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LOS ALAMOS SCIENTIFIC LABORATORY
OF THE UNIVERSITY OF CALIFORNIA ○ LOS ALAMOS NEW MEXICO

DELETED VERSION ONLY

REPORT OF THE COMMANDER, TASK GROUP 7.1
OPERATION REDWING

CIRCULATION LIMITED

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WT-1359(Prelim.)

WEAPON DATA

[redacted]

LOS ALAMOS SCIENTIFIC LABORATORY

OF THE UNIVERSITY OF CALIFORNIA LOS ALAMOS NEW MEXICO

REPORT WRITTEN: August 1956

REPORT DISTRIBUTED: March 15, 1957

REPORT OF THE COMMANDER, TASK GROUP 7.1
OPERATION REDWING

Contract W-7405-ENG. 36 with the U. S. Atomic Energy Commission

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The basic planning for the activities of Task Group 7.1 in Operation Redwing was done under the direction of William E. Ogle, Deputy Commander for Scientific Matters, Joint Task Force Seven, who until January of 1956 was Task Group Commander, and it is to him that credit should be given for the concept and major policy determinations. This report is a description of the way in which his plans were carried out.

Like the Operation itself, this report is the work of many people. It was assembled by the Task Group staff under the direction of Duncan Curry, Jr., Deputy for Administration, Task Group 7.1, from data provided by Programs, Projects, Task Units, and Staff Sections. A list of contributing authors is given below.

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* In order to emphasize operational conclusions and recommendations, sections where they appear have been marked with an asterisk.

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ILLUSTRATIONS

* In order to emphasize operational conclusions and recommendations, sections where they appear have been marked with an asterisk.

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TABLES

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ABBREVIATIONS

AEC	– Atomic Energy Commission
AFB	– Air Force Base
AFCRC	– Air Force Cambridge Research Center
AFOAT	– Air Force Office for Atomic Energy
AFSWC	– Air Force Special Weapons Center
AFSWP	– Armed Forces Special Weapons Project
AGC	– amphibious force flagship
ANL	– Argonne National Laboratory
APD	– high speed transport
ARDC	– Air Research and Development Command
ARSD	– salvage lifting vessels
ATF	– ocean tug, fleet
AV	– seaplane tender
AVR	– crash boat
BRL	– Ballistic Research Laboratories
BuAer	– Bureau of Aeronautics, U. S. Navy
BuShips	– Bureau of Ships, U. S. Navy
CFRES	– California Forest and Range Experiment Station
CINCPAC	– Commander-in-Chief, Pacific
CNO	– Chief of Naval Operations
CONUS	– Continental United States
CRL	– Chemical and Radiological Laboratories
CVE	– aircraft carriers, escort
DBM	– Division of Biology and Medicine, AEC
DD	– destroyer
DE	– escort vessel
DOD	– Department of Defense
D-T	– deuterium-tritium
DUKW	– amphibious truck - 2-1/2 ton capacity
EG&G	– Edgerton, Germeshausen & Grier, Inc.
ERDL	– Engineer Research and Development Laboratory
ESL	– Evans Signal Laboratory
FA	– forward area
GZ	– ground zero
HE	– high explosive
HMR	– Marine Helicopter Squadron

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H&N	– Holmes and Narver
IBDA	– indirect bomb damage assessment
ICC	– Interstate Commerce Commission
ICBM	– intercontinental ballistic missile
JCS	– Joint Chiefs of Staff
JTF	– joint task force
kt	– kiloton
LASL	– Los Alamos Scientific Laboratory
LCM	– landing craft, 30 ton capacity
LCPL	– personnel craft - 36 passenger
LCPR	– personnel craft with ramp - 36 passenger
LCU	– landing craft, utility - 150 ton capacity
LORAN	– long range navigation system
LSD	– landing ship, dock
LST	– landing ship, tank
L/T	– long ton
MATS	– Military Air Transport Service
Mc	– megacycle
MP	– military police
mr/hr	– milliroentgens per hour
MSL	– mean sea level
MSTS	– Military Sea Transport Service
Mt	– megaton
M/T	– measurement ton
MWB	– motor whale boat
NOL	– Naval Ordnance Laboratory
NRDL	– Naval Radiological Defense Laboratory
NRL	– Naval Research Laboratory
NTS	– Nevada Test Site
NYOO	– New York Operations Office, AEC
Op Plan	– operation plan
PacDivMats	– Pacific Division, Military Air Transport Service
PPG	– Pacific Proving Ground
psi	– pounds per square inch
Raydist	– navigation system
r/hr	– roentgens per hour
RSSU	– Radiological Safety Support Unit

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SAM	– Air Force School of Aviation Medicine
SAR	– Search and Rescue
SC	– Sandia Corporation
SFOO	– Santa Fe Operations Office, AEC
SIO	– Scripps Institution of Oceanography
SOP	– standing operating procedure
TAP	– transport (MSTS)
TCA	– transporation control agent
telecon	– teleconference
TG	– task group
TSU	– Test Services Unit
TU	– task unit
UCRL	– University of California Radiation Laboratory
UHF	– ultra high frequency
USNS	– United States Naval Service
UWFL	– University of Washington Applied Fisheries Laboratory
VHF	– very high frequency
WADC	– Wright Air Development Center
WETD	– Weapons Effects Test Division, Field Command, AFSWP
WWVH	– world wide NBS radio time signal
YAG	– auxiliary, miscellaneous (Liberty Ship)
YC	– open lighter
YCV	– aircraft transportation lighter
YFN	– covered lighter (non-self-propelled)
YFNB	– covered lighter, large
ZI	– zone of interior

[redacted]

[redacted]

CHAPTER 1

OBJECTIVES, DEVICES, AND WEAPONS

1.1 LOS ALAMOS SCIENTIFIC LABORATORY*

1.1.1 General Objectives

In Operation Redwing, ten devices designed by LASL were fired. Some of these were proof tests of devices suitable as weapons for the national stockpile, whereas others were experimental devices of a forward-looking nature which could be weaponized if their performance proved sufficiently attractive. On each of these shots diagnostic experiments were made to evaluate their performance if they worked properly, or to determine the difficulty if they did not. In addition, many experiments were undertaken to obtain more precise understanding of the factors and physical properties which underlie nuclear weapon design or the effects that they produce.

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The general emphasis of the program was on [redacted] of lower yield than the Castle devices. These included both Class D weapons for external carriage on fighter planes and for missiles, and Class C weapons for medium-weight bombers. It also included the testing of DELETED

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*Note added in proof. Yield figures given are those available in Dec. 1956.

[redacted]

AFWL/HC

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[redacted]

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For classifi[redacted]on and access reasons, only a general description of the devices fired will be given in this report. Detailed information on the devices and their performance may be found in reports of LASL.

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of the total, so that very little fallout was observed.

1.2 UNIVERSITY OF CALIFORNIA RADIATION LABORATORY

1.2.1 General Objectives

The Livermore Laboratory tested and obtained diagnostic measurements on seven devices during Operation Redwing. Three of the devices were

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1.3 DEPARTMENT OF DEFENSE

The Joint Chiefs of Staff on July 8, 1955, approved the incorporation of a military effects program in Operation Redwing, including a special effects test of an air-delivered thermonuclear weapon of approximately [redacted] yield; and the Secretary of Defense was requested to seek Presidential approval for the expenditure of a [redacted] complete with nuclear components, from the national stockpile for this specific purpose. DELETED

The Joint Chiefs of Staff on April 24, 1953, approved the following policy relative to field tests of atomic devices and weapons:

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"For tests involving nuclear detonations participated in or conducted by agencies of the Government of the United States, the Chief, Armed Forces Special Weapons Project, will exercise within any task force organization, technical direction of weapons effects tests of primary concern to the Armed Forces and the weapons effects phases of developmental or other tests of atomic weapons."

Under this authority the Chief, AFSWP, augmented the responsibilities of the Commanding General, Field Command, AFSWP, to include the responsibilities of the Chief, AFSWP, arising from the preparational, operational and postoperational phases of the weapon effects tests of primary concern to the Armed Forces and weapon effects phases of developmental and other tests of atomic weapons outside the continental United States. Accordingly, the Chief, AFSWP, having completed the preliminary phase of Operation Redwing, assigned to the Commander, Field Command, AFSWP, the mission of conducting the preparational, operational and postoperational phases of these tests.

The Director, WFTD, a staff agency under the jurisdiction of the Commander, Field Command, AFSWP, was assigned functions associated with the detailed planning and field implementation of the DOD Weapons Effects Programs, Operation Redwing. The joint AEC-DOD scientific organization, Task Group 7.1, was charged with conducting the scientific tests including the DOD Weapons Effects Programs during the operational phase at the PPG. The approved military weapon effects tests projects in Programs 1 through 9 inclusive (except 7, not used) for Operation Redwing are outlined in Chapter 2.

Within the established funds, the Commander JTF 7 could modify the projects as required by operational necessity. Within similar limitations, the Commander, Field Command, AFSWP, could modify the projects as required by technical necessity.

Colonel L. L. Woodward, USAF, was assigned as the Technical Director to the Directorate of Weapons Effects Tests, Field Command, AFSWP, and acted as the Deputy for DOD to Commander TG 7.1 during this operation. The DOD Weapons Effects Programs 1 through 9 were organized under Task Unit 3 of TG 7.1, which was commanded by Colonel K. D. Coleman, USAF.

Generally, the DOD program participation in Redwing was somewhat greater in magnitude than in Castle. The air drop of a thermonuclear weapon from a B-52 type aircraft flying at 40,000 ft MSL with the weapon detonated at approximately 5000 ft above MSL was of special interest to the military.

The blast program for Redwing was designed to obtain basic blast data from a number of different types of events. Of primary importance was participation on the air drop, on a [redacted] surface burst, and on the

[redacted]

[redacted]

[redacted] surface burst. Basic blast measurements included the use of the rocket smoke-trail photographic technique for determining peak pressure vs distance. Self-recording gages obtained air blast pressure-time and dynamic pressure-time measurements. Parachute-borne canisters measured and telemetered overpressures as a function of time at various ranges in free air from the high-yield air burst. Aerodynamic drag characteristics of various full-scale and model shapes were subjected to transient loadings under full-scale conditions. Crater survey measurements were made for certain surface shots, and the surface water waves generated by large nuclear devices were studied for effects.

One of the primary military results desired from Redwing was the development of criteria and models for calculating the distribution of radioactive fallout material resulting from high-yield nuclear detonations. This information is required in both offensive and defensive military planning. A comprehensive fallout program was designed to document thoroughly the distribution and nature of the fallout. This included measurements of the activity in the initial cloud and stem and the collection of samples of fallout material over vast surface areas. The analysis of all this information produced a valid model for the initial distribution of activity and particle size in the cloud and stem from which fallout patterns can be computed under various conditions with some degree of accuracy.

To add to the present available information on probable target vulnerability, six steel industrial building structures were constructed. Some were located on man-made islands, and were planned to demonstrate the differences in the effect of short and long duration blast loadings on drag-sensitive and on semidrag-sensitive structures. This was a continuation of a project, the first part of which was conducted during Teapot.

Rabbits and monkeys were used as test animals to gain knowledge of thermal effects of atomic weapons on the eye. Information was received on the portions of the time-light intensity curve that will produce retinal burns. This information will be used in the study of blink reflex times and the evaluation of the effectiveness of various filters and mechanical and electrical devices designed for eye protection.

Manned B-47, B-52, B-66, B-57, F-84F, F-101A and A3D-1 type aircraft were instrumented for blast and thermal effects and flown with a predetermined flight path so as to arrive at the proper test positions at the time of burst. Response data were recorded and used to determine aircraft capabilities for the delivery of atomic weapons. K-system radar and Raydist navigational systems were used in positioning the aircraft, and these systems were checked by aerial photography.

Two systems were tested for the purpose of locating ground zero and estimating yields of nuclear explosions. These systems measured at distant observation posts the electromagnetic pulse generated by the explosions. One system used a short base line of approximately 30 miles, and the other a long base line of approximately 1500 miles. Vertically transmitted electromagnetic pulses from 1 to 25 Mc were used to determine the effect of atomic explosions on the height and integrity of the F-layer of the ionosphere.

The principal effort in the thermal program was devoted to the measurement of basic thermal characteristics from stations located on or near the ground. A basic ground station placed close to GZ employed calorimeters and radiometers exposed from an instrument tree above ground, with recording instruments being protected underground. Stations farther removed from GZ contained spectrometers, bolometers, radiometers and calorimeters mounted inside instrument trailers. Some of the parameters determined from the basic thermal measurements were irradiance, total radiant energy, and times to first maximum, minimum, and second maximum. The spectrometers recorded the spectral distribution of radiant energy with distance. A spectrometer station was mounted in a P2V-2 type aircraft to correlate results of surface and airborne transmission and spectrum measurements. Alpha-cellulose paper, wood, and other materials were exposed to thermal radiation in order to determine critical ignition energies. Various types of aircraft sandwich panels were exposed to determine the damage effects of the long thermal pulse associated with high-yield devices.

A technical photography program was conducted to determine photogrammetrically the various parameters of nuclear clouds as a function of time and to establish appropriate scaling relations.

1.4 SANDIA CORPORATION

1.4.1 Program 30, Vulnerability

This program was designed to procure data leading to better knowledge of weapon vulnerability in relation to both blast and close-in thermal damage from the fireball.

The technical objectives of Program 30 were largely realized, although some data were lost owing to electromagnetic transients on Project 30.2. Results of Project 30.1 were extremely encouraging from the standpoint of performance of instrumentation systems within the fireball.

[redacted]

1.4.2 Program 31, Microbarography

Program 31 was designed to obtain wind and temperature data in the ionosphere by means of microbarographic techniques. This data will find application in the ICBM field as well as in long range detection considerations. Program 31 also furnished administrative and supervisory support for various service projects which were performed for LASL, UCRL, and DOD.

Positive microbarographic data were obtained on at least twelve shots. Further evaluation is necessary before statements can be made concerning the full significance of these data.

[redacted]

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CHAPTER 2

SUMMARY OF EXPERIMENTAL PROGRAMS

2.1 TASK UNIT 3, DOD PROGRAMS

2.1.1 Program 1, Blast and Shock

The blast and shock projects on Operation Redwing were planned primarily to obtain data for which there was an urgent need and which could not be obtained at NTS. Participation was planned for specific types of shots in the kiloton yield range as well as the megaton range. DELETED DE[redacted] the air burst of a device [redacted] held the highest priority for Program 1 participation. All five participating projects were seriously affected by the gross positioning error in air zero. It was planned to obtain free-air data vertically above the burst through a nonhomogeneous atmosphere out to an overpressure of 1 psi. The shock-photography method of obtaining pressure-distance data to about 10 psi suffered almost complete loss owing to the placement of air zero far out of the line of sight of the cameras. Laboratory analysis of the film, supplemented with that from other projects, may produce some data. Data were recorded from parachute-borne canisters placed in a vertical array over intended air zero in order to document pressure in the range from about 20 out to 1 psi. However, photography is not able at this time to give the position of the canisters in space, and the method used gives pressure data corresponding to a somewhat higher yield than the yield estimates now assigned to the device. Surface gages, aligned along the reef east of Namu, did not attain a gradation of range from actual air zero. Recorded pressure data are bunched in a range of only 5 to 10 psi. At present there is an anomaly between data recorded by gages located along the reef itself and those on the man-made islands and Yurochi. Drag gages and dynamic-pressure-recording pitot static gages, oriented towards intended GZ, received the blast wave from large incidence angles. Future laboratory analysis and shock tube work may resolve some of the records. DELETED

Next in priority was [redacted] land-surface burst. Both electronic and self-recording pressure gages obtained excellent, correlatable data. Observed was a precursor-type wave of limited extent – dying out at the close range of about 45 psi. Direct shock photography from the Mack tower failed. However, shock photography of the rocket trails from cameras on Runit should give pressure-distance data vertically over the burst and at horizontal range. Dragforce gages of model shapes recorded good loading data at two ranges in the clean Mach region. These models will be studied in the shock tube, data from which will be compared with that obtained on the shot. It is hoped that a correlation can be established to determine criteria for estimating or predicting drag forces on different targets by laboratory experiments. TED

DE [redacted] a surface burst in the [redacted] was instrumented with self-recording gages to obtain basic blast data on the ground surface and, with shock photography, to obtain pressure-distance data in the free air and along the water surface. The blast gages were placed on two lines from GZ, 180° apart, towards Eniirikku and down the Eninman complex. At present there seems to be a difference in the pressure-distance curve plotted for each line. Further study may reveal a reason for this, or it may turn out to be no more than normal scatter of the data. The pressure-time records from both blast lines show distorted wave shapes similar to those associated with a precursor. Excellent photography of both high- and low-level rockets should give good data vertically over the burst and at horizontal range over a water surface. A study of blast diffraction was made on a concrete cubical target, instrumented with flush-mounted gages on the front and side walls and on the top.

DE [redacted] was instrumented with surface gages to document the propagation of a precursor shock over a vegetated and over a cleared surface. The precursor was observed to be less severe over the vegetated surface than over the cleared area, showing later arrival times, higher overpressures, and lower dynamic pressures. ETED

The [redacted] was instrumented with self-recording surface gages to obtain basic blast data. Data were recorded which are expected, upon further analysis, to validate the height-of-burst curves for a fractional-kiloton device.

Crater measurements were made on all ground-surface shots. Measurements consisted of aerial photography to obtain crater diameter by means of stereoptic analysis and lead-line sounding surveys for depth profile. Preliminary results give crater size as follows: (1) [redacted] (2) [redacted] and

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[redacted]

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[redacted]

(3) [redacted] (easterly along the island). In addition, [redacted] a tower shot having a [redacted] yield, was surveyed for crater size. The results are not available at this time.

Jeeps were exposed on three events in an investigation of the response of drag-sensitive targets. Good results were obtained and will supplement the damage-prediction curves by including the blast conditions resulting from these particular types of shots.

Water-wave studies were made on the megaton-range devices. Instruments were placed to document the Bikini Lagoon waves, and at distant locations (Ailinginae and Eniwetok Atolls, and Wake and Johnston Islands) to record the long-period ocean waves. Microbarographs were operated at Wake and Johnston to investigate the possibility that these long-period waves are air-coupled. Considerable inundation photography was taken. Wave action from [redacted] in the Bikini Lagoon was less than expected, since the crater did not breach into the ocean or the deep channel and, apparently, there was unexpectedly great convergence and dissipation onto the near islands of the Eninman complex.

These results, based on preliminary analysis in the field, must be considered as tentative. Blast records will be re-examined and reanalyzed at the laboratories. Photographic analysis cannot be accomplished at the proving grounds and must await laboratory study.

However, a general statement of the accomplishment of this program can be made: With the exception of the [redacted] in which the drop error affected the results of those projects participating, the objectives of the Program 1 projects were carried out. On all events a high percentage of instrumentation successfully operated at and through shot time, recording reliable data. Blast data have been obtained which will supplement existing information. These data will extend presently established curves, and will strengthen the knowledge of blast phenomena in areas heretofore only meagerly instrumented or not documented at all.

2.1.2 Program 2, Nuclear Radiation and Effects

Program 2 was concerned with the distribution of radioactivity in the cloud resulting from nuclear explosions and the subsequent fallout of material from the cloud and with various nuclear radiation effects.

Gamma ion chambers were fired into the cloud by high-speed rockets and the resulting gamma-rate data were telemetered to recording stations. Preliminary analysis indicates there is comparatively little activity in the stem region and that cloud activity is in the lower portion of the cloud.

Destroyer escorts and the M/V Horizon were used to delineate the fallout pattern over water and to study the nature of the transport and

[redacted]

dilution of radioactive fallout material in the ocean and Bikini Lagoon. The difficult job of deep-mooring 14 to 17 skiffs in the open ocean to the north of Bikini Atoll was accomplished. The skiff stations were used for fallout collection.

Collecting stations were instrumented on islands of Bikini Atoll, two YFNB's and three rafts anchored in the lagoon, and on three manned ships. Samples collected and studied from early times with respect to gamma and beta activity were also analyzed for chemical and radiochemical composition, and determinations were made of certain of their physical properties, including distribution of particle size. It is certain that this effort will provide a basis for the improvement of theories describing the formation, dispersion, and over-all characteristics of fallout.

Four P2V-5 aircraft were used to survey gamma radiation from fallout-contaminated ocean areas. The data were used to direct survey vessels and for determining contours in producing land-equivalent fallout patterns.

Fallout samples collected from a number of land stations were subjected to radiophysical and radiochemical measurements to determine better the characteristics of in-close fallout material. A gamma-rate meter suspended from a helicopter was successfully used to measure dose-rate contours. A few stations were instrumented in an effort to evaluate the roll of the base surge in transport of radioactive material.

Five B-57B aircraft were used to collect data on radiation dose and aircraft contamination resulting from early penetrations into the clouds and stems of thermonuclear detonations. Twenty-seven penetrations of six radiation clouds from [redacted] detonations were made at times ranging from 20 to 78 min after detonation and at altitudes from 20,000 to 50,000 ft. The dose rate in the stem was found to be less than the dose rate in the cloud by a factor of 5 to 10. Important information for operational usage was obtained.

Sufficient data on gamma exposure as a function of distance from the point of detonation of various high-yield devices were obtained so that it will eventually be possible to conclude dosage contours and the validity of scaling laws.

A reasonable picture of the initial and the residual gamma intensities as a function of time after the detonation of high-yield devices should be obtained upon postoperational data analysis.

Several types of building surfaces were exposed at various orientations to fallout on the bows of two of the collection ships. Contamination on all events was so low that it was not possible to make good decontamination studies. Surfaces exposed to high fallout fields from [redacted] ended with very little contamination; however, this in itself may give data for the radiological recovery of military installations constructed from such

[redacted]

materials and subjected to fallout from this type of burst.

Results should be forthcoming on the neutron flux and energy spectrum as a function of distance and also as a function of angle from the axis of linear-type devices. Full evaluation of field data should advance the state of knowledge as to the type of protection, if any, required for bomb neutrons.

The experimental determination of the radioactivity from a thermonuclear detonation in various typical soil samples was attempted so that a basis could be obtained for predicting soil radioactivity for a nuclear explosion at any location. No data were obtained because of the bombing error on the [redacted]LETED [redacted]

Some data were obtained during ship-shielding studies on the relative radiation dose rates contributed by contamination of the air envelope, water envelope, and the ship's weather surfaces.

Phantoms for depth dose measurements, in conjunction with standard dosimeters worn externally, were exposed on two of the fallout ships. Data, primarily from [redacted] indicate inconsistencies in the dosimeter readings and the biologically significant depth dose.

Investigations on the relative effectiveness and cost of various proposed ship and personnel reclamation methods were made. These studies were primarily conducted in conjunction with the fallout-collection ships.

A proof-test decontamination procedure was conducted on the fallout-collection ships. The procedure consisted of firehosing, hand scrubbing with detergent, and a second firehosing.

Verification was attempted of Washdown Effectiveness as a Shipboard Radiological Countermeasure. The major fallout was encountered during [redacted] and the effectiveness of the washdown system on the contaminant from this shot is being studied.

2.1.3 Program 3, Structural Response

The primary objective of Program 3 and of the single, sizable Project 3.1 comprising the program was to obtain information regarding the effect of the positive-phase length of blast from nuclear weapons on the response of drag-type and semidrag-type structures. The secondary objective of Project 3.1 was to study further the general problem of drag loading and response of structures to blast forces.

This project on Operation Redwing was actually the second part of a two-part study. The first part was conducted during Operation Teapot and involved the response of four typical single-story, steel-frame, industrial buildings to a 22-kt burst, with a relatively short duration positive-phase air blast. The second part involved the response of identical industrial-building structures to an air burst of approximately [redacted] with a relatively

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long duration positive-phase air blast.

Six steel-frame industrial buildings were tested in Operation Redwing: three drag-type structures, 30 ft in height, 40 ft in span, and 40 ft in length; and three semidrag-type structures, 30 ft in height, 40 ft in span, and 80 ft in length. These buildings were located on Yurochi and on three man-made islands along the shallow reef between Yurochi and Namu. The locations from GZ were selected at such range distances (20,500, 24,000, 29,000, and 36,000 ft) as to produce expected degrees of damage ranging from severe to moderate deformation.

Because of a gross bombing error for the airburst of the [redacted] all structures were subjected to pressures higher than expected and suffered complete collapse; therefore, the planned gradation of damage was not achieved.

However, a qualitative demonstration of the effectiveness of the long duration positive blast phase was achieved, since one drag structure collapsed at a lower overpressure than that which an identical structure on Operation Teapot received without collapse. This agrees with theoretical studies which have indicated that, for drag-type targets, as the length of the positive phase of the blast wave increases, the overpressure required to cause a given degree of damage decreases.

Analytical studies will be made of the test results obtained during Redwing and Teapot in an effort to determine the magnitude of the bonus effect of the long duration of the positive phase.

2.1.4 Program 4, Biomedical Effects

The only project in this program was Project 4.1, Chorioretinal Burns, by Air Force School of Aviation Medicine, Randolph Air Force Base, Texas. It was a sequel to a study in 1953 during Operation Upshot-Knothole. In the latter study, weapons of about [redacted] produced burns in the eyes of rabbits at distances of 2 to 42.5 statute miles from GZ. On all studies prior to Operation Redwing, rabbits were the only experimental animals used to evaluate ocular damage. Four cases of accidental human burns were produced at distances of 2 to 10 statute miles.

The present study was designed to furnish additional information on the requirements for protection against retinal burns, utilizing both rabbits and monkeys as experimental animals. The effectiveness of various parts of the power pulse was evaluated as to its ability to produce chorioretinal burns on rabbits and monkeys. This was accomplished by two series of time-fractionating shutters. The first group, open at time zero, closed at increasing intervals of time. The second series, closed at time zero, were open for preselected time increments during the flash. The feasibility of protection by fixed-density optical filters was explored. Two types of developmental protective electronic shutters were field-tested.

Results at yields of [redacted] and [redacted] demonstrated that the blink reflex does not protect against chorioretinal burns. The [redacted] device caused retinal lesions at 8.1 statute miles. The device of [redacted] produced burns at 7.6 statute miles but not as far as 14.4 miles. Burns were not obtained from devices of [redacted] yield at distances of 12.9 and 21.6 miles. The lower effective range of burning at the PPG is attributed to higher atmospheric attenuation from excessive humidity and salt spray from the reefs. Note is made that additional information is needed in order to determine the limiting distance for retinal burns at [redacted] and, especially, higher yields. Both the [redacted] devices produced retinal burns in two of the eight animals exposed to only the first pulse. Both detonations produced burns during the second pulse.

The optical filters tested at near-threshold distances prevented retinal burns. At intermediate distance, filters reduced the incidence and severity of the lesions. The results obtained on protective shutters were inconclusive but can guide future development.

2.1.5 Program 5, Aircraft Structures

Program 5 included nine projects primarily concerned with the determination of the capability to deliver nuclear weapons of six Air Force types of aircraft and one Navy aircraft. One project, sponsored by the AFCRC, provided thermal-measurement support, and another will provide data on the thermal lethality of a nuclear detonation to certain basic missile structures and materials. Secondary objectives of the aircraft projects were to (1) obtain data for basic research and design of future aircraft, and (2) verify or correct the present analytical methods for the prediction of weapon-effect inputs and the resultant responses by the aircraft structure.

A test of an Air Force B-47 successfully obtained data for wing-bending loads from 39 to 91 per cent of design limit and temperatures of up to 550°F on thin-skinned control surfaces by the use of high-absorptivity paints. Some measurements of the effects of side loads on the aircraft structure were also made. Correction of the Weapon Delivery Handbook for the B-47 will be made after data evaluation.

A test of an Air Force B-52 proved its capability to deliver high-yield nuclear weapons. Extensive thermal, overpressure, and gust measurements will result in fairly clear definition of the safe-delivery envelopes. It appears that 0.9 psi will be the limiting overpressure, instead of 0.8 psi as had been predicted prior to the test series. The ability to predict structural

[redacted]

dynamic responses will be considerably improved as a result of data obtained.

A test of an Air Force B-66 proved the delivery capability of this aircraft. Sufficient data were obtained to define safe-delivery envelopes and to improve the ability of the aircraft industry to predict structural dynamic responses.

Testing of an Air Force B-57 proved the capability of this aircraft to deliver nuclear weapons. Gust loads of 20 to 65 per cent of design limit for shear on the wing were measured. Temperatures up to 580°F were obtained on the black, thin-skinned, control-surface tabs. Sufficient data were obtained to define safe-delivery envelopes of the black-painted B-57.

A test of two Air Force F-84F aircraft was successful in the completion of its two-fold objective to (1) determine its capability to deliver nuclear weapons, and (2) provide side-load data for aircraft structure research. Both aircraft measured high inputs, with resultant high aircraft structural responses to assist in defining the safe-delivery envelopes. In addition, the side-load aircraft provided data that were not previously available to the aircraft industry.

A test of an Air Force F-101A was successful in the determination of the capability of the F-101A to deliver nuclear weapons. Measured data included temperature rises up to approximately 500°F and gust responses of 100 per cent of design limit on the wing. The safe-delivery envelopes may be clearly defined from the data obtained in the test series. A supersonic run was made on one event, with the expected thermal inputs and with no overpressure or gust inputs.

Program 5 successfully measured thermal inputs and obtained useful fireball-spectral-distribution information from instrumentation mounted on the B-47, B-52, B-66, and B-57.

A test of a Navy A3D-1 proved the capability of the A3D-1 to deliver nuclear weapons. Data obtained during the test indicate a better capability than had been predicted by theoretical analysis. The A3D-1 was the first Navy aircraft with a high-yield weapon capability to be proven in an actual test series.

Over 100 specimens were mounted on towers and exposed to a fireball environment to determine the thermal lethality of a nuclear detonation to certain basic missile structures and materials. To date, only a few specimens have been recovered. Results of this project must be held in abeyance until the nuclear-radiation fields are low enough to permit recovery.

2.1.6 Program 6, Service Equipment and Techniques

This program, consisting of five projects, had a great amount of activity outside the PPG with stations extending from the Eastern United States to Hawaii and the Western Pacific.

[redacted]

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[redacted]

One project, sponsored by AFCRC, tested two systems for accurately locating GZ from long-range stations by measurement of the electromagnetic pulse generated by the nuclear detonations. Installed were four groups of stations, consisting of one long baseline and one short baseline in the Hawaiian area, one short baseline in the San Francisco area, and one long baseline in the Eastern United States. The short baseline system was tested for ability to determine a hyperbolic line of position by use of the inverse LORAN principle. The long baseline system was tested for the capability of each network to develop two hyperbolic lines of position which would give a fix on GZ. Preliminary results show that under the conditions of this test, where the expected yield and time of detonation are known, the detonation point of nuclear devices in the yield range obtained on Redwing could be accurately located at long ranges by this method. However, there are yet many problems to be solved before a continuous monitoring system is feasible.

In another project, Evans Signal Laboratory and AFCRC investigated the effect of nuclear detonations upon the ionosphere. The results of this purely scientific research effort have no immediate applicable military value. The high-yield detonations produced notable changes upon the ionosphere and upon the absorption of vertically transmitted radio waves, whereas small detonations had no observed effect.

