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Project Summaries (Revised)

March-April 1954

Pacific Proving Grounds

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Extract version prepared for:

Director
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FOREWORD

This report has had classified material removed in order to make the information available on an unclassified, open publication basis, to any interested parties. This effort to declassify this report has been accomplished specifically to support the Department of Defense Nuclear Test Personnel Review (NTPR) Program. The objective is to facilitate studies of the low levels of radiation received by some individuals during the atmospheric nuclear test program by making as much information as possible available to all interested parties.

The material which has been deleted is all currently classified as Restricted Data or Formerly Restricted Data under the provision of the Atomic Energy Act of 1954, (as amended) or is National Security Information.

This report has been reproduced directly from available copies of the original material. The locations from which material has been deleted is generally obvious by the spacings and "holes" in the text. Thus the context of the material deleted is identified to assist the reader in the determination of whether the deleted information is germane to his study.

It is the belief of the individuals who have participated in preparing this report by deleting the classified material and of the Defense Nuclear Agency that the report accurately portrays the contents of the original and that the deleted material is of little or no significance to studies into the amounts or types of radiation received by any individuals during the atmospheric nuclear test program.

PREFACE

This revision of the Project Summaries of Operation CASTLE supersedes the first edition. All copies of the first edition should be destroyed in accordance with applicable security regulations. When destroyed, notification should be made to:

Commanding General
Field Command
Armed Forces Special Weapons Project
P. O. Box 5100, Sandia Base
Albuquerque, New Mexico
ATTN: Directorate of Weapons Effects Tests

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

To develop doctrine for employment of and defense against nuclear weapons the Department of Defense (DOD) sustains a program to determine the capabilities of such weapons. This program, coordinated by the Armed Forces Special Weapons Project (AFSWP), embraces theoretical studies, laboratory studies, field studies employing high explosives, full-scale effects tests conducted specifically for weapons capability study, and full-scale effects tests incidental to development tests of the Atomic Energy Commission (AEC). Operation CASTLE falls within the latter category.

The broad program for study of weapon capabilities falls into two major divisions. The first division has the objective of determining generalized laws which will permit prediction of the blast, thermal, and nuclear radiation fields for any point of interest when bomb parameters (yield, burst height, etc.) are known. The second division has the objective of determining the reaction or response of personnel and items of military interest to the blast, thermal, and nuclear radiation fields.

In considering projects for the Military Effects Tests Program at CASTLE in furtherance of the over-all program for determination of weapon capabilities the DOD was guided by the following precepts:

1. The project must be justified on the basis of a military requirement.
2. The project must be such that:
   (a) Its objective cannot be attained except at a full-scale test.
   (b) Its objectives cannot be attained at the Nevada Proving Grounds.
   (c) Its objectives can be attained at the Pacific Proving Grounds without unreasonable support requirements.
3. The project must conform to the shot schedule (yields, locations, burst heights, and times) established for the developmental program of the AEC.

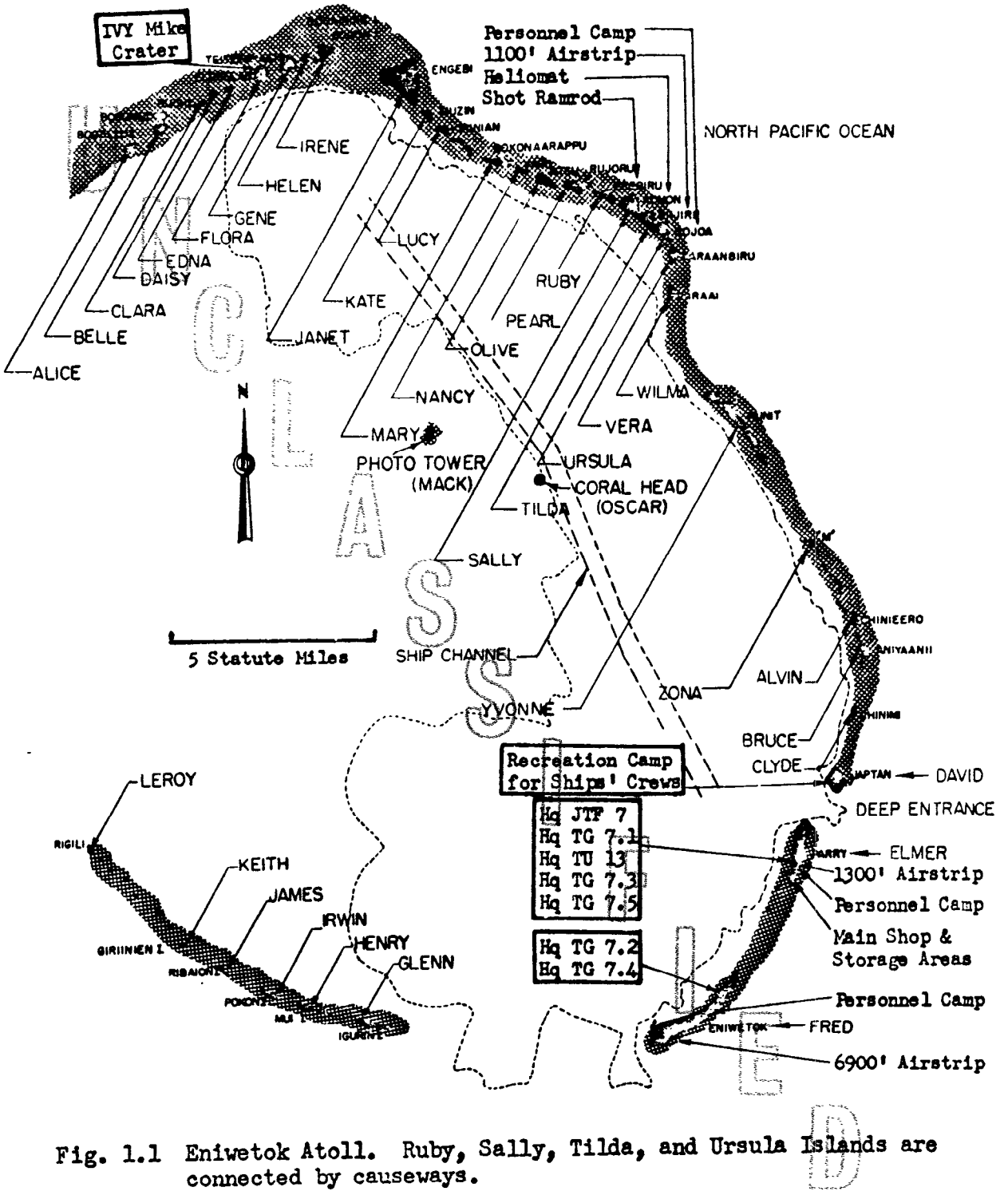

Fig. 1.1 Eniwetok Atoll. Ruby, Sally, Tilda, and Ursula Islands are connected by causeways.

