed-open-closed shutters were closed at time zero, opened at a specified time, remained open for varying durations, then closed.

[redacted]

[redacted]

Prototypes of electromagnetic shutters of two types are being field tested as a part of this program. These shutters are designed to prevent or minimize temporary flash blindness, after-images, or retinal burns. Results obtained on animals exposed behind these shutters will be compared with those obtained by other shutters and filter mechanisms.

None of the animals exposed had eyes held open by artificial means. This introduced the possibility that the eye might be closed at time zero. An alarm bell was set up to waken animals. Cameras focused on the animals were used to determine shutter speed and to ascertain whether eyes were open during the time of exposure.

RESULTS

An examination of the exposed eyes of the animals revealed no chorioretinal burns. Of the 83 rabbits and 8 monkeys exposed, 4 rabbits were dead. Inspection of the equipment at time of re-entry indicated that it had functioned properly. A check of actual shutter speeds must wait availability and study of the high speed motion pictures.

CONCLUSIONS

It is not believed that lack of chorioretinal burns can be attributed to the change in detonation point of the weapon. The absence of eye injury is very probably due to the animals receiving a total thermal energy lower than had been calculated, and delivery of this energy over a much greater time interval. The normal blink reflex time, as determined in laboratory tests, would permit these experimental animals to have their eyes closed by the beginning of the second pulse.

Animal deaths are attributed to sun stroke or heat prostration induced by the prolonged period of exposure to the afternoon sun after 1400 on D-1. This project has received the wholehearted cooperation

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of all agencies to enable placement of the animals at the latest possible time on D-1 and recover them as soon as possible after detonation. Some loss, however, must be accepted on megaton shots considering the 17 hour or longer time interval between placement and recovery.

Since no chorioretinal damage was incurred, no estimate of the value of shutters and filters can be made.

APPENDIX

Two civilian employees of Holmes and Narver were seen in consultation following this test. Both noted headache and photophobia. One, a DUKW driver had worked on the water some 90 hours previously during the week. it is believed all symptons were due to fatigue, long hours outdoors and on the water. No evidence, ophtalmoscopically, of chorioretinal burns was obtained. Visual acuity was not reduced in either case.

[redacted]

[redacted]

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

2nd Lt. Robert E. Gee

OBJECTIVE

The objective of this project was to measure the blast, gust and thermal effects of a nuclear detonation on an in-flight B-47 aircraft so that the data recorded could be used to verify and/or correct the criteria and methods used in the B-47 Weapon Delivery Handbook. In addition, the project will provide basic research data for the design criteria of future USAF aircraft.

INSTRUMENTATION

To accomplish the objective, it was planned to position the B-47 on [redacted] CHEROKEE) to receive approximately 450° ΔT in the 0.020 aluminum aileron which was painted white.

Approximately 281 data channels were utilized on this shot to record bending shear and torsion in the wing and horizontal stabilizer, thermal inputs in the aircraft, thermally induced strain, temperature measurements, and overpressures.

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Project 5.2 - In-Flight Participation of a B-52 - 1st Lt. 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] (CHEROKEE) shot consisted of 316 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, 16 cameras recorded photo-recorder instruments, wing deflection, cloud coverage, and fireball rise and growth.

AIRCRAFT POSITION IN SPACE

	True Heading (degrees)	Slant Distance* (feet)	Velocity (fps) TAS	Velocity (fps) Ground
Conditions at Time Zero	283	46,800	794	772
Conditions Prior to Time of Gust Arrival	277	89,200	822	800

*Slant Distance from aircraft to Burst Center

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Project 5.3 - In-Flight Participation of A B-66B - R. W. Bachman

OBJECTIVE

The primary objective of this test was to measure the thermal effects of a large yield nuclear airburst on a B-66B aircraft in flight.

INSTRUMENTATION

Instrumentation of the B-66 for [redacted] (CHEROKEE) consisted of 60 thermocouples and 73 strain gages at 7 stations on the left wing, 9 thermocouples and 10 strain gages at 2 stations on the right wing, 34 thermocouples and 18 strain gages at 7 stations on the left stabilizer, and 9 thermocouples and 12 strain gages at 3 stations on the right stabilizer, plus 63 channels of correlating information.

AIRCRAFT POSITION IN SPACE

Because of discrepancy in count-down, the B-66 flew an abort pattern which, at H-hour, positioned the aircraft 46 degrees from tail-on and right-side to actual GZ on a heading of 251 degrees with a true air speed of 495 knots. The absolute altitude and horizontal range at H-hour were 36,000 feet and 52,640 feet respectively. The absolute altitude horizontal range and heading at shock arrival (H + 125 seconds) were 36,000 feet, 143,000 and 251 degrees respectively.

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

OBJECTIVE

The objective of this project is to measure the effects of a nuclear detonation on an in-flight B-57 aircraft. Recorded data will be used to verify or correct the B-57 Weapons Delivery Handbook. In addition, the project will provide basic research data for design criteria of future USAF aircraft.

INSTRUMENTATION

For the [redacted] (CHEROKEE) shot, the B-57 was instrumented with approximately 220 channels to record blast, gust and thermal effects to the aircraft. Instrumentation consisted of strain gages, thermocouples, calorimeters, radiometers, pressure gages, and various other transducers. It was planned to position the B-57 in a position corresponding to approximately 80-85 per cent limit load on the critical member of the aircraft.

AIRCRAFT POSITION IN SPACE

The planned position of the B-57 was on an in-bound heading of 105°T, 42,000 feet absolute altitude, with a horizontal offset of 5,000 feet southwest to be abreast of ground zero at H-110 seconds. The horizontal range of the aircraft at T_o was to be 80,750 feet.