Ultrasonics Corporation tested airborne flush-mounted ferrite-core antennas and phototubes for yield determination. These components are to become a part of a Bhangmeter which is to be required equipment in the weapon system of the supersonic B-58 aircraft. It is considered feasible to use this unit, with some modification, for determining yield from aircraft.

ESL recorded the wave form of the electromagnetic pulse emanating from a nuclear detonation. The laboratory will correlate the wave-form parameters with the height and yield of detonations. This information is to be used as a basis for developing a tactical IBDA system to meet the requirements of the U. S. Army.

The Naval Research Laboratory measured microwave attenuation as a function of time in the ionization region resulting from a nuclear detonation. This information is of value in the development of a telemetering link for transmitting technical information from a high-altitude nuclear detonation.

2.1.7 Program 8, Thermal Effects

The primary objectives of Program 8 were (1) to make basic thermal radiation measurements with which to study the radiating properties of the fireball; (2) to determine, for further laboratory studies, critical ignition energies for cellulosic materials exposed to the relatively-long-duration

[redacted]

[redacted]

thermal pulse of high-yield nuclear devices; (3) to test three types of self-recording thermal indicators; (4) to determine, for primary data and for further laboratory study purposes, the effects of long-duration thermal pulse from high-yield nuclear devices on the strength of various aircraft structural panels of the sandwich type and the temperature-time histories of these panels as a result of their exposure to such radiation; and (5) to measure the spectral distribution of thermal radiation received by an aircraft in flight for comparison with that received at corresponding ground stations.

The above objectives were to be attained by (1) instrumenting stations at varying distances from GZ with calorimeters having varying fields of view and various broad-band filters, radiometers, modulated bolometers, and narrow-band recording spectrometers; (2) exposing specimens of cellulosic materials and fine natural kindling fuels; (3) comparing the data from the thermal indicators under test with that from a previously proven instrument; (4) exposing specimens of sandwich-type structural panels with various skin thicknesses and types and colors of paint while recording their temperature-time histories by means of thermocouples attached to the panels; and (5) flying a narrow-band recording spectrometer in a P2V-2 aircraft operating in the vicinity of nuclear detonations.

In general, Program 8 stations were located adjacent to each other, wherever possible, in order to obtain a maximum amount of information with a minimum of duplication and to simplify operational planning. In addition, most of the stations were designed to be either mobile or prefabricated, resulting in considerable savings in both cost and field construction time.

All of the projects suffered partial or total loss of data on the event of primary interest, the [redacted] due to displaced air zero. Projects participating only on this shot, however, obtained at least partial data, although correction and interpretation of the data may prove to be either extremely difficult or impossible. On the reminder of the shots, good data were obtained by the participating projects, with the following qualifications.

1. Project 8.1 (Basic Thermal Measurements) participated in the shots of [redacted] An anomaly appeared in times-to-second maximum from the two stations for [redacted] however, good data were obtained from this shot as well as from [redacted] It is suspected that this anomaly was due to dust obscuring the station on Runit. Analysis of pointing-camera data may provide the answer.

2. Project 8.3 (Self-Recording Thermal Indicators) was scheduled to participate on the shot [redacted] The radex situation at the project station locations remaining from [redacted] made this impossible. No other small-yield shot was suitable.

3. Project 8.5 (High Resolution Airborne Spectrometry). In addition to the objectives previously stated, this project attempted measurements of

[redacted]

[redacted]

the atmospheric transmission of thermal radiation near shot time over the paths from devices to the aircraft. Statistical runs planned for the [redacted] using an airborne light source were dropped, since no spectrometer data were obtained. For [redacted] the light source failed to operate at zero time; for [redacted] the light source malfunctioned during an interference test on D−2 night and was evacuated on D−1; for [redacted] the light functioned well, and good data were obtained; for [redacted] the aircraft was forced to abort due to engine trouble; and for the [redacted] because of the late hour at which the detonation took place, the transmissometer was saturated by sunlight. A small number of statistical runs were made on the premise that the atmospheric transmission over the paths of interest might be relatively constant. Reduction of the data accumulated on these runs will be accomplished after return to the laboratory, where the instrument will be calibrated. A preliminary examination of the amplitudes received under no-cloud conditions indicates that atmospheric transmission under these conditions was relatively constant.

2.1.8 Program 9, Technical Photography

The objective of Program 9 was to plan, program, and supervise technical and documentation photographic services for all DOD projects participating in the operation. Still photography, in support of projects for illustrating preliminary and final reports, was conducted by TG 7.1, TU-8. A technical motion picture depicting weapon effects tests was assigned to Lookout Mountain Laboratory for location shooting and final production. Technical photography in support of all projects, such as high-speed, time-lapse, and function-of-time photography, was conducted under contract with EG&G.

Project 9.1 was concerned with the photogrammetric determination of various parameters of nuclear clouds as a function of time and the attempt to establish approximate scaling (yield) relations. It was a continuation of a project first attempted on Operation Castle. Photography commenced at zero time and was continuous for as long as the nuclear cloud retained its visible identity, except for turnaround intervals due to the racetrack pattern flown. At stabilization time, sextant readings to determine approximate height of cloud top and base were made by the photo navigators.

Cloud-survey photography was planned for all shots with predicted yields of 30 kt or over. Cursory examination of the film in the field indicated that good data should be obtainable on at least six of nine events. Owing to natural cloud obscuration, negligible results were obtained on one shot and fair results for a limited time on two participations.

[redacted]

35

[redacted]

The operational plan for this project involved the participation of three modified RB-50E aircraft. The airplanes, air crews and ground maintenance echelon were furnished by the 6007th Reconnaissance Group, Far East Air Forces. The planes were equipped with identical camera assemblies on A28 gyro-stabilized mounts located in the aft section of the aircraft. Each mount held an EG&G 70-mm cloud camera, an Eclair 35-mm motion picture camera (shooting one frame every 15 sec), and a GSAP 16-mm motion picture camera loaded with 50 ft of color film. The three aircraft were positioned in the east, west, and south quadrants, respectively, at ranges of 70 nautical miles from GZ on all shots predicted within the kiloton range, and 110 nautical miles for the megaton shots. Starting altitudes at zero time were established at 20,000 ft for all three aircraft. On missions where natural cloud obscuration was encountered, altitudes were altered to 30,000 ft.

Processing of the cloud-survey negatives and final analysis of the photogrammetric data are the responsibility of EG&G. As of this date, pre-preliminary results have been submitted on only four events; however, the Program Director has been advised that analysis is proceeding satisfactorily, and it is anticipated that final results will exceed the Castle experiments, both quantitatively and qualitatively.

In addition to supporting Project 9.1, the three aircraft were equipped for vertical photography. Controlled mosaics were made for a number of shots in support of Project 1.8, Crater Survey.

Requirements were generated in the field for vertical photography of Eniwetok and Bikini Atolls. These were for low-altitude uncontrolled mosaics and proved to be of value to planning operations. As a result of these surveys, other outlying atolls were photographed for current and future planning purposes.

2.2 TASK UNIT 1, LASL PROGRAMS

2.2.1 Introduction

Task Unit 1 carried out experiments to determine the performance of the devices fired; to measure physical quantities of interest in weapon design; and to understand the mechanisms by which the various effects of the devices are produced. For further information on the details of the measurements or the analysis of the data, reference should be made to the Redwing preliminary reports or to the individual project pre-operational and final reports.

2.2.2 Program 10, Yield Measurements by Fireball Hydrodynamics

The J-10 Group of LASL analyzed fireball data obtained by Project 15.1 using several different methods of interpretation to obtain the yield of each device. The results of these methods are given in Table 2.1.

2.2.3 Program 11, Radiochemistry

a. Objectives

1. To determine fission yield of the device.
2. To ascertain when possible what nuclear reactions take place in the device.
3. To study specific aspects of the reactions by radiochemical tracers placed within the device.
4. To determine the production of specific activities in certain of the devices arising from materials included in them by design necessity or by intent.

b. Techniques

1. Samples of radioactive material from the cloud were obtained by manned aircraft equipped with especially designed sampling tanks.
2. Radiochemical analyses were made at LASL to determine the fraction of the bomb included in the sample and the number of fission events. From these data the fission yield was determined.
3. Radiochemical analyses were made of these samples to determine the production of various radioisotopes of interest from the bomb materials or from detector samples placed in or near the device.

c. Results

The results of measurement of fission yields by various methods are included in Table 2.2.

2.2.4 Program 12, External Neutron Measurements

a. Objectives

1. To determine the percentage [redacted] in the boosted devices.
2. To determine the [redacted]

TABLE 2.1

YIELD BY FIREBALL HYDRODYNAMICS
(Yield in kilotons unless designated by Mt for megatons)

Device	Integral Method	Differential Method	Mach Scaling	Bhangmeter	Weighted Value	Recommended Value Including Radio Chemistry*

DELETED

TABLE 2.2

FISSION YIELDS BY RADIOCHEMISTRY AND CAPTURE-TO-FISSION RATIOS
(Yield in kilotons unless designated Mt for megatons)

Device	DELETED	Recommended Yield	c/f

DELETED

b. Techniques

1. Zirconium samples used as threshold detectors were placed at various distances from the device and recovered several days after the detonation. The samples were counted, and the [redacted] leaving the device was determined from the zirconium activation cross section and the neutron transmission coefficients.

2. The [redacted] produced by the device was calculated and the percentage burn and amount of mixing estimated.

3. Nuclear emulsions were exposed to the collimated neutron flux from the device. The neutron flux and energy distribution were determined by track-counting analysis.

4. These data were analyzed to augment the data obtained from the threshold detectors.

c. Results

The results are listed in Table 2.3.

TABLE 2.3

EXTERNAL NEUTRON MEASUREMENTS ON BOOSTED DEVICES

Device	Per Cent Burn	DELETED	Total Number of 14-Mev Neutrons
DELETED	DELETED	DELETED	DELETED

[redacted]

2.2.5 Program 13, Alpha Measurements

a. Objectives

To measure alpha as a function of time for the fission devices or primaries in order to determine whether they worked properly and in case they did not, to aid in diagnosing the trouble.

b. Techniques

1. Alpha detectors, each consisting of a plastic fluor and photocell or photomultiplier combination in a light-tight can, were mounted at appropriate distances from the device to give a wide range in sensitivity. The signals were conducted over coaxial cables shielded against gamma, neutron, and electromagnetic radiation to concrete bunkers. These signals then were displayed on a series of high speed oscilloscopes together with timing frequencies and were recorded by cameras.

2. Data were obtained by measurements made on the film traces and analyzed to give the time history of alpha of the device.

c. Results

The results of the alpha measurements are given in Table 2.4. The alpha record is particularly useful in understanding the behavior of boosted devices.

2.2.6 Program 15, Photo-Physics

2.2.6.1 Diagnostic Photography

a. Objectives

1. To determine yield by fireball photography.
2. To determine yield by Bhangmeter records.
3. To determine symmetry of fireball growth by photography.

b. Techniques

1. Framing cameras were operated from three or more photo towers on each shot to record the fireball history.

2. Measurements of fireball radius as a function of time were made from the films. Empirical scaling was used to obtain an estimate of the yield.

3. The time history of the light intensity was obtained for each device by a photocell-oscilloscope-camera combination to give the time to the

[redacted]

[redacted]

TABLE 2.4

ALPHA MEASUREMENTS ON FISSION DEVICES

DELETED

[redacted]

[redacted]

first light minimum. Empirical scaling was used to obtain an early estimate of the yield.

c. Results

The results are given in Table 2.1.

2.2.6.2 High Speed Photography

a. Objectives

1. To study case reaction and symmetry of early fireball growth.

2. To determine time interval between primary and secondary detonations by observation of Teller light.

3. To make measurements of other parameters of interest in weapon design.

b. Techniques

1. Very high speed streak cameras were used to record the history of the light arising near the bomb in the first few microseconds to give time interval, [redacted] and very early growth of the fireball.

2. Elaborate experiments were devised to measure DELETED

DELETED

c. Results

The results of these experiments are contained in the preliminary shot reports and in the various technical reports made by the groups involved. The time interval measurements were in agreement with those made by other methods.

[redacted]

[redacted]

2.2.7 Program 16, Physics, Electronics, and Reaction History

2.2.7.1 Temperature and Time Interval Measurements

a. Objectives

1. To determine the performance of the [redacted] for the [redacted] by measuring alpha.

2. To measure the temperature history in three zones around the [redacted]

3. To measure the time of shock arrival at five points on the [redacted]

4. To determine the neutron population in the [redacted]

b. Techniques

DELETED

[redacted]

44

[redacted]

5. As a result of the above data, it was decided that the [redacted] DELETED would perform satisfactorily without any design changes.

2.2.7.2 Electromagnetic Measurements

a. Objectives

1. To measure time interval between primary and secondary in two-stage devices.

2. To develop methods for measuring alpha by direct oscilloscope recordings of the electromagnetic radiation in the radio frequency range.

b. Techniques

DELETED

c. Results

The results are given in the Redwing preliminary shot reports.

<u>2.2.8 Program 18, Radiation Measurements in the Optical Region</u>

a. Objectives

DELETED

<u>b. Techniques</u>

DELETED

[redacted]

45

DELETED

2.2.9 Program 19, Nuclear Vulnerability

a. Objective

To determine the damaging effects of neutron heating incurred when a nuclear weapon is exposed to the flux from a nuclear explosion.

b. Technique

DELETED

[redacted]

c. Results

DELETED

2.3 TASK UNIT 2, UCRL PROGRAMS

2.3.1 Program 21, Radiochemistry

a. Experimental Techniques

The main objectives were to determine the fission yields and the relative thermonuclear and fission efficiencies in various regions of the UCRL devices. To this end, samples of the particulate and gaseous debris were collected after each test. Portions of these samples were analyzed in the FA to obtain certain short-lived products and the remainder were flown to Livermore Laboratory for analysis. Recoverable threshold detectors were also utilized to measure emergent fast neutrons in the [redacted] All projects performed successfully and results will be obtained. Preliminary values for the fission yield and uranium reaction products were secured.

b. Results are shown in Table 2.5.

2.3.2 Program 22, Reaction History

2.3.2.1 Project 22.1

a. Experimental Techniques

The gamma rays produced by the nuclear reactions were detected by fluor-photocell detectors. The signals received by these detectors were transmitted by cable to recording oscillographs located in blockhouses where cameras provided a permanent record on film of the signals received. The location and collimation of the detectors varied from test to test, depending upon the information desired and the geometry of the test site.

b. Results

DELETED

1. [redacted] Measurement of Alpha, Nuclear Reaction Time Intervals, and HE Transit Time

The reaction history experiment was successful in measuring the HE transit time and the reaction rate in the [redacted]

[redacted]

[redacted]

TABLE 2.5

PRELIMINARY VALUES FOR THE FISSION YIELD AND URANIUM REACTION PRODUCTS

DELETED

[redacted]

DELETED

DELETED

NOTE: It should be emphasized that these are preliminary results, and that in particular the boost signal data have not been corrected for detector system response characteristics.

2.3.2.2 Project 22.2

a. Experimental Techniques

DELETED

[redacted]

DELETED

2.3.2.3 Project 22.3

a. Experimental Techniques

The technique used for obtaining HE transit time data and S-unit data on this project involved telemetering signals, received from detectors in the immediate neighborhood of the test device by high frequency radiofrequency methods, to a recording station located at a distance of the order of 20 miles from the explosion. The signals were then recorded on oscillographs.

b. Results

DELETED

[redacted]

51

DELETED

2.3.3 Program 23, Diagnostic Photography

2.3.3.1

DELETED

52

b. Instrumentation: Zero Site

DELETED

The results of the measurements may be found in the Redwing preliminary shot report.

[redacted]

2.3.3.2 DELETED

DELETED

All equipment functioned satisfactorily. The transmissometers indicated good visibility, approximately 72 per cent transmission at shot time. The Pirani gages on the three vacuum pipes all indicated better than 10-μ pressure, which is well below the upper limit of 50 μ.

[redacted]

c. Results

The films have been read with an optical comparator and the results may be found in the Redwing preliminary shot report.

2.3.3.3 [redacted]

The only photographic diagnostic done on the Apache event was the standard Xmas tree experiment. The long baseline (9-1/2 miles) from Station 2301 to zero site was a novelty, but results indicate that this was of no significance. Seven cameras were used on the experiment because it was as easy to set up and run seven cameras as two or three. Visibility over the 9-1/2 mile range was good, and all seven cameras produced good records.

2.3.3.4 DELETED

DELETED

2.3.3.5 DELETED

DELETED

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[redacted]

a. Objectives

DELETED

b. Instrumentation: Zero Site

DELETED

c. Instrumentation: Photo Bunker

All of the observations for this experiment were made with Model-100 streaking-image cameras. These were located at Station 1528, some 32,000 ft from the device. No difficulties in the operation of the cameras were encountered. Aside from the loss of film speed in the warm and humid atmosphere of the bunker and alignment problems on a small target at six miles, everything behaved exactly as planned.

d. Preliminary Conclusions

The [redacted] were nonetheless readable. The results of these measurements may be found in the Redwing preliminary shot report.

2.4 TASK UNIT 4, SC PROGRAMS AND PROGRAM 35

2.4.1 Program 30, Vulnerability

2.4.1.1 Project 30.1

DELETED

[redacted]

DELETED

2.4.1.2 Project 30.2

DELETED

DELETED

2.4.2 Program 31, Microbarography

2.4.2.1 Project 31.1

The principal objectives of Project 31.1 were (1) to study the propagation of pressure signals in air from large-scale detonations, and (2) to measure microbarograph signals received through the ozonosphere and ionosphere in tropical regions. These measurements determined the wind direction, speed, and temperatures at extremely high altitudes; such information will help define the environment of the ICBM and other weapons.

Five dual-receiving stations equipped with Wiancko microbarographic equipment were located on several islands from 20 to 250 miles from GZ. Sensing heads of the microbarographs were located about one mile apart on a radial line from the blast in order to determine the angle of pressure incidence.

Preliminary observations of the records reveal that the desired information of wind velocity and temperatures at high altitudes was obtained on 12 shots. A more specific evaluation awaits further study.

[redacted]

2.4.3 Program 35, Radiobiological Survey

Objectives were to measure the amount and distribution of radioactive materials in the fauna and flora on the islands and waters of the PPG and adjacent areas.

1. Pre-test surveys were conducted to determine the level of residual contamination from previous test programs.

2. During the period June 11 to 21, 1956, a marine survey operating on the USS Walton (DE-361) measured the radiation in plankton, water, and fish samples. Fifty-three stations in the area between 11° to 14°N and 159° to 166°E were covered during the 3300-mile cruise. A continuous record of the radiation in the surface water was obtained with a probe. Plankton samples from oblique tows to a depth of 200 meters and water samples from the surface, 25, 50, 75, and 100 meters, indicated radioactivity at each station. Highest radiation readings in plankton and water samples were from stations north of Bikini Atoll. Radiation decreased in amounts around the edge of the survey area.

3. Algae have been collected on the reefs of Eniwetok and the level of radiation, especially the short-lived materials such as I-131 determined.

4. Plankton samples from the deep passage at Eniwetok were obtained on a three-times-a-week schedule. Such samples should be useful in evaluating the drift of radioactive material from Bikini.

5. Foods of the native people of Wotho, Tarawa, Kusaie, Ponape and Ujelang were monitored.

6. Residual radiation in the soil, water, and foods of Rongelap Atoll is being evaluated prior to the return of the native people.

7. Post-test surveys will be conducted of biological contamination and the movement of radioactive material around and out of Eniwetok Lagoon.

8. Rat populations on Engebi will be studied to evaluate numbers of survivors, level of food contamination, and amount and kind of radiation in various tissues of the residual population.

9. Post-test survey of Bikini Atoll will be conducted.

10. An oceanic survey will start on September 1, 1956, at the eastern edge of the mass of radioactive water and proceed to the western edge of the contaminated water mass. This survey will be similar to the one conducted June 11 to 21, 1956, but will extend farther to the west.

[redacted]

[redacted]

CHAPTER 3

GENERAL ACTIVITIES OF TASK GROUP 7.1

3.1 MISSION

The mission of Task Group 7.1 included the following tasks:

1. Position, arm and detonate the weapons and devices.
2. Conduct technical and measurement programs.
3. Keep CJTF 7 informed on test and technical developments affecting the operational plan and military support requirements therefor.
4. Schedule the interatoll and intra-atoll movement of weapons and devices and provide required technical assistance to other task groups in connection with their responsibilities for such movements.
5. Complete the installation and calibration of the weapons and devices and all instruments and test apparatus.
6. Be responsible for the removal of all TG 7.1 personnel and necessary equipment from the shot site danger area.
7. When directed by CJTF 7, evacuate TG 7.1 personnel from Bikini Atoll.
8. Be prepared, upon directive from CJTF 7, to conduct emergency post-shot evacuation of TG 7.1 personnel from Eniwetok Atoll.
9. Provide CJTF 7 with a statement of preliminary test results.
10. Provide nontechnical film coverage.
11. Recommend to CJTF 7 safe positioning for aircraft participating in the scientific programs.
12. Conduct the radiological-safety program.
13. Initiate voice-time broadcasts for all elements of the Task Force.
14. Prepare appropriate technical reports at the conclusion of each shot and the whole operation.

[redacted]

3.2 ORGANIZATION AND COMMAND RELATIONSHIPS

Upon the completion of Operation Castle in May 1954, the headquarters of TG 7.1 returned to J-Division in the Los Alamos Scientific Laboratory and began preparations for the next Nevada operation and for Redwing. During the planning period, the organization of TG 7.1 was changed from that used in Castle to that shown in Fig. 3.1.

The major change involved was the establishment of four Program Task Units embodying the LASL, UCRL, DOD, and Sandia programs, and of eight Support Task Units providing timing, firing, radiological-safety, photographic and assembly services.

The Lookout Mountain photographic unit was assigned to CTG 7.4 and a UCRL documentary photography unit was established. UCRL provided two assembly units, one for large-yield and one for small-yield devices.

The Production (H. L. Johnston) and Cambridge Corporation task units, which existed in Castle, were no longer required and were eliminated.

A Deputy for DOD was added to the organization and was provided by WETD of the Field Command, AFSWP.

During the planning phase, close relationships were maintained with WETD, UCRL, and SC. This was accomplished by frequent exchanges of visits, telephone calls, correspondence, and joint participation in operations at Nevada.

Task Unit 3 (DOD programs) did not come under the operational control of CTG 7.1 until arrival overseas on March 16, 1956.

WETD and UCRL provided staff personnel who were integrated into the J-1, J-3, and J-6 sections. WETD also provided staff personnel for the J-4 section.

In January 1956, because of the illness of Alvin C. Graves, J-Division Leader and Deputy Commander for Scientific Matters JTF 7, W. E. Ogle, Commander TG 7.1, became Acting Deputy Commander for Scientific Matters, JTF 7, and Gaelen L. Felt, Group Leader of J-15 Group, LASL, became Acting Commander TG 7.1. On May 25, 1956, these acting appointments were made permanent.

Since the principal function of JTF 7 and of most of its task groups was to support the scientific effort, much of the over-all planning depended on the plans of TG 7.1. These in turn depended on the weapon development plans of LASL and UCRL; and on the programs developed by AFSWP and other DOD agencies, and by SC, to participate on weapon development shots and on shots required for other purposes.

For the above and other reasons, command relationships differed somewhat from the normal military pattern. Figure 3.2 shows the JTF 7 organization and some of the major command relationships involved.

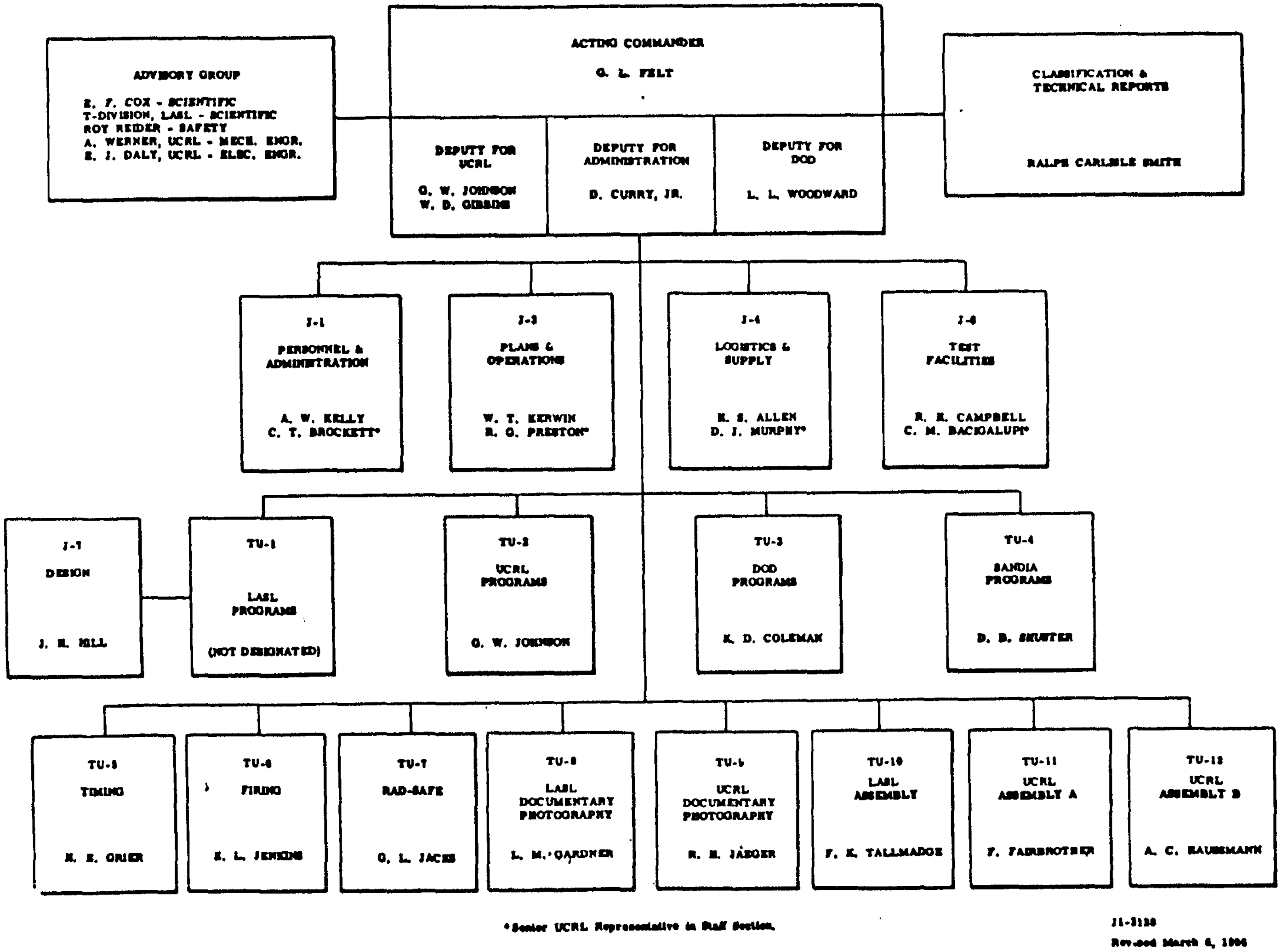

Fig. 3.1 Organization chart - Task Group 7.1.

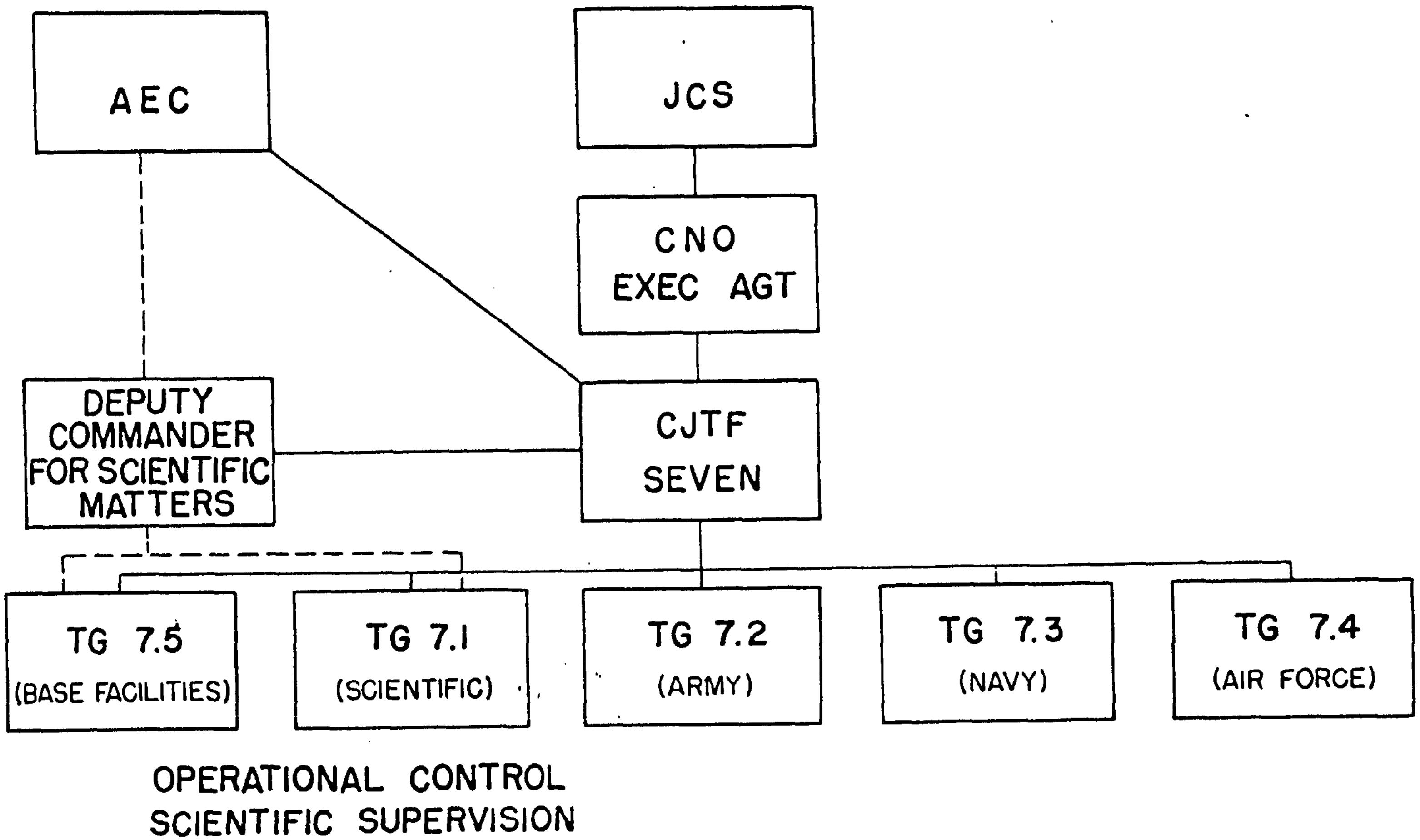

Fig. 3.2 CJTF 7 Organization for Redwing.

The Commander, JTF 7, coordinated the activities of TG 7.1 and TG 7.5 through the Deputy Commander for Scientific Matters, in accordance with existing AEC-CJTF 7 policy agreements. Late changes in the commanders and key personnel of JTF 7, TG 7.1, and TG 7.3 prevented the early establishment of the close relationships at the highest levels which are so important in this kind of operation. However, overseas such relationships were rapidly established. Relations with the Task Force and other Task Groups were cordial and the support received from them was generally excellent.

