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LOS ALAMOS SCIENTIFIC LABORATORY

of the

UNIVERSITY OF CALIFORNIA

410631

June 1954

JO-11 [redacted]

REPORT OF THE COMMANDER TASK GROUP 7.1

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A C K N O W L E D G E M E N T

In connection with the Scientific Task Group's planning for and participation in Operation Castle, I wish to acknowledge the overall direction and invaluable advice of Alvin C. Graves, J-Division Leader, LASL, and Deputy for Scientific Matters, Joint Task Force SEVEN.

It would not be possible in the limited time available to determine all of the contributors to this report. It is based largely on data provided by programs, projects, task units, and staff sections and was assembled by the Task Group staff.

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ILLUSTRATIONS Page

TABLES

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[redacted]

To record such data, photographically suitable light sources linked to the hydrodynamic phenomena and cameras capable of resolving small fractions of a microsecond have to be available. The light sources were provided for by the light radiated by the case of the device when heated by the shock wave.

At both the [redacted] sites four LASL Model 100 streaking cameras and one LASL Model 6 framing camera were employed. Each of the Model 100 cameras photographed all the case shots; the Model 6 was directed at the device end-on and was employed for qualitative reasons only.

No satisfactory pictures were obtained from the detonation of [redacted] device. Indications are that though all the cameras performed properly, a local heavy rainstorm between the bunker and the zero site cut the light transmission down to essentially zero. As a result no streaks were evident and all that was recorded by the Model 100 cameras was the fireball as it swept by the field of view. The Model 6 shows a faint glowing (Teller Light?) of about 11 microseconds duration and then a somewhat brighter glow growing in size about 40 microseconds later.

2.2.4 Program 24, External Neutron Measurements

The object of Program 24 was to measure the energy spectrum of neutrons emanating from [redacted] device. An energy resolution of about 2 per cent should be [redacted] for the (d,t) peak.

Neutrons from the device coming down the Tenex pipe strike two CH_2 radiators. Recoil protons from (n,p) collisions in the radiators are detected in nuclear emulsions. Measurements of proton ranges in emulsion yield proton energies, from which the neutron energies may be determined.

The signal-to-noise ratio in the exposed plates is good. The single grain background is small, indicating a negligible exposure to gammas and electrons. Under a magnification of 1000x, there is about 1 recoil proton from fission events per field of view and about 1 recoil proton from the (d,t) reaction per 20 fields of view. When corrections are made for angles of observation, solid angle, radiator thickness and the (n,p) cross-section, the resulting neutron energy spectrum shows a peak at 14 Mev, super-imposed on a fission spectrum. The (d,t) peak has about one-fourth of the area of the fission spectrum. There is a noticeable tail of the peak toward the low energy side which would indicate a contribution of scattered 14 Mev neutrons

[redacted]

[redacted]

down the pipe. The yield in the 14 Mev peak is about [redacted] of that expected from the initial calculations where a yield of 1 Mt was taken as the basis for calculation.

2.3 TASK UNIT 13 PROGRAMS (DOD)

2.3.1 Program 1, Blast and Shock Measurements

The broad objective of Program 1 was to measure and study the blast forces transmitted through the various media of the earth. In the main measurements were obtained in air by means of Wiancko and mechanical self-recording pickups. Those obtained within the water were taken by means of tourmaline, Wiancko, strain gage, and ball crusher pickups. A few earth measurements were made using Wiancko accelerometers. Successful measurements contributing to the fulfillment of the objectives were made by ten out of twelve projects. Of the two unsuccessful projects, one failure was brought about by the [redacted] coupled with the cancellation of [redacted] The other project failure was brought about by the scheduled time of firing which imposed unfavorable light conditions for photography.

Many interesting and valuable records were obtained during the shot series. These records were interpreted in the field and will be reexamined subsequently at the home laboratories of the various project agencies. The following tentative conclusions are based on preliminary data and, therefore, are subject to change upon a more careful study of the records.

a. The air shock pressure-time traces obtained at close-in ground ranges were distorted.

b. Although distorted air shock wave forms were noted, no serious peak pressure discrepancies (as compared to the 2W Operation Tumbler-Snapper Composite free air pressures) were noted.

c. Dynamic air pressures were obtained that were higher than those predicted by the Rankine-Hugoniot relations applied to air. The pressure discrepancies were probably a result of sand and/or water loading of the shock wave.