RESULTS

None. The B-57 aircraft aborted on the [redacted] (CHEROKEE) shot. The B-57 aircraft was to be positioned and tracked by the Raydist Navigation System, and shortly after take-off, all Raydist signals from Eniwetok Relay Station were lost. Raydist could not maintain positive

[redacted]

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control of the aircraft and aborted the B-57 approximately H-10 minutes. Evidently interference existed between four out of the five Raydist transmitters and receivers on Eniwetok.

[redacted]

Project 5.5 - In-Flight Participation of F-84F Aircraft - Capt R. F. Mitchell

OBJECTIVE

The objective of this project is to determine the response of the F-84F weapon system when exposed during flight to the effects of a nuclear detonation.

INSTRUMENTATION

Waiter - Instrumentation of primary concern consisted of 37 thermocouples located in the right flap, right aileron, right wing, right stabilizer and the engine inlet and outlet. Correlative instrumentation consisted of time zero fiducial signal, radiometer, and calorimeters located at sta. 80, bottomside of the fuselage.

Barley - The instrumentation consisted of strain gage bridges located at Sta 90 and 150 on left and right wing; Sta 365 on the fuselage; Flt. Sta 12 and 35.5 on the left and right stabilizer and W.L. 20 and 53 on the fin. The forementioned strain gage bridges yielded bending moment information. Structural responses were related to energy inputs with overpressure transducers located on a nose boom and in the sides of the fuselage. A total of 100 channels of information were capable of being recorded.

AIRCRAFT POSITION IN SPACE

Waiter - Aborted the mission

Barley - The research vehicle F-84F was at 28,000 feet absolute altitude on an inbound course of 057° to the south of, AZ. The primary consideration was to have the aircraft intercepted perpendicularly by the shock wave. [redacted]

[redacted]

[redacted]

RESULTS

Waiter - The Raydist positioning system was unable to control the aircraft after approximately H-10 min. The "progress" and "azimuth" needles on the pilot's indicator became erratic at that point.

Barley

(1) Thermal - not measured

(2) Gust - 43% design limit in side fuselage bending

[redacted]

The instrumentation failures experienced were comprised of jamming of the cockpit photo panel camera; malfunctioning nose boom pressure transducer and losing the right wing outboard station bending moment bridge.

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Project 5.6 - In-Flight Participation of an F-101A Aircraft -

Capt M. H. Lewin

OBJECTIVE

The objective of Project 5.6 is to determine the responses of an in-flight F-101A aircraft to the thermal, blast and gust effects of a nuclear detonation. A correlation of the responses, combined with known characteristics of any weapon, will be used to define the maximum safe delivery capability of the aircraft.

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 [redacted] (CHEROKEE) the aircraft was positioned to theoretically receive sufficient thermal input to produce a ΔT of 260°F on the .020 skin covered honeycomb surfaces of the aircraft based on the positioning yield and an on time position. With the pre-shot announced timing errors possible, the aircraft could have had a ΔT of 400°F.

AIRCRAFT POSITION IN SPACE

The aircraft was to fly at 25,000 feet absolute altitude on an inbound heading of 111°T at a ground speed of 800 fps. It was planned that the aircraft would pass 5,000 feet abeam of ground zero and be at a horizontal range of 54,500 feet at T_0 plus or minus 8,000 feet. On shot day, the aircraft was aborted at H-8 minutes due to a malfunction of the Raydist Positioning system.

RESULTS

None.

[redacted]

Project 5.7 - Thermal Flux and Albedo Measurements from Aircraft - Capt R. L. Dresser

OBJECTIVE

The objective of this shot was to obtain thermal flux and albedo information of a nuclear detonation with airborne calorimeters, radiometers, and sixteen mm 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 basic 21 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

[redacted]

[redacted]

back-scattered thermal radiation. The twenty one basic thermal 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 E.G.&G. Chieerete (William) photo tower.

AIRCRAFT POSITION IN SPACE

Information of the position in space of each aircraft is contained in the 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

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Photographic Data

Of the thirty five cameras under the purview of Project 5.7, six cameras were not operated because of the early abort of the B-57. Of the remaining twenty nine cameras two suffered film breakage. These films were destroyed. The three cameras looking forward obtained no pictures, which indicated that there was no reflecting surface for back-scattered radiation having a brightness greater than 100 watts/meter^2. This film was also destroyed. The four tail cameras of the B-47 obtained practically no pictures as the cameras were turned on early. One of these films was printed for record and the other three were destroyed. No fireball pictures were obtained as all aircraft were too far out of position, relative to the actual burst, to place the fireball within the field of view of the cameras. Pictures of various kinds were obtained on fourteen films. The four cameras with spectroscopic attachments on the B-66 and the two cameras with spectroscopic attachments in the Chieerete (William) photo tower apparently obtained good results.

Film Summary:

Number of magazines loaded	Number of magazines run	Number of magazines for analysis	Number of magazines destroyed
35	29	21	8

[redacted]

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

LCDR P. S. Harward

OBJECTIVE

Project 5.8 objective is to measure the thermal response of the A3D-1 aircraft to high yield nuclear detonations.