Table 3.1 lists the key personnel of TG 7.1.

3.3 ADVISORY GROUP

As shown in the organization chart, the Advisory Group consisted of experts in various fields who advised the Task Group Commander and the members of the Task Group and Task Force on technical problems. Seventeen members of T-Division represented the design interests of LASL at the PPG during part of Redwing. Their primary mission was to interpret the results of the [redacted] experiment and to determine the final design of the [redacted] They determined in the field [redacted] A. Werner provided advice in the field on UCRL mechanical engineering problems, and E. J. Daly on UCRL electronic engineering problems. Roy Reider, assisted by other members of the LASL Safety Group, provided advice and supervision in safety matters at both atolls.

3.4 PLANNING AND TRAINING

3.4.1 Programs, Concepts, and Schedules

After the completion of Castle, planned test series were Teapot, scheduled for the late winter and spring of 1955, and Dixie for the fall of 1955, both in Nevada. By December 1954 much work had been done on the Nevada shot programs but comparatively little on Redwing. A nebulous list of probable Redwing shots at that time included for LASL [redacted] fects, probably an air drop), and one unnamed shot. All of these but [redacted] would probably be barge shots. For UCRL it seemed probable that there would be two highly instrumented shots, one at Bikini (Eninman) and one at Eniwetok (Eberiru).

Since this program appeared similar in scope to Castle, preliminary

[redacted]

[redacted]

TABLE 3.1

[redacted] KEY PERSONNEL OF TASK GROUP 7.1

Unit or Section	Name	Organization
Commander, Task Group 7.1	Gaelen L. Felt	LASL
Deputy for UCRL	Gerald W. Johnson	UCRL
	Duane C. Sewell	UCRL
	Walter D. Gibbins	UCRL
Deputy for Administration	Duncan Curry, Jr.	LASL
Deputy for DOD	Lester L. Woodward, Col., USAF	WETD
Advisory Group		
T-Division, LASL	J. Carson Mark	LASL
Scientific	Everett F. Cox	SC
UCRL Mechanical Engineering	Arthur Werner, Jr.	UCRL
UCRL Electrical Engineering	Elisha J. Daly	UCRL
Safety	Roy Reider	LASL
Radiological Safety	Leo G. Chelius	LASL
	Edwin A. Bemis, Jr.	LASL
	William R. Kennedy, Jr.	LASL
Classification, Security Liaison, and Technical Reports	Ralph Carlisle Smith	LASL
	John M. Harding	LASL
J-1 - Personnel and Administration	Armand W. Kelly	LASL
	Robert B. Cruise, Lt. Col., USA	LASL
	Samuel R. Whitaker	LASL
	Clarence T. Brockett	UCRL
J-3 - Plans and Operations	Walter T. Kerwin, Col., USA	LASL
	Emil A. Lucke, Col., USA	LASL
	Robert H. Gattis, Col., USAF	LASL
	Reuben N. Perley, Cdr., USN	LASL
	Roger G. Preston	UCRL
	John P. Flynn	UCRL
	John Tyson, Lt. Col., USAF	WETD
J-4 - Logistics and Supply	Harry S. Allen	LASL
	Robert J. Van Gemert	LASL
	John W. Lipp, Lt. Col., USA	LASL
	Daniel J. Murphy	UCRL
J-6 - Test Facilities	Robert H. Campbell	LASL
	Robert W. Newman	LASL
	Clifford M. Bacigalupi	UCRL
	Arthur P. Minwegen, Cdr., USN	WETD
	William A. Mowery, Lt. Col., USA	WETD

[redacted]

[redacted]

Unit or Section	Name	Organization
TU-1 - LASL Programs [redacted]	Keith Boyer	LASL
	A. T. Peaslee, Jr.	LASL
	David A. Liberman	LASL
J-7 - Design	James H. Hill	LASL
Program 10	Herman Hoerlin	LASL
	Joseph F. Mullaney	LASL
	Leroy N. Blumberg	LASL
Program 11	George A. Cowan	LASL
	Harold F. Plank	LASL
	Phillip F. Moore	LASL
	Jere D. Knight	LASL
Program 12	Rodney L. Aamodt	LASL
	Wendell A. Biggers	LASL
	Donald D. Phillips, Sr.	LASL
Program 13		
Project 13.1	John S. Malik	LASL
	Robert B. Patten	EG&G
	William A. Ward	EG&G
	Richard E. Knappenberger	EG&G
	Bruce M. Carder	EG&G
Project 13.2	Roger Ray	LASL
	Leland K. Neher	LASL
	Douglas O. Cochrane	EG&G
Project 13.3	Carroll B. McCampbell	SC
	David E. Henry	SC
	Jesse C. Rehberg	SC
Program 15	Gaelen L. Felt	LASL
	Arthur N. Cox	LASL
	Robert S. Fitzhugh	LASL
	Avery L. Bond	LASL
Program 16	Bob E. Watt	LASL
	Ralph E. Partridge, Jr.	LASL
Program 18	Herman Hoerlin	LASL
Project 18.1	Harold S. Stewart	NRL
	Walter F. Weedman	NRL
	George F. Wall	NRL
Project 18.1 & 18.3	Gordon G. Milne	U. of Rochester
	Francis D. Harrington	NRL
Project 18.2	Dennison Bancroft	LASL
	Joseph E. Perry, Jr.	LASL
Project 18.2 & 18.4	Robert B. Day	LASL
Project 18.3	Donald F. Hansen	NRL
Project 18.4	Donald R. Westervelt	LASL
	Elbert W. Bennett	LASL
Program 19	Lew Allen, Jr., Capt., USAF	LASL

[redacted]

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[redacted]

Unit or Section	Name	Organization
Program 5 [redacted]	Milton R. Dahl, Cdr., USN	WETD
Project 5.1	Clarence W. Luchsinger	WADC
Project 5.2	Francis L. Williams, 1st Lt., USAF	WADC
Project 5.3	Richard W. Bachman	WADC
Project 5.4	Harold M. Wells, Jr., 1st Lt., USAF	WADC
Project 5.5	Robert F. Mitchell, 1st Lt., USAF	WADC
Project 5.7	Richard L. Dresser, Capt., USAF	AFCRC
Project 5.8	Philip S. Harward, Lcdr., USN	BuAer
Project 5.9	Charles J. Cosenza, 2nd Lt., USAF	WADC
Program 6	Clyde W. Bankes, Lt. Col., USA	WETD
Project 6.1	Edward A. Lewis	AFCRC
Project 6.3	Arthur K. Harris	ESL
Project 6.4	Alan J. Waters	ARDC
Project 6.5	Charles J. Ong, 2nd Lt., USA	ESL
Program 8	Alfred H. Higgs, Cdr., USN	WETD
	William C. Linton, Jr., Maj., USA	WETD
Project 8.1	William B. Plum	NRDL
Project 8.2	Wallace L. Fons	CFRES
Project 8.3	Jerry J. Mahoney	CRL
Project 8.4	Alexander Julian, Lcdr., USN	BUAER
Project 8.5	Ralph Zirkind	BUAER
Program 9	Jack G. James, Lt. Col., USAF	WETD
TU-4 - Sandia Programs	Don B. Shuster	SC
	Robert E. Hepplewhite	SC
	Edwin L. Jenkins, Jr.	SC
Program 30	Charles G. Scott	SC
	Francis E. Thompson	SC
	Hans E. Hansen	SC
Program 31	Don B. Shuster	SC
	Willard A. Gustafson	SC
	Billy M. Ray	SC
Program 35*	Lauren Donaldson	UWFL
	Edward E. Held	UWFL
	Arthur D. Welander	UWFL
	Allyn H. Seymour	UWFL
	Ralph E. Palumbo	UWFL
	Frank G. Lowman	UWFL
TU-5 - Timing	Herbert E. Grier	EG&G
	Bernard J. O'Keefe	EG&G
	Lewis Fussell, Jr.	EG&G
TU-6 - Firing	Edwin L. Jenkins. Jr.	SC
	Robert J. Burton	SC

* Sponsored by DBM, AEC; carried out by Applied Fisheries Laboratory, University of Washington.

[redacted]

[redacted]

[redacted]

Unit or [redacted]	Name	Organization
TU-7 - Radiological Safety	Gordon L. Jacks, Maj., USA	LASL
	Charles L. Weaver, Maj., USA	1st RSSU
	Benjamin H. Purcell, Capt., USA	1st RSSU
	Rex Gygax, Lt., USN	LASL
TU-8 - LASL Documentary Photography	Loris M. Gardner	LASL
	Robert C. Crook	LASL
	Gustaf N. Lindblom	LASL
TU-9 - UCRL Documentary Photography	Raymond H. Jaeger	UCRL
[redacted] - LASL Assembly	Francis K. Tallmadge	LASL
	David R. Smith	LASL
	John H. McQueen	LASL
	Andrew M. Koonce	LASL
	Douglas F. Evans	LASL
	Edwin L. Kemp	LASL
	Jay E. Hammel	LASL
TU-11 - UCRL Assembly A	Forrest Fairbrother, Jr.	UCRL
TU-12 - UCRL Assembly B	Alfred C. Haussmann, Jr.	UCRL
	Joseph A. Lovington, Cdr., USN	UCRL

[redacted]

estimates of military support requirements submitted at that time were based accordingly.

On February 15, 1955, representatives of LASL, UCRL, and SFOO met to discuss the Dixie and Redwing programs. At this meeting it was decided that (a) the fall of 1955 was too early for Dixie; (b) Dixie should be held in the spring of 1956; (c) the spring of 1957 was unsatisfactory for Redwing because of the time urgency for its completion; and (d) the fall of 1956 was unsatisfactory because of the close proximity of Dixie. It was therefore decided that the two laboratories would recommend to the AEC that Dixie and Redwing be combined for firing at the PPG in the spring of 1956.

The operation, envisaged in a letter written at that time by the Deputy Commander for Scientific Matters to the Commander of JTF 7, would consist of [redacted]

It was tentatively planned to schedule all of the medium and large shots at Bikini and the small shots at Eniwetok, with a two-atoll capability so arranged that the small shots could be tested under almost any weather condition while waiting for suitable weather for the large shots. With such a plan it did not appear necessary to expect a longer duration for Dixie/Redwing than was experienced in Castle. It was even hoped that the operation would be shorter because of the smaller number of large shots under consideration at that time.

Because of the proposed location of the shots, it was estimated that the requirements for the L-20 type aircraft, helicopters, boats, and vehicles would be greater than for Castle, but that the construction requirements as far as scientific structures were concerned would be considerably smaller. A tentative ready date of March 15, 1956, for the first shot at each atoll was being considered.

During the spring of 1955, many of the test personnel from LASL, UCRL, AFSWP, WETD, and SC participated in Teapot at Nevada. A number of meetings were held at Camp Mercury as well as at the home locations of the various groups to discuss the Redwing programs, operation plans, and support requirements. The conclusions reached were embodied in the CTG 7.1 General Concept No. 1-55, dated April 12, 1955, which was distributed for planning purposes. The shot schedule listed [redacted] Nearly all of these except the 1-point detonations, which eventually were fired at Nevada, continued in the Redwing schedule, which, as shown in Table 3.2, finally included [redacted]

The basic operational principles outlined in the CTG 7.1 General Concept were reasonably well adhered to throughout the operation. Those principles were as follows:

TABLE 3.2

REDWING SHOT SCHEDULE
(L = LASL, U = UCRL, E = Eniwetok, B = Bikini)

Model and Laboratory	Shot Name	Probable Yield Limits(2)	Location	Date Fired	Actual Ready Date	Listed in Concept(3)	Revision(4) (10/11/55)	Op Plan Date(5)	Actual Shot Time(6)
DELETED	Lacrosse	DELETED	Runit (E) ground	5/5	4/29	No	5/1	5/1	0625:05
	Cherokee		Namu (B) 5000 ft air burst	5/21	5/9	Yes	5/1	5/1	0551
	Zuni		Eninman (B) ground	5/28	5/28	Yes	5/15	5/8	0556
	Yuma		Aomon (E) 200 ft tower	5/28	5/28	Yes	5/8	6/1	0756
	Erie		Runit (E) 200 ft tower	5/31	5/31	No	5/23	5/23	0615:05
	Seminole		Bogon (E) ground	6/6	6/5	No	5/26	5/28	1255:05
	Flathead		South of Yurochi (B) barge	6/12	6/10	Yes	5/30	6/2	0626
	Blackfoot		Runit (E) 200 ft tower	6/12	6/12	Yes	6/7	6/7	0626
	Kickapoo		Aomon (E) 300 ft tower	6/14	6/14	Yes	5/18	6/18	1126
	Osage		Runit (E) 700 ft air burst	6/16	6/16	Yes	6/7	6/14	1314
	Inca		Rujoru (E) 200 ft tower	6/22	6/22	No	5/1	6/8	0956
	Dakota		South of Yurochi (B) barge	6/26	6/22	No	---	6/13	0606
	Mohawk		Eberiru (E) 300 ft tower	7/3	7/3	Yes	6/8	7/1	0606
	Apache(1)		Mike crater, west of Teiteiripucchi (E) barge	7/9	7/8	Yes	7/1	6/20	0606
	Navajo		South of Yurochi (B) barge	7/11	7/9	Yes	6/18	6/8	0556
	Tewa		Halfway between Yurochi & Namu (B) barge	7/21	7/18	No	---	7/7	0546
	Huron		Mike crater (E) barge	7/22	7/2, 7/20(7)	No	6/11	6/12	0616
	Proposed Shots, Eventually Deleted from Schedule								
	Pawnee		Engebi (E) ground	---	---	No	Unspecified	Unspecified	
	Pueblo		Bogairikk (E) ground	---	---	Yes	---	---	
	Hopi		Runit (E) 100 ft tower	---	---	Yes	---	---	
	Shawnee		Runit (E) 100 ft tower	---	---	Yes	---	---	
	Shawnee 2		Engebi (E) ground	---	---	No	---	---	
	Shawnee 3		Engebi (E) ground	---	---	No	---	---	

DELETED

Notes

(1) [redacted] was originally planned as a LASL model. Later, by agreement between LASL and UCRL, it became a UCRL model.
(2) Probable yield limits, estimated before the shot, for construction, instrumentation, evacuation, aircraft positioning, fallout prediction and other purposes.
(3) CTG 7.1 General Concept No. 1-55 (dated 4/12/55). First shot at each atoll was to be ready 4/15/56 but no shot dates or orders were given.
(4) Ready dates in Revision No. 4 (dated 10/11/55) to CTG 7.1 General Concept No. 1-55.
(5) CTG 7.1 Operation Plan No. 1-56 (dated 1/25/56). Later dates of UCRL small shots caused by December 1955 estimate of UCRL that this program was a month behind schedule. Dates listed are from Revision No. 2 to Op Plan (dated 2/4/56).
(6) Eniwetok (Zone-12) dates and times are used in this table.
(7) [redacted] postponed at H-3 min, 7/2/56, because of unsatisfactory [redacted] which was later replaced.

DELETED

[redacted]

a. CJTF 7 and his staff will normally be based on Parry. (After the first two shots at Bikini, CJTF 7 and most of his staff remained at Parry even during the Bikini shots.)

b. CTG 7.1 and major elements of the task units and staff sections will normally be located on Parry, although each staff section will have an integrated advance section at Bikini.

c. A capability of firing a shot at either atoll on the same day will be maintained. (This was done on two occasions, on one of which identical shot times were used at both atolls.) Priority for firing will be given to Bikini Atoll shots.

d. Firing of shots other than air drops will be accomplished at Eniwetok from the timing and firing station on Parry, and at Bikini from the timing and firing station on Enyu, using radio control from the USS Curtiss when it is necessary to evacuate the Enyu firing station.

e. At Bikini all personnel except those in the firing station will be evacuated for all shots; at Eniwetok they will be evacuated to Parry and Eniwetok as necessary.

f. The Task Force and Task Groups will be prepared to conduct all operations from afloat at Bikini after the first megaton shot there. CTG 7.1 and staff plus representatives of certain scientific programs and projects and of TG 7.5 will operate from the TG 7.1 command ship, USS Curtiss. (Since the Enyu camp was not contaminated or destroyed, it never became necessary to accomplish this for longer than overnight.)

g. At Eniwetok the main camp will be located on Parry with temporary work camps located on Rojoa, Runit, and Teiteiripucchi. At Bikini temporary camps will be located on Enyu, Eninman, and Romurikku.

h. Principal laboratory, machine shop, photographic, warehouse, and stock room facilities will be located on Parry with limited field facilities located at Bikini.

i. Trailers, vehicles, equipment, etc., will be evacuated to islands outside the danger area for each shot.

j. An emergency capability for post-shot evacuation of personnel because of fallout will be maintained at both atolls. Such an evacuation will not include equipment.

This concept provided a basis for the monthly status reports required from the projects beginning in June 1955. The purpose of these status reports was to obtain from the project officers information as to how they planned to carry out their experiments, their operational activities overseas, and their estimated requirements for support including housing, office and laboratory space, office furniture, communications, vehicles, boats, aircraft, timing signals, photography, air and surface transportation, etc. A Project Officers' Meeting was scheduled at Los Alamos in July 1955 to orient

[redacted]

the project officers in overseas operational and logistic problems and to obtain more complete information from them for planning purposes.

Fortunately, a few of the shakier projects discussed at that meeting fell by the wayside; but the bulk of them, augmented by a comparatively few later expansions and additions, became the Redwing experimental programs, summarized in Chapter 2.

By April 1955, the ready date for the first shot had been changed to April 15, 1956, and by June it had been delayed until May 1, 1956. In July it was decided to fire the 1-point shots in Nevada in the late fall and winter of 1955, and to delete them from the Redwing program.

In order to make the maximum use of the limited land available and of instrument stations already in existence, three shots were sceduled on the Eberiru complex plus one on Rujoru, three on Runit and one in the air above Runit, and six on barges near the Yurochi complex. When weather for large shots proved more favorable at Eniwetok than Bikini, and completion of the Bikini program lagged, the [redacted] barges were shifted to the Mike crater at Eniwetok. Because of the size of [redacted] and the fact that it had to be fired early in the program, the [redacted] Runit towers were not built until after [redacted] was detonated.

3.4.2 Determination of Requirements

As shown in the preceding section, a list of probable Redwing shots prepared in December 1954 indicated an operation similar in scope to Castle; preliminary estimates of military support requirements submitted at that time were based accordingly. Unfortunately, the DOD system for planning the support of overseas nuclear tests entails estimates of requirements long before the shot schedule (which governs all of the planning of the Scientific Task Group) is in any way firm. The result is that preliminary estimates of requirements must be based to a degree on the preceding operation, and change substantially as planning progresses.

Except for motor vehicles, Table 3.3 lists the principal items of military support of both direct and indirect interest to TG 7.1, and shows how requirements changed during the planning phase of the operation. No distinction is drawn in the table between items of direct interest to TG 7.1, such as a command and firing ship, and effects ships and aircraft, and items resulting from TG 7.1's requirements for services such as base facilities, transportation, and communications, which generate material requirements in the task groups which have to provide those services.

Preliminary estimates of Redwing motor vehicle requirements, made in January 1955, were based on experience gained during Castle and totaled

[redacted]

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TABLE 3.3

MAJOR ITEMS OF MILITARY SUPPORT

Ships or Aircraft and Purpose	Dec. 1954[1]	April 1955[2]	Aug. 1955[3]	Actual	Remarks
AGC (Estes) - Command		1	1	1	Provided Program 2 Control Center
AV-4 (Curtiss) - TG 7.1 Command and Weapons	1	1	1	1	Transport of devices, housing, shops and offices
CVE - Helicopter base, early recovery and re-entry base	1	1	1	1	Master Raydist Station Base
LSD - Barge lift and boat pool support	1	1	1	1	Project 1.4 Telemetering Station
LST - Weather island support	1	1	1	1	
LST - Interatoll	1	1	1	1	
ATF - Towing	3	4	4	4	One with echo sounding equipment; one with skiff handling equipment installed
APD - Personnel transport and fast freight[4]	2	2	2	1	Project 2.61 Telemetering Station
TAP - Afloat housing at Bikini	1	1	1	1	
DD/DE - Security		as req'd	4	4	Two DD's used for Security; two DE's used for Security and by Program 2
LST-611 - Program 2		1	1	1	
YAG-39 and 40 - Program 2		2	2	2	
Navy Boat Pool	1	1	1	1[5]	
AVR - Firing Party	1				Actual, used helicopters and LCM's as required
ARSD - For possible buoy project	1				No buoy project authorized
YC - Sample packing - Program 2	1	1	1	1[4]	
YCV - Copter barge	1	1	1	1	
Sectional Pontoon - Program 2			3	2	Instrument platform, Bikini Lagoon
YFNB - Program 2				2	
Submarine - Program 2 - Fallout		1 or more			None authorized

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Ships or Aircraft and Purposes	Dec. 1954	April 1955	Aug. 1955	Actual	Remarks
SA-16 - Off-atoll and SAR		7	9	7[7]	
C-47 - Interatoll airlift	4	4	4	4	
L-20 - Interisland airlift	6	6	6	8	
P2V - Security		as req'd	10	10	
Copter Squadron - Bikini - Carrier Based	1[6]	1	1	1	15 copters in squadron
H-19B - Copters, Eniwetok	9	9	9	10	
Sampling					
B-57B - Sampling aircraft		6	6	6	Three B-57D also requested in April; not authorized
F-84G - Sampling aircraft		8	10	10	
Effects					
B-36 - Cannister drop (Project 1.4)		2 B-29	1	1 B-36	
B-57 - Cloud penetration (Project 2.66)		6	6	5 B-57	Three B-57 and three B-47 requested in April
P2V5 - Early Fallout (Project 2.64)			3	3	
B-47 - Effects (Project 5.1)		1	1	1	
B-52 - Effects (Project 5.2)		1	1	1	
B-66 - Effects (Project 5.3)		1	1	1	
B-57B - Effects (Project 5.4)		1	1	1	
F-84F - Effects (Project 5.5)		2	2	2	
F-101A - Effects (Project 5.6)		1	1	1	
A3D1 - Effects (Project 5.8)		1	1	1	
F-89D - Effects (Project 5.11)			1		Project cancelled
C-97 - Project 6.3		2	1	1	
P2V5 - Effects (Project 8.5)		1		1	
RB-50E - Photography		3 R7V's	3	3	Support for Program 9 and Project 1.8

<u>Others</u>

Ships or Aircraft and Purposes	Dec. 1954	April 1955	Aug. 1955	Actual	Remarks
Drop aircraft		2 FB-36 or 2 B-47	2	3	Actual: Two B-52 and one B-36
B-47 - IBDA		2	3	3	

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(1) Reference, CTG 7.1, Secret letter, J3-26, subject: Major Military Support Requirements for Redwing, dated December 2[illegible] 1954.

(2) Reference, JTF-7, Secret letter, J-3/SRD-221-55W, subject: Resumé of Conference on Military Support Requirements, dated April 29, 1955. Date of conference was April 21, 1955.

(3) Reference, JTF-7, Secret letter, J-3/S-483-55W, subject: Record of Conference Held at CJTF7 Headquarters to Discuss Military Support Requirements for Operation Redwing, dated September 7, 1955. Conference was held August 23, 1955.

(4) To be used in event of full shipboard operation.

(5) 5 LCU's, 19 LCM, 2 LCPR, 1 LCPL, 1 MWB and 1 YFN.

(6) 16 to 20 helicopters.

(7) Amphibian or seaplane support would have been required at Bikini if airstrip had become unusable.

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[redacted]

70 jeeps, 65 3/4-ton trucks, and 12 2-1/2 ton trucks.

As vehicle requirements became clearer, in late August 1955 a revised estimate was submitted to CJTF 7. This new requirement, which with few alterations, was eventually approved and filled, consisted of 145 jeeps, 93 3/4-ton trucks, 20 2-1/2-ton trucks and 3 1/4-ton trailers.

Final status reports submitted by the projects in January 1956 brought the total requirement to 169 jeeps, 112 3/4-ton trucks, 28 2-1/2-ton trucks, and 4 1/2-ton pickups. The late additional requirements could not be met and the operation was carried out with the vehicles listed in the preceding paragraph, plus 4 1/2-ton pickups.

As the designs and yields of devices to be tested became reasonably firm, locations for firing them were selected, experiments to be performed on them were determined, and the plans and designs for scientific stations were made. This permitted other operational and logistic planning to proceed.

The details of support requirements were then determined through the monthly status report system and the Project Officers' Meeting, discussed in the preceding section, plus innumerable other meetings, visits, conferences, correspondence, telephone conversations, teletypes, etc. The over-all requirements for the Task Force were firmed up at meetings at the Headquarters of JTF 7, attended by representatives of all the task groups and of various supporting agencies.

From the AEC, through the Albuquerque Operations Office and TG 7.5, TG 7.1 obtained extensive base facilities throughout the PPG, communications, and construction of scientific stations, including man-made islands, shot sites and shot cabs, towers, and barges – to mention just a few major items. Among the many services provided by the AEC were the badge and security guard system and boat services at both atolls from a boat pool consisting of 14 LCU's (five of which were houseboats for the support of TG 7.1 projects), 29 LCM's, 41 DUKW's, and three water taxis.

The Army operated the base facilities on Eniwetok Island and provided vehicles and some communication facilities for TG 7.1, as well as the military police to man the local security system sponsored by the AEC.

As shown in Table 3.3, the Navy provided ships, boats, planes, Marine Corps helicopters, and interatoll surface lift, including transportation of the barges, and helped to establish and support the island stations outside of the PPG.

TG 7.3 participated heavily not only in support functions but also in the effects programs and provided a back-up system for TG 7.1 afloat communications. Plans were made for both temporary and long-continued operations from afloat at Bikini; main reliance was placed on the Navy and MSTS for this capability.

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The Curtiss transported a number of devices to the FA and MSTS continued to provide regularly scheduled surface lift from the West Coast to the PPG. As the operational period approached, MSTS increased the frequency of sailings and provided a special ship to expedite the shipment of large numbers of scientific trailers, a necessary feature of the late build-up phase of overseas tests.

Alteration of a number of naval and MSTS ships and craft was required for their support and scientific functions and was accomplished by the Navy.

As shown in Table 3.3, the Air Force provided drop and sampler aircraft; effects, photographic, and other scientific project aircraft; helicopters at Bikini and Eniwetok; liaison planes, interatoll aircraft and offatoll support. The extensive and detailed meteorological information required by various scientific projects was provided by the Air Force, as was the weather information on which the decisions as to whether or not to fire were made.

MATS provided airlift of the great majority of TG 7.1 personnel and many tons of urgent freight, furnished all of the sample return services, and lifted a number of the devices from Travis AFB to Eniwetok.

Details and statistics of a number of the items of support provided by the AEC and the DOD are covered elsewhere in this report.

Determination of all these support requirements represented many months of study, discussion, negotiation, and compilation of information. The phasing overseas of major elements of military support was determined in December 1955 and January 1956. Subsequent changes were of a minor nature.

3.4.3 Training and Rehearsals

Details of training are covered as appropriate in the reports of the various programs, projects, and task units. Extensive training of personnel and testing of equipment began at the various laboratories in the U. S. and continued overseas.

In order to make the maximum use of project Rad-Safe monitors, about 125 of them were trained at Fort McClellan, Alabama, during the week of January 9, 1956. During the operation several courses were conducted by TU-7 at the PPG to provide additional project monitors. Five chemical laboratory technicians were trained in basic radiochemistry techniques at LASL, and four members of TU-7 were trained in alpha monitoring at LASL and Mercury, Nevada. NRDL trained 30 individuals from various naval shipyards throughout the U. S. to act as TU-7 monitors for Program 2. Six men were trained in radiac instrument repair at Treasure Island and Los Alamos.

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In preparation for each shot, TG 7.1 conducted several dry runs of the timing and firing systems, including at least one full power dry run before each shot. These runs were normally conducted twice a day until satisfactory, and then once a day until the shot or weather postponement. During prolonged states of readiness on a –1 basis, they were held every other day, or more often as necessary. Operations for which timing was important, such as recovery operations and key operations affecting the D–1 day schedule, were rehearsed as often as necessary to determine the actual time required and to decrease it as practical.

A fairly complete Task Force rehearsal for Cherokee was conducted at Bikini beginning 0500 April 23 and ending at 1200 April 24. H-hour was as scheduled for Cherokee. Neither the TG 7.1 command ship, the USS Curtiss, nor the USNS Ainsworth was available for this rehearsal. A very small token number of TG 7.1 personnel completed evacuation and re-entry. Nearly all of the vessels present proceeded to their shot-time positions at sea. Effects and other planes participated on a large scale. A voice count-down was provided, messages were sent to offatoll stations for time studies, and the communication rehearsal was as complete as possible in order to test communications and detect frequency conflicts. The rehearsal was satisfactory.

A number of other communication rehearsals were conducted during April at both Eniwetok and Bikini. Several of them were for the purpose of positioning aircraft as well as for testing communications and for determining interference caused by electronic equipment. Task Group 7.4 conducted a number of bombing rehearsals in which TG 7.1 participated to a limited extent.

3.5 MOVEMENT TO THE FORWARD AREA AND ASSEMBLY OF SUBORDINATE UNITS

3.5.1 Personnel

Information regarding the expected number of personnel to be present in the FA during Operation Redwing was obtained from the monthly status reports submitted prior to forward movement by the various units of the Task Group. These population figures were subdivided by location into the following general categories: sites at Bikini Atoll; sites at Eniwetok Atoll; and shipboard space. Detailed compilations were prepared showing the estimated weekly population at any location in the PPG. These population estimates were useful in determining such things as camp locations, camp size, MATS transportation required, and over-all camp support required of

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Holmes & Narver. Actual strength attained during the operational phase proved to be approximately 95 per cent of the estimate made in August 1955.

The total number of quarters requested in all camps, except Parry and Enyu, exceeded the total estimated population for the camps by about 10 per cent. The excess was required to permit a few personnel who moved frequently between locations to have permanent quarters in two camps.

Parry and Enyu Islands were considered base camps for their respective atolls, and accordingly permanent space at these camps was requested for all personnel temporarily living at camps on other islands. This proved especially beneficial when the temporary camps were no longer habitable and it was necessary to billet all personnel on Parry or Enyu.

Prior to each individual's departure for the FA, certain routine procedures were accomplished by the Adjutant General's Section. Assistant Adjutant Generals were established at UCRL Livermore and with the TG 7.1 Liaison Office at Hickam AFB, Honolulu, to accomodate the personnel traveling to the FA from UCRL, and for those individuals who arrived at Honolulu without proper travel orders. Procedures included the following:

1. Preparation of travel orders for each individual.
2. Preparation of identification cards for those persons not already possessing them.
3. Notification to each individual of the immunization requirements for travel west of Hawaii and the procedure for obtaining this immunization.
4. Issuance of necessary government transportation requests to military personnel required to use commercial transportation within the ZI.
5. Notification by teletype to the following that individuals were good security risks to enter the PPG: CINCPAC and Liaison Officers at Travis AFB, California; Hickam AFB, Honolulu; and Kwajalein Naval Station, Kwajalein.
6. Assurance that each traveler had complied with all security requirements for indoctrination, badges, etc.