[redacted]

[redacted]

d. Within the ranges instrumented (7,500 to 20,000 ft), underwater shock pressures were not appreciably larger than the air pressure at the corresponding distance. Approximately equal peak pressure inducing signals were transmitted through the earth and air, and these induced peak pressures were approximately equal to those of the air shock wave at corresponding distances.

e. The heights of the water waves induced within the Bikini lagoon can be approximated by the empirical relationship:

$$H_t R = \frac{2.25\, W^{1/2} \left(\frac{\phi}{180}\right)^{1/2}}{\rho}$$

Where:

H_t = Shallow water crest height in feet

R = Range in feet

W = Equivalent charge weight in Mt

ϕ = Angular breach width in degrees in a semicircle into the lagoon

ρ = Relative density of media beneath fireball

2.3.2 Program 2, Nuclear Radiation Effects

The general objective of this program was the determination of the militarily significant nuclear radiation effects of high yield surface detonations. Of primary interest was the determination of the nature, intensity and distribution of radioactive fall-out resulting from surface-land and surface-water detonations of high-yield devices. In addition, the effects of initial gamma radiation and the flux and spectrum quality of neutrons were investigated.

Gamma film and chemical dosimetry techniques and gamma scintillation counter equipments were employed to evaluate initial and residual gamma radiation exposure and to provide information on arrival time and early field decay characteristics of gamma radiation from fall-out.

Neutron detection techniques, including the use of a variety of

[redacted]

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fission and threshold detectors, were employed to document the neutron flux from [redacted] devices.

The fall-out instrumentation included a variety of types of collectors including samplers for total liquid and dry fall-out collection, intermittent collectors, and liquid aerosol collectors. The lagoon and island areas local to the shot zero points were heavily instrumented for all Operation Castle detonations except [redacted]

Documentation of fall-out over extensive downwind ocean areas encountered serious experimental and operational difficulties. The problem was attacked initially by the employment of an array of free floating buoys equipped with sample collectors. For [redacted] an area survey was mounted which involved surface and subsurface [redacted]ty measurements, water sampling, and hydrographic measurements. This survey covered a broad downwind zone to a distance of 200 miles and met with a large measure of success.

Neutron flux measurements for [redacted] and initial gamma data for [redacted] established the nature and magnitude of these effects for these types of high-yield surface detonations. Initial gamma radiation and neutrons are of minor significance in relation to other effects of such bursts.

Considerable information was obtained on the distribution and characteristics of fall-out from high-yiel[redacted]d water surface detonations. Extensive close-in data for [redacted]re augmented by a post-shot survey of numerous downwind islands within the path of the fall-out to a [redacted] 300 miles. The oceanographic and radiological survey for [redacted] provided good coverage of the principle zone of downwind fall-out to a range of 200 miles. The results of the latter, [redacted]ed good buoy samples taken 35 to 50 miles downwind for [redacted]should allow evaluation of the nature and distribution of fall-out for high-yield surface-water bursts.

These results indicate that surface bursts of megaton yields distribute casualty-producing fall-out over areas upwards of 1,000 square miles.

The oceanographic survey for [redacted] indicates that the techniques employed, coupled with a rapid synoptic monitor survey of the water surface by fast surface vessels or aircraft or both, provide a feasible method for documentation of fall-out over water areas.

2.3.3 Program 3, Structures

The objective of Program 3 was to study the effects of blast in

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various areas of military interest. The nature and results of this study are briefed in the following paragraphs.

In Project 3.1 a rigid 6 by 12 by 6 ft cubicle at 9500 ft from the [redacted] detonation was instrumented to record pressure vs time o[redacted] cubicle faces. Records were obtained, but the pressure field was on the order of 3.5 psi instead of the order of 15 psi which had been expected on the basis of predicted yield. The data are yet to be analyzed and interpreted.

In Project 3.2 the apparent craters formed by the [redacted] detonations were measured by fathometer soundings as originally planned. The results are briefed as follows:

Crater formed by	Diameter, ft	Depth of Apparent Crater, ft
[redacted]	6500	120
	700	24
	1500-2500	20*

*Below original bottom which was 160 ft below water surface.