INSTRUMENTATION

Instrumentation of the A3D-1 for [redacted] (CHEROKEE) consisted of thermocouples located at critical points on the aircraft skin. Additional thermocouples were used to measure the temperature of various specimens mounted on a special rack on the underside of the fuselage. Calorimeters and radiometers were utilized to measure the direct and indirect thermal effects. Five calorimeters and one radiometer, mounted in the tail turret, were positioned at the correct angle of declination to afford direct field of view of the fireball. Similar thermal instruments were mounted vertically for measuring indirect thermal effects. GSAP cameras were mounted with each group of thermal instruments to provide information on the field of view of the thermal instruments and the terrain and cloud cover below the aircraft. Additional instrumentation included pickups to determine the aerodynamic effects on the aircraft's stability and calibrated air pressure pickups to measure overpressure.

AIRCRAFT POSITION IN SPACE

For [redacted] (CHEROKEE) the A3D-1 aircraft was on an abort heading of 215° absolute altitude, 34,100 feet; horizontal dis-

[redacted]

tance from actual GZ at T_0, 57,000* ft; slant range at T_0, 64,000 ft; horizontal distance from actual ground zero at T_s, 192,000 feet (H + 175.4 seconds).

RECORDED EFFECTS

Temperature rise lower surface elevator - - -
(.025" skin) TC #26

Temperature rise in quartz covered therm- - -
ocouple (#31) on lower surface elevator

Temperature rise on Radome (TC #19) - - - - -

Overpressure from Boom (See Note 1) - - - - -

Overpressure L. H. side fuselage (See Note 1

Load factor increments due to gust
At center of gravity - - - - - - - - - - - -
At tail - - - - - - - - - - - - - - - - - - -
In photo recorder (shock mounted) - - - -

Note 1. The A3D-1 aircraft started a turn prior to shock arrival and therefore was not exactly tail-on at this time.

DISCUSSION

The ASB-1/CP-66 positioning worked very nicely and the A3D-1 aircraft was in its correct position based on real time at time of release. Errors in the count-down combined with missing certain time-counts made time correlation very difficult. Improvements in the system for the establishment of time zero position have been developed, but the ASB-1/CP-66 system will not give the desired accuracy in after-the-fact positioning required for data correlation.

It was planned to utilize Raydist for positioning and tracking the

*Horizontal distance from actual GZ is based on the assumed location of actual GZ (i.e., 20,000 ft, bearing 060°T from intended GZ). Horizontal distance from intended GZ at T_0 was 38,000 ft. (This position is based on the readings taken from the ASB-1/CP-66 system at entry into the abort turn and shortly after time zero, correlated with calculations of the abort flight path made from the known characteristics of the aircraft).

[redacted]

[redacted]

A3D-1 on [redacted] (CHEROKEE); however, approximately 40 miles from ground zero, all signals from the Raydist relay station on Eniwetok Island were abruptly lost. Evidently interference existed between four out of five Raydist transmitters and receivers on Eniwetok. The A3D proceeded on the same flight pattern discussed above utilizing the ASB-1/CP-66 positioning equipment.

[redacted]

[redacted]

[redacted]

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 gound 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 known 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 (Pittsburg, Woodland, and Maryville).

RESULTS

Short base line.

Hawaiian Area - Kona net all stations received and recorded

[redacted]

[redacted]

electromagnetic pulse emanating from bomb detonation. Line of position determined with an estimated error of 1.3 nautical miles plus or minus 8 nautical miles.

California - Woodland net reports all stations received and recorded electromagnetic pulse emanating from bomb detonation. Line of position determined with an estimated error of 6.6 nautical miles plus or minus 16 nautical miles.

Long base line.

Hawaiian Area - Lahaina net. Lahaina and Palmyra stations received and recorded electromagnetic pulse emanating from bomb detonation. Midway sites reports equipment failure. Line of position determined with an estimated error of 3500 yards.

Stateside - Harlingen AFB Texas reports all stations received and recorded electromagnetic pulse emanating from bomb detonation.

Griffiss AFB N. Y. received and recorded electromagnetic pulse emanating from bomb detonation.

[redacted]

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[redacted]

Project 6.3 - Effects of Atomic Explosion on the Ionosphere -

M. A. 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 effect of orientation relative to the earth's magnetic field on F2 layer effects.

INSTRUMENTATION

The system comprises:

1. 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.

2. One Ionosphere recorder, type C-3, operating on pulse transmission, installed in a C-97 plane based at Eniwetok Island.

Detailed Description:

1. Ionosphere recorder site (Rongerik Atoll)
site (Kusaie)

a. AN/CPQ-7, type C-2 Ionosphere recorder with a power output of 10 KW peak pulse alternately transmitting and receiving automatically over the range of frequencies from 1 to 25 megacycles. This equipment measures and records at vertical incidence the virtual height and critical frequencies of ionized regions of the upper atmosphere.

b. A 600 ohm multiple wire antenna designed and erected, so that the direction of maximum intensity of radiation will be at the desired vertical angle over all of the operating frequency range from

[redacted]

[redacted]

1 to 23 megacycles. The transmitting and receiving antennas and the ground plane were in mutual perpendicular planes with the plane of the transmitting antenna oriented 53 degrees to the East of Magnetic North.

2. Ionosphere recorder site (C-97 airplane)

a. Same as for Rongerik and Kusaie, except that a C-3 Ionosphere recorder was used. This recorder is the same as the C-2, except for a few modifications and improvements.

b. The transmitting antenna in the C-97 was a single wire delta fastened to the lateral extremities of the tail assembly.

OPERATIONAL

Ground stations at Rongerik and Kusaie, using 15 second sweep operated on normal 24 hour schedule, 5 sweeps per hour until H-15 min; thence once a minute until H + 8 hrs; thence routine. Stations operated on C + 1 and C + 2 days the same as on C day.