The movement to the FA was by individual rather than by unit. Most nongovernment employees traveled from their parent organizations to Hawaii via commercial airline and thence to the FA by MATS. With few exceptions military personnel and DOD civilian employees traveled from Travis AFB, Calif., to the FA via MATS. A small percentage of personnel, both military and civilian, were transported by MSTS or naval ships. The number of Overseas Travel Orders written for individuals traveling to the FA are listed below:

1. TG 7.1 at Los Alamos, N. M. – 1015 travel orders involving 1934 individuals.
2. TG 7.1 at Livermore, Calif. – 189 travel orders involving 413

[redacted]

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individuals.

3. TG 7.1 Liaison Officer, Hickam AFB – 2 travel orders involving 2 individuals.

4. TG 7.1 (Fwd), APO 437 – 73 travel orders involving 221 individuals. (In the majority of cases these were amendments adding delays en route which could not be determined in advance of publication of original orders.)

Eniwetok Atoll was considered the base of operations for the entire PPG, and the largest portion of the TG personnel was located at that atoll. Bikini Atoll was used as a forward working area for those units participating in the shots fired at this location. A maximum population of 1404 was attained at the PPG on May 6, 1956, when 906 persons were at Eniwetok Atoll and 498 were at Bikini. A complete chart showing the total personnel present by week is shown in Fig. 3.3.

Although the majority of personnel were present at Eniwetok and Bikini Atolls, a few of the project personnel of TU-3 and TU-4 were based at Palmyra, Wake, Ailinginae, Kusaie, Johnston, Midway, Ujelang Atoll, Rongerik Atoll, Wotho Atoll, the Hawaiian Islands, Woodland, Calif.; Pittsburg, Calif.; Marysville, Calif.; Carolina Beach, N. C.; Harlingen AFB, Texas; Kinross AFB, Mich.; Blytheville AFB, Ark.; and Forestport, N. Y. These projects situated at outlying sites were primarily concerned with long range fallout, ionosphere recordings, water wave studies, microbarography, and electromagnetic studies.

All arrivals at Eniwetok Atoll were received by the Headquarters Commandant for TG 7.1 at Parry Island. This reception included billeting, transportation, and an orientation with regard to facilities and procedures in the FA. An accurate daily account by name was kept to show individuals present at each of the major locations.

3.5.2 Equipment

The movement of the Scientific Task Group equipment from CONUS was accomplished through the facilities of MSTS, the U. S. Navy, and MATS.

As the monthly progress reports were received, the shipping requirements were projected and submitted to the Task Force. Projects were kept advised when ships would be on berth at Oakland, enabling the project people to move their equipment to the port in time to meet sailing dates with a minimum waiting period. The J-4 Liaison Officer at Oakland kept the J-4 Office informed regarding the receipt and movement of cargo at the port.

Equipment began arriving at the Naval Supply Center at Oakland in early December 1955. Approximately 2800 L/T of material were moved by

[redacted]

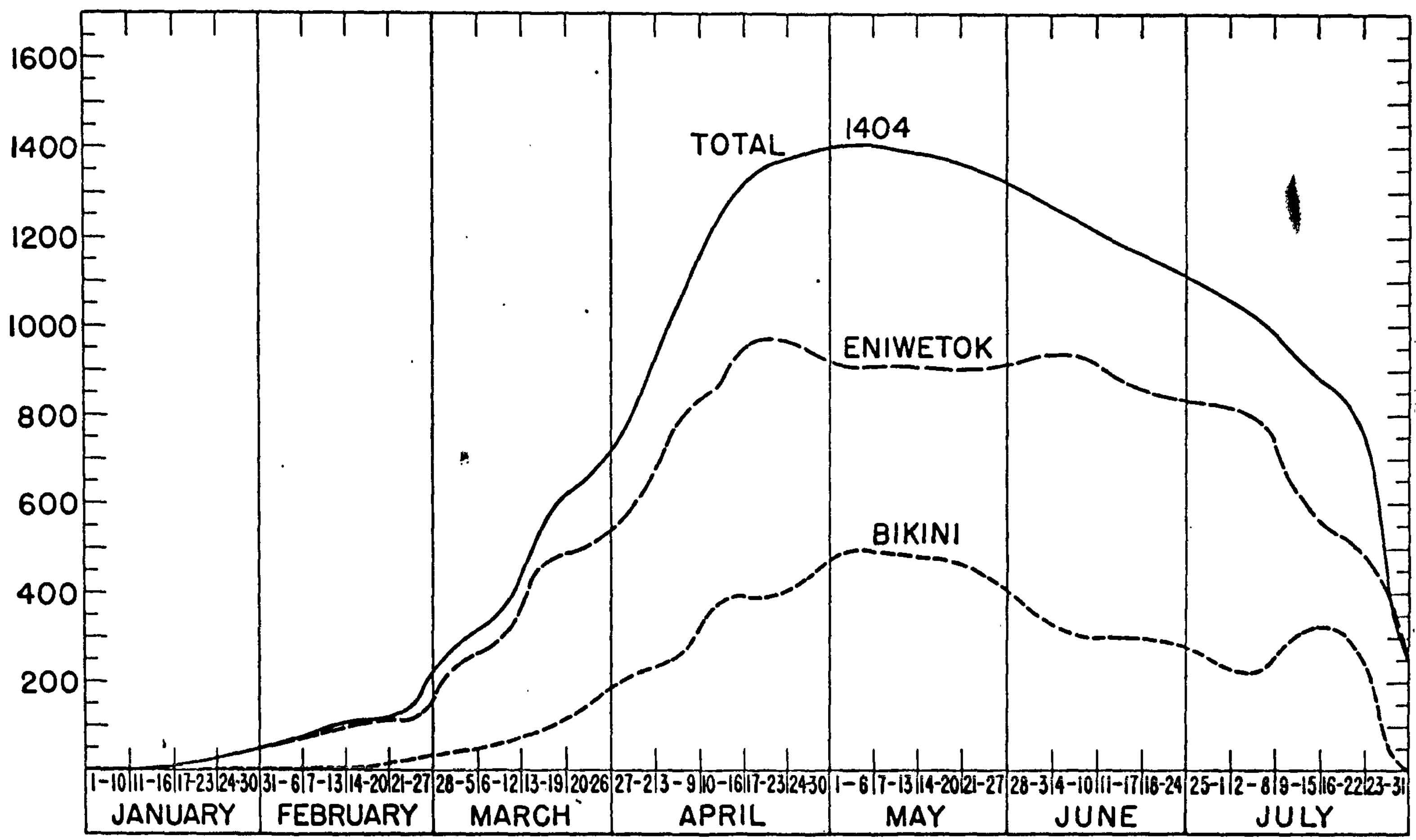

Fig. 3.3 Task Group 7.1 weekly population at the Pacific Proving Grounds, Jan. 1, 1956, to Aug. 1, 1956.

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MSTS ships to Eniwetok Atoll. All ships were off-loaded at the deep water pier at Parry. Cargo vessels were scheduled to depart from Oakland at 20- to 22-day intervals during the peak of the shipping record. Later in the operation the schedule was revised to one vessel a month. The peak of the cargo movement was reached in March when the Marine Fiddler completed a second trip. The Marine Fiddler was diverted from its regular run to make two trips, primarily to move trailer vans. One hundred forty-seven trailers were shipped during the operation, of which approximately 70 per cent were large van-type trailers that normally have to be shipped on the deck of a Victory ship.

The deep water pier at Parry was used for the first time this operation. It has facilitated the handling of delicate and critical cargo in an expeditious manner.

Water Shipments (MSTS) – ZI to PPG

January	117 L/T	April	58 L/T
February	1257 L/T	May	61 L/T
March	1301 L/T	June	7 L/T
July	2 L/T (Est.)		

Cargo destined for Bikini was off-loaded at Parry and transhipped to Bikini on USNS LST vessels. This amounted to approximately 1800 L/T.

Approximately 76 L/T of weapons and other critical items were shipped aboard the USS Curtiss from Port Chicago, Calif., March 26, 1956.

Air requirements were developed from the information supplied on the monthly progress reports submitted by each project. A compilation of this information was forwarded each month to JTF 7. All air movement designators were issued by the J-4 Office at Los Alamos. An effort was made to screen requests to avoid the shipment of materials by air that could be obtained in the Forward Area. Shippers were constantly reminded to ascertain prior to shipment of material that it had been properly packed and labeled to comply with ICC regulations.

Air shipments were consigned to Eniwetok and, when necessary, transhipped to Bikini on the daily C-47 shuttle. The following figures do not include weapons shipped on special air missions.

Air Shipments (MATS) – ZI to PPG

December	2,402 lb	April	165,918 lb
January	13,801 lb	May	78,377 lb
February	54,030 lb	June	29,578 lb
March	59,708 lb	July	20,000 lb

[redacted]

[redacted]

3.6 MOVEMENT OF DEVICES AND COMPONENTS

Weapons and components including vulnerability weapons were transported from CON[redacted] on the USNS Pvt. Joe E. Mann, USS Curtiss and by ten USAF special air missions.

On February 6, 1956, six vulnerability weapons were loaded on the Mann at the Oakland Naval Supply Center. This material was shipped by SC and was delivered to the port by an AEC-guarded motor convoy. These weapons were returned to the ZI June 11, 1956, on the USNS Sgt. Archer T. Gammon. Weapons were escorted to Oakland by a detachment of MP's. They were off-loaded at Oakland and transported to Albuquerque by escorted motor convoy.

Five devices, four vulnerability weapons, and four dummy devices plus miscellaneous component parts were shipped aboard the USS Curtiss from Port Chicago, Calif., March 26, 1956. The heavy devices, vulnerability weapons, and dummies were moved by rail from the SC railhead after the Los Alamos and American Car and Foundry material had been combined with the Sandia material. All material was stowed in Shop 18, Shop 1, or the Pyrotechnic Locker. Material was accompanied by a technical courier from Port Chicago to Eniwetok. Stowage spaces were guarded by USMC guards.

The Carco C-54 was used to transport the [redacted] Plane departure was from the Santa Fe airport and arrival was at the Concord, Calif. airport. Material was unloaded and transported to shipside by Port Chicago personnel and equipment. Material was lifted aboard with ship equipment. Port facilities were utilized to shore cargo. Ship departed Port Chicago March 26, 1956.

The USS Curtiss arrived at Eniwetok April 10, 1956. The ship was berthed at the Parry deep water pier. Holmes & Narver assisted ship personnel in discharging cargo and it took approximately six hours. Cargo was delivered directly to assembly areas.

Spare components and dummy devices were returned to the ZI aboard the USS Curtiss. Unused gas and vulnerability weapons were returned on Flyaway as space was available.

Ten special air missions utilizing C-124 aircraft were established and delivered the following weapons to the PPG from Travis AFB on dates indicated:

DELETED	April 20, 1956
	May 12, 1956
	May 22, 1956
	May 22, 1956

[redacted]

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[redacted]

[redacted]

DELETED

June 8, 1956
May 30, 1956
June 6, 1956
June 13, 1956
June 25, 1956
June 25, 1956

The weapons shipped by LASL were flown by Carco C-54 from the Santa Fe airport to Travis AFB or by C-47 direct from Los Alamos. The UCRL weapons were delivered to Travis by motor convoy.

In addition to the above special missions, it was necessary to return parts of the [redacted] to LASL for examination and to return similar components, including a new pit, to the PPG. In order to avoid possible further delay, a second pit assembly was forwarded from LASL, but was not needed before it had departed Hickam; it was returned to LASL on [redacted] Flyaway One. The movement of components was on regular scheduled MATS flights.

The movement of devices within the PPG, that is, from the assembly areas to the zero stations, was considered to be an operational problem and so was handled by the J-3 Section.

The method for both ground and tower devices for Eniwetok Atoll was to utilize either flatbed trucks or a tractor-trailer combination to transport the devices to the Parry Marine Ramp; there the vehicles were put aboard an H&N LCU, taken to the shot island, and delivered to the zero station. The same method was used to deliver the airdrop devices to the aircraft at the Eniwetok Island airstrip. Barge-mounted devices were loaded on the barge in the Parry Island barge slip. Homes & Narver marine craft then towed the barge to the LSD and loaded the barge into the LSD well. The LSD transported the barge to Bikini where H&N marine craft removed the barge from the well and towed it to the prepared moorings at the shot site. [redacted] was loaded onto trailers which were then loaded into a TG 7.3 LCU. The LCU moved into the well of the LSD for transportation to Bikini. Upon arrival at Bikini the LCU proceeded to the Eninman beach where the tractor-trailer combination delivered the device to its zero site.

There were no special problems encountered in the movement of devices. The primary effort made in each move was that of coordinating the activities of the numerous agencies involved to ensure a smooth and orderly movement.

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3.7 ON-SITE OPERATIONS

3.7.1 General [redacted]

Although Parry Island was the main base of operations for TG 7.1, the command and staff sections, task units, programs, and projects provided enough qualified personnel at Bikini to conduct operations there on a virtually autonomous basis, except for over-all guidance and decisions on policy matters and schedules from headquarters. The two-atoll firing capability, which was well tested during this operation, required such a system.

The capability of operating from afloat at Bikini was fairly well tested by numerous evacuations. Although none of them lasted longer than overnight, the muster and personnel accounting systems, communications, firing system, transportation, and Rad-Safe procedures proved satisfactory; they should have enabled us to complete the operation from afloat if it had been necessary. The weakest link in the chain was intership communications, which are discussed in Section 3.13.2.

On several occasions Enyu was the only island at Bikini which did not receive fallout. Of course such good luck cannot be counted on in the future, and the afloat capability must again be provided whenever large shots are planned at Bikini.

As the operation progressed, experience improved, participation decreased, and flexibility reached the point where a potential –1 status could be maintained for days on end, and a real –1 day could be announced as late a H–9 hours. Such flexibility proved invaluable under the rapidly changing weather conditions which prevailed during most of the shot schedule.

3.7.2 Test Facilities

Criteria for the design and construction of test facilities and estimates of labor and equipment support required by TG 7.1 were collected from the various Task Unit Commanders, program directors, and project officers by the J-6 Section. Conflicts were resolved, locations assigned, completion dates established, and our total requirement passed to TG 7.5 for execution. In addition to the foregoing basic responsibility, J-6 also prepared the work orders necessary for the actual support of the various projects; operated a machine shop for the convenience of the experimenters; furnished a representative at each of the LASL zero areas to coordinate the activities of the various projects in these congested areas; and assigned tent, trailer, and laboratory space as required.

J-6 was composed of 13 men representing DOD, UCRL, and LASL, with the LASL group serving as the final clearing house for all three agencies in transmitting the requirements of TG 7.1 to TG 7.5. During the planning phase the ~~four~~ UCRL representatives functioned from their own laboratory while the DOD representative established residence at Los Alamos. During the instrumentation and shot periods these three groups combined in the Forward Area and representatives of this combined group were stationed at various sites throughout the PPG where major activities concentrated. Under this method of operation in the field, individual members of the group were not restricted to problems of their parent agency and frequently assisted other agencies in accomplishing the over-all mission of the Task Group.

During the spring and summer of 1955, devices or weapons and experiments were added or deleted from the operation with a frequency that produced a continual revision of the test facilities required by the resulting scientific programs. However, at the end of September 1955 it was estimated that the basic criteria necessary for the design of 95 per cent of the scientific structures had been transmitted to the AEC Field Manager, Eniwetok Field Office. The technique employed during this period was to delineate items which would be required in the operation regardless of the concept of the day. This included items such as submarine cable systems, gas storage building, HE magazines, standardized shot barges, and the basic major scientific stations. This approach was necessary because the time involved in design, procurement, and construction precluded waiting until participation was firm and locations selected before gathering the test facility criteria.

By mid-September construction necessitated opening the J-6 Office in the FA to maintain close coordination with the construction forces.

The field revisions in the shooting sequence and locations had little effect upon the facilities required beyond the expansion of the existing capability of firing a barge shot in the Mike crater at Eniwetok Atoll.

In the course of the operation, approximately 735 scientific stations were constructed, nearly 1300 work orders prepared, and 20 man-months of machinist time were expended in the J-6 Shop in support of the mission of TG 7.1.

3.7.3 Intra-atoll Airlift

Airlift support to the islands of Eniwetok Atoll was provided by TG 7.4 using eight L-20 aircraft and ten H-19B helicopters. The full complement of L-20 aircraft was not in place until after the arrival of the USS Badoeng Strait on March 16, 1956. In addition, one L-20 was in place at Enyu to support special missions at Bikini Atoll during the build-up phase.

The airlift support of Bikini Atoll was provided by HMR-363, a Marine Helicopter Squadron with a complement of 15 HRS-1 (H-19A) aircraft. The squadron initially provided eight aircraft with the remainder arriving on the USS Badoeng Strait. Additional support by one Air Force L-20 was available during early phases of the operation; this was increased to a total of two, immediately preceding [redacted] to support the Tare complex. Following Zuni, the L-20's were no longer required.

On March 27, the Marine Squadron at Bikini lost a helicopter owing to engine failure. With the cause undetermined and with a history of similar trouble, all helicopters were grounded. Subsequently, limited numbers were made available but were used for freight only following the decision of CTG 7.1 that personnel would not be airlifted by Marine helicopter until the engine deficiency was corrected or replacement aircraft were available. A decision was made to use the Air Force helicopters from Eniwetok until later-model replacements were made available. This was considered essential due to critical requirements at Bikini. On March 29, the Air Force was flying necessary support. On April 25, HRS-3's (H-19B's) were available at Bikini as replacement aircraft for grounded aircraft and took over responsibility for Bikini airlift.

Helicopter support at Eniwetok Atoll was curtailed effective March 27 with the movement of the AF H-19's to Bikini to support airlift requirements there. The AF helicopters were returned to Eniwetok on April 26 after the arrival of the new Marine helicopters.

The Eniwetok islands were supported by air as follows:

Runit - L-20 and H-19
Rojoa complex - L-20's primarily
Teiteiripucchi complex - L-20 and H-19

The Bikini islands were supported as follows:

Romurikku complex and north islands of atoll - helicopter.
Eninman complex and south islands - helicopters and L-20.

Procedures were established at both atolls for providing airlift for TG 7.1 personnel. For published scheduled flights, it was normal for individuals to request space by direct contact with the appropriate TCA dispatcher. For all special flights which regular scheduled service could not accomodate, requests were submitted to J-3 for approval and booking.

The short airstrip at Runit necessitated using H-19's for airlift any time the wind velocity dropped to less than 10 mph or became a cross wind.

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[redacted]

With the temporary movement of the AF helicopters to Bikini, support to the Teiteiripucchi complex was accomplished by landing L-20 aircraft at Engebi and using surface transportation to Teiteiripucchi. The decision was made at this time to complete construction of the Teiteiripucchi airstrip which eliminated the need for using Engebi and surface transportation.

For periods of three to four days after some of the shots, certain of the airstrips were out of commission for L-20 traffic owing to radiation. H-19's were used to move priority personnel to those complexes, supplemented by water taxis for low priority traffic.

After [redacted] the Runit airstrip was completely out of commission. Preparation for [redacted] at Runit was supported entirely by H-19's and surface transportation.

L-20 aircraft were used to support [redacted] preparation as soon as radiation levels permitted use of the Teiteiripucchi strip; however, H-19's primarily supported Seminole preparatory work.

During a representative week of the build-up phase (April 1-7), the interisland airline had the following traffic load:

Bikini

H-19B	844 flights	1900 passengers (382 - TG 7.1)

Eniwetok

H-19B	47 flights	84 passengers (62 - TG 7.1)
L-20	223 flights	717 passengers (548 - TG 7.1)

During a representative week of the operational phase (May 6-12), the interisland airline had the following traffic load:

Bikini

HRS-3 (H-19B)	589 flights	1563 passengers (1250 - TG 7.1)

Eniwetok

H-19B	91 flights	313 passengers (191 - TG 7.1)
L-20	279 flights	742 passengers (400 - TG 7.1)

The L-20 liaison-type aircraft was the answer to many of the demands for rapid transportation of personnel and its performance and "in operation" rate were very high. The HRS-1's (H-19A), with which the HMR-363 was first equipped, did not prove adequate in performance or in the availability of replacement parts for an operation of this sort. Such was not true of the HRS-3's with which the Marine Squadron at Bikini was later equipped (after

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CTG 7.1 had stopped using the HRS-1's for passengers, and recommended to CJTF 7 that they be replaced) or the H-19B's at Eniwetok. This later model of helicopter performed well and was adequate performance-wise for the operation. Numbers available for TG 7.1 and 7.5 missions were often inadequate because of SAR, Task Force, other task group, VIP, and maintenance requirements.

3.7.4 Interatoll Airlift

Initial plans for the routine airlift of personnel and air cargo between Eniwetok and Bikini generated a requirement for four scheduled flights to and from Bikini each day. During the build-up phase of the operation, two round trip flights each day were flown on a scheduled basis, one departing Eniwetok at 0800 and one at 1300. As the traffic load between atolls increased, it was found to be more efficient to continue using these same two scheduled departure times but with additional sections as required. Task Group 7.4 had four C-47 aircraft which were assigned primarily for interatoll airlift. When required and as available, C-54 aircraft were used to supplement the C-47 airlift.

Task Group 7.1 personnel desiring airlift placed space requirements directly with the J-3 Airlift Booking Section. J-3 forwarded these requirements to TG 7.5 Personnel Section who in turn manifested combined requirements with TG 7.4. Since TG 7.1 and TG 7.5 (H&N) were primary users of the interatoll airlift, the consolidation of passenger bookings by the TCA permitted improved coordination and eliminated much unnecessary duplication. Surface transportation to and from Eniwetok Island for TG 7.1 passengers departing or arriving on interatoll flights was provided by TG 7.5 on a routine scheduled basis in conjunction with the movement of their personnel. In addition TG 7.1 passengers were placed on TG 7.5 Movement Orders which served as an aid in accounting for personnel movement between atolls during muster periods.

The following is a summary of the passenger and cargo load during a representative week in April (1-7 inclusive) while in the build-up phase of the operation:

Number of flights	28 (14 round trips)
Total passengers	366 (166 TG 7.1 personnel)
Total cargo	44,596 lb

The following is a summary of the passenger and cargo load during a representative week in May (6-12 inclusive) at the beginning of the operational phase:

[redacted]

Number of flights	34 (17 round trips)
Total passengers	422 (246 TG 7.1 personnel)
Total cargo	32,128 lb

*Last minute urgent requirements created numerous difficulties in coordination. In addition the actual handling of all airlift requirements would have been much improved if TG 7.4 had an Operations Section to receive and coordinate all airlift requirements. J-4 Section of JTF 7 attempted to fill this requirement on D-1 and shot days for Bikini Atoll shots. Unfortunately, this tended to increase the confusion by interposing an additional agency on a temporary basis, and on some occasions resulted in unwarranted delays in the emergency movement of key personnel between atolls. The system never proved able to provide this group with the timely and rapid transportation required.

*Although most requirements for interatoll airlift were satisfied, it was concluded that during the period of peak activity one or more additional aircraft would have materially increased the efficiency, safety, and general support capability. Of the four C-47 aircraft on hand, TG 7.4 was reluctant to guarantee the availability of more than two on any given day. The three C-54 aircraft assigned to Test Services Unit were not consistently available when requested, and could not be counted on. In addition, the lack of any central operations section in TG 7.4, in combination with what appeared to be a lack of coordination between Base Operations and TSU Operations, caused a certain amount of confusion and inefficiency when these aircraft were used for interatoll airlift. Because of the extremely willing attitude of most of the personnel providing the support required, the effects of these deficiencies were minimized.

3.7.5 Motor Vehicle Transportation

Motor vehicle requirements for TG 7.1 were developed after analysis of the final status reports from the various projects. Two main motor pools were operated, one on Parry Island and one on Enyu Island. The vehicle density of these motor pools was also based on the project final reports. Although the reports provided a fairly sound basic figure for establishing vehicle strength, in many instances the information was not adequate.

*It became evident during the first month of operation that the notion of providing only one vehicle for a project working alternately on both atolls

*In order to emphasize operational conclusions and recommendations, sections or paragraphs where they appear have been marked with an asterisk.

was not feasible, even though it had so been requested. The objection to this practice stems from the fact that the projects virtually never moved intact - rather they split forces and created a dual requirement.

Final requirements, as shown on status reports, were 169 jeeps, 112 3/4-ton weapon carriers, 28 2-1/2-ton 6 x 6 trucks, and 4 1/2-ton pickups. Authorization for TG 7.1 was 145 jeeps, 93 3/4-ton weapon carriers, 20 2-1/2-ton 6 x 6, and 4 1/2-ton pickups.

Some inconvenience was caused by delays in processing and delivery of vehicles. When large quantities of vehicles arrived and the TG 7.2 Ordnance Shops could not process and deliver more than 10 to 15 per day, assistance was obtained from H&N facilities. The movement of vehicles from the U. S. to the PPG was behind the planned schedule, which created numerous problems, particularly where the movement of personnel was ahead of schedule.

Maintenance of TG 7.1 vehicles on Eniwetok Atoll was accomplished by two methods. (1) All TG 7.1 vehicles on Eniwetok Island were scheduled through the TG 7.2 Motor Pool on a two-week cycle. This ensured a complete first and second Echelon Maintenance inspection every other week. Third Echelon Repair as needed on Eniwetok Island was accomplished by TG 7.2 Ordnance. (2) All remaining TG 7.1 vehicles were maintained by H&N (TG 7.5).

Maintenance of TG 7.1 vehicles on Bikini Atoll was performed by H&N on an "as required" basis. Maintenance records were kept on each vehicle and as maintenance was required the vehicles would be turned over to H&N for service.

Vehicles which were in use on the various islands of Bikini and Eniwetok Atolls were serviced by portable units, and in some cases temporary camp sites were provided with mechanics and service personnel as needed by H&N.

By July 1, a program of turn-in of vehicles to TG 7.2 was in operation. This program was designed to prevent a large back-up of vehicles awaiting entry into H&N shops for final repair prior to return to TG 7.2. Plans were made to return approximately 20 vehicles of all types weekly until the final shot, at which time the remaining vehicles would be processed as quickly as possible.

3.7.6 Intra-atoll Boat Service

Boat service was provided by a combined H&N and Navy Boat Pool. Control of the boats was maintained by a TCA designated at each atoll by CTG 7.5. At the beginning of the operational period the TG 7.5 boats were

[redacted]

assigned as follows:

Bikini	Eniwetok
13 LCM	16 LCM
4 LCU	5 LCU
5 LCU houseboats	18 DUKW
27 DUKW (includes 4 DUKW belonging to TG 7.1 projects)	

Three water taxis were delivered during the operational period and were put into service at Eniwetok as quickly as they could be readied. They were not available, however, during the critical periods when the three temporary camps were in operation. An average of two LCM's, one LCU, and four DUKW's were out of service for maintenance at any one time. The remaining boats were adequate to handle the daily loads. The boats were employed full time with many boats running into long hours of overtime.

All special trips in support of TG 7.1 were arranged for through the J-3 office. The trip was then set up with the TG 7.5 TCA either by telephone or by the use of boat slips as requested by the TCA. Scheduled water taxis were utilized between Parry Island and Eniwetok Island and also between Enyu and the ships in the Enyu anchorage.

CTG 7.2 had 7 DUKW's, used for mooring of ships and ferrying to crash boats at Eniwetok.

There were no special problems encountered in obtaining boat service. The number of boats available at each atoll proved to be sufficient for the magnitude of the operation. There was never an excess of boats during the height of the operational period and most days found all operational craft in use.

3.7.7 Interatoll Surface Lift

Surface lift between the two atolls was provided by two MSTS LST's which made approximately weekly trips as scheduled by the H&N Supply Department. Cargo for TG 7.1 was handled through the J-4 Section which arranged for the movement with H&N Supply Department. Approximately 1800 long tons of test material were transhipped from Eniwetok to Bikini during the operation. Passengers were few in number and were booked by J-3 through the H&N Personnel Department.

Surface lift was also available in TG 7.3 ships which occasionally sailed between atolls. Arrangements were made through the TG 7.3 representative at Eniwetok Atoll.

[redacted]

No particular problems were encountered with interatoll surface lift.

3.7.8 Off-atoll Activities

The initial problem met in off-atoll activities was that of emplacing project equipment and the equipment for the camp and communication facilities. Task Group 7.1 stations on Rongerik Atoll and on Kusaie Island shared the camp and communication facilities which supported the Task Force weather stations. Those on Wotho Atoll and Ujelang Atoll required their own facilities. The stations on Wake and Johnston Islands were supported by local forces. In many cases project equipment was delivered late to the PPG, which required a special trip for movement to the site. In some cases agreement had not been reached between TG 7.1, TG 7.5, and JTF 7 as to what camp and communication facilities were required and who was to pay for them. These two factors delayed the scheduling of lifts to establish the stations.

Holmes & Narver Supply Division, which controlled shipping, was forced to divert its two LST's at intervals and to arrange for repeated trips of the LSD in order to cope with the problem of getting all equipment into place. Some facilities were still in process of establishment when the operational period commenced.

*In the case of the stations on Wake and Johnston Islands, the project shipped all its equipment to Eniwetok and much of it had to be reshipped back to the stations. A direct shipment from Hawaii would have saved considerable time and shipping space.

The rotation of personnel and supply for the activities were accomplished using SA-16 aircraft. By mutual agreement those flights which involved both H&N and TG 7.1 were arranged through the J-3 office. A schedule of regular flights was established which was sufficient to handle normal requirements. Special flights were called for when an emergency arose. A representative week included five round trip flights carrying a total of 22 passengers and 7987 lb of cargo.

*If there are to be off-atoll stations in future operations, especially at places where no Task Force weather stations are contemplated, the plans for them must be finalized early. An early determination of the agency to be responsible for the camp and communications support is necessary. Permission to use the sites must be obtained from the Trust Territory organization and site surveys must be made as soon as requirements are known. A shipping schedule which permits all participants to gather their equipment in the PPG ready for movement to the off-atoll sites must be established early. This will permit the required shipping to be obtained. The key

[redacted]

[redacted]

factor to the accomplishment of the above is to ensure that each project which contemplates an off-atoll station completes its major support planning at least six months prior to the operational phase.

3.8 EVACUATION, RECOVERY, AND RE-ENTRY PLANNING

The results of the [redacted] Castle, and the locations and predicted yields of the proposed Bikini Redwing detonations made it clear that it would probably be necessary to evacuate that atoll for each Bikini shot, and that the capability of continuous operations from afloat would be necessary once the shot schedule began. Preliminary planning studies were therefore based on complete evacuation of Bikini.

J-3 was responsible for preparing detailed evacuation and re-entry plans for each shot and for supervising the execution of those plans; for supporting the evacuation, the recovery of data, and the re-entry of personnel and material; and, in coordination with J-1, for planning and executing emergency evacuation of personnel.

A comprehensive study of the instrumentation requirements was made in order to evaluate helicopter and small boat needs for operations afloat. Careful analysis of monthly status reports provided a general guide for evacuation, recovery, and re-entry planning. Detailed evacuation and re-entry–recovery plans were issued for each shot. These plans were a consolidation of event participation cards prepared to cover items of operational interest during the period covered by the check list. To ensure the validity of completed plans based on status report and other requirements, consultations were held with interested supporting agencies prior to the effective dates of the plans. This was particularly valuable in the case of helicopter and boat support and prevented unrealistic planning.