In Project 3.3 a study was made of tree damage on Eniirikku, Rukoji and Chieerete islands from the [redacted] shots. Graded damage was observed, but data obtained are yet to be analyzed and interpreted.

Project 3.4 determined the effects of [redacted] upon naval mines of various types planted at distances of 2,000 to 15,000 ft from the detonation site. Graded damage was obtained from 0 per cent at 15,000 ft to 100 per cent at 2,000 ft.

Project 3.5 was activated immediately after the [redacted] shot to document the unexpected damage to the camp on Eninman and certain instrumentation shelters near ground zero. This was done primarily by photography.

2.3.4 Program 4, Biomedical

This study represented the first observations by Americans on human beings exposed to excessive doses of radiation from fall-out. The groups of exposed individuals are sufficiently large to allow good statistics. Although no pre-exposure clinical studies or blood considered either to be essentially instantaneous, or received at a constant dose rate over a period of minutes. From previous animal experimentation it might be expected that the dose received by exposed individuals in the present study, extending over two or three days, would produce less of an effect than would the same total dose given over a few minutes. It is not possible without further experimentation to attempt quantification of the degree to which observed effects in the population studies may have been altered by this particular combination of dose rate and time during which the total dose was delivered.

Hematological findings were somewhat similar to those seen following single doses of penetrating radiation in animals. However, the time course of changes in both the leukocyte and platelet counts in the Rongelap group was markedly different from that seen in animals. Maximum depression of these elements occurred much later in these individuals than is seen in animals, and the trend toward normal was considerably delayed. The marked delay in return to normal leukocyte values in the present study appears to exceed that observed in the Hiroshima and Nagasaki casualties. Further evidence that the return to normal may be later in human beings than in animals can be seen in the response of the few cases of the Argonne and Los Alamos accidents. Although the doses, types, and conditions of irradiations were sufficiently different in the several series of exposed human beings to preclude strict comparisons among them, the added evidence from the present studies would seem to validate the general conclusions that the time pattern or hematological changes following irradiation in man is significantly different from that observed in the large species of animals studied to date.

2.3.5 Program 6, Service Equipment and Techniques

Program 6 included six projects concerned with the developing, testing, and analysing of various aspects of weapons effects on service equipment and operational techniques.

Project 6.1 was successful in obtaining excellent radarscope photos of the detonation and blast phenomena for utilization in establishing Indirect Bomb Damage Assessment (IBDA) procedures for high yield weapons.

The high-yield weapons detonated in regions such as Bikini, where sharp land and water contrasts are obtainable, gave excellent results for radar return studies and air crew training for the 20 Strategic Air Command (SAC) air crews who participated.

[redacted]

Projects 6.2a and 6.2b were successful in obtaining significant data concerning blast, thermal and gust effects on B-36 and B-47 aircraft in flight. Minor blast damage was sustained by the B-36 on several shots; however, predictions on temperature rise as a function of incident thermal energy for both the B-36 and B-47 were shown to be conservative. Some concern arose over the response of the B-36 horizontal stabilizer to gust-loading at a critical station. Additional studies will be required, including instrument calibration, before any revisions of current concepts of delivery capabilities can be expected.

Project 6.4 was successful in evaluating the effectiveness of washdown systems for naval vessels. Also much valuable experience was gained in ship decontamination procedures and techniques. In addition, one vessel (YAG 39) assisted in the collecting of fall-out data for Project 2.5a. Project 6.4 has demonstrated that a typical naval vessel, when adequately equipped with washdown apparatus, can operate safely in regions of heavy fall-out and still maintain operational capability without excessive exposure of the ship's company to residual radiation from fall-out.

Project 6.5, operating in conjunction with Project 6.4, evaluated current decontamination procedures on representative walls, roofing, and paving surfaces which were subjected to the wet contaminant of barge and land shots. The contaminant, particularly from the barge shots, was found to be much more tenacious than that experienced in similar tests at the Buster-Jangle underground shot, and the accepted decontamination procedures less effective.

Project 6.6, recordings of effects on ionospheric layers, particularly the F_2 layer, were successful in most instances. Because of rediation levels, the Rongerik station could not be operated continuously for complete ionosphere history, but the station was activated for all shots. The significance of recorded results will require detailed study prior to the writing of a final report.