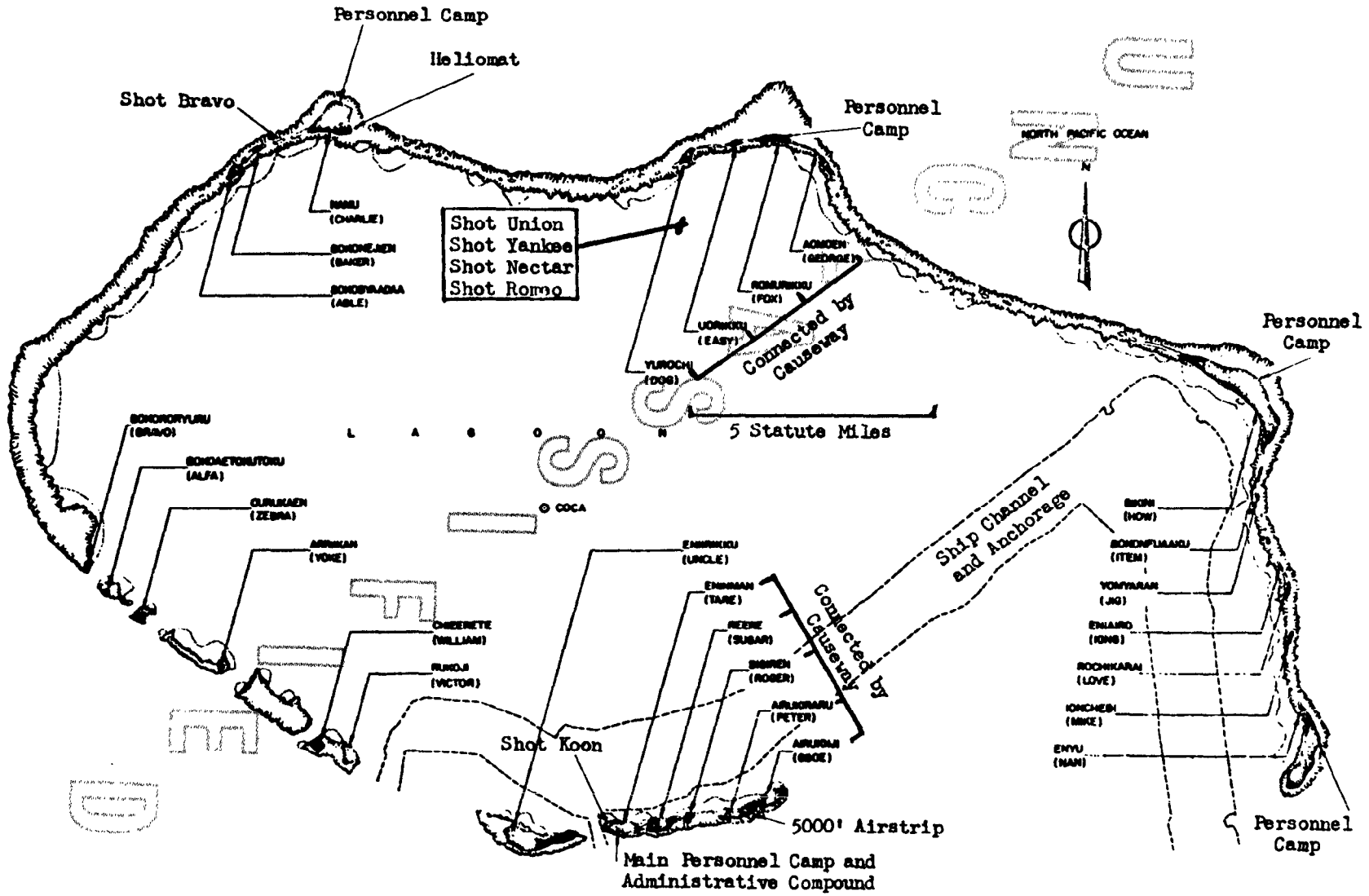

Fig. 1.2 Bikini Atoll

Within the limitations of the above precepts a Military Effects Tests Program comprised of projects detailed in the following sections of this handbook was evolved. Each set of allied projects has been placed in an individual program. The general objectives of the individual programs are as follows:

1.2 PROGRAM 1 - BLAST AND SHOCK MEASUREMENTS
Director - LCDR W. L. Carlson, USN

1.2.1 Objectives

1. To determine air pressures as a function of distance in the air near yield detonations.
2. To obtain data on the occurrence of a precursor blast wave formation from high yield detonations.
3. To determine the time characteristics of air overpressure as a function of distance from surface zero for high yield weapons in order to confirm the validity of scaling laws.
4. To determine the dynamic pressure of the shock wave and after-wind velocities for high yield detonations.
5. To obtain information on the pressure-time history of underwater shock for high yield detonations on the surface of shallow water.
6. To determine the transmission of acoustic pressure signals generated by high yield detonations in water.
7. To determine water wave phenomena from the surface burst of high yield weapons in shallow water.
8. To determine ground accelerations at distances relatively close to surface zero for high yield detonations.

1.3 PROGRAM 2 - NUCLEAR RADIATION STUDIES
Director - Lt Colonel E. A. Martell, USA

1.3.1 Objectives

1. To determine the time-intensity characteristics and total dosage of gamma radiation as a function of time and position for surface detonations of high yield devices.
2. To determine the nature and distribution of residual radioactive contamination resulting from the surface detonation of high yield devices.
3. To determine the neutron flux and energy distribution as a function of distance for the surface detonation of high yield devices.

1.4 PROGRAM 3 - STRUCTURES
CAPT N. E. Kingsley, USN

1.4.1 Objectives

1. To determine as a function of time the loading imposed by the blast wave from a high yield device upon an idealized structure.

2. To determine the dimensions of craters formed by surface detonations of high yield devices.

3. To study the effects of the shock wave and attendant winds upon a natural tree stand.

1.5 PROGRAM 4 - BIOMEDICAL STUDIES

Initial plans for CASTLE included a study to determine the biological effects of neutron flux as a function of distance for high yield detonations. This program was cancelled because the IVY test results indicated reduced significance of effects of neutrons relative to other effects for nuclear detonations of high yield.

1.6 PROGRAM 6 - SERVICE EQUIPMENT AND TECHNIQUES
Director - Lt Col D. I. Prickett, USAF

1.6.1 Objectives

1. To obtain weapons effects information by use of manned aircraft for use in determining and improving the delivery capability for high yield weapons.

2. To operationally evaluate shipboard atomic warfare countermeasures in regions of intense radioactive fall-out, outside the limits of direct blast and thermal damage, in conjunction with water surface and ground surface detonations of high yield devices.

3. To provide for the limited study of effects and techniques bearing on the problems of detection, communications, decontamination and protection.

1.7 PROGRAM 7 - LONG RANGE DETECTION
Director - Col P. R. Wignall, USAF

1.7.1 Objective

To continue the development and evaluation of the various techniques under consideration by the U. S. Air Force for the long range detection of atomic detonations.

1.8 PROGRAM 8 - THERMAL RADIATION MEASUREMENTS
Director - CAPT N. E. Kingsley, USN

There exists a military requirement for the determination of the physical characteristics of thermal radiation from large airburst detonations to provide information on energy partition and provide a basis for assessment of effects on personnel and materials.

Since all CASTLE detonations are planned as surface detonations it is considered that the military effects requirements for thermal radiation information is adequately covered under Program 18 Los Alamos Scientific Laboratory (LASL) which provides for power-time, spectrum, air transmission and total thermal energy measurements.