Because of the extensive instrumentation on the first two Bikini detonations and the complexity of the evacuation and re-entry problems, a chronological check list covering the period from D−5 to D+3 was used for each of those shots. Thereafter, the check lists covered the period from D−3 to D-Day. The evacuation planning check lists were, from the first, considered flexible guides; rigid adherence to predicted schedules was neither envisaged nor attempted.

Plans included consolidation of vehicular equipment in a central area for each Bikini shot. For [redacted] which caused particular concern because of predicted water wave effects), [redacted] all vehicles plus all heavy construction equipment were parked in a special area protected by a 10 ft high, rip-rapped berm in the south-central part of Enyu. Since the times of recovery and re-entry were critical, evacuation plans for

[redacted]

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[redacted]

personnel were closely correlated with their re-entry and recovery requirements. Afloat housing assignments are discussed in the following section.

As the operation progressed, the decreases in the number of camps, personnel, participating projects, and trailers and vehicles made evacuation planning and execution progressively easier. Toward the end of Redwing, a "minus one" capability was maintained at Bikini for many successive days; and a real D–1 could have been declared and evacuation could have started as late as 2100 on D–1, with a probable completion time of about 0200 D-Day.

3.9 PERSONNEL EVACUATION AND MUSTER

3.9.1 Muster

On April 12, 1956, the TG 7.1 plan for the conduct of sight-musters in the PPG was published. This plan established a Task Group Muster Officer, and two Atoll Muster Officers for Eniwetok and Bikini Atolls, respectively. The plan also provided a Muster Officer to represent each of various units and programs and to carry out the muster for his group.

Muster rolls were prepared by TG 7.1 Headquarters Commandant at varying times, depending upon the number of changes occasioned by arrivals and departures from the PPG. The first muster was conducted on April 26 and 27, 1956, as a [redacted] rehearsal, and the last one on July 21, 1956, for [redacted] During this period of approximately twelve weeks, eight different muster rolls were published.

Musters were normally conducted on D–1 in order to minimize the false starts, but on occasion musters were started as early as the late afternoon of D–2, if necessary. Where the shot was being detonated determined the time of muster and the details. Therefore, the following is a discussion of only the most commonly used procedures.

a. Shots at Eniwetok Atoll only

1. Muster of personnel at Bikini commenced at 0900 on D–1 with each Muster Officer submitting to the Atoll Muster Officer signed muster sheets for that portion of his unit he had sight-mustered. Results of the Bikini muster by line and page number were telephoned to the Eniwetok Atoll Muster Officer, who was responsible for consolidation and reconciliation.

2. Muster of personnel at Eniwetok commenced between 1200 and 1400 on D–1, depending upon the nature of the morning weather forecast, with the later time being more common to take advantage of the 1330 weather briefing. Muster Officers submitted signed muster reports.

3. Once the Muster was completed, normally about 1800, an

[redacted]

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[redacted]

account of the movements of each individual was maintained until all personnel were out of danger areas. Once this condition was met, a report of completion of the muster was submitted to CJTF Seven by the TG Evacuation Officer.

b. Shots at Bikini Atoll only

1. Muster at Bikini Atoll commenced on D–1 and was conducted concurrently with evacuation aboard ship. Task Group 7.1 had J-1 representatives aboard the USS Curtiss, USS Badoeng Strait, and the USNS Ainsworth. Each member of TG 7.1 was mustered upon boarding. This information was passed to the Bikini Atoll Muster Officer aboard the USS Curtiss, who consolidated the muster. Task Group personnel boarding other vessels were mustered by Commander, TU-3, who in turn reported to the Bikini Atoll Muster Officer.

2. Muster at Eniwetok Atoll was accomplished as in Paragraph a-2 above. Results of muster were telephoned to Bikini for consolidation and reconciliation.

3. Completion of the muster at Bikini was concurrent with completion of the evacuation. Final muster reports were then submitted by the Task Group Evacuation Officer to CJTF Seven.

c. Shots at both Atolls

1. For musters at Bikini, the procedure set forth in Paragraph b-1 above was used.

2. For musters at Eniwetok, the procedure set forth in Paragraph a-2 above was used.

3. Although the report of completion of muster was normally done by the Task Group Evacuation Officer of each atoll for his atoll only, this procedure varied considerably and depended upon the location of CJTF Seven, and which atoll was last to have personnel out of danger areas.

d. Postponements

In the event a shot was postponed after the muster was completed, an attempt was always made to retain the validity of the muster for as long as possible by keeping account of the movements of individuals. At Eniwetok, this procedure could be maintained for not more than two to three days, as the constant check on the numerous avenues of egress drew heavily on the manpower of J-1. At Bikini, the means of egress were more limited and thus this surveillance could be accomplished without any great additional effort. Nevertheless, when a new evacuation at Bikini was required, all personnel were re-mustered in the manner described in Paragraph b-1 above.

[redacted]

[redacted]

3.9.2 Evacuation

The extent of personnel evacuation at Eniwetok Atoll for Eniwetok shots depended on the magnitude of the shot. The maximum involved withdrawal of all personnel from the upper islands to Japtan, Parry, and Eniwetok with a limited number of project personnel permitted on Aniyaanii.

For shots at Bikini Atoll, all Bikini personnel were evacuated except the firing party in the bunker at Station 70 on Enyu. For [redacted] the firing party was on the USS Curtiss. Personnel were advised to take all personal belongings afloat for each shot. Average evacuation time at Bikini, including readying and buttoning up instrument stations, was eight hours.

In general, afloat housing at Bikini was assigned as follows:

USS Curtiss (AV-4) - TG 7.1 Command Section (less those at the Control Station on Enyu) and key scientific, staff section, and task unit personnel.

USS Badoeng Strait (CVE-116) - J-3 and J-1 representatives, Rad-Safe team, and persons scheduled for early re-entry and recovery by helicopter.

USNS Fred C. Ainsworth (TAP-181) - J-3 and J-1 representatives, project personnel, CTG 7.5, and H&N civilians.

USS Estes (AGC-12) - Joint Task Force Seven, TG 7.3 and TG 7.4 commanders and staffs, and Program 2 Control Center personnel.

USS Catamount (LSD-17) - Early TG 7.1 boat re-entry—recovery parties, and a small number of Rad-Safe personnel.

Assignment of cabin space was as follows:

Name of Ship	Agency Making Cabin Assignments	When Cabin Assignments Were Made
USS Curtiss	J-1 Bikini	D–2 to morning of D–1 but prior to embarkation
USNS Ainsworth	J-1 Representative on USNS Ainsworth	Same as above
USS Badoeng Strait	J-1 Representative on USS Badoeng Strait	Upon embarkation
USS Estes	Representative of CTG 7.3	Upon embarkation
Other Ships	Representative of Ship's Captain	Upon embarkation

[redacted]

Troop space (for enlisted personnel) was assigned by the J-1 representative on the USNS Ainsworth. Task Group 7.1 was also responsible for assigning cabin and troop space aboard the USNS Ainsworth for personnel of TG 7.2, 7.3, and 7.4. Approximately 100 such spaces were required for each evacuation. On all other ships, troop space assignment was accomplished by a member of the ship's complement.

*The number of personnel evacuated at Bikini varied with project participation but generally decreased from the peak of 488 reached at Cherokee (see Table 3.4). Numbers evacuated to the USS Curtiss and USNS Ainsworth were substantially lower than would have been required if it had been necessary to operate from aboard ship for prolonged periods. Except on the carrier, which was badly overcrowded, billeting facilities afloat were adequate.

3.10 PROPERTY EVACUATION

J-4 made pre-shot surveys to ensure that all excess equipment and material had been evacuated from the shot island and those areas subject to significant effects. J-4 assisted H&N in getting material to the beaches and in relocating it when it was received on the base islands.

Vehicles, trailers, and other equipment which would no longer be required at Bikini after a particular shot were turned over to J-4 prior to the shot for further shipment to Eniwetok.

The shot phase evacuation of scientific trailers involved, besides the users, J-3, J-4, J-6 and H&N. In general, the procedure was for J-3 to determine when the scientific users could afford to release the trailers, particularly those aboard houseboats, and also to determine the facilities required during evacuation and re-entry, such as power for dehumidifiers and air conditioners, water for Photo Lab tanks, etc. The actual movement of the trailers was accomplished by H&N personnel under J-4 supervision, and physical facilities were developed by J-6.

3.11 OPERATIONS AFLOAT, RECOVERY AND RE-ENTRY

3.11.1 Operations Afloat

*Since Enyu, the main Bikini base, was the only Bikini island not contaminated by Redwing fallout, and since its partial inundation from the effects of [redacted] was not crippling, operations afloat never lasted longer than overnight. Of course, such remarkably good luck cannot be counted on in future operations, and the capability of prolonged operations from afloat when large shots are fired at Bikini must be maintained.

TABLE 3.4

BIKINI EVACUATION

Vessel	Cherokee (May 20) Cabin Class	Troop Class	Total	Zuni (May 27) Cabin Class	Troop Class	Total	Flathead (June 11) Cabin Class	Troop Class	Total	Dakota (June 25) Cabin Class	Troop Class	Total	Navajo (July 10) Cabin Class	Troop Class	Total	Tewa (July 19) Cabin Class	Troop Class	Total
USS CURTISS	53	22	75	72	24	96	58	19	77	55	17	72	62	18	80	42	18	60
USNS AINSWORTH	169	56	225	117	56	173	97	48	145	83	51	134	60	44	104	58	45	103
USS BADOENG STRAIT	56	17	73	68	14	82	37	11	48	23	7	30	35	11	46	27	9	36
USS ESTES	18	3	21	16	3	19	15	3	18	2	2	4	13	3	16	15	3	18
USS McGINTY	3	0	3	3	0	3	3	0	3	0	0	0	3	0	3	3	0	3
USS CATAMOUNT	12	9	21	1	4	5	3	4	7	3	6	9	1	4	5	1	4	5
M/V HORIZON	26	0	26	26	0	26	26	0	26	0	0	0	24	0	24	24	0	24
USS SIOUX	3	0	3	4	2	6	3	0	3	0	0	0	2	1	3	3	0	3
USS KNUDSON	6	0	6	10	2	12	0	0	0	0	0	0	6	0	6	6	0	6
USS McKINLEY	3	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
YAG 39	8	2	10	9	2	11	8	3	11	0	0	0	7	3	10	7	3	10
YAG 40	13	2	15	14	2	16	15	2	17	0	0	0	12	2	14	14	2	16
LST 611	1	3	4	4	2	6	3	2	5	0	0	0	2	3	5	2	3	5
USS SILVERSTEIN	3	0	3	3	0	3	2	0	2	0	0	0	4	0	4	3	0	3
TOTAL	374	114	488	347	111	458	270	92	362	166	83	249	231	89	320	205	87	292

As stated before, Redwing planning provided such a capability; and when the CTG 7.1 operated from the firing bunker on Enyu, as he did on all Bikini shots except [redacted] he stationed one of his deputies aboard the USS Curtiss to ensure that operations could continue without interruption if communications failed or if re-entry proved impractical.

*Communications by Motorola and AN/VRC-18 between ships and between the Curtiss and the firing bunker were generally excellent when the ships were at anchor, but deteriorated as the ships went to sea and became separated. Communications by the AN/TRC shipboard telephone equipment were generally unsatisfactory.

After [redacted] the Romurikku complex was untenable for permanent occupation. Therefore, operations ashore on that complex were supported from four H&N LCU's, which had been converted to houseboats for this purpose and assigned to Programs 13, 15 and 18. A YCV, used as a helicopter barge, served both the houseboats and the shot barges off Yurochi. An LCU houseboat supported the shot barge. Movement to and from the houseboats to barge or complex was by helicopter or by LCM. Each houseboat had an assigned DUKW.

3.11.2 Eniwetok Recovery and Re-entry

Re-entry and data recovery problems at Eniwetok Atoll were simplified by having a permanent base of operations on Parry. Support craft and personnel necessary for each recovery operation were alerted and briefed prior to shot day. Following a radiological and damage survey conducted by CTG 7.1 and the Rad-Safe Officer, a recovery timetable was established. Factors such as station location, nature of mission, and the urgency of obtaining the data determined the departure times of the missions.

Due to a lack of helicopters for the first event [redacted] the recovery was primarily by marine operation. Four DUKW's were moved to Runit by two LCU's. The LCU's served as a base of operations from which the DUKW's were dispatched to stations located on the island and on the reef north of Runit. Limited Rad-Safe supplies were also available aboard the LCU's. This method of recovery was found to be successful within the limitations of the speed of the craft. The capability of shuttling samples and personnel from LCU to Parry by LCM and by helicopter was maintained. The helicopter shuttle was used to expedite sample return to meet Flyaways returning to the U. S. Although this capability was not used on [redacted] it proved very successful on subsequent shots.

Recovery on [redacted] and later shots was primarily by helicopter. However, recovery of reef stations was always done by a DUKW

[redacted]

operating from an LCU with sample return from the LCU to Parry by helicopter. A limited number of recoveries were made using trucks and heavy equipment, such as tractors. Recovery by this means was limited to the complexes on which safe parking was possible during the shot. This system was successfully used on the Rojoa complex for recovery of the detector cable lines; however, prompt recovery on the Teiteiripucchi complex by this method was unsuccessful due to contamination of the tractor and land areas. This recovery was delayed for several days and, eventually, was accomplished using substitute equipment.

Precautionary measures were observed on those missions entering hot areas where engine failure or other mishaps could result in dangerous radiation overdose. Recovery teams and helicopter or boat crews were thoroughly briefed on the procedures to be followed and the signals to be used, and stand-by helicopters and boats were provided.

At Eniwetok Atoll, the main camp on Parry was not evacuated for any of the events. Up-island camps were evacuated as required by specific events. Re-entry consisted of postshot recovery missions as governed by the radiological conditions; and as levels went down, by the re-entry of work parties preparing for subsequent shots; and in the case of Runit, by re-establishment of the camp on a limited basis five days after [redacted] was fired.

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3.11.3 Bikini Recovery and Re-entry

The scope of the data recovery problem at Bikini depended on the number of experimental projects participating on a given shot. Once the early recoveries were completed, later recoveries phased into and became a part of the general re-entry, which involved, among other things, the early transfer of control of operations from ship to shore without interruption and without disruption of transportation services, and re-establishment of camp services as soon as possible.

The procedure used to accomplish this recovery—re-entry was, in general, as follows. When the Badoeng Strait had closed to within about five miles of Enyu Island (usually at approximately H + 1-1/2 hours), two radiological survey helicopters were launched (via USS Curtiss for Rad-Safe Officers and the CP on Enyu, as appropriate, for CTG 7.1) to obtain information concerning radiological situation at Enyu and in the lagoon, and, as conditions permitted, general lines and levels of contamination throughout the atoll. As soon as definite indication was received that Enyu and the anchorage were clear, permission was obtained to proceed with early recovery missions and with the initial phase of re-entry. By mutual agreement,

[redacted]

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the priority for re-entry on helicopters was (1) ten 7.4 men to activate the Enyu Airstrip; (2) five 7.1 men to establish the J-3 Section ashore; (3) twenty 7.5 men to begin essential camp services ashore; and (4) seven 7.1 men to man Rad-Safe check points. In all cases, this ship-shore shuttle was completed before the declaration of Re-entry Hour.

Recovery operations varied from shot to shot and conduct of them was dependent upon the radiological conditions resulting from the event and upon the extent of participation.

The greatest participation was on the DOD effects shot, [redacted] (Cherokee). A very tight recovery schedule was anticipated for shot day as the schedule called for a full commitment of all available helicopters between 1200 and 1500 hours. The total absence of detectable contamination, however, alleviated the demand for helicopters in several ways. First, the need for empty safety aircraft, which were scheduled for about 50 per cent of the early missions, was obviated. Second, 60 per cent of the missions devoted to recovering fallout samples were cancelled because of the obvious fact that there was nothing to recover. One carefully rehearsed mission to the intended GZ area to recover neutron threshold samples was greatly simplified, inasmuch as only one recovery team was required rather than two, as had been anticipated. Several Cherokee + 1 day missions were accomplished on Cherokee-Day as a result of availability of helicopters.

Recovery missions for [redacted] were performed more nearly as scheduled, with one important exception. Recoveries scheduled from the Eninman complex were delayed for one full day because of initially high radiation readings in the area. Helicopter utilization was at the maximum owing to the extensive participation on this shot. The number of projects participating on [redacted] was about 80 per cent of the number for [redacted]

Participation on subsequent events was about 50 per cent or less than on [redacted]

Initially, camps on the Bikini Atoll were located on the Romurikku complex, the Eninman complex, and on Enyu. After the first Bikini event [redacted] the camp on Romurikku was not re-established, so re-entry to that location was not made on a permanent basis. Following the second Bikini event [redacted] the Eninman camp was not re-established. Thus, all subsequent postshot re-entries were made to the camp on Enyu and to the houseboats.

Once it had been determined that Enyu was not contaminated to a level which prohibited 24-hour occupancy, general movement of personnel was initiated. After the re-entry of the USS Catamount (LSD-17) into Enyu anchorage and the discharge of the LCM's, scheduled water taxi service was established. This was generally done by H + 7 hours. The LCM's on a half-hour schedule provided a continuous ship-to-ship-to-shore circuit.

The system operated extremely well and movement of personnel ashore was rapid.

Staff sections and Rad-Safe were normally fully operational ashore no later than 1200, and a noon meal was served at the Enyu mess hall to the early re-entrants. In order to decrease the load on the camp facilities, most of the Enyu residents ate lunch aboard ship on shot days. The camp was normally fully operational again by H + 8 hours.

3.12 SAMPLE RETURNS

Prior to the overseas phase of Redwing, a study of the transportation requirements for delivery of radioactive samples to the ZI laboratories was submitted to JTF 7. As a result of this study and subsequent discussions, the following flight schedule for return of samples was established:

Flyaway 1	H + 6 to 10 hours
Flyaway 2	H + 24 to 36 hours
Flyaway 3	D + 4 to 5 days

In addition to these flights, which were to be made after most of the shots, provisions were made for the transport of samples by first priority MATS flights when necessary. During the course of the operation, this service was not utilized to any great extent as samples from one shot were airlifted with samples of a subsequent shot, resulting in the use of fewer aircraft than originally scheduled.

Flyaway aircraft were R6D, capable under normal wind conditions of arriving at Albuquerque within 24 hours after take-off, including a 30 to 40 minute refueling stop at Hickam AFB.

The total number of seats available on each Flyaway for monitors, couriers, passengers, and the sample-return project officers was held to a maximum of ten. All personnel were customs-cleared at Eniwetok by a member of MATS who was authorized by the U. S. Customs Service to perform that duty.

Staff handling of samples included the combined efforts of J-3 and J-4 of TG 7.1, in conjunction with the J-4 Section of JTF 7. J-3 coordinated and supervised the recovery, transportation, and turnover of samples to J-4.

The J-4 Section, through its representative on Eniwetok, received the radioactive samples from the projects, made sure that they were properly packaged, marked, and monitored, and informed JTF 7 of the load and estimated time of departure of the aircraft. Each Flyaway aircraft was assigned a Sample Return Project Officer, whose responsibility was the delivery of each sample to a representative of the laboratory concerned. All

[redacted]

radioactive samples were manifested by the J-4 Section, listing project, box number, weight, radiation level, monitor's name, and destination airport. Two copies of this manifest accompanied the Flyaway and were also used as a receipt for samples at each en-route stop. One completed copy was returned to TG 7.1, J-4 Section, for file and the other retained by the Sample Return Project Officer as his final receipt. The J-4 Section of TG 7.1 dispatched a message to each laboratory having samples aboard, giving estimated time of arrival of the aircraft, so that the representative could meet the aircraft and assume custody of the samples.

The particulate cloud samples were normally split for transport on two planes. The bulk of these samples departed on Flyaway 1 while the "hold backs" were placed aboard Flyaway 2. LASL, UCRL, and AFOAT-1 had primary interest in these flights. Flyaway 3 also carried samples for the following laboratories: NRDL; Army Chemical Center; ANL, and NYOO. On those occasions when it was necessary for Flyaway 1 to continue to the eastern laboratories after making the first stop at Albuquerque, samples for AFOAT-1 and UCRL were flown to McClellan and Alameda by AFSWC planes. This arrangement was very helpful in expediting samples to laboratories.

The sample return program was successful in every instance, performing its function on or ahead of schedule and without mishap. The number of aircraft assigned and the number of flights scheduled were both ample to meet the needs of the using agencies.

For a shot schedule of 17 events, 36 Flyaway missions were planned on the assumption that no consolidation of requirements could be made. However, with the dual shot capability, which resulted in two shots being fired either on the same day or within a day or so of each other, of the 36 Flyaway missions planned, only 29 were required.

3.13 COMMUNICATIONS

3.13.1 Teletype and Mail Service

On January 23, 1956, the TG 7.1 Mail and Records Section for Operation Redwing opened at Parry Island, Eniwetok. On February 22, 1956, a branch office was opened at Enyu Island, Bikini. When Bikini was evacuated, the Enyu Mail and Records Section operated aboard the USS Curtiss. Civilian and military personnel were utilized to man the two offices. The maximum strength at Parry Island was eight; at the Enyu Island office it was three. From March 1, 1956, until July 21, 1956, at Bikini, and until July 26, 1956, at Eniwetok, the Mail and Records Section operated 24 hours a day, seven days a week.

[redacted]

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Teletypes. Teletype service was furnished at both locations for the entire TG and accounted for the greatest portion of the total work load. During Redwing, the following teletype traffic was handled by the two offices:

Classified Outgoing	1,300
Classified Incoming	1,950
Unclassified Outgoing	4,840
Unclassified Incoming	5,860
Total	13,950

Official Correspondence and Personal Mail. The TG Mail and Records Section normally handled official correspondence only for LASL, NRL, and UWFL. However, service was provided for UCRL, DOD, SC and EG&G until these organizations had their own mail system in operation. Personal mail was handled in a like manner.

Interatoll Mail. The TG 7.1 Mail and Records Section operated a daily pouch between the mail rooms at Eniwetok and Bikini Atolls. This service was available to all units of the TG and permitted the rapid transmission of unclassified and classified (up to and including Secret RD) correspondence between sites.

Reading File. A TG Reading File was maintained by the Parry Island office. This file consisted of copies of outgoing correspondence and teletypes, and was circulated among the headquarters staff sections.

3.13.2 Other Communications

The CJTF 7 assigned the following communication responsibilities to TG 7.1 for Operation Redwing:

a. Provide, operate, and maintain special communications-electronics equipment required for conduct of scientific test programs.

b. Initiate voice-time broadcast for all elements of the Task Force.

c. Prepare a TG 7.1 Telephone Directory.

d. Coordinate special communication requirements originated by subordinate task units.

The CTG 7.5 provided long range communications, including cryptographic service for this task group. The planning for communication facilities and services for Redwing was based on lessons learned during Castle, plus requirements submitted by the various projects of this task group in their monthly status reports.

In order to eliminate mutual interference on long range circuits, the receiving antenna farm was moved from Eniwetok Island to Japtan Island and the transmitter farm was re-engineered to provide for a maximum number of transmitters. During the interim phase, experiments were conducted by TG 7.5 which proved the feasibility of extending VHF range to cover the Bikini Atoll–Eniwetok Atoll area. This VHF link has given excellent service and, as a result, communication between Eniwetok Atoll and Bikini Atoll was the most reliable of all circuits. In addition to telephone and teletype circuits carried on this link, in June of 1956 the remaining channels were utilized to extend the range of voice ciphony equipment from the Bikini to the Eniwetok area.

Off-atoll communication circuits were required to provide communication service to Wotho Island, Wotho Atoll; Wake Island, Marshall Islands; Eniwetok Island, Rongerik Atoll; Kusaie Island, East Caroline Islands; and Ujelang Atoll. Communication equipment, cryptographic equipment, and personnel required for this service were provided by CJTF 7 Weather Detachment. The JTF 7 Net was used for Kusaie, Rongerik, and Wake, while at Wotho and Ujelang communication stations were established to serve the projects. In order to provide cryptographic training and to provide time studies for messages on off-atoll circuits, a series of drill messages was sent during the month of April 1956. These drill messages disclosed message handling weaknesses which were corrected prior to the first event of the series.

Short range communications for TG 7.1 were provided by EG&G (TU-7.1.5) using commercial equipment, and TG 7.5 using DOD equipment. Antenna location was given prime consideration in the planning phase of Redwing. Shipboard antenna and coaxial cabling were installed at West Coast shipyards on the large vessels. Equipment was installed as ships arrived in the FA.

Installation of antennae and leads at locations in the PPG began in January 1956. As stations were completed, masts were erected and antenna lead-in wire installed. As users arrived, their sets were installed.

This task group used 134 Motorola transceivers, 34 remote units, 28 Handi-Talkies and 11 pack sets to activate eight voice nets. In addition to the above commercial equipment, approximately 40 AN/VRC-18 and 20 AN/PRC-10 units were utilized to cover four nets serving DOD projects.

*Operation Castle proved the need for an adequate TG 7.1 control point afloat, in addition to the control points ashore on Enyu Island and Parry Island. After the USS Curtiss (AV-4) was designated CTG 7.1 Command Ship, plans were submitted for a complete Control Station to be located just aft of Flag Plot on the 03 Deck. Prior to the Curtiss' departure for PPG, this installation was completed. This control point was used to remotely fire [redacted] and was in stand-by condition for all other Bikini events.

A teleconference capability was established from Parry Island to Enyu Island and USS Curtiss (AV-4) in the PPG. Additionally, there was the

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capability of telecon between Parry Island and Los Alamos, New Mexico. By utilizing re-encryption off-line and a TWX circuit, this second telecon capability was extended to Livermore, Calif. These circuits, which were cleared for Top Secret RD, proved especially useful during the months of April and May, 1956, and relieved an overloaded unclassified telephone net.

*Operation Redwing again pointed out the need for increasing the telephone plant at Parry Island. The presently installed 270-line manual switchboard is entirely inadequate to meet the needs of JTF 7. One hundred and twelve main lines were allocated this task group at Parry Island. In order to meet requirements of users, it was necessary to assign as many as five extensions on numerous main lines. The Parry Island–Los Alamos unclassified telephone circuit voice quality was so poor that it received almost no use during the operation.

It developed that radio silence was required in the Eniwetok Atoll area on all frequencies below 200 Mc, in order that certain scientific projects could be performed. The J-5 Section of Headquarters JTF 7 provided excellent service in locating and, by judicious reallocation of frequencies, eliminating objectionable interference. EG&G performed a study of frequencies in the 150 to 160 Mc band and, as a result of this study, submitted recommended frequencies for TG 7.1 scientific voice nets. It is interesting to note that mutual interference between frequencies in this band was nonexistent. Although many more frequencies were used during Redwing than in previous operations, radio interference showed a marked decline.

There were made available to TG 7.1 for Operation Redwing two of the latest type ciphony equipment held by the National Security Agency, namely the AFSAY D-806-A and D-808-A. Owing to poor voice quality of the D-806-A, this equipment was used for approximately 57 min during a two-month period. As a result, the D-806-A was released by TG 7.1 on June 13, 1956. The D-808-A, a laboratory model, proved a most acceptable unit. During the last week of May and first week of June, tests were conducted which proved that the D-808-A could be used with the VHF interatoll telephone and teletype circuit without sacrifice of channels in use. The D-808-A net was then changed to provide sets at Parry Island, Enyu Island, and USS Estes. Remotes were installed at ground stations and eventually all three locations were netted. This circuit proved most reliable, and provided a clear net, secured for Secret RD, so essential to operations of this type.

The voice count-down for each event was broadcast on 245.0 Mc, 168.975 Mc, and 154.47 Mc. The requirement for 245.0 Mc broadcast was dictated by the conversion of all aircraft to UHF communication equipment. CTG 7.3 required a simultaneous voice count-down on 168.975 Mc. Scientific stations used receivers from previous operations crystallized on 154.47 Mc.

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The TG 7.1 voice count-down receiver was used to drive TG 7.2 and TG 7.5 public address systems on Eniwetok and Parry Islands at Eniwetok Atoll.

JTF 7 utilized approximately 400 frequencies in the PPG. TG 7.1 was assigned about 160 frequencies of this total. The greatest users of frequencies were Program 5 (Effects Aircraft) and Program 2 (Fallout). The 215 to 260 Mc telemetering band was particularly crowded, requiring maximum coordination to meet requirements of users. After arrival in the PPG, it became necessary for CJTF 7 to reallocate certain of the lower frequencies because of harmonic interference.

The complexities of JTF 7 communications require an abnormal amount of coordination. Experience has proved that this coordination can best be accomplished by personal conferences, and as a result many trips are required to be made by the TG 7.1 Communications Officer.

3.14 SECURITY

As during Castle, only certain aspects of the security function were a responsibility of TG 7.1. The security liaison function was delegated to the Classification Officer, and the implementation of personnel-security policies was delegated to J-1. Problems concerned with these aspects are discussed below.

3.14.1 Predeparture Security Indoctrination

After receiving the comments of TG 7.1, CTG 7.5 on February 1, 1956, issued the "Security Indoctrination Letter for Task Group 7.1 and 7.5." Subsequent to that date, each member of TG 7.1 was required to have on file with the headquarters a completed Security Indoctrination Certificate prior to being authorized travel to the PPG. Completed certificates on file with the Task Group number 2366.

3.14.2 Transmission of Classified Documents in the Personal Custody of Individuals

After securing the concurrence of CTG 7.5, TG 7.1 implementing procedures concerning this subject were published on July 7, 1955. Generally, they followed the procedures observed during Castle, in that hand-carrying of classified documents between the PPG and other locations was discouraged, but was permissable if operational necessity so required and if certain security measures were observed. On November 25, 1955, Amendment No. 1

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was issued. In that document security requirements for small quantities and bulk shipments of documents were differentiated. On April 26, 1956, Amendment No. 2 was issued. This document expanded the scope to include "Classified Material" as well as documents; furthermore, the policy for the transmission of classified documents and materials within the PPG was set forth. By the end of Redwing, twenty-five TG 7.1 personnel were authorized to transmit classified documents/material in their possession to or from the PPG.

*During the operation, a major difficulty arose on the official mail shipment of bulky material. The Post Office Department diverted such mail to the Customs Office at the port of entry nearest to the delivery point in CONUS, requiring the addressee to recover the package mail there. The resulting delay interfered with the evaluation of test data in some situations. Although the problem was referred to the Washington level, no solution was obtained. Instructions were received in the field to work out some technique to get the bulk shipments into the U. S. by some other method than mail channels. There were insufficient funds and personnel for couriers; hence it was necessary for TG 7.1 to request civilian contractor employees to carry the packages through customs at Honolulu and then arrange for mailing there. That practice is, of course, wholly inconsistent with standing AEC instructions on the personal carrying of classified materials and has undermined established practices that have been repeatedly urged in security education programs. It is imperative that the Washington level overcome this anomalous situation before another operation is undertaken at the PPG.