2.3.6 Program 7, Long Range Detection

The general objectives of Program 7 experiments in this test series were the improvement of present techniques, development of new techniques, and collection of calibration data in furtherance of the AFOAT-1 mission. Participation in the test was really two-fold, consisting of some experiments specifically designed for Operation Castle and some operational tests of routine procedures.

[redacted]

CHAPTER 3

GENERAL ACTIVITIES OF TASK GROUP 7.1

3.1 MISSION

The mission of Task Group 7.1 included the following tasks:

a. Position, arm and detonate the weapons and devices.

b. Conduct technical and measurement programs.

c. Keep CJTF SEVEN informed on test and technical developments affecting the operational plan and military support requirements therefor.

d. Schedule the inter-atoll 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.

e. Complete the installation and calibration of the weapons and devices and all instruments and test apparatus.

f. Be responsible for the removal of all TG 7.1 personnel and necessary equipment from the shot site danger area.

g. When directed by CJTF SEVEN, evacuate TG 7.1 personnel from Bikini Atoll.

h. Be prepared, upon directive from CJTF SEVEN, to conduct emergency post-shot evacuation of TG 7.1 personnel from Eniwetok Atoll.

i. Provide CJTF SEVEN with a statement of preliminary test results.

j. Provide non-technical film coverage.

k. Recommend to CJTF SEVEN safe positioning for aircraft participating in the scientific programs.

[redacted]

l. Conduct the radiological-safety program

m. Initiate voice-time broadcasts for all elements of the Task Force.

n. Prepare appropriate technical reports at the conclusion of each shot and the whole operation.

3.2 ORGANIZATION AND COMMAND RELATIONSHIPS

With the completion of Operation Ivy in November 1952, the Headquarters of Task Group 132.1 returned to J-Division in the Los Alamos Scientific Laboratory to begin planning for Operation Castle. The final organization is shown in Fig. 3.1. It includes task units for the University of California Radiation Laboratory programs, for UCRL device assembly, and for the Department of Defense programs. These are changes from the Ivy organization. In order to free himself for other urgent commitments, the Task Group Commander did not personally take charge of the Firing Party Task Unit. This proved to be a worth-while change from the previous practice.

At midnight Washington time, January 31, 1953, Joint Task Force 132 became Joint Task Force SEVEN and Task Group 132.1 became Task Group 7.1. On March 4, 1953, Task Group 7.5, AEC Base Facilities, was established.

During 1953, UCRL organized, staffed, and established L-Division at Livermore, California. Relationships between the L-Division group and Headquarters, Task Group 7.1, were very close during this period. For most of the time UCRL had a liaison representative in residence at Los Alamos, and visits were constantly exchanged between members of the two organizations. In order to support UCRL overseas and to train personnel for future overseas tests, L-Division integrated personnel into the Task Group 7.1 J-1, J 3, and J-6 staff sections and filled billets in those sections overseas.

Since the principal function of the Task Force and most of the Task Groups was to support the scientific effort, most of the overall planning depended on the plans of Task Group 7.1. Therefore, command relationships differed somewhat from the normal military pattern. Figure 3.2 shows the Joint Task Force SEVEN organization and some of the major command relationships involved, and Table 3.1 shows the key personnel of Task Group 7.1. CJTF SEVEN coordinated the activities of Task Groups 7.1 and 7.5 through his Scientific Director, in accordance

[redacted]

15

[redacted]