TABLE 1.1 - Shot Schedule, Operation CASTLE

Shot Number	Shot Date	Yield (Presumed Range)	Code Name	Type of Shot	Atoll	Location of GZ
1 LASL	1 Mar	6 MT (4-8)	Bravo	Surface (reef)	Bikini	On reef 2950' bearing 250° true from SW tip of Namu. (Charlie).
2 LASL	11 Mar	3-4 MT (1-6)	Union	Surface (barge)	Bikini	On barge at intersection of arcs with radii of 6900' from Yurochi(Dog) and 3 statute miles from Aomoen. (Fox)
3 LASL	22 Mar	8 MT (6-10)	Yankee	Surface (barge)	Bikini	Same as Union
4 UCRL	29 Mar	125 KT (65-275 KT)	Echo	Surface (land)	Eniwetok	Eberiru (Ruby)
5 LASL	5 Apr	1.8 MT (1-2.5)	Nectar	Surface (barge)	Bikini	Same as Union
6 LASL	15 Apr	4 MT ($1\frac{1}{2}$-7)	Romeo	Surface (barge)	Bikini	Same as Union
7 UCRL	22 Apr	1 MT ($1/3$-$1\frac{1}{2}$)	Koon	Surface (land)	Bikini	Eninman (Tare)

TABLE 1.2 - Program 1 Project Participation

Projects No.	Projects Title	Performing Agency	Project Officer	Shots 1	2	3	4	5	6	7
1.1a	Blast Pressures by Rocket Trail Photography	NOL	Mr. C. J. Aronson	x	x		x			x
1.1b	Blast Phenomena by Surface Photography	NOL	Mr. C. J. Aronson	x	x	x	x	x	x	x
1.1c	Base Surge Phenomena	NOL	Mr. C. J. Aronson				x			x
1.1d	Peak Pressure by Aerial Photography	NOL	Mr. C. J. Aronson	x	x	x	x	x	x	x
1.2a	Pressure vs Time (Moderate Pressures)	Sandia Corp	Dr. J. M. Harding	x	x	x	x	x	x	x
1.2b	Pressure vs Time (High Pressures)	BRL	Mr. J. J. Meszaros	x	x	x	x	x	x	x
1.3	Shock Winds and Afterwinds	Sandia Corp	Dr. J. M. Harding		x	x	x	x	x	x
1.4	Underwater Pressure vs Time	ONR, DTMB, NOL, NRL	Dr. W. J. Thaler	x	x	x		x	x	
1.5	Acoustic Pressure Signals in Water (SOFAR)	NEL	Mr. J. W. Smith	x	x	x	x	x	x	x
1.6	Water Wave Studies	Scripps I.O.	Dr. R. R. Revelle	x	x	x	x	x	x	x
1.7	Close-in Ground Accelerations	Sandia Corp	Dr. J. M. Harding				x			x
1.8	Dynamic Pressure Investigation	BRL	Mr. E. Bryant		x	x	x			x

TABLE 1.3 - Program 2 Project Participation

Projects No.	Projects Title	Performing Agency	Project Officer	Shots 1	2	3	4	5	6	7
2.1	Total Gamma Exposure Measurement	ESL	Capt R. Dempsey	x	x	x	x	x	x	x
2.2	Gamma Rate vs Time	ESL	Mr. P. Brown	x	x	x		x	x	x
2.3	Neutron Flux and Spectrum Measurements	NRL	Mr. T. D. Hanscome	x	x	x		x	x	
2.5a	Distribution and Intensity of Fall-out	NRDL	Dr. E. R. Tompkins	x	x	x	x	x	x	x
2.5b	Fall-out Distribution Studies	CRL	Mr. E. F. Wilsey	x	x	x		x	x	x
2.6a	Chemical, Physical and Radiochemical Analysis of Surface Contamination	NRDL	Dr. E. R. Tompkins	x	x	x	x	x	x	x
2.6b	Radiochemical Analysis of Surface Contamination	CRL	Mr. R. C. Tompkins	x	x	x		x	x	x

TABLE 1.4 - Program 3 Project Participation

Projects		Performing Agency	Project Officer	Shots					
No.	Titles			1	2	3	4	5	6
3.1	Loading of Structures	SRI	Mr. L. M. Swift						
3.2	Crater Survey and Evaluation	SRI	Dr. R. B. Vaile, Jr.	x	x		x		
3.3	Blast Effects on Tree Stands	USFS	Mr. W. L. Fons						

TABLE 1.5 - Program 6 Project Participation

Projects No.	Projects Title	Performing Agency	Project Officer	Shots 1	2	3	4	5	6	7
6.1	Test of Interim IBDA Procedures for High Yield Weapons	SAC	Lt Col G. G. Keeling	x	x	x	x	x	x	x
6.2a	Blast, Gust and Thermal Effects on a Manned B-36	WADC	Col W. A. Anderson	x	*	x	*	x	x	x
6.2b	Thermal Effects on B-47 Aircraft	WADC	Col W. A. Anderson	x	*	x	*	x	*	x
6.4	Proof Testing on AW Ship Countermeasures	BuShips	Capt. G. G. Molumphy	x		x		x		x
6.5	Decontamination and Protection	CRL	Mr. J. G. Maloney	x		x		x		x
6.6	Ionosphere Studies	ESL	Capt Andrew Giroux	x	x	x	x	x	x	x

* Possible participation

TABLE 1.6 - Program 7 Project Participation

Projects No.	Projects Title	Performing Agency	Project Officer	Shots 1	2	3	4	5	6	7
7.1	Electromagnetic Radiation Calibration		Mr. J. A. Crocker	x	x	x	x	x	x	x
7.2	Detection of Airborne Low Frequency Sound from Atomic Explosions		Mr. G. B. Olmsted	x	x	x	x	x	x	x
7.4	Calibration Analysis of A-Bomb Debris		Mr. W. Singlevich	x	x	x	x	x	x	x

TABLE 1.7 - Program 8 Project Participation

DOD Thermal Measurements Program integrated into LASL program which will come under Mr. Harold Stewart of NRL.

TABLE 1.8 - Program 9 Project Participation

Projects No.	Projects Title	Performing Agency	Project Officer	Shots 1	2	3	4	5	6	7
9.1	Cloud Photography	EG&G LOML	Lt Col J. G. James	x	x	x	x	x	x	x

1.9 PROGRAM 9 - SUPPORTING MEASUREMENTS

Director - Lt Col J. G. James, USAF

1.9.1 Objectives

1. To determine the spatial development and movement, as functions of time, of the cloud from high yield devices as a supporting measurement for Programs 2 and 7, and to obtain information for aircraft delivery problems.

2. To provide for support of photography, meteorology, etc., required by individual projects other than paragraph 1 above.

CHAPTER 2

PROGRAM 1 - BLAST AND SHOCK MEASUREMENTS

2.1 Project Number: 1.1a Title: Blast Pressures by Rocket Trail Photography

Sponsor: AFSWP Performing Agency: Naval Ordnance Laboratory

Project Officer: Mr. C. J. Aronson

2.1.1 Objective

To obtain peak air overpressure as a function of distance by means of rocket trail photography. Because all shots will be on the surface, true free air pressures can not be obtained.

2.1.2 Procedure

The procedure is essentially the same as that used during IVY. A series of rocket smoke trails in a fantype grid will be established a few thousand feet from ground zero approximately 8 sec. prior to zero time. A camera placed in such a position as to photograph the rocket smoke trails through the expanding shock wave will obtain a photographic record of the propagation of the blast wave related to time. The velocity of the shock wave in air may be calculated and the peak overpressures may be deduced from the velocity of the shock wave.

2.1.3 Remarks

Project 1.1a will participate in Shots Bravo, Union, Koon and Echo using rocket smoke trails. Photographs without the smoke trail background will be obtained for Shots Nectar, Yankee and Romeo.

2.2 Project Number: 1.1b Title: Blast Phenomena by Surface Photography

Sponsor: AFSWP Performing Agency: Naval Ordnance Laboratory

Project Officer: Mr. C. J. Aronson

2.2.1 Objective

To measure, by photographic means, the motion of the shock wave over land and water to obtain peak overpressure near the earth's surface and to study the propagation of any precursor waves if they are formed.

2.2.2 Procedure

The project will be done by means of direct photography. For those shots in which Project 1.1a will participate, no additional photography is required.