3.14.3 Access to Restricted Data

Concerning exchange of Restricted Data between DOD and DOD-contractor participants and AEC contractors, it was determined that all DOD and DOD-contractor personnel required certification in accordance with Chapter 2318, Atomic Energy Commission Manual. Accordingly, no travel to the PPG was permitted until proper certification was on file with TG 7.5. Certification for personnel of TU-3 was accomplished by Commander, Field Command, AFSWP, with liaison channels established with J-1 of TG 7.1. For other DOD participants, certification was accomplished by JTF 7, normally with concurrence of J-1 of TG 7.1. Only when certification was made a matter of record with TG 7.5 was this portion of individual clearance for the PPG deemed completed. As of the end of the operation 876 DOD personnel were authorized access to Restricted Data by Field Command, AFSWP, and 268 by TG 7.1, making a total of 1,144.

Generally, certification was for access to Sigma 4 information. Only

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in a few instances when circumstances required were military personnel authorized access to Sigma 14 information.

Several problems arose during the operation relative to the basis for access to Restricted Data. To illustrate, a few examples will be given.

The most disconcerting related to the visits of the VIP parties. At the beginning of the operation, the personnel of the VIP visiting groups arrived with Sigma 14 or Sigma 4 clearances, in roughly equal proportions. In order to determine what local access should be given, a talk by William E. Ogle was drafted and approved by General Starbird, in which information relative to the weight, size, and [redacted] on the several devices was specifically itemized. Some technical description of the operation of the devices and the diagnostic experiments was also included. It was determined that the contents of this talk could be given to the VIP visiting groups even though certain members thereof had arrived with only a Sigma 4 clearance. In addition, these VIP groups were authorized to have access to the external appearance of each of the devices.

Whether or not it was so intended, these standards were apparently applied internally within the Task Force organization as setting the maximum limit of Sigma 4 clearance. The VIP parties had included in their membership many observers whose positions in the home organization were well known to members of the Task Groups. Hence, some standard of need-to-know was also established by the membership of these VIP parties. Subsequent instructions from AEC, Washington Headquarters, indicated that there was some doubt as to the propriety of the initial Washington approvals on access to the external appearances of the devices, but these subsequent instructions in no way modified the approved talk on technical aspects.

*It is recommended that a better screening be attempted at the Washington level in the declaration of membership in VIP parties and the assignment of Sigma categories. Furthermore, it is suggested that the amount of weapon data approved for such visitors either be materially reduced, or that only Sigma 14 approved visitors be included in the VIP parties. Another possibility would be to divide the parties into categories of access and not attempt to brief, in a single briefing, visitors with such a diversity in category access. Furthermore, VIP and technical observers should not be sent on test operations for routine indoctrination that could more easily be handled in CONUS. Many requests were received from individuals, who apparently had a need-to-know, for access to the assembly building and the shot barges when the individuals could more readily obtain that information at Sandia Base or one of the weapon research laboratories. The workers at the PPG were operating under less than ideal conditions and under the strain of a test operation with deadline schedules, so that observers become something of a nuisance and safety problem.

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*Another example might be the number of people permitted continuing access to the assembly area and shot barges who have only incidental need to visit these highly classified and safety hazard areas. Because of their limited knowledge of the activities, the casuals threatened to cause operational difficulties by tripping over cables, lines, and other essential connections. Access to these areas should not be considered as a matter of prestige, but as a matter of necessity.

*In line with the foregoing comments, a further suggestion is made as to the marking of badges. It has been the general rule that Q-cleared or Top Secret cleared individuals may have access to Restricted Data. The nature of PPG working premises, with only partial partitions which permit ordinary conversation to be heard throughout a building, makes it almost impossible to prevent Restricted Data from being heard by visitors to the Administrative Compound. However, access has been granted to the Administrative Compound to individuals who were not authorized access to Restricted Data. It has also been noted that individuals having Top Secret clearance would also have the Sigma category access indicated on their badges, whereas those with Q clearance had no indication of Sigma category. In addition, as noted above, some individuals had a military clearance indicated on their badges, but no Sigma category. It would seem more reasonable to adopt a uniform practice of indicating Sigma category on all badges. This would require the assignment of a Sigma category number to indicate "No access to Restricted Data." It is realized that the assignment of a Sigma category does not authorize all information within that category, but only that portion for which the individual has a need-to-know, but it does set a maximum limit for access. The Security Liaison Office of TG 7.1 in the second half of the operation was used by members of the Task Group for receiving assurance that there was a bona fide need-to-know on each individual request for access.

3.14.4 Exclusion Areas

Exclusion areas and physical security thereof were a responsibility of TG 7.5. As TG 7.1 had prime interest in exclusion areas, all recommendations for access were sent to TG 7.5 through TG 7.1 for the latter's concurrence.

Number of personnel authorized continuing access to the Exclusion Areas is as follows:

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Station/Area	JTF 7	TG 7.1	TG 7.5	H&N	Total
Assembly Area	15	178	7	45	245
Barge Slip, only	0	193	0	90	283
CMR Area	0	243	6	92	341
Station 1 (Kickapoo)	14	20	0	8	42
Station 2 (Yuma)	0	15	0	0	15
Station 3 (Mohawk)	0	41	0	0	41
Station 4 (Inca)	0	29	0	0	29
Station 6 (Erie)	15	256	4	9	284
Station 7 (Blackfoot)	15	111	3	8	137
Station 10 (Huron)	12	37	0	15	64
Station 11 (Navajo)	14	63	2	18	97
Station 12 (Apache)	0	54	0	14	68
Station 13 (Flathead)	15	96	3	15	129
Station 14 (Dakota)	14	63	3	18	98
Station 15 (Tewa)	0	33	0	18	51
Station 18 (Cherokee)	0	25	2	0	27
Station 22 (Zuni)	0	177	4	5	186
Station 23 (Seminole)	15	256	4	11	286
Station 24 (Lacrosse)	0	268	4	8	280

3.14.5 Clearances

Joint Task Force Seven SOP 205-3 required all participants in TG 7.1 to possess either a Secret or Top Secret military clearance or an active Q clearance. Prior to the issuance of any orders permitting travel to the PPG, J-1 of TG 7.1 was required to have verification that the traveler possessed the necessary clearance. The system used was as follows:

a. The existence of a Q clearance was determined from the Status Reports. This information was periodically compiled and submitted to TG 7.5 for verification. TG 7.5 verified the existence of an active Q, and so informed J-1, TG 7.1.

b. Verification of military clearances for DOD personnel under the operational control of TU-3 was accomplished by Field Command, AFSWP. As the AEC Form 277 submitted by Field Command contained the military clearance, a copy of this was sent to J-1, TG 7.1, and constituted certification of the military clearance.

c. Verification of the military clearance of DOD personnel on duty with TG 7.1, other than TU-3, was a responsibility of the Military

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Executive of J-1. In some instances it was necessary for the Task Group to grant military clearances. To permit this, the Military Executive was designated a member of the J-2 Section of JTF 7 and granted clearances in the name of the Commander, JTF 7.

d. J-1 performed additional duties concerning military clearances as liaison between TG 7.1 and AEC security representative at Albuquerque Operations Office, Los Alamos Area Office, and San Francisco Operations Office. Further, J-1 granted or verified crypto clearances necessary for the operation of the DOD portion of the AEC Communication Center at Los Alamos.

A compilation follows:

Q clearances verified		1641
Military clearances verified by Field Command, AFSWP	Secret	678
	Top Secret	186
Military clearances verified by Military Executive of J-1, TG 7.1	Secret	207
	Top Secret	68
Military clearances granted by Military Executive of J-1, TG 7.1	Secret	7
	Top Secret	24
Crypto clearances granted by Military Executive of J-1, TG 7.1		2

3.14.6 Badge Requests

The issuance and control of badges for TG 7.1 was a function of TG 7.5. However, all requests for badges were submitted through J-1, TG 7.1. J-1 assumed the responsibility of ensuring that the request was prepared properly, accompanied by a photograph, and that the individual had either a minimum clearance of military Secret and had been certified for access to Restricted Data, or a verified Q. During Redwing, a total of 2307 badge requests were submitted to TG 7.5 by TG 7.1.

3.14.7 Compliance with CINCPAC Serial 020

A total of 3465 clearances were accomplished under the provisions of CINCPAC Serial 020. Of these 1730 were cleared by electrically transmitted messages and 1735 by mail, being listed on four different rosters. Duplication in clearing amounted to about 35 per cent and was attributable to retransmission resulting from nondelivery to addressees and to the necessity for clearing by electrical means when the receipt of letter rosters by addressees was delayed.

3.14.8 Security Briefings

By agreement, all TG 7.1 personnel were given a security briefing by TG 7.5 upon arrival at and prior to departure from the PPG.

3.14.9 Security Posters

A total of 1075 different types of security posters were received from JTF 7. These posters were distributed to 20 different Task Group organizations. An additional 500 posters were placed throughout the various TG 7.1 offices in the PPG.

3.14.10 Security Violations

A total of 35 security violations were committed by TG 7.1 personnel. The nature of the violations has been within two categories: (1) unlocked and unattended repositories, and (2) classified documents left loose on desk tops, desk drawers, trays, and in one incident documents were found in a wastepaper basket. The following is a breakdown of the violations by type and unit

Unit	Unlocked Repositories	Loose Documents
TG 7.1 Staff	5	9
TU-1	2	
TU-2	3	
TU-3	8	5
TU-4	1	
TU-5	1	
TU-8	1	
TOTAL	21	14

3.14.11 Quickie Movies

The determination of the necessary security measures was accomplished

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by agencies outside of the Task Group. The J-1 Section disseminated information on approved procedures to the two task units responsible for the preparation of the Quickies.

3.14.12 Summation

The personnel and information security policies for Redwing originated with JTF 7 and TG 7.5, and in general the views of TG 7.1 were secured prior to announcement. Once the policy was established, TG 7.1 became responsible for its implementation.

3.15 CLASSIFICATION AND RELATED ACTIVITIES

3.15.1 Classification

In Operation Redwing, the Classification Office of TG 7.1 for the first time did not have the over-all responsibility for classification in JTF 7. However, for about one month during the operation, that function was temporarily assigned to the Classification Office of TG 7.1.

Personnel of the Classification Office included Captain Frederick A. DePalma, Field Command, AFSWP (TU-3), and John M. Harding and Ralph Carlisle Smith, LASL.

The PPG Classification Guide and its unclassified extract were drafted originally by the TG 7.1 Classification Office. With changes approved by the AEC and DOD it was distributed by JTF 7, and in its final form included new and generally more realistic grading on several topics, thus recognizing publicly available knowledge and existing practices.

Unfortunately, at least one topic in the PPG Classification Guide received interpretations from outside the Task Group that confused the situation and, to a large extent, destroyed the effectiveness of the more realistic approach in the guide. The most significant of these confusing interpretations related to proposed shot dates, actual shot dates, and numbers of shots. A number of unclassified topics became Confidential Defense Information by a literal interpretation of topic 6.4.1 which relates to the fact of a detonation being classified until officially announced. Therefore, during the operation, open communication on these unclassified items was prohibited since it would indicate the fact that a shot had been detonated.

*It is seriously questioned whether the fact that a detonation has occurred really affects the national defense and security if publicly revealed. As a matter of fact, the information is readily available to competent observers. Shots of significant yields have been routinely announced by the

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Japanese. Furthermore, the fact of a detonation can be, and has been, noted long range by a brief interruption in all radio communications, which occurs only at the time of a detonation to prevent interference with experimentation. A continuous signal is transmitted on at least one long range radio link from Eniwetok to Los Alamos except for the brief interruption at shot time. It is possible, of course, to have identical interruptions at approximately the same time each day, but the Japanese have been able to detect shock waves and report the fact of detonations of substantial yields without the use of this signal interruption. Such observations have also been made by nonparticipating personnel on previous PPG operations.

*Unless there is a definite substantial security benefit, it is strongly recommended that the mere fact of a detonation need not be considered classified, even though an official announcement is not made. This would not authorize public release of the detonation until official announcement; however, it would materially relieve the unnecessary security interference with the operation, and at the same time minimize the resulting disrespect of real security matters by their dilution with psuedo-security matters.

The situation on proposed shot dates, specifically the D–3 to D–1 dates, is of even less significance because there are always many more such dates than actual detonations. A completely anomalous situation has arisen on this score. In preparation for a shot, it is necessary to have conspicuously posted on blackboards, at several points in the compound, identification of shot name, shot date, and atoll location for all forthcoming detonations at least from the D–3 to D–1 stage. If such information were placed on a piece of paper and left unsecured in an office, an individual would be charged with a security violation, but the identical information remains posted 24 hours a day in at least two locations within the same administrative compound.

Furthermore, a mimeographed announcement is placed on every bed on each atoll at a fixed time before a detonation, indicating that a shot will be detonated and at which atoll. The night before the shot, a sound truck travels through all open areas announcing the exact date and time of detonation and the required safety precautions, which to a large extent are a function of yield and location of the shot within the atoll. Also, for operational reasons, including safety, open radio circuits of presumably short range are used to communicate within and between the atolls giving such information.

*The Task Force has ruled that the information is unclassified at the atoll but Confidential Defense Information outside the atoll. It is questioned whether such information may retain two separate classifications, and, even if legally justified, whether or not it is reasonable to expect the large number of individuals of varying background and access to realize that such publicly available information is still classified, or that there is a difference as to who you are or what position you hold in determining whether you may waive standing security requirements.

In a similar vein is the classification of the fact of an airdrop. Experience has demonstrated that the crew of a drop aircraft operates under such pressure during a drop test that code communications are not practical for transmitting essential information for operational and safety purposes. Therefore, airdrop information is transmitted in the clear over radio, which definitely indicates the fact of an airdrop and bomb-release time. According to the guide such information would be graded Confidential Defense Information but, as noted, it is practically handled as unclassified.

*In other words, the guide is waived for practical purposes but leaves the individual members of the Task Force subject to the threat of security violation for similar handling of the information. It is completely disconcerting when one reads in a news magazine the fact of a classified airdrop and the increased accuracy of that drop over the drop publicly announced.

Mention should be made of the fact that there is a definite difference of opinion between AEC Washington and the several field groups in the use of Top Secret. Information which is routinely handled as Secret, a very high level of classification, at home stations and during field operations is often graded Top Secret at the Washington level. Such information cannot be graded Top Secret and have operations continue in the field. In one situation a Top Secret RD teletype was received containing only information that would have been graded, according to existing guides, no higher than Confidential Defense Information.

*An illustration of the use of security classification for reasons of administrative privacy with the danger of entrapment of personnel was the classification of the inaccuracy of the [redacted] (Cherokee) drop. It was an open shot observed by uncleared newsmen with the general knowledge of all participants of the open nature of that detonation. It was also common knowledge that the detonation missed the target by a substantial distance. The decision to make the fact of that miss Confidential Defense Information not only seemed inconsistent with the fact of an open shot and the general philosophy for classification of information, but also failed to recognize that such incidents cannot be kept from the public even though an attempt is made to identify such information as affecting the national defense and security, with threatened prosecution for any public leak. Past experience was confirmed by the information leaking at a number of points. The use of security classification for reasons of administrative privacy undermines the security program internally as well as in the view of the American public.

*The fact that the open shot provided access by uncleared newsmen to the atoll and its installations has changed a long standing situation so that

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photographs of many areas should now be considered unclassified, even though they show physical installations and previously would have required grading of Con[redacted] Defense Information.

3.15.2 Control of Nonclassified Information

Although the following matters are not classification problems, they are usually referred to the Classification Office for decision.

For some unexplained reason, extremely stringent limitations are placed on the Task Group organization and personnel relative to statements in private communication or in noncommittal home town news stories, even though that information has been declared to be unclassified. Such information is still placed under an administrative ruling that it shall not be privately communicated until announced by the Joint Office of Test Information, or authorized for individual release by that office.

*That practice is inconsistent with the AEC policy on the use of the marking Official Use Only or any equivalent administrative privacy grading. An exception has been made in Redwing Administrative Directive No. 19, June 22, 1956, permitting the sale of unclassified photographs without prior Joint Office of Test Information review. However, as a security order, the organizations were not permitted to have printed in home town papers the simple statement that the individuals of the organizations were taking part in the current test operation at Eniwetok Atoll, without prior approval of the Joint Office of Test Information. Suspension of this normal privilege for no security or classified reasons deprives the organization of an excellent means of improving the morale of many workers.

The aforementioned limitation that no unclassified information may be privately communicated until official release by joint AEC-DOD announcement appears as a generally controlling condition in the classification guide. As a result, all unclassified information or photographs relating to the operation have been marked Official Use Only as a constant reminder to all individuals.

*It is believed more practical and consistent with U. S. Government policy to eliminate Joint Office of Test Information censorship of unclassified information which obviously has no administrative policy significance. The administrative marking Official Use Only or the equivalent "Not to be released until officially announced by Joint Office of Test Information" could then be used on that class of information which is considered of real administratively-private significance, such as statements bearing international political significance, including the announcement of the completion of a test series.

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3.15.3 Photographic Material Control

In February 1956, J-1, LASL, commenced the processing of badge request forms for all units of TG 7.1. A record, listing by projects and programs the individuals who were to be issued "official photographer" badges or "handler of photographic equipment" badges, was maintained. On April 21, 1956, a memorandum was distributed to the project officers and program directors of the individuals listed in this record reminding them that all agencies handling and processing exposed photographic material must register with Commander, TG 7.1, before engaging in operations.

On May 2, 1956, the first report of photographic processing points was submitted to CTG 7.5, indicating 22 photographic processing points and 43 agencies. On May 7, 1956, a second report was submitted to TG 7.5, listing all agencies which had been registered with TG 7.1. This report reflected an addition of eight different processing points, nine agencies, and four individuals. On June 16, an additional agency was reported to TG 7.5. A recapitulation revealed that 53 agencies and four individuals were handling and processing photographic material and that they were being served by 30 different processing points.

Cooperation was generally obtained in receiving registration memoranda from the various agencies. Lack of difficulty was attributable to the tie-in with the badge request form and the notification to the agencies prior to the actual commencement of the operation of their obligation to register their photographic processing points with TG 7.1.

Following up a change in classification procedure for test photography effected by LASL Classification Office for continental test operations, TG 7.1 required the units or individuals for whom photographs were made to decide the correct classification of the photographs. Photographs are of no essentially different significance as to security content than the material or scenes depicted, or other documentary materials such as drawings, correspondence, or the like, all of which are classified by the originating and using groups.

By placing the responsibility on the using organization, the classification review was based on first-hand knowledge of the scene depicted as well as of its security significance. Furthermore, delivery of photographs was not delayed awaiting classification review of a large mass of material by the Classification Office. In general, only questionable cases were submitted to the Classification Office for decision.

Near the end of the operation, the TF Headquarters issued Administrative Directive No. 19, June 22, 1956, an instruction authorizing the several task group commanders to arrange for the sale of unclassified prints and negatives of official photographs. The photography facilities within TG 7.1, operated by contractor organizations, could not accept the responsibility

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of making a large number of souvenir photographs by reason of staff limitations. Furthermore, it was not clear that such contractor personnel could sell government property under the respective controlling government contracts.

*It is proposed that in a future operation the AEC arrange for H&N to prepare and sell such souvenir photographs. Unclassified official negatives could be loaned to H&N for duplication and preparation of prints.

3.15.4 Legal Advisory

No major legal problems arose during the operation. A few claim questions were raised but they were not submitted for formal processing by TG 7.1. One of these claims raised a long-standing question as to the method of handling of claims made by DOD and DOD-contractor personnel for loss or damage to personal possessions under the control of AEC contractor personnel. For example, DOD personnel assigned to TG 7.1 arrange for transportation of their possessions through the J-1 Section (LASL personnel), who in turn use the services of H&N personnel and transportation facilities. If personal possessions are lost or damaged during control by either contractor, against whom should the claim be made?

3.16 TECHNICAL REPORTS

The editorial review and related aspects of formal technical (WT) reports have been diversified for Operation Redwing into four major responsibilities. The Military Weapon Effects test reports are the responsibility of TU-3. Task Unit 4 test reports are the responsibility of SC. Reports on UCRL participation are the responsibility of UCRL. The remainder are the responsibility of LASL.

*The preparation of special internal reports for each individual detonation might be expedited on future operations if the staff of the TG 7.1 Classification Office were made responsible for their preparation. If such an arrangement were approved, the two LASL Staff Members in the Classification and Security Liaison Office of TG 7.1 would handle the work with the only increase in staff that of two male typists. Typing assistance is needed in the Classification Office whether or not the additional responsibility is given to that office. By such assignment of this function in the planning stage of a future operation, the classification staff could do much of the preliminary drafting of the report so that the operational units would have less interruption to their work during the actual test period. Inasmuch as the Classification Office staff maintains a continuing contact with most units,

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it would be convenient for them to obtain the data from those units after each detonation to complete each section of the report.

*Consideration should be given to the purchase of an ozalid duplicating machine for use by the photographic group, TU-8, for preparation of such reports within the Administrative Compound. The present method of duplicating such documents under special controls in the H&N area is not the preferred method for handling restricted data reports.

3.17 SAFETY

3.17.1 Preparation

The TG 7.1 Administrative Plan of November 25, 1955, established safety as a command responsibility and assigned a Safety Advisor to Headquarters, TG 7.1, for consultation on all matters pertaining to accident prevention.

Although home laboratories incorporated safety requirements into their preparations for Redwing, the TG 7.1 Safety Advisor, by invitation, visited the Livermore Site, UCRL, and SC in February 1956 for consultation of safety problems associated with devices, experiment stations, and handling, shipping, and storage of hazardous materials.

Experimental weapon systems and the procedures associated with their assembly and testing were reviewed at LASL during the development of these devices.

"Abort" procedures were also worked out to an extent deemed reasonable on the basis of past experience and existing knowledge of the Redwing devices. However, in this regard, following the performance failure of the first attempt with [redacted] only part of the preplanned procedures fitted the circumstances, and other necessary steps were developed as indicated by the problems that arose and as advice was received from LASL. (This incident is discussed further in Section 3.17.3.)

In consultation with J-6, safety considerations were reviewed in the design and construction of new facilities and in major alterations of existing facilities.

The TG 7.1 Safety Advisor discussed "Safety Problems in the Forward Area" at the Redwing Project Officers' meeting held in Los Alamos in July 1955.

A letter on "General Health and Safety Considerations - Pacific Proving Grounds" was distributed to all TG 7.1 personnel before their departure to the FA.

Close liaison was maintained with J-4 of TG 7.1, and through them with J-4 of JTF 7, on the problems of packaging, handling, and shipping hazardous materials associated with Redwing. The Safety Advisor attended the meeting called by J-4, JTF 7, at the Naval Supply Center, Oakland, Calif., in February 1956. Problems of shipping and handling hazardous and valuable materials were discussed. For this meeting's discussion and for subsequent publication as safety annex to the JTF 7 shipping concept, the Safety Advisor prepared a paper on the safety problems (including various emergencies) associated with active components of Redwing test devices.

3.17.2 Personnel

Roy Reider, Safety Director, LASL, was named Safety Advisor to the Scientific Task Group; and four additional safety officers were chosen to permit two safety engineers to be in residence in the FA for most of the period from March 2 to August 2, 1956.

All members of the safety group (staff members of LASL) had substantial experience on one or more previous test operations.

*In future operations consideration should be given to using safety personnel from major participating laboratories, integrating them with individuals who have had previous test operation experience. Such integration should be made complete enough to function for the benefit of all elements of the Scientific Task Group without excessive duplication of personnel and efforts.

3.17.3 Operations

A Safety Officer was on duty at both Eniwetok and Bikini Atolls. Exchange and rotation were effected with minimum loss of availability of safety personnel. No Safety Officer was on duty at overseas stations other than these two atolls, nor was any deemed necessary.

For J-3 the Safety Officer prepared safety requirements of pressurized dry runs of those test devices using gas systems.

All personnel elevators used in test device towers received safety checks in conjunction with H&N engineering.

The movement of all sensitive materials, specifically components of test devices, into and out of the PPG, within and between atolls, was carried out with procedures advised upon by the Safety Officer who was in attendance at one stage or another during such movements.

Subsequent to the failure of the [redacted] device, the Safety Advisor monitored all procedures carried out in preparation for the return of the device components to the ZI. Abort procedures have received detailed

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advance planning in all operations. In the past there was no subsequent benefit save insofar as personnel acquired increased knowledge of the devices to be fired. In the present instance [redacted] device, what actually happened did not entirely fit the prior planning. Nevertheless, the work was completed with no untoward happening. Each step carried out on the dismantling was scrutinized beforehand and monitored in its execution. John Russell (LASL) made a special trip to the PPG to advise on the low temperature technique of removal of high explosive. All the work was carried out in varying degrees of isolation (the final steps in a station on Runit).

Some unsafe practices in the use of military vehicles were observed. Many jeeps were overloaded with passengers, carrying as many as eight or nine people at a time. Occasional indiscreet use of vehicles by a few people occurred. Stricter enforcement of existing administrative procedures in the use of motor vehicles may be indicated in future operations.

Routine inspections of scientific stations were carried out. Special attention was given to the shot towers and barges, elevators, ladders, and small boat activities.

Accident reports were executed on all injuries where required, including reports to the AEC, the Bureau of Employee Compensation in Honolulu, and the employee's home station.

Safety information was published in the Information Bulletins issued by the Adjutant General's Office, J-1.

*Substantially prior to the next operation, a review of all PPG administrative procedures having safety implications should be carried out between TG 7.1 and the AEC. Reasonable standards of safety for swimming and for the use of self-contained underwater breathing apparatus should be agreed upon at that time.

3.17.4 Unusual Incidents and Special Problems

In April during some pipe line excavation work in the Administrative Compound on Parry near building 209, a cache of ammunition (more than 50 Japanese fuzed mortar shells) was unearthed. Using appropriate safety measures the shells were jettisoned in deep water. This was the only war relic find brought to our attention in Redwing; since Greenhouse, Spring 1951, less and less of such material has appeared.

There were several incidents of helicopter engine failures of which, fortunately, only one might be considered serious. On March 26, at Bikini, a helicopter carrying five TG 7.1 personnel (all EG&G) and two crew was forced to ditch on the reef in about five feet of water. Other than minor abrasions there were no personal injuries, although the salvaged aircraft

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was probably a total loss. A detailed investigation report is available.

There were two apparent drownings involving TG 7.1 personnel on approved recreational activities. The first, Evan George Lenont, SC employee, on April 29, 1956, was found submerged in shallow water, three to four feet deep, at the Parry Island beach. Subsequent autopsy showed asphyxia due to submersion - drowning.

The second, Earl Lee Phillips, Bremerton Naval Shipyard (on temporary duty with TG 7.1, TU-3) on June 14, 1956, was found floating near the Parry Island Beach. Post-mortem examination showed death due to cerebral hemorrhage.

*A detailed report on each of these incidents is available. Both of these cases emphasize the necessity of careful screening to assure the physical fitness of all task group personnel.

Other than the above, accidents in recreational activities, although numerous, were minor in nature. It seemed that there was rather more talk and stronger feeling on the subject of the perils of the tropical seas than were prevalent in previous operations. Notwithstanding this preoccupation, there were no accidents to TG 7.1 involving tropical seas fauna. One TG 7.3 sailor while spear fishing in shallow water in the Bikini lagoon was bitten in the leg by a shark; the individual was returned to duty in a few weeks. This is the only documented incident of this nature during and preparatory to the Redwing operation.

Several specimens of the venomous stone fish were captured in authorized lagoon swimming areas. Displays of the photographs and specimens warned personnel of this animal's appearance and habits.

*Previous to Redwing there was some discussion of netting swimming areas and it might be predicted that this subject will again appear prior to the next operation at the PPG. We believe that experience does not warrant such questionable protective measures unless they receive the endorsement of experts on tropical fish. In other words, a decision to install nets should not be a command decision without full approval of recognized authorities.

The official stand of the Safety Advisory Group on the use of self-contained underwater breathing apparatus was that in recreational activities this was entirely a personal matter; that we would assure the air supplied to be of an acceptable purity; that the equipment used should be factory made and the pressure tanks have proof of proper safety tests.

The subject may be expected to produce more, rather than fewer, problems requiring an official position in future operations. Holmes & Narver did not permit the recreational use of such equipment by its personnel. TG 7.3 did not permit its use unless the individual had been graduated from the Navy underwater training school.

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We do not know how widely used was such equipment during Redwing; perhaps several dozen individuals participated. No untoward incidents were reported.

Following the Zuni shot at Bikini fifteen unexploded rocket heads washed up on Enyu (Nan). These were gathered up in a period of three days and disposed of in deep water.

3.17.5 Roll-Up

To eliminate difficulties that occurred subsequent to previous operations when some hazardous materials were left behind, it was decided to have safety personnel remain for at least a week after the last shot to look at this problem. All stations are to be given a final check, either visually or by consultation with experimental and J-4 personnel. All J-4 warehouses are to be given a final check for hazardous materials. All high explosives were either shipped to the ZI or destroyed by jettison in deep water or by burning.

3.17.6 Accident Summary

Although a detailed study of accident causes will be prepared when all reports can be examined after the operation, a preliminary approximation shows the following injuries reported to dispensaries:

Occupational	100
Recreational	50
Total	150

Of these the following five cases were disabling in addition to the SC death discussed in Section 3.17.4.

1. Robert E. Roy, UCRL, fell while answering the telephone in his barracks, receiving a deep laceration of the right arm; lost time - one week.
2. John Clifford, Reeves Instrument Corp. (Proj. 5.5, TU-3), fell while playing volleyball, receiving a fracture of the left fourth toe; lost time - 2 days.
3. Hans E. Hansen, SC, stepped down from a 2 ft high box and received a fracture of the right foot; lost time - 3 days.
4. W. B. Plum, NRDL, laceration right lower leg stepping from barge to smaller boat; lost time - 1 day.
5. Colonel David Griffin, TU-3, broke bone in foot while using boat ladder; lost time - none (limited duty - several weeks).

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The recreational accidents were mostly softball, volleyball, and water sports (fishing, swimming, and shell hunting); there were three injuries from altercations and several from falls.

Occupational accidents were mostly from handling objects and tools, falls, striking stationary objects, and there were ten accidents involving boats.

NOTE: An Air Force Officer, Captain Paul Crumley of Project 2.66, was lost in an aircraft accident (May 1956) approximately 90 miles east of Eniwetok while engaged in an authorized project mission. Extensive search was unsuccessful; a detailed report may be found in the records of TG 7.4.

3.17.7 Special Comment

The safety officers report a universally cooperative response in dealings with TG 7.1 senior personnel.

3.18 DISPOSITION OF FORCES (ROLL-UP)

3.18.1 General

Personnel of the Task Group began to be gradually redeployed from the PPG to the ZI during the second week of May. This redeployment followed the detonation of Lacrosse on May 5, 1956, and continued through the latter part of July 1956. Following the detonation of Huron (the last device) on July 22, 1956, the remaining personnel phased out very rapidly.

3.18.2 Phase-out of Personnel

Personnel phase-out estimates were obtained from the status reports submitted by various elements of the Task Group during the planning phase of the operation, commencing in June of 1955, and ending in January 1956 with the submission of the last status report. The peak population was expected to be met about May 1, 1956, with a gradual decrease during May, a more rapid decrease during June, and completion of roll-up during early July. These figures were based upon the operation schedule that indicated the last detonation would take place July 1.