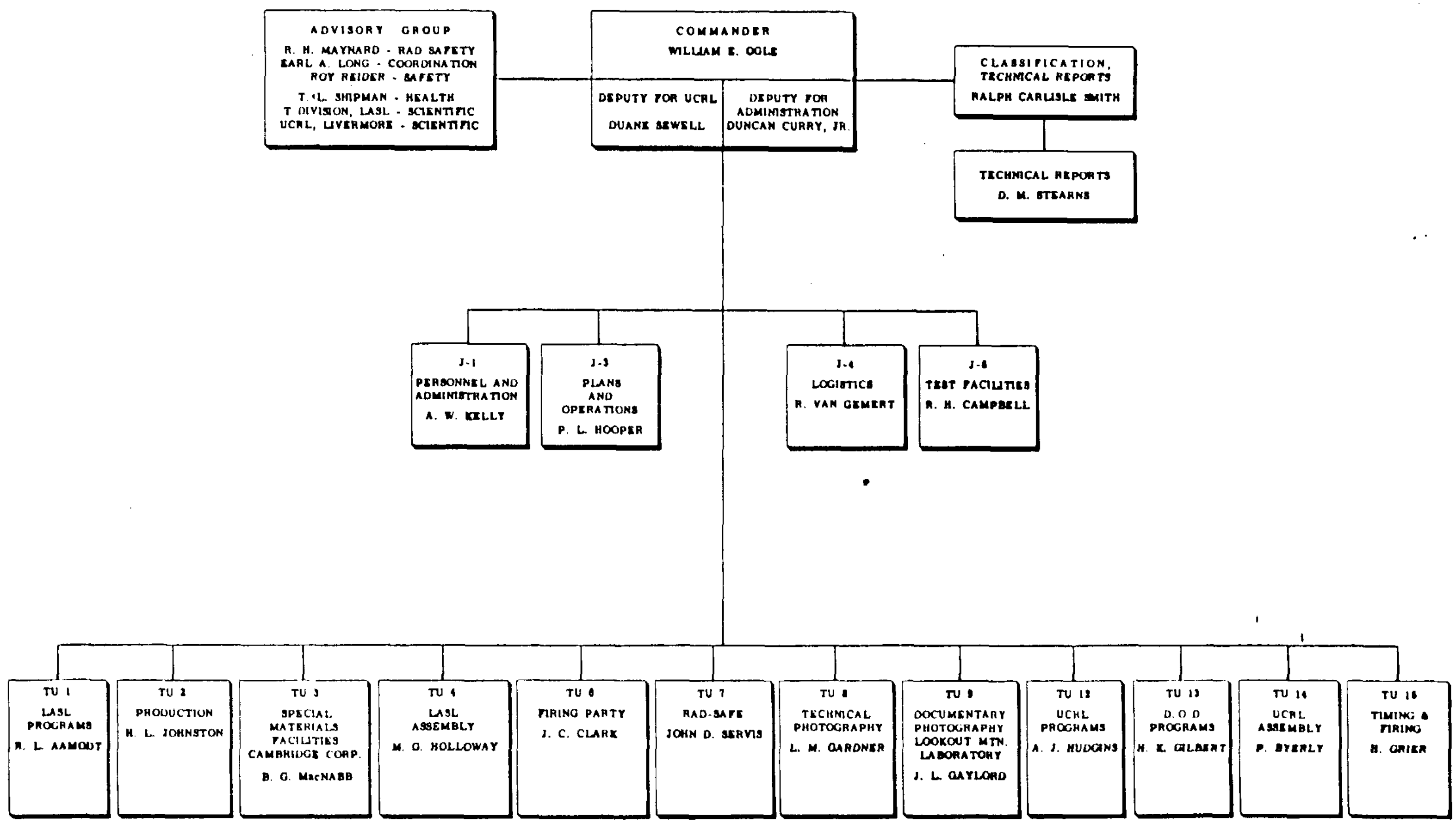
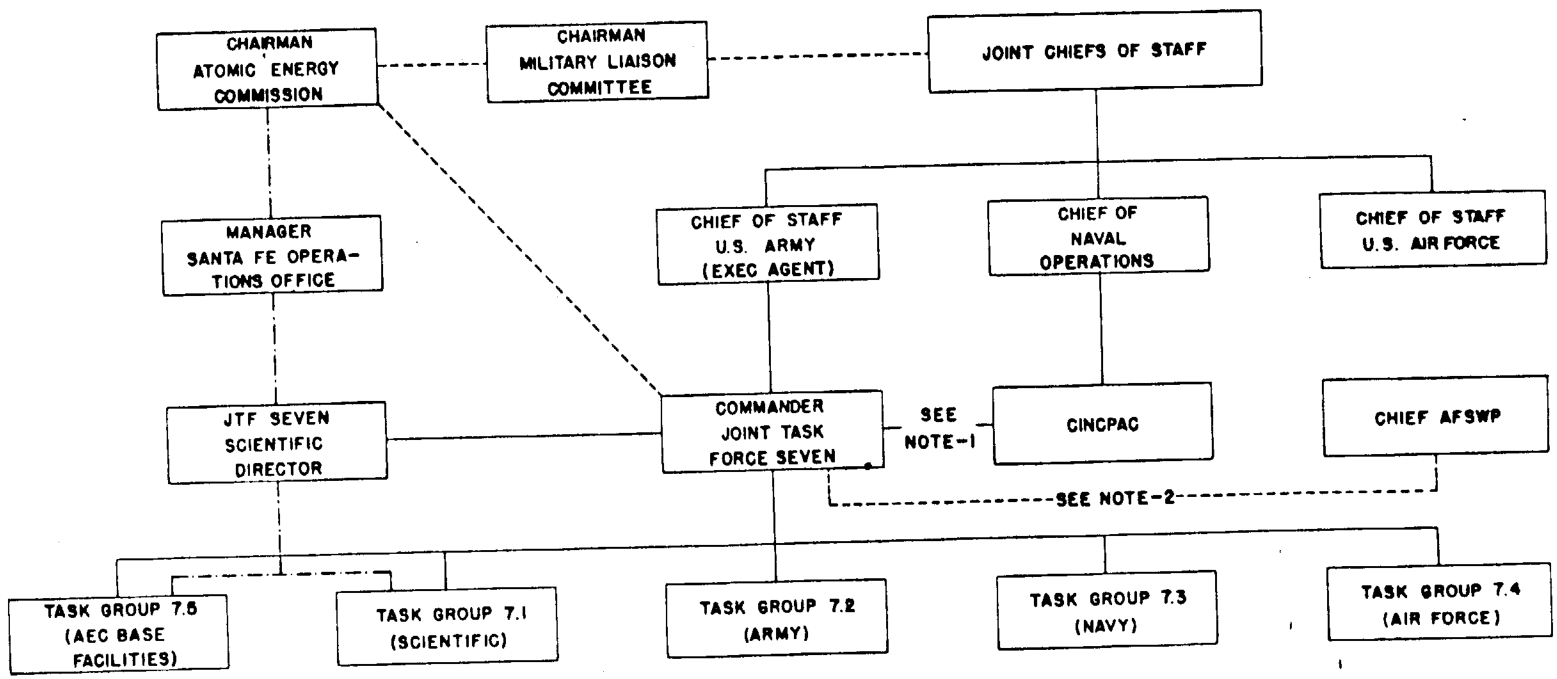