2.2.3 Remarks

The participation will include all shots.

2.3 Project Number: 1.1c Title: Base Surge Phenomena

Sponsor: AFSWP Performing Agency: Naval Ordnance Laboratory

Project Officer: Mr. C. J. Aronson

2.3.1 Objective

To determine the rate and extent of the base surge formation for a surface burst.

2.3.2 Procedure

Instrumentation will consist of cameras only. Photographs obtained from various photo towers and from cameras installed in a C-54 aircraft will be studied and space-time data will be obtained directly.

2.3.3 Remarks

This project will participate in Shots Echo and Koon.

2.4 Project Number: 1.1d Title: Peak Pressure by Aerial Photography

Sponsor: AFSWP Performing Agency: Naval Ordnance Laboratory

Project Officer: Mr. C. J. Aronson

2.4.1 Objective

To study the propagation of the blast wave over the surface of the water.

2.4.2 Procedure

A 35 mm camera to operate at 24 frames/sec. will be installed in the RB-36. The aircraft will fly at an altitude of approximately 40,000 ft and at a range of from 30 - 60 miles from ground zero. It is estimated that the light from the burst will provide sufficient light to permit the photographing of the shock wave along the water. If sufficient resolution of the shock propagation can be obtained a peak pressure vs distance curve may be constructed from the observed velocity of the shock wave.

2.4.3 Remarks

This project is scheduled to participate in all shots.

2.5 Project Number: 1.2a Title: Pressure vs Time (Moderate Pressures)

Sponsor: AFSWP Performing Agency: Sandia Corporation

Project Officer: Dr. J. M. Harding

2.5.1 Objective

To investigate the validity of the static pressure scaling laws for large yield surface bursts. The principal pressure region of interest is in the pressure range below 40 psi.

2.5.2 Procedure

Wianko pressure-time gages in ground baffles will be installed on islands at various distances from ground zero generally in the pressure region below 40 psi. The pressure-time response of the gages will be transmitted by signal cable to Ampex recorders placed in a concrete shelter.

2.5.3 Remarks

This project is scheduled to participate in all shots. Limitations imposed by Rad-Safe considerations may restrict the participation to fewer shots.

2.6 Project Number: 1.2b Title: Pressure vs Time (High Pressures)

Sponsor: AFSWP Performing Agency: Ballistic Research Laboratories

Project Officer: Mr. J. J. Meszaros

2.6.1 Objective

To investigate the validity of the static pressure scaling laws for large yield surface bursts. The principal pressure region of interest is above 40 psi. In addition, supporting pressure-time measurements will be obtained within the Project 3.3 tree stand.

2.6.2 Procedure

Self-contained, flash initiated pressure-time recording gages in ground baffles will be installed at various distances from ground zero, generally in the pressure region above 40 psi. In addition, pressure-time gages will be placed in ground baffles ahead of the Project 3.3 tree stand, within the tree stand and behind the tree stand as an instrumentation service to Project 3.3 personnel.

2.6.3 Remarks

The self-contained mechanical gage was field tested during UPSHOT-KNOTHOLE. The stated accuracy of the gage is ± 10 per cent. Project 1.2b will participate in all shots. Limitations imposed by Rad-Safe considerations may restrict the participation to fewer shots.

2.7 Project Number: 1.3 Title: Shock Winds and Afterwinds

Sponsor: AFSWP Performing Agency: Sandia Corporation

Project Officer: Dr. J. M. Harding

2.7.1 Objective

To determine the dynamic pressure-time characteristics of the shock wave produced by large yield surface bursts.

2.7.2 Procedure

Pitot tubes oriented toward ground zero will be installed on islands at approximately 5 ft above the ground at three different ground ranges. The pitot tube will contain a side-on pressure opening and the static pressure will be obtained for comparative purposes. In addition, a multiple instrument station will be installed on George. This station will contain a density gage, a temperature gage, a pitot tube, a drag gage and a ground level pressure gage.

2.7.3 Remarks

This project is scheduled to participate in all shots except Bravo. Limitations imposed by Rad-Safe considerations may restrict the participation to fewer shots.

2.8 Project Number: 1.4 Title: Underwater Pressure vs Time

Sponsor: AFSWP Performing Agency: CUR, NOL, NRL, DTMB

Project Officer: Dr. William Thaler

2.8.1 Objective

To determine for a surface burst the amount of blast energy transmitted into the water.

2.8.2 Procedure

Instrument stations will be anchored in the lagoon at various distances from ground zero. Nine close-in stations will each have 68 ball crusher gages in groups of four spaced vertically from the water surface to the bottom of the lagoon. The stations located beyond approximately 10,000 ft from ground zero will contain from two to eight pressure-time gages suspended at different depths in the water. Twelve stations of pressure-time gages are planned.

2.8.3 Remarks

The actual spatial distribution of stations will be determined at a later date from the results of high explosive experiments. Project 1.4 will participate in Shots Union, Echo and Nectar. In addition, a few stations may be activated for Shots Bravo and Yankee.

2.9 Project Number: 1.5 Title: Acoustic Pressure Signals in Water (SOFAR)

Sponsor USN Performing Agency: Office of Naval Research

Project Officer: Mr. J. W. Smith

2.9.1 Objective

To determine the relative intensity of the long range acoustic signals produced by surface bursts. An effort will be made to determine device yields relative to the GREENHOUSE and IVY shots, acoustic velocity, shot location and/or time.

2.9.2 Procedure

The USN Electronics Laboratory will be requested to continue observation and analysis of data at Pacific SOFAR stations. Similarly, groups from Columbia University will undertake observations at Atlantic SOFAR Research Station.

2.9.3 Remarks

This project will be conducted off site and will participate in all shots.

2.10 Project Number: 1.6 Title: Water Wave Studies

Sponsor: ONR-USN Performing Agency: Scripps Institution of Oceanography

Project Officer: Dr. R. R. Revelle

2.10.1 Objective

To (1) obtain measurements of the water wave characteristics, (2) determine if possible the wave forming and dissipating mechanism for waves formed by a detonation close to the water surface.

2.10.2 Procedure

Since the wave produces a passing change of water pressure, the wave height as well as other characteristics of the wave can be determined by measuring the subsurface pressure variation with time. Four pressure-time sensitive heads will be placed on coral heads within the Bikini lagoon. Recorders will be installed in skiffs anchored above the pressure heads. Distances of the stations from ground zero will change for each shot, however, the closest station will be approximately $2\frac{1}{2}$ nautical miles and the farthest will be approximately 17 nautical miles from ground zero. One each shore recorder will be located in 20 to 30 ft of water off Eninman and Enyu. Distance wave recorders will be located at La Jolla and Oceanside, Calif., Midway, Wake, Guam, and Eniwetok Islands.

Two other gages will be used. Open cans will be fastened to existing poles on three islands in the Bikini Atoll to indicate the maximum inundation and feasibility tests will be made on water shock vs time gages installed at the bottom of the lagoon.

2.10.3 Remarks

Principal participation will be in Shots Bravo, Union, Yankee, Nectar, Romeo and Koon. The distant island stations will participate on all shots.

2.11 Project Number: 1.7 Title: Close-in Ground Accelerations

Sponsor: AFSWP Performing Agency: Sandia Corporation

Project Officer: Dr. J. M. Harding

2.11.1 Objective

To determine the amount of blast energy transmitted radially outward through the earth's surface.

2.11.2 Procedure

Bull plugs containing Wianko accelerometers for detecting the magnitudes of the vertical, radial and the tangential components of earth acceleration will be installed approximately 15 ft below the earth's surface. The three components of acceleration-time will be recorded at an underground shelter by means of Ampex tape recorders.