Airborne Station C-97: Routine operation until H-15 min using 30 second sweep time; thence continuous until approximately H + 5 hours.

RESULTS

DELETED

[redacted]

[redacted]

DELETED

15

[redacted]

[redacted]

[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 92 miles.

[redacted]

RESULTS

Because of missed count-down, equipment was not turned on until approximately 30 seconds after blast at which time it was impossible to collect relevant data.

CONCLUSIONS

None.

[redacted]

[redacted]

Project 6.5 - Analysis of Electromagnetic Pulse Produced by Nuclear Explosion - Charles 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 micro-seconds/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.

[redacted]

[redacted]

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

The Eniwetok station was in operation for [redacted] (CHEROKEE). No data was recorded due to an early trigger from some unknown source.

CONCLUSIONS

Since this event was an air drop and having only basic timing it was not known at the time that the waveform recorded was not correct. Consultation with other projects involved in the same research revealed the error. Since the equipment is a single-shot trigger device and unable to distinguish between atmospheric noise and the electromagnetic pulse, a certain percentage of false data can be expected.

[redacted]

[redacted]

[redacted]

Project ~~8.1~~ - Basic Thermal Radiation Measurements - W. B. Plum

OBJECTIVE

The objective of this project was to measure the time history of irradiance, thermal radiant energy, and the spectral distribution of thermal radiant energy from three stations with a time resolution of 20 msec; the irradiance and spectral distribution of irradiance from two stations with a time resolution of 50 microseconds. From these data it was expected to get a general transmission coefficient for the atmosphere, the transmission coefficients for the atmosphere for narrow wavelength bands, scattering coefficients as a function of the field of view, and the partition of energy between the first and second thermal pulses.

INSTRUMENTATION

Three stations were instrumented for this shot. Station 810.01 on Yurochi (DOG), 34,940 feet from GZ; Station 811.01 on Aomoen (GEORGE), 48,979 feet from GZ; and Station 811.02 on Bikini (HOW), 92,628 feet from GZ. NRDL radiometers and calorimeters, listed below were used at each station. Two recorders were used at each station. Duplicate instruments consisting of 11 calorimeters and one radiometer were connected to each Heiland oscillographic recorder.

(1) Total energy, quartz filter, 90 degree field of view

(2) Total energy, quartz filter, 90 degree field of view

(3) Spectral, 3-69 filter, 90 degree field of view

(4) Spectral, 2-58 filter, 90 degree field of view

(5) Spectral, RG-8 filter, 90 degree field of view

(6) Spectral, 7-56 filter, 90 degree field of view

(7) Field of view, quartz filter, 11 degree field of view

[redacted]

[redacted]

(8) Field of view, quartz filter, 22 degree field of view

(9) Field of view, quartz filter, 45 degree field of view

(10) Field of view, quartz filter, 90 degree field of view

(11) Field of view, quartz filter, 160 degree field of view

(12) Radiometer, quartz filter, 90 degree field of view

The NRDL recording spectrometer was used at Stations 811.01 on Aomoen (GEORGE) and Station 811.02 on Bikini (HOW). This spectrometer was used to measure the spectral distribution of irradiance as a function of time with a time resolution of 50 microseconds.

The NRL bolometer was used to measure the irradiance as a function of time with a time resolution of 50 microseconds. Two bolometer channels were located at Station 811.01 on Aomoen (GEORGE) and two at Station 811.02 on Bikini (HOW).

RESULTS

All of the instrumentation with the exception of two aiming point cameras functioned satisfactorily on this shot. All the reliable data obtained at the Yurochi (DOG) and Aomoen (GEORGE) stations was from instruments with a field of view greater than 45 degrees and on Bikini (HOW) with a field of view greater than 30 degrees. All of the spectrometer data and at least half of the bolometer data were lost because of the large bombing error. The calorimeters with fields of view less than those specified above for each station will not give usable data.

A preliminary reduction of the data without the aid of precision equipment gives the following results:

Station	Quantity Measured	
810.01	Total Energy	DELETED
810.01	Maximum Irradiance	

[redacted]

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[redacted]

810.01	Time of Max Irradiance
811.01	Total Energy
811.01	Maximum Irradiance
811.01	Time of Max Irradiance
811.02	Total Energy
811.02	Maximum Irradiance
811.02	Time of Minimum
811.02	Time of Max Irradiance

[redacted]

[redacted]

Project 8.2 - Thermal Effects on Cellulosic Materials - W. L. Fons

OBJECTIVE

The objective of Project 8.2 was to expose various combustible materials to the thermal radiation from [redacted] (CHEROKEE) to ascertain the level of energy at which the materials would ignite and burn.

INSTRUMENTATION

Instrumentation consisted of specimens of materials exposed at Yurochi (DOG) 35,000 ft and at Aomoen (GEORGE) 49,000 ft from planned target zero. The materials were white, gray, and black alpha-cellulose paper, each of two densities and several thicknesses, newspaper, charcoal-colored rayon cloth, blue cotton denim, dry grass, pine needles, and corrugated Kraft fiberboard. Also exposed were specimens of maple, willow, and balsa woods to ascertain the depth of char produced in woods of different densities by the thermal radiation from a megaton weapon.

For exposure, the specimens were mounted in cylindrical metal cells, 4 inches in diameter and 5 inches from the front rim of the cell to the specimen. The cells were mounted in metal boxes, half of which were perforated so that the specimens would come to a high moisture content in equilibrium with the ambient atmosphere, and half of which were closed with a dessicant to keep the specimens at a low moisture content. The boxes were opened at H-15 seconds by EG&G signal, and the cells were pointing at the expected point of burst on Namu (CHARLIE) at the moment of explosion.