Changes in the schedule and postponements of shots caused the phase-out of personnel to be more gradual than estimated. The estimate made in August 1955 showed a peak of 1578, with a drop off to 1097 by the end of June. The population actually reached a total of 1404 on May 6, 1956, and

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had dropped to 1023 as of June 30, 1956. The total then decreased slightly until the last detonation on July 22, 1956, when many of the project personnel were released. There were 793 TG 7.1 personnel in the PPG at that date. There was a rapid phase-out of personnel during the last ten days of July.

Although the peak population was not as high as expected, a total of 2024 different TG 7.1 people had been in the PPG by the time of the last detonation. Also as rotation of personnel was practiced by several units of the Task Group, many individuals made more than one trip to the PPG during the operation.

The Headquarters Commandant on Parry Island handled the necessary arrangements for each individual's departure. The Reservations Section took reservations, maintained the priority list for each MATS flight, made MATS reservations, notified H&N in Honolulu about desired hotel reservations in Hawaii and commercial reservations for those personnel traveling to the mainland via commercial carrier, and accepted the clearance sheets from departing personnel. The Adjutant General Section issued the clearance sheets, prepared the indorsement of orders for DOD military and civilian personnel, and processed pay and per diem records for such personnel. Departure security briefing was accomplished by E-2, TG 7.5, for TG 7.1. MATS reservations generally were available when desired although usually not confirmed until the latest possible moment.

Arrangements were made with JTF 7 for Task Group 7.1 to have an allocation of a specified number of seats on each scheduled MATS plane. Phase-out airlift requirements were determined during June, based upon the expected conclusion of the operation about July 20, 1956. The MATS schedule for July indicated additional flights after that date and additional aircraft were to be made available after the last detonation. At a meeting with JTF 7 on July 21, a TG 7.1 allocation for each day after the last detonation was established. Following the last detonation, additional aircraft were made available and personnel were booked to fill the allocation for each day. Figure 3.4 shows the estimated and actual population during roll-up.

Most Task Group personnel were airlifted by MATS to Hickam AFB. Military personnel and most government civilian employees proceeded on to Travis AFB by MATS, whereas AEC and civilian contractor personnel usually traveled via commercial carrier from Honolulu. A few Task Group personnel returned to the U. S. by MSTS or naval vessel.

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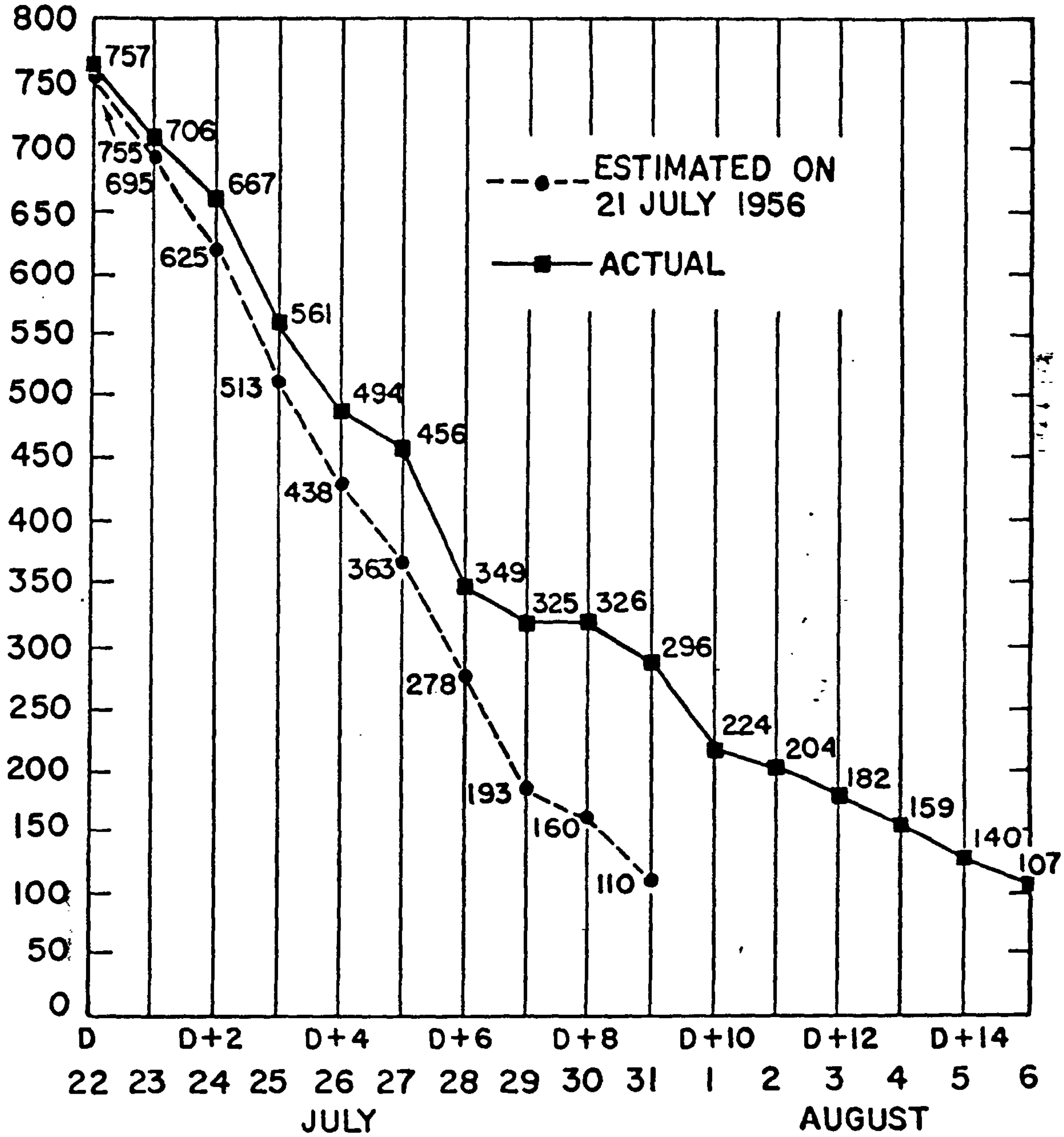

Fig. 3.4 Estimated and actual population during roll-up of 7.1.

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3.18.3 Property Roll-up

Property roll-up consisted of two stages, preliminary and final. Preliminary roll-up consisted of the return of equipment as it became surplus, and project property from completed operations. It started after the first shot, Lacrosse, and continued until Tewa. Final roll-up can be considered the period after Huron, the last shot. Preliminary roll-up cargo was returned to the ZI on the cargo vessel USNS Sergeant Archer T. Gammon in June and on the USNS Private Joe E. Mann in July. Cargo breakdown was as follows:

USNS Sergeant Archer T. Gammon	850.7 M/T Special Cargo
	152.3 M/T General Cargo
USNS Private Joe E. Mann	1164.5 M/T Special Cargo
	821.9 M/T General Cargo

Inasmuch as at the time of writing of this report the final phase is just starting, planned shipping will be listed.

The bulk of TG 7.1 property will be returned to the U. S. on the USNS Brostrom which is scheduled to be on berth August 10, 1956, and should consist of the following:

7318.6 M/T Special Cargo
2168.0 M/T General Cargo

USNS Sergeant Archer T. Gammon will return about August 15 to pick up the last of the cargo which is estimated as follows:

892.0 M/T Special Cargo
125.1 M/T General Cargo

Bikini cargo was moved to Eniwetok by LST for processing and documentation, and then consolidated with Eniwetok cargo for movement to the U. S.

Owing to high radioactivity at certain stations, and to remoteness in the case of weather stations, some equipment cannot be recovered by project people prior to their departure. Arrangements have been made with H&N to recover this equipment when conditions permit. Necessary work orders have been prepared to cover these requirements.

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Property drawn on memorandum receipt from TG 7.2 and 7.5 has been cleared.

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3.18.4 Headquarters Roll-up

The FA Headquarters of TG 7.1 closed as of 2400 hours, July 29, 1956 (Eniwetok time and date). The mail and teletype service continued to be handled by the Mail and Records Section of J-1 on Parry Island until August 4, 1956, when this function was assumed by the Branch Manager of the AEC Eniwetok Branch Office.

Seventy-eight boxes of classified records of the Task Group were returned to home stations by air a few days after the last detonation.

All AEC and DOD equipment was shipped to the respective headquarters' locations in the U. S. Furniture and other office equipment on loan from H&N and TG 7.2 were returned to their warehouses or left in place.

*3.19 CONCLUSIONS AND RECOMMENDATIONS

*3.19.1 General

June and July provided substantially more firing weather than March, April, and May. Weather studies should continue and, if they confirm the apparent superiority of the summer months for firing purposes, tests should be scheduled accordingly.

Since weather that would otherwise be acceptable for megaton shots usually presaged some fallout to the westward, there were fewer good firing days for large shots at Bikini than at Eniwetok. In order to make optimum use of both atolls, some megaton shots should be scheduled in the Mike crater at Eniwetok and necessary stations to instrument them should be constructed.

Facilities for housing and messing personnel at the PPG during Redwing were quite inadequate in at least three camps, and only barely adequate at other locations. Severe overcrowding on Eniwetok Island was due to the extensive military effects test programs, particularly those involving participation of aircraft. Since it is unlikely that effects programs will be smaller in the future, it is recommended that the facilities on Eniwetok Island be substantially increased to provide adequate quarters and other living facilities for the anticipated population of the next operation.

The planned size and the camps "as built" at Romurikku and Runit were inadequate, in view of the population estimates. It had been hoped that construction and some service personnel could be moved out before the technical personnel required quarters in these camps, but last minute requirements made it necessary for construction and technical personnel to work at these sites at the same time. As a result, the camp facilities were

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overtaxed, expensive emergency expansion of facilities was undertaken, much time was lost in commuting from other sites, air transport was overloaded, and morale was adversely affected. Experience on many operations has proven that it is unsound to depend on completing all construction and modifications in time to phase-out construction personnel before technical installation begins. It is strongly recommended that camps be built to take care of estimated peak population of both types of personnel.

Transportation of the arming team, from the shot barges after arming, and to the shot barges for disarming, continued to be unacceptably slow and complex as it was on Castle. Each shot barge should have an elevated unobstructed helicopter platform with a suitable hatch or hatches to permit installation of devices and equipment. If this proves impractical, two small, rugged, two-engined boats, capable of going alongside the shot barge, and fast and seaworthy in rough weather, should be provided for this purpose.

The over-all support provided by MATS was generally excellent and contributed substantially to the success of the operation. Unfortunately, the convenience, comfort, and peace of mind of the passengers are still neglected. Scheduled departure hours from both Hickam and Eniwetok were inconvenient to passengers, as was the two-hour check-in; and mechanical and other troubles caused great variance between scheduled and actual flight times. Information provided to waiting passengers and to those embarked on planes which had to turn back because of mechanical difficulties was often scarce or nonexistent.

Passenger convenience was often subordinate to that of the airline. For example, during most of the operational period, a passenger flight was scheduled to depart Eniwetok at 8:00 AM. However, MATS would not guarantee to wait until 8:00 AM if the aircraft was ready to leave earlier, and thus passengers from Parry had to spend the night on Eniwetok ready to leave at the pleasure of the airline, although it rarely happened that the flight was ready to leave before the scheduled hour.

It is recommended that the Commander of MATS be asked to improve passenger arrangements and relations in every way possible; and that CJTF 7 be represented when the PacDivMats passenger schedules for the support of Eniwetok during build-up and operational phases are developed.

*3.19.2 J-1 Section, Personnel and Administration

During the planning phase of Redwing it was generally agreed that a considerable effort should be made to preserve a high level of morale by providing adequate recreational facilities, recreation trips, etc. Funding problems delayed the design and construction of such items, however, until

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the operational phase, when they had such a low priority that facilities in general were inadequate or marginal. To cite two examples, the project to enlarge the Parry theater was not completed until midway of the operational phase, and the tennis courts were still under construction when the last test shot was fired.

In view of the difficulty of maintaining a competent scientific staff for conduct of nuclear tests, and the high cost of turnover of personnel, it appears that "austerity" is not really economical in the long run. Effort and funds expended in maintaining high morale pay high returns in the reduced cost of keeping a competent staff and in the high operating efficiency of satisfied personnel.

It is recommended that a serious effort be made before the next operation to provide facilities for spare-time activities and other morale-building items, such as less crowded quarters, adequate PX stocks, a decently stocked library, recreational trips both within and without the Marshall Islands, etc. A planning group with representatives from Joint Task Force Seven and the Task Groups concerned might be useful in developing a detailed morale-maintaining program.

The Bikini-Eniwetok airlift was served by World War II C-47 cargo aircraft with bucket seats for passengers. Consideration should be given to providing reasonably comfortable transportation on these flights. Most desirable would be regular passenger aircraft for the personnel flights, but even a combined cargo-personnel carrier might have comfortable seats installed.

*3.19.3 J-3 Section, Plans and Operations

1. Communications

a. An automatic switchboard, with an appreciable increase of main lines, should be installed at Parry Island. Further, the Parry Island and Eniwetok Island telephone exchanges should be cross-connected. The interatoll telephone circuits were a distinct improvement over previous operations.

b. The AN/TRC telephone equipment installed aboard ship should be replaced. This equipment was very unreliable, and proved a source of radio interference throughout the entire operation.

c. An unclassified telephone circuit of acceptable voice quality between Eniwetok Atoll and the U. S. should be provided. This circuit was not at all satisfactory on Redwing.

d. The voice count-down should be broadcast on one UHF frequency and all units of JTF 7 should cover that frequency, eliminating

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unnecessary duplications of transmitting and receiving equipment.

e. A frequency control officer should be ordered to the staff of CJTF 7 sufficiently early to coordinate all frequency requirements. In order to expedite procurement of special equipment, certain frequency bands, normally used by commercial telemetering equipment, should be reserved for the Scientific Task Group.

f. In order that the incoming Scientific Task Group Communications Officer may become aware of problems encountered on an operation of this type, and to provide a TG 7.1 Communications Officer at each test site, this officer should report to TG 7.1 at least one month prior to the operational phase of an ensuing operation.

g. A telecon room, similar to the one installed at Parry Island during Redwing, should be provided on Enyu Island and the TG 7.1 Command Ship.

h. The need of a TG 7.1 Command and Firing Control Ship has been reconfirmed. Every effort should be made to improve the performance of the command ship communication facilities, principally by decreasing interference which was frequently encountered during Redwing.

2. Boat Support

In general the boat support proved adequate. However, it is recommended that the feasibility of using fast water taxis at Bikini be investigated and, if practicable, that they be provided and employed in the next operation.

3. Motor Vehicles

A system of vehicle maintenance (including necessary spare parts) which will permit adequate maintenance throughout the operation should be established by TG 7.5 prior to the operation.

4. Off-atoll

The planning and funding of off-atoll activities should be completed as early as possible in order to permit the delivery of equipment at the PPG and the construction of camps and stations to be accomplished with the least interference with other projects and activities.

5. Air Operations

a. Early agreement should be reached by the Task Force and Task Groups as to the numbers and types of helicopters and liaison type aircraft required. Both planning and utilization would be improved by an early general understanding of the types and estimated numbers of missions to be performed during the operation.

b. L-20 landing strips should be constructed on Bikini Atoll at

Bikini, Romurikku, and Namu Islands in addition to existing airstrips on Enyu and Eninman.

c. Facilities should be provided at Bikini Atoll to permit the establishment of an intra-atoll air support control system similar to that employed at Eniwetok Atoll during Redwing.

d. The Reflector system of interatoll flights in Redwing was not flexible enough to provide timely and satisfactory service for those key members of TG 7.1 whose tasks required them to do extensive traveling between atolls, particularly on −1 and shot days, and to meet very tight schedules. Suitable passenger aircraft with a capacity of eight or more should be provided, on call by CTG 7.1, for such interatoll service as he requires. During other times it could be used for general passenger purposes.

*3.19.4 J-4 Section, Logistics

1. Water Transportation

The J-4 Section was well pleased with the logistic support furnished by MSTS in movement of water cargo to the FA. The use of the Marine Fiddler during the critical period of movement of large trailer vans to the FA was very advantageous. This type of ship with her capability of lifting approximately 65 or 70 trailers at one time is most suitable for moving TG 7.1 cargo.

The Brostrom, sister ship of the Marine Fiddler with identical configuration and capacity, was used for roll-up.

It is strongly recommended that JTF 7 make every effort to obtain the Marine Fiddler or the Brostrom for future operations.

2. Air Transportation

The support rendered by MATS for the Weapons Lift and Sample Return Program was outstanding. However, during the lift of general cargo several instances occurred where extremely important cargo was lost in the MATS system for several weeks. These items were such that their delay definitely interfered with several important programs. Close supervision of the transshipment of TG 7.1 cargo at Travis and Hickam is required in order to prevent such delays.

It is therefore recommended that more enlisted men be assigned to the Liaison Offices at Travis and Hickam AFB to provide such supervision. It is also recommended that at least three officers be on duty at Travis in order to provide 24-hour service, particularly during the time the Sample Return Program is in effect.

3. Vehicles

The late arrival of motor vehicles in the FA was a serious problem. It is recommended that vehicles be on hand ready for use not later than three months prior to the first shot date.

4. Supply

The J-4 Supply Section operated in two echelons. The supply section at Parry operated in Warehouse 511 and maintained a major portion of our stock. Resupply was effected by radio orders and air delivery from Warehouse SM-30, Los Alamos. The supply section at Bikini operated in two van-type trailers that operated either on Enyu or Romurikku. This supply section was prepared to move aboard the USS Curtiss in case the shore installations were untenable. Supply room space was earmarked for this purpose on the USS Curtiss.

This supply system proved satisfactory on both Castle and Redwing and its use on future operations is recommended.

5. Nitrogen Plant

J-4 operated the Nitrogen Plant in the CMR compound for the purpose of furnishing both nitrogen and dry air for various projects.

It is recommended that some N_2 capacity be preserved for use on future operations.

6. Movement of Weapons by the USS Curtiss

Prior to the Sandstone Operation, Shop 18 of the USS Curtiss was modified to transport the weapons to be used on that operation. Since then the size and configuration of the weapons have greatly changed, causing the fittings in Shop 18 to become obsolete.

If the USS Curtiss continues to be used for transporting weapons and weapon components, consideration should be given to modifying hold space in order that it can be utilized more efficiently.

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CHAPTER 4

SUMMARY OF TASK UNIT ACTIVITIES

4.1 TASK UNIT 1, LASL PROGRAMS

4.1.1 Objectives

The function of TU-1 was to carry out experiments designed to measure certain properties of the LASL-designed weapons and nuclear devices; to measure certain physical quantities of fundamental importance to weapon design; and to study the physics underlying certain effects produced by nuclear weapons or devices.

4.1.2 Techniques

The techniques used to make the measurements are described briefly in Chapter 2, Section 2.2. They are described in much more detail in the preoperational and technical reports of the various programs prepared at LASL and in the preliminary reports prepared for each shot.

4.1.3 Operations

In general it was possible to live ashore and make repeated use of various stations and facilities at Eniwetok Atoll, as originally planned. At Bikini it was necessary for some technical personnel to live on LCU's because of fallout on all islands except Enyu. Due to the excellent facilities and support provided on these boats, this arrangement proved very satisfactory. The Bikini operation was greatly facilitated by the fact that it was possible to keep the Enyu base camp occupied except for evacuation during shot time.

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The helicopter shuttle system gave reliable transportation for the technical personnel throughout most of the operation, but was badly overloaded at times at Bikini. The L-20 shuttle system was very satisfactory at Eniwetok.

The radiation safety problem was well handled and caused little inconvenience to the scientific personnel during the operation.

Communications through the various radio nets were very good but some trouble was experienced with the telephone system at the more remote stations.

4.1.4 Results

Results are given in Chapter 2, Section 2.2, and in the preliminary reports prepared for each shot.

*4.1.5 Recommendations

1. TU-1 was handicapped by the lack of an officially designated Task Unit Commander. It is essential to have someone with official stature represent the Task Unit's interests and to coordinate its work and requirements with other task units and organizations. It is also helpful to have someone to coordinate programs within the Task Unit, promote discussions of the experiments, and keep each group informed of the progress and problems of the operation as a whole. To be completely effective the Task Unit Commander should participate in the planning as well as the operational stage of the operation.

2. When it is necessary for the scientific personnel to spend considerable length of time at remote sites or on LCU's, it would be extremely useful to have a Secret RD communication link to the base camp available in the vicinity.

4.2 TASK UNIT 2, UCRL PROGRAMS

4.2.1 Objectives

Task Unit 2 was organized to carry out diagnostic experiments on UCRL-designed nuclear devices.

4.2.2 Techniques

The techniques used are described in Chapter 2, Section 2.3.

4.2.3 Operations

Conditions on the Eninman and Rojoa complexes where most of the UCRL diagnostic effort was located were very satisfactory before the shot schedule commenced. These conditions were largely the result of having L-Division personnel stationed at each complex to ensure that sufficient attention was paid to UCRL support requirements. Unfortunately, the Rojoa complex was contaminated by the [redacted] shot which required that the camp be deactivated as a full scale installation. After a period of daily commuting from Parry, a few tents were made livable and the diagnostic crews returned to the complex on a full time basis which reduced the strain on meeting the UCRL Rojoa shot schedule.

4.2.4 Results

Results are given in Chapter 2, Section 2.3.

*4.2.5 Recommendations

a. The policy of concentrating an individual laboratory's major efforts on an island complex should be continued.

b. The staff function (L-Division) required on an island complex should continue to be supplied by the Laboratory with the major effort in the area.

c. Reoccupation of a contaminated complex should be expedited if a major portion of the program is yet to be accomplished, in order to minimize commuting. Many diagnostic procedures are best done at night, which makes commuting a problem.

4.3 TASK UNIT 3, DOD PROGRAMS

TU-3 was organized to conduct approved weapon effect tests under the operational control of CTG 7.1 and the technical direction of AFSWP. The organization included a TU headquarters at Eniwetok with a Forward Area command at Bikini. The Bikini command was assigned a minimum number of permanent personnel (four officers and three enlisted men) and was

[redacted]

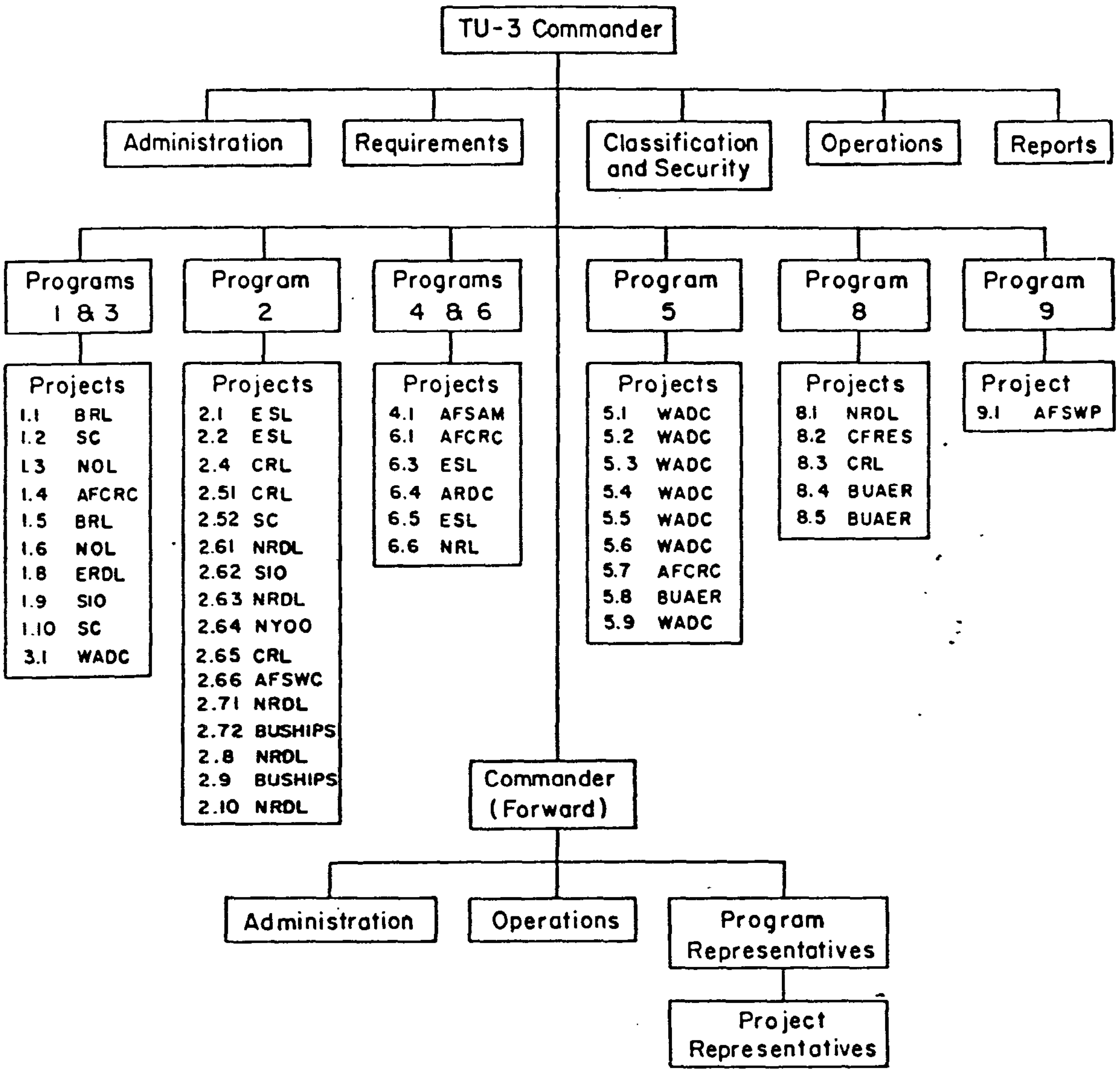

Fig. 4.1 Organization chart, TU-3.

[redacted]

[redacted]

augmented by staff and program personnel from Eniwetok as test activities required. This arrangement provided efficient control of activities at both atolls with a minimum of overhead, and proved to be quite satisfactory for this type of operation involving experiments at both atolls.

At Eniwetok the Commander, TU-3, supported by a small staff, supervised the activities of the directors of the eight technical programs. There were 47 projects grouped under the eight programs (see the organization chart, Fig. 4.1). During the course of the operation approximately 50 TU-headquarters personnel and 900 project personnel were present in the PPG. The peak strength was 710 on May 6, 1956. Headquarters personnel were furnished by Field Command, AFSWP. Project agencies are indicated on the organization chart.

The programs were the most extensive yet undertaken for an overseas test. Although the experimental objectives were numerous, the major overall objectives were to define or document (1) the weapon-delivery capabilities of late-model aircraft; (2) the radioactive fallout from high-yield devices, including the initial and final distribution of activity, the time history of accumulation locally and at sea, and the physical and chemical nature of the radioactive material; and (3) the basic effects of a high-yield air burst. In general, it appears that the program objectives were met, except for a considerable loss of data on the high-yield air burst [redacted] due to a bombing error. Individual program results are covered in Chapter 2, Section 2.1.

*The TU-3 mission was accomplished without major operational problems. The large number of scientific stations involved in the weapon effects tests were widely scattered throughout the PPG and made the task unit dependent upon logistic-support agencies. Close liaison was maintained with TG 7.1's J-1, J-3, J-4, and J-6 staff sections, and all essential requirements were met in an excellent manner.

*Special problems were posed by the projects operating outside the PPG. Excellent cooperation on the part of staff sections, support agencies, and communications personnel led to satisfactory solutions.

4.4 TASK UNIT 4, SC PROGRAMS

4.4.1 Mission of Task Unit 4

In addition to technical and adminstrative responsibilities for Sandia programs, TU-4 was assigned administrative support and technical monitor responsibilities for service projects being performed by Sandia Corporation for DOD, LASL and UCRL. These service projects included the following:

[redacted]

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Project 23.2, Project 13.3, Project 1.10, Project 1.2, Project 2.52, assembly of [redacted] device, assembly of [redacted] device, assembly of portions of the [redacted] weapon, and furnishing of all XR devices and instrumentation on those shots requiring external initiators.

4.4.2 Operations in Forward Area

TU-4 began operations in the PPG in February shortly after the arrival of the logistics support group and construction liaison personnel. Peak activity was reached in May when 104 SC personnel were present at the PPG. Operations gradually tapered off until less than 30 people remained for the last two events.

A major objective of TU-4 planning was to limit both number of personnel in the FA as well as duration of individual stay. These objectives were realized with considerable success by the utilization of instrumentation systems and components prefabricated in the ZI. On most projects where participation in a multiplicity of shots was required, personnel were rotated at the end of two months with an overlap of approximately two weeks. Some minor problems in continuity were encountered with this system but better planning should eliminate a reoccurrence.

*4.4.3 Conclusions

1. An evaluation of early test data indicates that the technical phases of TU-4 participation in the Redwing operation were generally successful.
2. Support and assistance rendered by the Staff of TG 7.1 contributed materially to TU-4 success.

*4.4.4 Recommendations

1. The more extensive use of prefabrication and trailer-mounted instrumentation should further reduce the number of personnel and the length of stay per given instrumentation project. Rotation of personnel should be on an individual replacement basis to permit continuity within projects.
2. Difficulties encountered with radio interference by Projects 13.3 and 23.2 indicate the need of good portable radio direction-finding equipment which will permit location of interference.
3. More attention should be directed toward better organized off-time recreational programs such as picnics, hobby shops, etc.
4. Off-atoll communications methods should be revised to permit

direct contact with project personnel in situations where last minute changes of schedule or plans are encountered.

4.5 TASK UNIT 5, TIMING

4.5.1 Objectives

TU-5 had two principal objectives--the first, to provide a remote control system that would arm and fire a surface-detonated device with a high degree of reliability; the second, to supply experimenters with an accurate sequence of timing signals related to zero time for the purpose of starting or stopping their equipment on either airdrop or ground operation.

Closely associated with these objectives were six other projects:

1. To determine the time of burst with respect to WWVH.
2. To furnish personnel as members of the firing party.
3. To install a system capable of monitoring vital information from zero site to the control station.
4. To provide signals to experimenters for airdrop tests.
5. To provide voice-time announcements synchronized to the timing system.
6. To provide a shipboard control station for remote operation of the Bikini timing system.

4.5.2 Procedure

Early in August 1955, preliminary planning for a timing system to meet anticipated Redwing requirements was begun. As planning progressed, station locations and details of the timing system were worked out.

The equipment was assembled and operationally tested under simulated field conditions in the Las Vegas laboratory prior to shipment to the FA. Shipment of equipment to the FA began in December 1955 and continued through April 1956.

Early in February, a group of field personnel was sent to the FA to start field installation of the timing and firing system. As equipment continued to arrive, additional personnel were dispatched. A total of 55 tons of timing system equipment was shipped to the FA. Installation of all equipment was completed by May 1, 1956.

The following control and distribution stations were used in the Bikini area:

[redacted]

Station 70	Enyu	Station 75.01	Yurochi
Station 73.05	Chieerete	Station 75.02	Bikini
Station 74	Airukiiji	Station 76	Aomoen

The control and distribution stations used in the Eniwetok area included:

Station 71	Parry	Station 73.04	Bogon
Station 71.01	Engebi	Station 73.08	Rujoru
Station 72.02	Rojoa	Station 77	Runit

In addition to the stations listed above, a remote control station was maintained aboard the USS Curtiss.