2.11.3 Remarks

Project 1.7 will participate in Shots Echo and Koon.

2.12 Project: 1.8 Title: Dynamic Pressure Investigation

Sponsor: AFSWP Performing Agency: Ballistic Research Laboratories

Project Officer: Mr. F. Bryant

2.12.1 Objective

To make a comparison of effects of a classic, dust free, shock front with effects observed at the KNOTHOLE operation, in order to assess dynamic overpressures as a damage parameter.

2.12.2 Procedure

For comparative purposes jeeps will be deployed in the region of 20 psi side-on pressure and 12 psi side-on pressure. These overpressures are calculated to produce the same dynamic pressures which at KNOTHOLE produced severe damage and light damage respectively.

2.12.3 Remarks

A few jeeps may be exposed on Shots Union and Yankee. No entry will be required after Union; however, low level aerial photographs will be used to record the damage. The main participation will be on Shots Echo and Koon. Entry after the shots will be necessary to record damage.

CHAPTER 3

PROGRAM 2 - NUCLEAR RADIATION STUDIES

3.1 Project Number: 2.1 Title: Total Gamma Exposure Measurement

Sponsor: AFSWP Performing Agency: Evans Signal Laboratory

Project Officer: Capt Robert Dempsey, USA

3.1.1 Objective

To document total gamma radiation dose as a function of distance and direction for the various types of high yield nuclear devices to be tested.

To provide total gamma radiation dosage measurements at positions of gamma time-intensity and neutron flux measurements for purposes of correlation and calibration.

The limited total gamma dose data available from the IVY tests indicate considerably higher values of gamma dosage for high yield devices than expected. Scaling laws that apply over a wide range of sizes for small yield devices do not apply for those of high yield, primarily because of the striking effect of the shock wave on the gamma radiation attenuation for the latter. It is thus important to document total gamma radiation dose for high yield devices to provide a basis for its quantitation prediction and for evaluating its significance relative to other effects.

3.1.2 Procedure

A number of dental films of overlapping sensitivity, covering the range of gamma dosage from 1 roentgen to 40,000 roentgens, will be placed in National Bureau of Standards type holders. Control films will be field calibrated against standard cobalt-60 sources followed by laboratory betatron recalibration. A number of stations will be activated for each event, providing from 10 to 25 measurements per shot. Some of these measurements will be made at Project 2.2 station locations, some at positions along reefs and others 50 ft below high tide line at island positions. In addition, film packets will be placed at Project 2.3 stations.

3.1.3 Remarks

Project 2.1 will be provided limited access to the Rad-Safe Photo Trailer for film processing. A DUKW will be required for placement and recovery of film packs for reef and offshore stations. A helicopter will be required for recovery from contaminated land areas.

3.2 Project Number: 2.2 Title: Gamma Rate vs Time

Sponsor: USA Performing Agency: Evans Signal Laboratory

Project Officer: Mr. Peter Brown

3.2.1 Objective

To provide for the measurement of gamma radiation intensity as a function of time and position along the ground for surface detonations of high yield.

The rate data will be recorded over a period from 0.1 sec. to 24 hr after detonation. These data will provide a basis of evaluating the dosage contribution from the various sources of initial gamma radiation and the decay rate and dosage contribution for residual contamination fields over the first 24 hr period.

The limited gamma time intensity data obtained for the IVY detonations indicated a drastic difference in the time-rate of gamma exposures for high yield devices as compared to that for nominal weapons, primarily due to the effect of the blast wave on gamma radiation attenuation for high yield detonations.

3.2.2 Procedure

The equipment used for these measurements consists of four scintillation counter units capable of detection of gamma ray intensities over a range of five decades. Each unit will be equipped with two recorders, one of about 0.1 sec. resolution covering the first minute period; the other of slower resolution covering a 24 hr period. A total of 15 stations will be located on islands of the Bikini Atoll, 10 of which will be doubly instrumented stations, capable of recording intensities over a range of nine decades. The equipment with associated power supplies will be sealed in steel drums and placed below ground surface except for the scintillation counter probe which will project above ground. A combination of of 5 to 10 stations will be activated for each of the Bikini shots.

3.2.3 Remarks

Project laboratory space will be provided on Elmer and all electronics will be processed there and transhipped to Tare. In addition, an 88 curie and 4 and 5 curie sources will be on hand for calibration necessary for Projects 2.1 and 2.2. These sources will

remain on Elmer, with the large one being stored in the Rad-Safe area. Since all stations are on land masses, access for installation prior to Bravo may be by boat. Recovery of records and reactivation of stations will require helicopter flights. No courier or sample return flights are required.

3.3 Project Number: 2.3 Title: Neutron Flux and Spectrum Measurements

Sponsor: AFSWP Performing Agency: Naval Research Laboratory

Project Officer: Mr. T. D. Hanscome

3.3.1 Objective

To document the fast neutron and thermal neutron flux as a function of distance for the various high yield devices to be tested.

To extend measurements of spectrum distribution, particularly in the region below the sulfur threshold by using nuclear emulsions to detect the fissions fragments from neptunium, uranium-238, and thorium detectors, all of which have fission thresholds in the region of 1 MEV.

Although the limited neutron flux data obtained for the IVY detonations indicate little significance for neutron radiation relative to other effects from high yield detonations, several considerations indicate the importance of neutron measurements. Neutron flux does not scale simply with the KT equivalent of a device but both the flux and spectrum are very dependent on the details of mechanical design of a device. Knowledge of the neutron flux and spectrum is essential for thorough analysis of weapons effects. For example, such knowledge is required for the interpretation of biomedical effects of bomb radiation.

3.3.2 Procedure

Gold and tantalum detectors will be used for thermal flux measurement and sulfur detectors (3 MEV threshold) for fast neutrons, using the techniques described in WT-524.[1] The fission threshold detectors (uranium-238, thorium, and neptunium) used for measurement of the flux in the region of 1 MEV will be calibrated against a known flux from a Van de Graaff neutron source target and exposed in the cavity of 4 cm and 8 cm wall lead spheres. A limited number of measurements will be made on all shots at distances ranging from 2500 to 5000 yd from zero. Stations will be spaced approximately 500 yd in a range with several stations in a given direction and with 1 or 2 stations in different directions for some events. The use of Pu^{239} detectors is contemplated.

1. WT-524, Neutron Flux Measurements, Operation TUMBLER-SNAPPER.

3.3.3 Remarks

Space will be available on both Elmer and Tare to prepare samples. Since some sample containers will weigh several hundred pounds, it has been proposed to use a DUKW with monorail and chain fall to handle containers. This will provide enough elevation and also allow processing of the bar stations east of Charlie. Prior to Shot Nectar it will be necessary to use this DUKW for installations. Boat travel to various islands will also be required. Recovery of detectors and reactivation of some stations will involve the same procedure and entry into contaminated areas when radiological conditions permit. Hot sample return by aircraft from Bikini to Eniwetok will be necessary. Samples will be sorted and one group forwarded to the Naval Research Laboratory (NRL), Washington, D. C., for counting. Short-lived activities will be counted in laboratory trailer on Elmer. Sample return will amount to about 2 cu ft per shot. Flights have been requested at plus 2 and plus 4-5 days after each shot. Couriers will be required.

3.4 Project Number: 2.5a Title: Distribution and Intensity of Fall-out

Sponsor: AFSWP, Department of the Navy

Performing Agency: U. S. Naval Radiological Defense Laboratory

Project Officer: Dr. E. R. Tompkins

3.4.1 Objective

To document the time-intensity and total distribution of radioactive fall-out resulting from high yield surface detonations.