[redacted]

[redacted]

Project 8.2 also had 12 calorimeters at Aomoen (GEORGE) directed to the expected point of burst above Namu (CHARLIE) with which to measure the radiant energy incident on the combustible specimens. In front of both specimens and calorimeters were screens of various transmissions, to vary the amount of incident radiant energy.

RESULTS

Because the bomb burst was not directly over planned target zero, the direct radiation from the entire fireball entered the cells at an appreciable angle, irradiating only a small portion of each specimen at Aomoen (GEORGE) and missing the specimens entirely at Yurochi (DOG).

The small sensitive elements of the calorimeters at Aomoen (GEORGE) were illuminated by only a part of the fireball, and it is doubtful if the oscillograph deflections can be given a meaningful interpretation.

The wood specimens were charred to different depths depending on their densities and the transmission of the screens.

Some of the specimens of black and gray alpha-cellulose papers, newspapers, and pine needles were ignited, so that on these the critical ignition energy was well bracketed.

Ignition was not obtained on the grass, cotton denim, rayon cloth, or the white alpha-cellulose paper. Corrugated fiberboard was burned at Yurochi (DOG) by the radiation from a part of the fireball at an unknown calorie level. The critical ignition energies for these fine materials cannot be ascertained from the test. The manner of mounting specimens for ignition test and of exposing them immediately before shot times - both tried for the first time in this field test - were highly successful.

[redacted]

[redacted]

[redacted]

Project 8.3 - Evaluation of Self-Recording Thermal Indicators - J. J. Mahoney

OBJECTIVES

The objectives of this project were to field test three new models of thermal radiation calorimeters - (only two types were suitable for use in this event).

INSTRUMENTATION

The types of instruments tested on [redacted] (CHEROKEE) were:

The Thermistor Calorimeter, in which the thermal radiation was measured by a "bead" thermistor embedded in a copper cylinder. The copper cylinder acted as the heat receiver.

The Passive Indicator. In this instrument, chemical paints which changed colors at certain definite temperatures (all above 100°F) were put on the end of a block made of alternate sheets of different lengths, of aluminum and heat insulator.

RESULTS

DELETED

The results for the Passive Indicators will be calculated for the preliminary report. (All except one of the Passive Indicators gave readable results).

REMARKS

Both type of instruments used were 180° angle receivers. This was quite fortuitous in that the ground zero direction for the event was considerably off.

The third type of thermal indicator, a thermocouple type with self

[redacted]

[redacted]

contained magnetic "spot" recorder, was not used on this shot as it was not suitable for a long thermal pulse.

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[redacted]

[redacted]

Project 8.4 - Thermal Effects on the Strength of Aircraft Structural Sandwich Type Panels - LCDR A. Julian

OBJECTIVE

The objective of this project was to determine the effects of short-duration, high intensity thermal inputs on the strength of aircraft structural sandwich type panels, and thereby to establish critical temperature limits for delivery of special weapons by aircraft utilizing this type of construction.

Two distinct efforts are required to accomplish the objective of Project 8.4; a field phase and a laboratory phase.

The field phase, accomplished with participation on [redacted] Shot (CHEROKEE), is directed toward measuring the temperature-time history in the specimen panels, and making visual observations of panel behavior under irradiation.

The laboratory phase will be to determine the strength and moduli changes in irradiated panels as a result of transient heating of the type producing the temperature-time histories measured in the field test.

INSTRUMENTATION

Instrumentation for the field phase of Project 8.4 consisted of exposing several types of representative aircraft structural sandwich panels to thermal radiation effects. The test display, erected at Station 840.01 on Aomoen (GEORGE) contained several types of instrumented panel specimens in no-load mountings. Also, panels of a variety of face gages (0.008 inch to 0.032 inch) and colors (gray and white) were exposed in an attempt to obtain variations in temperature rise. Temperature history was taken by thermocouples mounted on the panels and was recorded as a function of time.

[redacted]

[redacted]

RESULTS

All equipment functioned properly and good records were obtained. Since the panels may be considered to have a 2π field of view, the misplacement of air zero did not result in a complete loss of data. Temperature rises in excess of the 180° design requirement were recorded; however, in general, peak temperatures were only of the order of 50 per cent of those desired.

DISCUSSION

The misplacement of air zero resulted in a large angle of incidence of the thermal radiation on the specimens. Since the input was not normal to the surfaces of the panels, the variation of absorptivity of the paints as a function of paint surface characteristics could cause serious difficulties in attempting to relate temperature rises in the panels to thermal input.

[redacted]

[redacted]

[redacted]

Project 8.5 – Airborne High Resolution Spectral Analysis - Ralph Zirkind

OBJECTIVE

To determine the spectral distribution of the irradiation of an airburst megaton device at an airborne station and compare with an identical measurement from a surface station. Also, the fireball color temperature is to be determined by utilizing transmission data based on a statistical analysis of simulated runs.

INSTRUMENTATION

The spectral distribution of irradiance 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 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 located at the planned position. (The P2V established a race-track pattern south of GZ (oriented 106^{o} - 286^{o}T) at 23,000 feet absolute; broke and proceed in-bound on a heading of 106^{o}T, to be in a tail-on position at T_o, with a horizontal range of 92,620 feet).