Preliminary dry runs in the Eniwetok area commenced on April 19, 1956. Preliminary dry runs started in the Bikini area on May 2. Dry runs and tests were continued in both the Eniwetok and Bikini areas throughout the test series.

A World Time rack identical to that used on Operations Castle and Teapot was included in the design of the timing system to record actual zero time with respect to WWVH. This measurement was obtained through use of a 1000-cycle oscillator driving the World Time clock synchronized to WWVH and located in the control room. The initial flash of the detonation triggered a Fiducial Marker on the roof of the CP. This, in turn, triggered a flash tube which produced a photographic record of the clock face at zero time, and was accomplished by checking the clock reading with the precise signals received from WWVH.

In addition to engineering assistants, a full-time technician was assigned in each atoll to TU-6, the Firing Party.

Telemetering equipment was installed as a part of the timing system. Its purpose was to monitor vital information from the zero site in addition to various operations of the timing system.

Magnetic tape recording and playback equipment provided prerecorded audio voice-time announcements synchronized to the timing system. The recorder was automatically started with the −15 min signal, and continued to give time hacks down through zero time. The voice count-down was originated at the control station and further distributed to various ships and stations about the atoll through the use of radio links.

A radio link was used to transmit tone signals from the USS Curtiss to the master control station, Enyu. These signals were used in remotely controlling the master timing station.

In order to provide timing signals to users at locations which were inaccessible to the hard-wire timing system, a radio timing signal system was provided. This system was synchronized to the master timing system and transmitted various tone frequencies to radio receivers, which in turn activated equipment at the user's station.

[redacted]

[redacted]

Both AC and DC Blue Boxes were used throughout the operation to provide experimenters with a zero signal of millisecond accuracy.

4.5.3 Results

The timing system installed by TU-5 proved, on the whole, to be both reliable and satisfactory. Approximately 1000 hardwire signals were delivered, and approximately 50 radio time signal receiving units were installed at remote locations.

Two major difficulties were encountered during the operation. The first of these was operational and consisted of trouble experienced in maintaining wet batteries on the remote radio receivers. The development of low power radio time signal receivers would eliminate this difficulty.

The second difficulty encountered was the inability of Fiducial Markers and Blue Boxes to trigger during local rain storms in the area of these units. This resulted in failure to obtain a World Time from the control station for the [redacted] shot. However, the Bureau of Standards backs this measurement up, so that the failure was not critical.

The various other functions of TU-5 were performed as scheduled and require no comment.

4.6 TASK UNIT 6, FIRING

TU-6 responsibilities consisted of arming and firing the nuclear weapons and devices detonated during the operation. Two teams were provided so that arm and fire capabilities could be maintained at both atolls. These teams worked in close liaison with TU-5 and the Weapon Assembly Groups (TU-10, TU-11, and TU-12). The arm and fire activities were always performed with the aid of detailed check lists which enumerated each operation and measurement necessary to accomplish the mission. The work was apportioned into four parts which consisted of the prearming tests, arming, firing, and disarming.

The prearming tests included visual inspection, functional checks, and adjustments with the live equipment while connected in a simulated final arrangement. The interlocks in the fire line were checked in a positive and negative manner. All monitor lamps, meters, and recorders associated with the arming and firing were checked for true indications and calibrations.

The arming was anywhere from 6 to 14 hr prior to firing time and included the final connections and preparations. During the final preparations a safe-separation timer, whose contacts completed the arm line, was set to close 2 hr before zero time and open 4 hr later. This provided a safe time interval after the weapon or device had been armed to allow complete evacuation of the atoll when necessary, and to permit the Firing Team to retire to the Control Room. When a shot was canceled within 2 hr of zero time, the Disarming Team entered the zero area after the timer opened the arm line. On some of the smaller shots at Eniwetok where the diagnostic measurements were not restricted to a certain early time period, the safe separation timer was set to open the arm line up to 8 hr after zero time. This provided several hours in which zero time could be rescheduled when the weather was uncertain. When possible the arming operations were conducted during the daylight hours, but on several occasions it was necessary to arm after dark. Transportation for the Arming Team was provided by plane, helicopter, or watercraft, according to the type best suited for the particular zero location.

Firing was accomplished from a Control Room by starting, 15 min before zero, a motor-driven timer which automatically provided the timing signals. There was a Control Room at Parry, Eniwetok, and Enyu, Bikini. The Control Room at Enyu could be remotely controlled by radio from the USS Curtiss. [redacted] was the only test where the remote station aboard the USS Curtiss was used.

Several disarming operations were conducted at both atolls because of postponements due to unfavorable weather conditions. Only one disarming was conducted under an emergency situation. This was [redacted] after the shot had been canceled with 3 min of zero time because of [redacted]TED

TU-6 did not have responsibility for the two airdrops during the operation. However, through visual observance it was noted that the airdrops were handled in accordance with Sandia approved field procedures. The fuze and firing circuits of the weapons operated well within the specified tolerances.

All weapons and devices were detonated at the proper time and no misfires occurred during the operation.

4.7 TASK UNIT 7, RADIOLOGICAL SAFETY

4.7.1 Mission

The mission of TU-7 was as follows:

1. Perform all ground and aerial monitoring services associated with the scientific mission except those in conjunction with aircraft and airborne collection of scientific data; assume responsibility for rad-safe for TG 7.5 during the operational phase.

[redacted]

2. Provide laboratory and technical assistance to all task groups.
3. Provide all official dosimetry services for JTF 7.

4.7.2 Organization

The necessity of maintaining a capability for firing at both Bikini and Eniwetok Atolls at the same time required that TU-7 provide two complete and independent rad-safe organizations. Over-all control over the two organizations was maintained by CTU-7. Each organization contained the following sections:

1. Monitoring section for providing all monitoring services and manning check points.
2. Plotting and briefing section for conducting all aerial surveys and briefing all personnel going into radex areas.
3. Supply section for maintenance of rad-safe supplies, including laundry (facilities furnished by TG 7.5).
4. Instrument repair section for maintenance of rad-safe instruments.
5. Laboratory section for determining the amount of activity contained in soil and water samples.
6. Decontamination section for operating facilities for personnel and equipment decontamination.

Control over the official dosimetry and records section was maintained directly by CTU-7. This was necessitated by the double badge system (permanent and mission film badges) that was used during the operation. A small photodosimetry section was maintained at Bikini for processing mission film badges used at that atoll. All permanent badges were processed by the Eniwetok photodosimetry section. The master record file for all personnel in JTF 7 was maintained at Eniwetok.

Personnel for manning TU-7 were obtained from the Army, Navy, and Air Force. The majority of the personnel were obtained from the Army's 1st Radiological Safety Support Unit, a Chemical Corps unit stationed at Ft. McClellan, Alabama. The Army provided 102 officers and enlisted men; the Navy 8 officers and enlisted men, and 30 civilians; and the Air Force 12 officers and enlisted men. Los Alamos Scientific Laboratory provided four personnel in an advisory capacity.

Scientific projects in TG 7.1 and contractor personnel in TG 7.5 were required to provide their own monitors for recovery and construction missions. The majority of these personnel were trained by members of TU-7 at either Ft. McClellan, Alabama, or the PPG.

[redacted]

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4.7.3 Operations

In support of TG 7.1 and 7.5 at both Bikini and Eniwetok, check points were established as required. Main check points utilized at all times at both atolls were located at the air dispatcher's office and the marine landing. All personnel entering or returning from a radex area were processed through the check points. An area was considered as a radex area if the contamination exceeded 100 mr/hr. Full protective clothing was required for entry into a radex area. Limited radex areas were established when the contamination level was above 10 mr/hr, but less than 100 mr/hr. Clothing requirements varied with the situation in the limited radex areas. An area contaminated to a level less than 10 mr/hr was considered non-radex. The following is a summary of rad-safe processing:

1. A total of 1560 parties, containing from 1 to 50 men per party, were processed through the Eniwetok check points from May 5, 1956, to July 20, 1956. Approximately 9500 personnel were processed through Bikini check points during the same period. The personnel decontamination station at Eniwetok handled a total of 1558 individuals, while the facility at Bikini processed 3350.

2. At the equipment decontamination facility at Eniwetok a total of 225 vehicles, ranging from jeeps and trailers to large mobile cranes, were processed. In addition, all equipment from three camps was decontaminated. Six helicopters, contaminated on aerial surveys, were also decontaminated. At Bikini, approximately 100 vehicles were processed.

The majority of the rad-safe surveys of radex areas at both atolls were conducted by helicopter. Normal operations included a pre-entry survey with CTG 7.1 at H + 1 to 3 hr, a detailed survey at H + 6 to 8 hr, and detailed surveys on the morning of D + 1 and 2 days. Additional surveys were made as required. Instruments used in the surveys included special Jordan ionization chambers and standard AN/PDR-39's converted to read to 500 r/hr. Ground surveys of islands in the atolls were conducted when required.

During the entire Eniwetok operational phase, the contamination from any one shot did not materially interfere with preparations for the next event. In all events local contamination was quite high, with the exception [redacted] shot. Contamination resulting from the [redacted] shot required that the camps on Rojoa and Teiteiripucchi be closed up. The [redacted] and [redacted] shots gave significant amounts of alpha (plutonium) contamination on Aomon.

Contamination from Bikini shots was such that Enyu could be used as a base of operations during the entire period. No significant delay in preparations for any shot resulted from contamination found in the atoll area.

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[redacted]

No critical recoveries were delayed more than 24 hours. Roll-up operations in the Yurochi-Aomoen chain were curtailed by the contamination resulting from [redacted] shot.

The only significant fallout observed at Eniwetok Atoll (on Parry and Eniwetok) during the operation resulted from [redacted] shot at Bikini. Fallout started at approximately 1500, July 21, and ended approximately 0800, July 22. Peak intensity measured on Parry reached 100 to 120 mr/hr depending upon the location. Early decay was rapid, but after 48 hours the decay of the active material followed the fission product decay curve. The impact of this dose rate on the Eniwetok roll-up was such that a 7 r total dose limit was established by CJTF 7 for 7.1 and 7.5 personnel.

Fallout was observed at Bikini (Enyu) one day after [redacted] shot. Maximum level observed was 12 mr/hr. The [redacted] event also caused minor fallout on Enyu; maximum level observed in this case was 10 mr/hr.

A total of approximately 500 water and soil samples were handled at both atolls by laboratory personnel. Swimming areas at both atolls were declared off limits for several days following certain of the shots that significantly increased the lagoon contamination levels. An arbitrary limit of 50,000 disintegrations per minute per liter of water was established as the tolerance level for swimming.

4.7.4 Official Dosimetry

The permanent badge program was designed to provide a dosage-indicating device to all personnel in the Task Force. Issue of the first permanent badges was made on April 15, 1956, with exchange scheduled approximately each six weeks. As the operational phase progressed, it was found that permanent badges in use in excess of four weeks were badly watermarked and difficult to read. As a result, the exchange period for TG 7.1 and TG 7.5 was shortened to three weeks. During the operation approximately 40,000 permanent badges were issued, processed, and recorded.

The mission badge program was designed to provide a rapid determination of the dosage an individual had received while participating in recovery or construction missions in radex areas. Only those personnel entering a radex area were provided with mission badges. No deficiencies were noted in these badges as the usual period of wear was approximately 12 hours. A total of 30,000 mission badges were processed at Eniwetok, and approximately 20,000 at Bikini.

All film processing and record posting were done manually. As a result, approximately 40 individuals out of the entire Task Unit strength were assigned to the dosimetry and records sections.

[redacted]

[redacted]

Prior to the fallout at Eniwetok resulting from [redacted] shot, approximately 50 individuals had received technical over-exposures in excess of 3.9 r. The dosage received from fallout at Eniwetok increased this number to approximately 600.

*4.7.5 Conclusions

1. The project monitor program was successful and significantly reduced the personnel strength of TU-7.
2. The permanent and mission film badge programs were successful in providing the necessary dosage information for all personnel in the Task Force. It is believed that the total number of personnel engaged in official dosimetry work should be reduced. Difficulties encountered with the permanent film badge can be remedied.
3. Maximum permissible levels and exposures were not established to cover all important cases. A need for flexibility in a few specific cases is apparent.
4. The Task Unit organization was adequate and satisfactorily met all requirements.

*4.7.6 Recommendations

1. The project monitor program should be continued in future operations.
2. A development program aimed at improving the permanent film badge package and providing a certain amount of automation to the film processing and recording procedures should be established.
3. Maximum permissible levels and exposures should be restudied and rewritten in the light of current thinking and past experience.

4.8 TASK UNIT 8, LASL DOCUMENTARY PHOTOGRAPHY

The following were the assigned responsibilities of TU-8 during operation Redwing:

1. To make all negatives necessary to provide full report coverage for TG 7.1, and for TU-1 and TU-3 programs, in black and white and color, still and motion pictures.
2. To provide construction, accident, and general record coverage. This included a limited number of pictures of the public relations type.
3. To make technical documentary records in still and motion picture of each operation.

[redacted]

[redacted]

4. To make a quickie 16-mm sound motion picture in black and white of each LASL test during the operation.

5. To provide facilities and aid to the scientific staffs of the LASL and DOD programs in the processing of photographic records.

6. To store, issue, process, and account for technical documentary and, in some cases, scientific record film in accordance with security and classification instructions.

These responsibilities were fulfilled. To implement the coverage twelve men from Los Alamos were phased at six-week periods into and out of the FA. Ten military photographers were assigned to TU-8 as well.

Equipment was taken from Los Alamos and rented from other sources in the U. S., which enabled the quickie motion pictures to be completely finished at Eniwetok. The facility was extended to UCRL as well. These quickies were delivered in the main within the required D + 4 deadline to JTF 7 forward.

Photographers to help in, or take charge of, scientific record processing were provided for Programs 10, 13, and 16.

The following is a summary of work performed. Obviously much more will be done in the U. S. before final reports are finished.

2400 documentary photographic negatives were made.
5000 4 x 5 inch prints from above negatives were printed.
750 orders were accepted for processing.
5000 prints, including prints from a large number of aerial negatives, were made.
125 copy negatives were made.
3000 prints were made from these negatives.
15,500 ft of 16-mm negative was processed. This includes the assembly record footage as well as quickie footage.
4000 ft of 16-mm negative was processed for UCRL.
20,000 ft of working print was printed and processed.
26,000 ft of final release print was printed and processed.

4.9 TASK UNIT 9, UCRL DOCUMENTARY PHOTOGRAPHY

TU-9 is comprised of members of the Graphic Arts Department of UCRL. This group serves to provide continued photographic support for the scientific programs of UCRL from Livermore into the FA.

The primary objectives of this group are the following:

1. Produce and deliver in the field to CJTF 7, seven Top Secret 10-min sound 16-mm film reports on the current series of devices designed, developed, and tested during the operation by UCRL. Each production

[redacted]

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required four release copies, of which three were couriered to the ZI four days after each shot date.

2. To provide still photographic documentation of all technical programs and activities conducted or directed by this laboratory.

3. To provide laboratory darkroom facilities, special equipment, and film storage to aid programs requiring such assistance.

4. To store, issue, process, and account for film and maintain film records in accordance with security and classification procedures.

To accomplish these objectives, a staff of nine people was required, with appropriate rotation, for a period of five months in the FA. TU-9 headquarters was located on Parry Island where two specially equipped trailers allowed adequate operating facilities. Trailer facilities and manpower were assigned to two other sites, including Bikini, where requirements necessitated continued support.

General statistics are as follows:

1300 still black and white negatives, and color transparencies were exposed and processed.

19,000 ft of 16-mm original film stock were exposed to meet all assignments throughout the operation.

4.10 TASK UNIT 10, LASL ASSEMBLY

TU-10 was formed in July 1955 for the purpose of handling all assembly and zero point readiness for firing of all LASL weapons. A further responsibility of zero cab planning for the coordinated use by both weapon and diagnostic programs was assumed.

The initial phase of operation of TU-10 started with the appointment of a task unit commander as a functioning member of J Division Office and sitting as a member of TU-1 Staff. The primary object of this initial phase was to establish personal liaison between the diagnostic programs of TU-1 and the groups of LASL W Division, LASL GMX Division, and SC whose prime function was the manufacture of the Redwing devices during the initial phase. It is felt that the establishment of this early liaison was worth the effort and should be tried again. Great care should be used, however, to have liaison that is familiar and sympathetic with both weapon and diagnostic programs.

TU-10 moved into a second and active phase with the shipment of Redwing devices from LASL. At this time personnel from W-1, W-7, GMX-3, GMX-7, and Sandia became actively engaged in TU-10 activities and formed the total TU-10 team at the PPG.

Eleven devices were brought to the PPG for test. These were [redacted]

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[redacted]

DELETED

were transported by ~~air~~ to the PPG. All other devices were transported on the USS Curtiss. All transportation was accomplished on schedule without delay.

TU-10 operated by using specific teams of people for specific jobs - for example, gas handling, X units, ENS units, etc. Each team did its particular job on each weapon under the coordinating control of the Commander or Deputy Commander of the Task Unit. In addition, the handling and moving of the device was supervised by the engineer most familiar with the general design of the weapon. By rotating crews at the PPG, it was possible to have an average of only about 17 people present, of whom only five were required to remain for the full duration of Redwing.

A complete diversity of zero stations was used. Two ground stations, two airdrops, three towers, and four barges were planned. Of these ten were used, only the [redacted] a ground shot, being cancelled.

The firing of one device, [redacted] was aborted during the first firing run, [redacted] It was necessary to dissassemble this device and install a second primary before firing. This was accomplished without incident.

A very tight schedule was maintained throughout the operation and after a slow start relatively little delay occurred. This could not have been done if the weapon teams involved had not operated at peak efficiency.

A summary of the highlights of TU-10 operation follows:

Lacrosse [redacted] DELETED

April 10	Arrived PPG
April 24	Dummy moved to location
April 25	Detonators installed
April 25	Device moved to location
April 29	First scheduled date
May 5	Lacrosse detonated

Cherokee [redacted] DELETED

April 10	Arrived PPG
May 6	Device checked out
May 8	First scheduled date
May 10	Device taken to Eniwetok and put into aircraft
May 12	Device returned to Parry
May 16	Device taken to Eniwetok and put into aircraft
May 21	Cherokee detonated

[redacted]

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[redacted]

Erie [redacted]

May 12	Arrived PPG
May 25	Dummy installed
May 28	Device installed on tower
May 31	Erie detonated on schedule

Seminole [redacted]

May 12	Arrived PPG
May 19	Device moved to location
June 6	Seminole detonated on schedule

Flathead [redacted]

May 22	Arrived PPG
June 5	Barge moved to Bikini by LSD
June 6	Barge anchored at Bikini
June 9	First scheduled date
June 12	Flathead detonated

Blackfoot [redacted]

May 22	Arrived PPG
June 6	Device assembled at Parry
June 8	Dummy moved to tower
June 9	Device moved to tower
June 10	First scheduled date
June 12	Blackfoot detonated

Osage [redacted]

April 10	Arrived PPG
June 15	Device taken to Eniwetok and installed on plane
June 16	Osage detonated on schedule

Dakota [redacted]

June 8	Arrived PPG
June 14	Barge taken to Bikini by LSD
June 15	Barge anchored at Bikini
June 18	First scheduled date
June 26	Dakota detonated

[redacted]

Huron, [redacted]

May 22	Arrived PPG
June 27	Barge taken to Bikini by LSD
June 28	Barge anchored at Bikini
July 2	Aborted [redacted] 3 min before firing
July 2-3	Secured device for safe transport
July 4	Barge returned to Eniwetok by LSD
July 5	Barge returned to slip, device unloaded, disassembly started

Navajo [redacted]

April 10	Arrived PPG
July 5	Barge loaded on LSD and taken to Bikini
July 6	Barge anchored at Bikini
July 9	First scheduled date
July 11	Navajo detonated

Huron [redacted]

July 10	New pit arrived PPG
July 17	Barge moved to location in Mike crater
July 20	First scheduled date
July 22	Huron detonated

*Recommendations are as follows:

1. The use of mobile workshop equipment for the various teams operating at Zero sites should be considered wherever possible. The W-7 trailer for gas filling, which was used very effectively, proved the value of the mobile unit.

2. In the future, it is recommended that the task unit consider purchasing good handling equipment, such as fork lifts and box movers, and not count on saving them between operations. All packaging of devices and gear should be designed around the existing handling equipment for ease of handling.

3. If barge shots are included in future operations, all barge construction and ballasting should be done either prior to the start of the active Task Unit work at the PPG or at a location other than the Assembly Area.

4. All permanent buildings and equipment at the Assembly Area require repairs and maintenance. A program of repair followed by constant preventive maintenance should be initiated at once.

5. In order to facilitate handling of devices and equipment into the magazines, large level concrete pads in front of each magazine are needed.

4.11 TASK UNIT 11, UCRL ASSEMBLY A

TU-11 was formed from a group of engineers and physicists to provide a field capability for assembling and detonating the [redacted] They were members of the UCRL small weapons program who were also responsible for the original design and fabrication of the three devices. A design and assembly team accompanied each device to the PPG. The use of C-124 aircraft for the transportation of the devices to Eniwetok allowed a maximum time for design and fabrication at Livermore and assembly at PPG.

The [redacted] were fabricated by the Hanford Works of the General Electric Corporation and delivered to Livermore. The [redacted] were fabricated at the Dow Chemical Company's Rocky Flats Plant.

Owing to the relatively small size of the detonations associated with [redacted] there were no delays caused by weather and the respective detonations occurred on the scheduled days: May 28, June 14, and June 22, 1956.

A [redacted] The assembly mission for the [redacted] was accomplished as a joint effort of TU-11 and TU-12 of UCRL. [redacted] detonated on July 3, 1956.

4.12 TASK UNIT 12, UCRL ASSEMBLY B

The prime function of TU-12 was the field assembly of the large devices [redacted]

The Task Unit was made up of A Division (Large Weapons) and Device Engineering Division personnel who were thoroughly familiar with the devices from having followed them through their design and fabrication phases. These men were further subdivided into device assembly teams under the immediate control of the lead engineer for the particular device. This proved to be a highly workable system.

Full trial assembly of each device was made in the U. S. The only compromise was that dummy primaries were used in these "fit-ups." This assembly included matching support stand and local diagnostic equipment to the device. On some devices it proved desirable to airship jigs, representing, and connecting points between, the device and external equipment tied to the device, to PPG to facilitate early completion of field diagnostic work.

Another technique of value was the shipping of the devices in a nearly assembled condition -- that is, for shipment after final stateside assembly each device was broken down as little as possible. This enabled a rapid

[redacted]

final PPG assembly to be made, since much of the more time consuming work had already been completed.

The [redacted] was stored and checked in Building 341 on Parry and then loaded aboard an LSD for transport to Bikini Atoll. The final assembly was done on a concrete slab on Eninman Island. The [redacted] device was detonated at 0556 local time, May 28, 1956.

The assembly of the [redacted] was completed in CMR Building 341 and the complete package (warhead, missile nose cone, and support stand) was transferred to the shot barge. The barge was towed to the firing position in the Mike Crater and detonated at 0606 local time, July 9, 1956.

The [redacted] device was stored and checked in CMR Building 341 on Parry, then shipped by T-boat and truck to the 300-ft tower located on Eniwetok Atoll, Station 3, Eberiru Island. [redacted] This final assembly was completed in the shot cab on July 2 and detonated at 0606 local time, July 3, 1956.

The [redacted] device was stored and checked in CMR Building 341, then transported to the barge slip, and lowered aboard the barge. The barge was then transported by LSD to the shot location in Bikini Lagoon, towed into position, and anchored. Final assembly was completed on the anchored barge and the [redacted] device was detonated at 0546 local time, July 21, 1956.

[redacted]

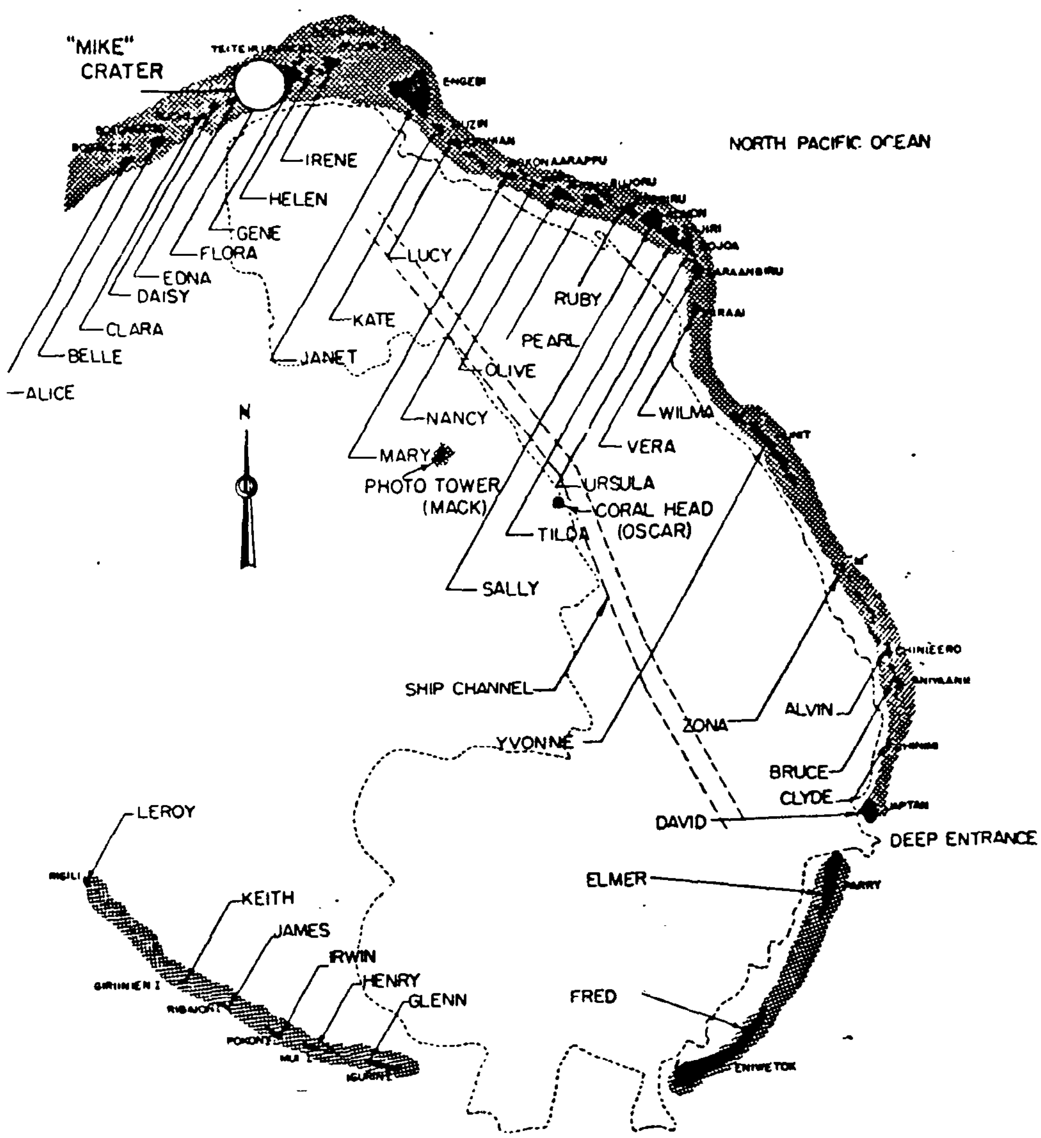

Fig. 4.2 Map of Eniwetok Atoll.

[redacted]

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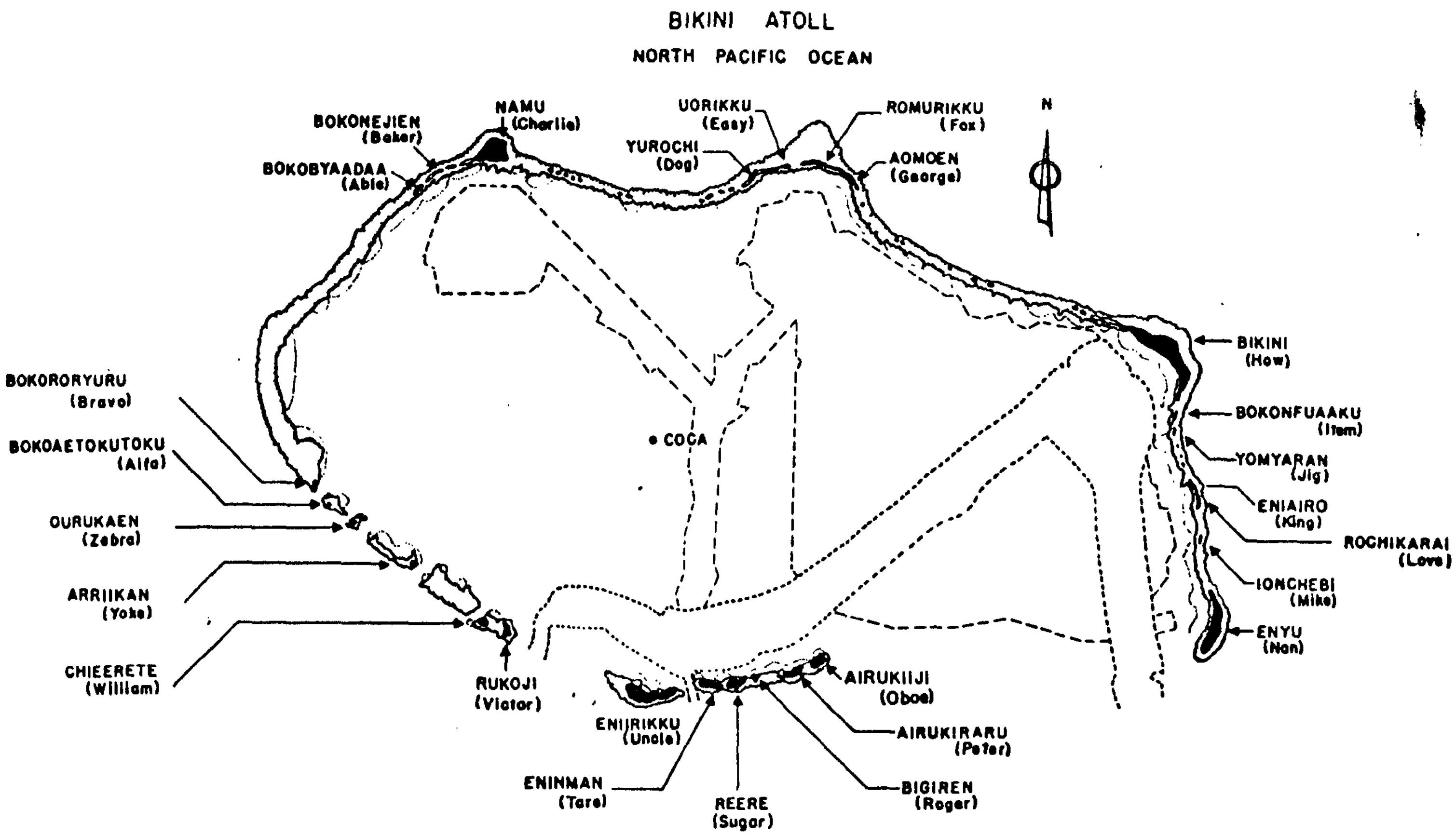

Fig. 4.3 Map of Bikini Atoll.

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