To provide samples for physical and radiochemical analysis which will provide basis for evaluation of the residual contamination hazards resulting from such bursts.

There are severe limitations to reliable scaling of the residual contamination resulting from the JANGLE surface detonation but the indications are that residual contamination resulting from large surface detonations produces very significant radiation fields over an extensive area. Only fragmentary coverage of the fall-out distribution was obtained in the IVY tests. It is planned to thoroughly document the fall-out resulting from several of the current test detonations in order to evaluate the significance of residual contamination from high yield surface bursts.

3.4.2 Procedure

Both total and intermittent collectors will be placed at each of a broad pattern of fall-out stations. A total of 10 island and 26 lagoon raft stations will be instrumented for the detonations at

Bikini Atoll. In addition, a broad pattern of free floating stations (Dan buoys) extending 50 miles from zero will be instrumented for Shots 1, 3, 5 and 7. The more extensive coverage for these three events will serve the additional purpose of aiding the evaluation of the Project 6.4 experiment which is to be conducted during these same events. In addition, 32 lagoon stations will be instrumented at Eniwetok for Shot Echo.

3.4.3 Remarks

Instrumentation will be processed at Elmer and transhipped to Tare for distribution. Access to land stations for instrumentation and recovery will require boat and helicopter support. A landing craft utility (LCU) equipped with crane will be needed for raft station instrumentation. Dan buoy stations will require the full time support of two vessels for several days before and after each of Shots 1, 3, 5 and 7. Samples will require transhipment to Elmer and courier flights to USNRDL after each event.

3.5 Project Number: 2.5b Title: Fall-out Distribution Studies

Sponsor: AFSWP Department of the Army

Performing Agency: CRL, Army Chemical Center

Project Officer: Mr. L. F. Wilsey

3.5.1 Objective

The general objectives of this project are identical to those stated for Project 2.5a (provide data in the high overpressure regions).

Different types of instrumentation will be employed with sufficient overlap with Project 2.5a to provide for good correlation. Project 2.5b instrumentation will be largely concentrated on land areas, plus a number of lagoon raft stations, within about 15 miles of the Bikini detonations.

3.5.2 Procedure

Thirteen islands and nine raft positions in the lagoon of Bikini Atoll will be instrumented with blast resistant intermittent fall-out collectors and a limited number of total fall-out collectors. Documentation is planned for all Bikini events.

3.5.3 Remarks

Processing of equipment will be carried out at Elmer and the equipment transhipped to Tare for distribution. Boat and helicopter support will be required for instrumentation and recovery at land stations. A crane equipped LCU will be shared with Project 2.5a for

instrumentation of lagoon raft stations. Samples will require transhipment to Elmer and courier flights to Army Chemical Center, Md., after the events.

3.6 Project Number: 2.6a Title: Chemical, Physical and Radiochemical Analysis of Surface Contamination

Sponsor: AFSWP
Department of the Navy

Performing Agency: U. S. Naval Radiological Defense Laboratory

Project Officer: Dr. E. R. Tompkins

3.6.1 Objective

To determine the physical, chemical and radiochemical nature of residual contamination in order to assess the hazards associated with residual field radiation.

To provide information of use for the evaluation of the mechanism of distribution of bomb debris and thus improve the capability of scaling and prediction of residual contamination effects.

To provide basic information essential to the study of decontamination and protection techniques.

3.6.2 Procedure

Radiochemical analysis for short-lived radioactive constituents of fall-out debris, early gross decay measurements, and chemical analysis to determine the presence and nature of transitory chemical states will be made in the forward area. Some of this work will be carried out in limited laboratory space aboard the light aircraft carrier (CVL) and further work carried out in mobile laboratory facilities on Elmer.

Size distribution studies and most of the chemistry and radiochemistry will be carried out at the U. S. Naval Radiological Defense Laboratory (USNRDL) on arrival of the samples collected under Project 2.5a.

3.6.3 Remarks

The only support requirement for this project except for forward area laboratory facilities is the expeditious return of Project 2.5a samples to Elmer and the USNRDL.

3.7 Project Number: 2.6b Title: Radiochemical Analysis of Surface Contamination

Sponsor: AFSWP
Department of the Navy

Performing Agency: CRL, Army Chemical Center

Project Officer: Mr. R. C. Tompkins

3.7.1 Objective

The general objectives of this project are the same as those indicated for Project 2.6a. However the scope, techniques, and direction of attention of Projects 2.6a and 2.6b differ considerably in detail.

3.7.2 Procedure

Analysis procedures include the size grading of samples collected under Project 2.5b by standard sieves down to approximately 40 microns and by roller analysis below this size. Radiochemical analysis will include determinations of Na^{24}, Zr^{97}, Mo^{99}, Cd^{115}, and Ba^{140}. Sodium-24 and Fe^{59} to fission product ratios will be determined.

Some early analysis will be conducted using mobile facilities at Elmer. Remainder of study will be carried out at the Chemical and Radiological Laboratories, Army Chemical Center, Md., upon receipt of couriered Project 2.5b samples. The scope of the analysis will depend upon the degree of success of sampling by Project 2.5b.

3.7.3 Remarks

Operational support requirements for this project are included with those for Project 2.5b.

CHAPTER 4

PROGRAM 3 - STRUCTURES

4.1 Project Number: 3.1 Title: Loading of Structures

Sponsor: AFSWP-ONR Performing Agency: Stanford Research Institute

Project Officer: Mr. L. M. Swift

4.1.1 Objective

To investigate the loading pattern (as a function of time) imposed upon a parallelopiped.

4.1.2 Procedure

This project will participate only in Koon. The project effort will be confined to Uncle Island. The test structure will be a 6'x12'x6' concrete cubicle with the 12 ft dimension normal to the line from ground zero. The distance from ground zero to test structure will be 9507 ft. The front, roof, rear, and one side of the structure will be instrumented for imposed overpressure. In addition to the instrumentation on the structure, free field pressures will be measured at ground surface stations in front of the structure and at ground and tower stations along a line offset to the south of the structure. It is also proposed to make $Q(\frac{1}{2}\rho u^2)$ measurements along this line.

4.1.3 Remarks

This project is designed to extend the data obtained on similar test structures in Project 3.1 of UPSHOT-KNOTHOLE.

4.2 Project Number: 3.2 Title: Crater Survey and Evaluation

Sponsor: AFSWP-ONR Performing Agency: SRI*

Project Officer: Dr. R. B. Vaile, Jr. Army Map Service

*Coordinates all agencies.

4.2.1 Objective

To obtain dimensional data on craters formed by nuclear detonations for use in developing a generalized "theoretical-empirical" means of predicting crater dimensions.

4.2.2 Procedure

Two measuring techniques will be used for this project. These are:

a. Photo Interpretation -

The Army Map Service will employ stereoscopic photogrammetry to map the craters. By this technique it is expected to obtain the crater diameters for Bravo, Union, Echo and Koon and some detail of the crater lips for Bravo, Echo, and Koon.

b. Fathometer Traverse -

An LCU equipped with a MK-6 fathometer will traverse the craters formed at Bravo, Union, and Koon. The position of the LCU will be correlated with the fathometer soundings by use of "Ray dist."

4.2.3 Remarks

a. Predicted crater diameters and apparent crater depths are as follows:

Shot	Diameter	Depth
Bravo	4000'	180'
Union	9000'	80'
Echo	1350'	70'
Koon	2000'	100'

b. Incidental to its participation in this project the Army Map Service will prepare maps of Eniwetok and Bikini Atolls.