[redacted]

89

[redacted]

All instruments functioned properly however the fireball was outside of the field of view of the spectrometer until sometime past the second maximum of the thermal pulse. Therefore, at most, only a half of the fireball was seen by the spectrometer. This failure to obtain data was due to errors in placement of the device.

As a consequence of the loss of data, no simulated light runs will be made.

[redacted]

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

On [redacted] Shot (CHEROKEE) two of three 9.1 aircraft participated. CARTER 2 aborted the mission at 0400. Decision to abort was made for flying safety reasons. Sufficient time had not elapsed from the 18 May mission to repair electrical system damaged by internal fire.

CARTER 1 was moved into the CARTER 2 position 110 nautical miles South of Ground Zero. CARTER 3 remained in his prescribed position 130 nautical miles West of Ground Zero. Both aircraft were on orbit properly positioned, flying at 20,000 feet at Time Zero. CARTER 1 had an unrestricted view of the detonation and resulting cloud. Photographic results were good for approximately 45 minutes with the exception of the Eclair camera which malfunctioned. CARTER 3 flying the Western quadrant encountered a towering cumulus at plus 2 minutes. An attempt was made to climb out on the back leg flight. The aircraft attained 31,000 feet but was still in heavy cloud cover. On post flight critique it was found that this cloud cover was approximately 45,000 feet high and about 20 miles across.

Understandably cloud photographic results from this aircraft was virtually negative. In addition to the photographic effort both aircraft carried bhangmeters mounted in the oblique camera window on starboard side of aircraft.

CARTER 1 carried in the right scanners blister two Project 4.1 rabbits for flash exposure.

[redacted]

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 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

[redacted]

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[redacted]

[redacted]

Project 10.1 - Fireball Hydrodynamics - J. F. Mullaney

L. N. Blumberg & J. F. Mullaney

DELETED

Roughly about half the estimated uncertainty in yield comes from uncertainty of burst position, and half comes from the spread of diameter-time data. Careful re-reading of the film will probably decrease the uncertainty due to data spread. A second film, 33263, gives [redacted] (the uncertainty is less owing to decreased diameter-time data spread); however in EG&G report PPG 2247 it is recommended that despite decreased data spread this film be considered less reliable than 33264 because of poor image quality.

The coordinates on the Bikini grid for the position of the burst as given by Keith Boyer are:

N: 185,100 ± 500

E: 96,200 ± 100

Horizontal distances and bearings from Bokobyaadaa(Able) station 1519, were worked out for the endpoints and midpoint with results as listed in Table 10.1-1. EG&G had previously (PPG 2323) placed the burst at

N: 185,450 ± 500

E: 96,300 ± 150

Height of burst: 4,320 ± 150

Yields were calculated according to phi-fifth scaling procedure for the several distances and bearing corresponding to the midpoint and

[redacted]

[redacted]

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[redacted]

endpoints, with results as noted in Table 10.1-1. The density of air was taken as 1.035 grams/liter. The yield was also calculated for the midpoint of the EG&G coordinate; the yield obtained is slightly higher than that given in PPG 2247 since an estimated air density of 1.02 was used by EG&G in calculating the yield given there.

With the high yield-to-mass ratio [redacted] mass correction of course does not enter into the yield calculation. When early-time data become available, the differential method will be used.

[redacted]

TABLE 10.1-1

Phi-Fifth Yields for [redacted] Several Burst Positions

	COORDINATES, GROUND ZERO			STATION 1519, TABLE TO GZ		
	N Ft	E Ft	Height of Burst Ft	Bearing	Horizontal Distance	Total Distance
Far endpoint	185,600	96,300	4,470	233°40'	30,721	31,044
	185,600	96,300	4,320	233°40'	30,721	31,023
Midpoint	185,100	96,200	4,320	234°19'	30,347	30,653
	184,600	96,100	4,320	234°59'	29,975	30,285
Close endpoint	184,600	96,100	4,170	234°59'	29,975	30,264
EG&G	185,450	96,300	4,320	233°54'	30,633	30,936

Film 33263 was exposed in 16 - mm Fastax.

Film 33264 was exposed in 35 - mm Fastax.

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* Note added in proof:
On June 2[illegible], 19[illegible], EG&G issued Report 1[illegible]5, EG&G Out 000[illegible]. This report contains revised diameter-time data, with correction made for lens distortion. The numbers indicated by asterisks are based on these revised data, and are believed to be more reliable.

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[redacted]

Project 10.2 - TIME OF ARRIVAL - J. F. Mullaney

An attempt was made to estimate the yield of [redacted] (CHEROKEE), from aboard the U.S.S. CURTISS. The position of the ship, as determined by a radar fix on the ENYU tower (Station 70), was 27,900 ± 200 yards, bearing 328°. Using the coordinates of point of burst as suggested by Keith Boyer, the position of the ship, relative to point of burst, was:

Range: 197,580 feet.

Bearing: 310°.

The sound speed, as calculated from weather observation on the ship, was 1141.1 fps. The wind was from the east (090°) at 16 knots.

At time of burst, a large cloud was between the explosion and the ship, but the reflected flash could be seen clearly. No shock wave was heard; there was a feeling of pressure on the ears, accompanied by or followed by a muffled rumble.

DELETED

[redacted]

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[redacted]

[redacted]

Project 11.1 - Radiochemical Analysis - G. Cowan

DELETED

[redacted]

Project 11.2 - SAMPLING - H. F. Plank

Sampling [redacted] was conducted with two F-84G, and five B-57B type aircraft as programmed in "Project 11.2's Detailed Sampling Plans", H. F. Plank, 16 April 1956, 1174JFE. The altitudes, penetration times, and radiation exposure chosen were similar to those used in CASTLE. It was assumed that radiation intensities within the cloud would be typical of those found for the CASTLE high yield devices, (See Preliminary Report [redacted] Operation CASTLE, page 87, REF: JF-8022.) in spite of the high burst height planned.

Sampling results [redacted] are summarized in Table 11.2-1. In general, the samples collected were disappointingly small. Of five, only three were large enough to permit the determination of yield by the relatively inaccurate "total uranium method".

The [redacted] mission afforded Project 11.2 the first opportunity to test critically the effectiveness of sampling direction from the B-57B type airplane and to establish experimentally the distribution of radioactive debris from a hig burst in the multimegaton range. The six B-57B type aircraft available for cloud sampling on REDWING were equipped with flight, communication, navigation, radiati and sampling instrumentation, so that any of them could be used, either as a samp ler, or as a control platform. This provision eliminated a requirement for two additional aircraft for control purposes, such as the RB-36's on CASTLE, with a consequent reduction in operational costs.

The B-57B proved to be greatly superior to the RB-36, as a control platform, and to the F-84G airplane, as a sampler: with bomb-bay fuel and filter units at t wing tips, it has a five hour flight time capability, and was able, both to dire the sampler aircraft, and to collect a sample of a primary sampling aircraft which aborted.

The rate of decrease of radiation intensity within the cloud as a function of time after burst appeared to be typical of CASTLE bomb clouds. The levels at corresponding times, however, were substantially lower (about a factor of 50) at a below an indicated pressure altitude of 50,000 feet. From the control aircraft, numerous strokes of lightning were observed at approximately H + 15 to 20 minutes within the stem below the cloud base. The latter was estimated to be about 25,000 feet. This observation, as well as the pure white appearance of the stem, suggest that no radioactive debris was present within it.

On the other hand, as the control airplane performed a climbing approach on a westerly heading toward a persistent layer of bomb cloud with a base about 55,000 feet true altitude, it found patches of debris having approximately CASTLE-like radiation intensities. This finding, as well as the radiation field observed belo this layer and its physical appearance, suggests that a "normal" concentration of radioactive material is approached only at altitudes above 50,000 - 55,000 feet [redacted] DELETED [redacted] It is concluded that sampling aircraft with at least 10,000 feet higher altitude capability than the B-57B must be used in order to collect satisfactory samples from high yield bursts fired at altitudes of 5,000 feet or higher.

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TABLE 11.2-1

SAMPLING RESULTS [redacted]

AIRCRAFT CODE NAME	AIRCRAFT TYPE AND NUMBER	DURATION SAMPLING MISSION	TOTAL TIME IN CLOUD (Mins)	INDICATED PRESSURE ALTITUDE (1000's ft)	TOTAL FISSIONS COLLECTED	TOTAL FISSIONS DESIRED
TIGER RED I	F-84G 51038	0753-0853	47	35	3.2×10^{15}	20×10^{15}
TIGER RED II	F-84G 51053	0802-0855	47	38	2.4×10^{15}	20×10^{15}
HOTSHOT I	B-57B 21502	0825-0950	85	45	18.0×10^{15}	20×10^{15}
HOTSHOT II	B-57B 21504	ABORT				20×10^{15}
HOTSHOT III	B-57B 21496	0910-0935	25	42	0.52×10^{15}	20×10^{15}
HOTSHOT IV	B-57B 21500	1001-1031	17	48.8 - 51.5	1.6×10^{15}	20×10^{15}
CASSIDY CONTROL	B-57B 21504	0925-0941	16	49.8 - 52.8	2.4×10^{15}	20×10^{15}

(1) Duration of sampling mission may include time spent out of cloud required for re-entry turn.

(2) Indicated pressure altitude is less than true altitude. The difference is dependent upon altitude and varies from approximately 2000 feet at 40M to about 1400 feet between 50 and 55M.

101

[redacted]

[redacted]

Project 13.1 - Measurement of Alpha and Time Interval - H. Grier
J. Malik

DELETED

Instrumentation for measurement of alpha [redacted] and of time interval between primary and secondary was made by EG&G (Knappenberger) at Namu station 1319 located 400 ft from predicted ground zero. The miss of 20,000 ft made the slant range to the detectors too great to even trigger the system. No data were obtained.

[redacted]

[redacted]

Project 13.3 - Measurement of Transit Time - D. Henry

J. Malik

Measurement of the transit time of the primary was attempted by Sandia (D. Henry) using their R. F. telemetering system. The device was detonated outside of their field of view and no data were obtained.

[redacted]

[redacted]

Project 15.1 - EG&G PHOTOGRAPHY - H. Grier

D. Seacord

BURST POSITION AND YIELD

Upon receipt of the surveyed aiming angles of the Bokobyaadaa cameras, a new burst position was calculated. The three intersections of Bokobyaadaa-Chieerete, Enyu-Chieerete and Enyu-Bokobyaadaa are not in good agreement; however, the most probable burst position, with the Bokobyaadaa-Chieerete intersection weighted most heavily, is:

N 185,450 ± 500'

E 96,300 ± 150'

H 4,320 ± 150'

CLOUD DIMENSIONS

Approximate measurement of height-to-top and maximum diameter at the time of stabilization have been taken on one 70 mm airborne cloud camera film. The camera-cloud distance has been taken from the A/C navigation log and is, at this time, an approximate value.