4.3 Project Number: 3.3 Title: Blast Effects on Tree Stands

Sponsor: AFSWP- U. S. Department of Agriculture

Performing Agency: U. S. Department of Agriculture (Forest Service)

Project Officer: Mr. Wallace Fons

4.3.1 Objective

To determine the rate of attenuation of the shock wave in a forest stand.

To determine blast damage to trees where effects are influenced by their location in a stand.

To obtain individual tree breakage data in a region of long positive phase durations in order to substantiate the basis for breakage and blow down predictions.

4.3.2 Procedure

This project will participate in the Koon shot only. The project effort will be confined to Uncle Island. There will be no instrumentation employing electronics. A tree stand (approximately 1000' x 1000') will be selected on Uncle Island by ground survey. Pressures within this stand will be obtained from Project 1.2b which will place eight self recording pressure gages in the stand. $Q(\frac{1}{2}\rho u^2)$ forces will be deduced from theory and measurements made at other locations by Project 1.3. Snubbers (wire from center of pressure on tree stem to a friction grip on a ground stake) will be installed on selected trees for measurements of maximum deflection. A few isolated trees in cleared areas outside the stand will be instrumented and observed for comparison with those within the stand. Static breakage tests will be performed on trees which are typical of those within the stand. There will be extensive pre- and post-shot still photography of the tree stand.

4.3.3 Remarks

This will be the first observation of the effects of a nuclear detonation on a natural tree stand. From previous experimental work, culminated by observation and instrumentation on an artificial tree stand in UPSHOT-KNOTHOLE, a tree breakage prediction system is in preparation (by U. S. Forest Service) presenting 90 per cent (severe damage) and 10 per cent (light damage) levels of probability. Project 3.3 will serve as a test of this prediction theory.

CHAPTER 5

PROGRAM 6 - SERVICE EQUIPMENT AND TECHNIQUES

5.1 Project Number: 6.1 Title: Test of Interim IBDA Procedures for High Yield Weapons

Sponsor: USAF Performing Agency: Strategic Air Command

Project Officer:
Lt. Colonel Gerald Keeling, USAF

5.1.1 Objective

To determine by tests under field conditions current IBDA capabilities for high yield weapons.

5.1.2 Procedure

Strategic Air Command (SAC) aircraft with standard combat radar equipment will fly in positions simulating strike and support aircraft formations but will be offset from a straight fly over consistent with safe slant ranges from ground zero. Three B-50 aircraft will participate in each shot with the possible exception of Echo. The aircraft will operate out of Guam and will coordinate all flight patterns with Task Group 7.4.

Upon completion of this mission the SAC aircraft will return to Guam where the data collected will be processed and analyzed in accordance with SAC Reporting Guide and other standard operating procedures (SOP) for IBDA.

5.1.3 Remarks

The SAC interim IBDA systems and techniques employed during UPSHOT-KNOTHOLE proved to be reliable under usual conditions and promising for all-weather conditions provided certain operating calibration procedures on current SAC radar equipment are referred. This additional participation in CASTLE should assist in the final adoption of optimum operating procedures for the interim IBDA system.

5.2 Project Number: 6.2a Title: Blast, Gust, and Thermal Effects on a Manned B-36

Sponsor: USAF Performing Agency: Wright Air Development Center

Project Officer: Col. W. A. Anderson, USAF

5.2.1 Objective

To develop a theory whereby the blast, gust, and thermal effects on aircraft in flight can be predicted with acceptable accuracy. To this end, a manned B-36 participated in IVY and UPSHOT-KNOTHOLE. The same B-36 airplane will participate in CASTLE to:

a. Proof test the theory

b. Obtain additional data to eliminate areas of uncertainty.

5.2.2 Procedure

The present instrumentation in the B-36 utilized during IVY and UPSHOT-KNOTHOLE will be reconditioned. Additional instrumentation will be added in areas of uncertainty, i.e., empennage and fuselage. The aircraft will be flown and maintained by SAC and will be instrumented and positioned by WADC. Participation in Shots Nectar, Union, Romeo, Koon, and Yankee is planned. Flight plans will be coordinated with Task Group 7.4. The aircraft and project will be based on Eniwetok (Fred).

A straight fly-over pattern is desired; however safety requirements may dictate a pattern similar to the IVY pattern (time and distance). In any case, the aircraft will be on an outbound radial heading at time zero.

5.3 Project Number: 6.2b Title: Thermal Effects on B-47 Aircraft

Sponsor: USAF Performing Agency: Wright Air Development Center

Project Officer: Col. W. A. Anderson, USAF

5.3.1 Objective

To investigate, in flight, the response of the B-47 aircraft structure to the thermal effects of nuclear weapons. This information will be used to determine the delivery capability of the B-47 and will also be extrapolated for determining the B-52 capabilities, as well as to assist in positioning the latter aircraft in future tests. The data gathered on CASTLE will further verify and supplement data obtained on IVY.

5.3.2 Procedure

The B-47 will be based on Eniwetok Island. It will be instrumented by Wright Air Development Center contractors and Naval Radiological Defense Laboratory. The WADC will furnish the flight crew, Strategic Air Command will furnish the maintenance. Flight plans will be coordinated with Task Group 7.4 after WADC has determined the desired positioning. Participation in Shots Bravo, Yankee, Nectar, and Koon is planned.

A straight fly-over pattern is desired. However, safety requirements may dictate a pattern similar to the IVY pattern (time and distance). In any case, the aircraft will be on a radial outbound heading at T_o.

5.4 Project Number: 6.4 Title: Proof Testing of AW Ship Countermeasures

Sponsor: USN Performing Agency: BuShips Naval Radiological Defense Laboratory

Project Officer: CAPT G. G. Molumphy, USN

5.4.1 Objective

To proof-test existing and proposed radiological countermeasures for naval ships and aircraft not in flight against surface and sub-surface atomic attack; to gain sufficient basic knowledge of the radiological situation in ships and aircraft not in flight to permit proper countermeasures development; and to gain such information for protection of harbor targets as is appropriate within test conditions and without jeopardizing primary test objectives.

5.4.2 Procedure

Project TRANSIT is composed of two specially altered and instrumented drone Liberty ships, a control P2V5 aircraft, a fleet tug for escort, tow and decontamination operation and a post-test operation space at Eniwetok. One ship will be equipped with all prospective AW protective devices and fully instrumented; this ship will be identified as TRANSIT ABLE. The second ship, designated as TRANSIT BAKER, will be completely unprotected, but instrumented the same as the protected ship. TRANSIT BAKER will also incorporate special ventilation tests. Skeleton crews and instrumentation parties will be removed from the drone ships prior to each shot at approximately H-3 hr by fleet tugs, sea conditions permitting, or by helicopters, at which time complete radio control of the test vehicles will be initiated. The test ships under radio control will then steam to a rendezvous position some 10 to 20 miles downwind from the shot site, depending on the wind velocity, and at a predesignated time somewhere between H plus 1 or 2 hr will steam in a straight line toward ground

zero to a point within a few miles of the atoll at which time they will veer off toward a designated rendezvous with the recovery tugs. Contact by recovery tugs is expected to be in the neighborhood of H plus 4 to 6 hours. After each test it is planned to board the protected ship and steam her to Eniwetok, radiation levels permitting. In event of excessive radiation levels both ships will be recovered by tugs after each shot participated in and towed to Eniwetok for post-test operations. Post-test operations will consist of:

a. Detailed radiological survey of each ship both above and below decks.

b. Instrument recovery.

c. Removal of test aircraft and test panels for survey purposes and decontamination studies.

d. Tactical decontamination of each ship, both above and below decks.

e. Final preparation of each ship for participation in the next test.