Preliminary results from CHEROKEE are:

Time of stabilization: 05:53:56

Height-to-top: 14.3 Nautical miles

Maximum diameter: 11.1 Nautical miles

[redacted]

[redacted]

BHANGMETERS

Four Bhangmeters at the control point operated successfully for time-to-minimum data,

Insufficient data exist at the present time to allow a closer determination of Bhangmeter yield in this yield range. Time-of-fall data are not yet available.

APPENDIX

Final Estimate of Burst Position of [redacted] (CHEROKEE): The fireball was seen by the Chieerete phototheodolite, whose alignment was found to be accurate within 2' of arc by surveys taken before and after the shot.

The Aomoen phototheodolite did not see the fireball directly, but exposure on the edge indicated it was just out of the field of view. Using the radius of the fireball at breakaway, the azimuth of the optical axis and the field of view of the Aomoen phototheodolite, a minimum distance of GZ from the Chieerete phototheodolite, was obtained.

Radar pictures of the fireball were obtained giving absolute position of GZ with a maximum expected error of 500 feet. This point lies on the Chieerete phototheodolite line 500 feet beyond the minimum distance required by the Aomoen phototheodolite.

The Bokobyaadaa camera line of sight gave an intersection with the Chieerete phototheodolite line of sight 200 feet nearer than the radar position.

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[redacted]

[redacted]

The Enyu camera line of sight gave an intersection 1,600 feet further along the Chieerete phototheodolite line.

Numerous surveys were made of burn marks, blast streaks over the target position, poles and debris aligned by the blast. The weighted mean position of these determinations were 100 feet northeast of the radar position.

From this data, it is concluded that GZ lies at the radar sight point with a maximum expected error of ± 500 feet along the Chieerete phototheodolite line. This gives GZ coordinates as N 185,100; E 96,200 with limits of N 184,600; E 96,100 and N 185,500; E 96,300.

[redacted]

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[redacted]

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

TIME INTERVAL

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LANL

109

[redacted]

DELETED

110

[redacted]

Project 16.3 - Electromagnetic Measurements - R. Partridge

DELETED

[redacted]

[redacted]

[redacted]

Project 18.4 - Chord Spectroscopy and Time Interval in Selected Emission Channels - H. Hoerlin

(E. W. Bennet, R. Day, D. Westervelt)

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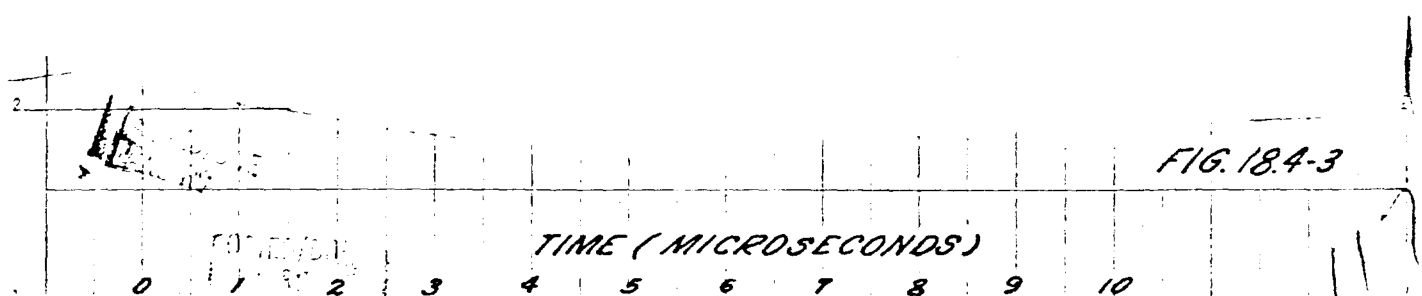

FIG. 18.4-3

[redacted]

DELETED

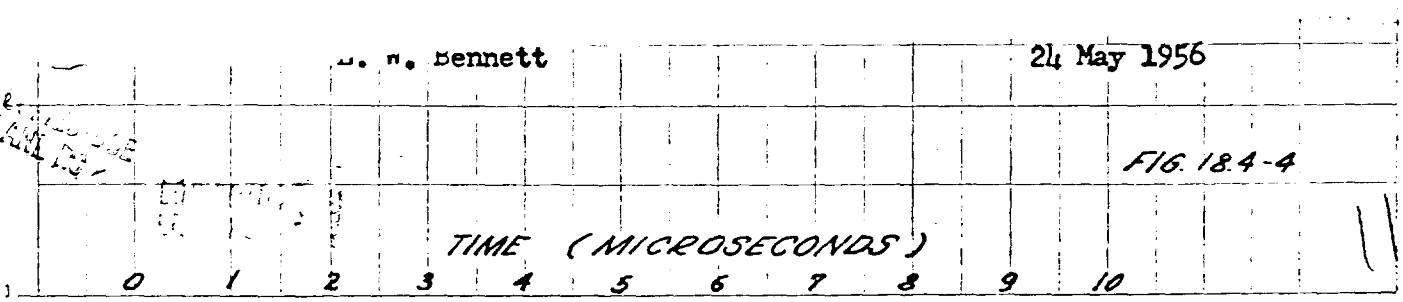

FIG. 18.4-4

[redacted]

PART IV

TASK UNIT 4

SC PROGRAMS

E. L. Jenkins

E. L. Jenkins
CTU-4

Program 31 - Microbarography — R. Heppelwhite

119

[redacted]

[redacted]

[redacted]

Project 31.1 - MICROBAROGRAPH - W. A. Gustafson

The purpose of this project was to measure winds in the 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.

On the [redacted] (CHEROKEE) shot, good records were obtained from all stations, but no wind velocities are yet available.

[redacted]

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