5.4.3 Remarks

This project will be closely coordinated with Projects 2.5 and 6.5. Present plans include participation in Shots Bravo, Union, Koon, and Yankee.

5.5 Project Number: 6.5 Title: Decontamination and Protection

Sponsor: USA Performing Agency: CRL
Army Chemical Center

Project Officer: Mr. J. G. Maloney

5.5.1 Objective

To determine the contamination and decontamination characteristics of representative harbor area construction surfaces and coatings when exposed to fall-out from surface detonations over shallow water and land. Particular interest is concentrated on the wet contaminating particles since no field studies have been conducted under these conditions.

5.5.2 Procedure

A set of 14 construction material panels, 4 ft square, will be mounted on each drone liberty ship of Project 6.4 which will operate in the heavy fall-out areas of Shots Bravo, Union, Koon, and Yankee. When the ships are returned to Eniwetok between shots the panels will be removed to Parry Island for various types of decontamination procedures with intermittent radiation level readings being taken for analysis to determine applicability of the different decontamination

procedures. Project 6.5 will also perform operational procedures on the Project 2.5b fall-out collectors aboard the Liberty ships.

5.5.3 Remarks

This project will operate in close coordination with 6.4. Fabrication and installation of test panels mounting racks will be accomplished by BuShips. Use of special facilities on Parry Island will be in conjunction with Project 6.4. This project will also participate in 6.4 ventilation system studies aboard the Liberty ships.

5.6 Project Number: 6.6 Title: Ionosphere Studies

Sponsor: USA Performing Agency: Evans Signal Laboratory

Project Officer: Capt Andrew Giroux, USA

5.6.1 Objective

To further investigate an ionospheric phenomenon recorded during IVY, which had not previously been observed by ionospheric studies on GREENHOUSE, BUSTER, and TUMBLER-SNAPPER. This phenomenon was the apparent increase in height of the F-2 layer and associated effects, beginning about the time the sonic wave from the blast would have reached the ionosphere. It is desirable to establish a cause and effect relationship for this phenomenon. The effects on the ionosphere of atomic detonations have possible application in long range detection and ionospheric research as well as predictions of radio transmission disruptions.

5.6.2 Procedure

A repetition of the IVY experiment will be conducted with some extension. Recorders will be operated at sites located on opposite sides of the blast for the Bikini shots, and on the same side but at different distances, for the larger Eniwetok shot. For the smaller Eniwetok shot, one recorder will be operated in the vicinity of the test site, and one at some distance from the site. In addition sonic equipment, capable of responding to periods as long as 10 min. will be operated in order to correlate sonic and ionospheric effects.

5.6.3 Remarks

The final results will be in the form of photographic film records of oscilloscope traces. The special camera used is an integral part of the ionosphere recorder.

CHAPTER 6

PROGRAM 7 - LONG RANGE DETECTION

6.1 Project Number: 7.1 Title: Electromagnetic Radiation Calibration

Sponsor: USAF

Project Officer: Mr. J. A. Crocker

6.1.1 Objective

To determine the characteristics of the electromagnetic pulses from nuclear detonations as a function of distance from the source.

6.1.2 Procedure

Equipment will be trailer mounted and located in an area of low background noise; at the present, location is planned on Elmer. Fast sweep oscilloscopes with still and strip film data recording will cover the range of frequencies emitted. Additional stations outside the Task Force area will be established along northerly and easterly azimuths to obtain supplemental data relating to attenuation.

6.1.3 Remarks

One trailer will be located on Elmer and will require positioning and utilities. In addition, a tent or other suitable office facility has been requested. Radio time notifications planned for Elmer will be utilized. Telegraphic advices of changes in schedule and notification that the detonations have occurred are required to specified addressees. After-the-fact knowledge of world time of detonation, accurate to the nearest millisecond, will be required. World time is defined herein as receipt of radio signals from WWVH.

6.2 Project Number: 7.2 Title: Detection of Airborne Low Frequency Sound from Atomic Explosions

Sponsor: USAF

Project Officer: Mr. G. B. Olmsted

6.2.1 Objective

To determine at long range the period, amplitude, velocity, and azimuth of acoustic waves from atomic explosions.

6.2.2 Procedure

Generally, the method which will be used consists of a microphone capable of detecting slight variations in atmospheric pressures (low frequency sound) caused by atomic explosions thousands of miles away. By placing several microphones in a pattern, and recording the "sounds" from each separately on a time record, it can be seen that an azimuth, or the direction of the explosion, can be determined. If several such stations, great distances apart, each get an azimuth on the explosion, its position can be plotted by triangulation. Further, period, velocity, and amplitude can be determined. Stations will be located within and without the United States.

6.3 Project Number: 7.4 Title: Calibration Analysis of A-Bomb Debris

Sponsor: USAF

Project Officer: Mr. W. Singlevich

6.3.1 Objective

To obtain data based on physical, chemical, and radiochemical analysis of gaseous and particulate material associated with airborne atomic debris following the explosion of an atomic weapon. These data are used as calibration or reference points in evaluating similar data obtained by analysis of atomic debris whose origin resulted from nuclear explosions of unknown origin, composition, and design.

6.3.2 Procedure

Particulate atomic bomb debris will be collected under Los Alamos Scientific Laboratory (LASL) Project 11.2. Division of these particulate samples is made by agreement.
All sampling aircraft will also be equipped with gas sampling devices which are engineered and installed, by WADC and Air Materiel Command (AMC), respectively. Division of gas samples will be

made by agreement among LASL, and UCRL, [redacted] Ultimate analysis of [redacted] particulate and gaseous samples will be performed by various contracting agencies and by agreement with certain Atomic Energy Commission (AEC) installations under the technical direction [redacted] The necessary miscellaneous samples, such as lagoon water sampler, ground filter sampler, etc., will be obtained from other agencies performing these functions. Analysis of these latter samples will be correlated with the airborne filter samples.

6.3.3 Remarks

Approximately 1800 sq ft of building space is required on Fred for equipment maintenance and decontamination, sample preparation, and for office space for project personnel. Lights, running water, telephones, furniture, and a small amount of electrical power are required in this structure. Vehicles and labor assistance from Task Group 7.4 will be required to remove the samples.

CHAPTER 7

PROGRAM 9 - SUPPORTING MEASUREMENTS

7.1 Project Number: 9.1 Title: Cloud Photography

Sponsor: AFSWP Performing Agency: EG&G LML

Project Officer: Lt. Col. Jack G. James, USAF

7.1.1 Objective

To record photographically cloud formation phenomena in order to supply data which may be used in studying the high yield bomb delivery problem and the correlation of fall-out studies in relation to cloud drift. Aerial and ground photography will be employed in order to determine the spatial dimensions and location of the atomic cloud as functions of time. The accuracy of these determinations is expected to be approximately 10 per cent from time zero until the cloud attains its maximum height and approximately 25 per cent thereafter.

7.1.2 Procedure

One RB-36 and three C-54 aircraft will perform the aerial photography utilizing gyro stabilized cameras. Synchronized readings for clock timing, azimuth and camera tilt will be recorded on each negative. The RB-36 aircraft will operate above 30,000 ft for approximately 10 min. after zero time. The C-54 aircraft will operate at altitudes of 10,000 to 14,000 ft depending on local cloud cover and will continue photography operations until the cloud dissipates.

In addition to the aerial photography, motion picture cameras will be operated from ground stations in order to record the initial phases of the cloud formation. These cameras will shoot 100 frames/sec. for the first 15 sec. and then reduce to one frame/sec. for 45 min.