FIG. 3.1 ORGANIZATION CHART - TASK GROUP 7.1

[redacted]

16

[redacted]



LEGEND:

- ——— OPERATIONAL CONTROL
- - - - - - LIAISON
- —·—·— AEC POLICY

NOTE 1: BY DECISION OF THE JCS ON 13 APRIL 1951, THE COMMANDER OF THE JOINT TASK FORCE WILL REPORT TO THE APPROPRIATE COMMANDER UNDER THE JCS (CINCPAC) FOR MOVEMENT CONTROL, LOGISTIC SUPPORT AND FOR THE PURPOSE OF GENERAL SECURITY WITH RESPECT TO THE TASK FORCE AND ENIWETOK ATOLL (LATER BROADENED TO INCLUDE BIKINI ATOLL). IN THE ABSENCE OF THE TASK FORCE COMMANDER FROM THE ENIWETOK AREA, THE SENIOR TASK FORCE OFFICER PRESENT WILL, AS ATCOM, REPORT TO CINCPAC FOR THESE PURPOSES.

NOTE 2: BY DECISION OF THE JCS ON 23 APRIL 1953, THE CHIEF OF THE ARMED FORCES SPECIAL WEAPONS PROJECT (AFSWP) WILL EXERCISE, WITHIN ANY TASK FORCE ORGANIZATION, TECHNICAL DIRECTION OF THE WEAPONS EFFECTS TESTS OF PRIMARY CONCERN TO THE ARMED FORCES AT ATOMIC TESTS CONDUCTED OUTSIDE THE CONTINENTAL UNITED STATES. PRIOR TO THE ON-SITE PHASE OF AN OVERSEAS TEST OPERATION, THE TASK FORCE COMMANDER WILL CONSULT THE CHIEF OF AFSWP ON MODIFICATIONS OR DELETIONS TO THE DEPARTMENT OF DEFENSE WEAPONS EFFECTS TEST PROGRAMS.

FIG. 3.2 ORGANIZATION CHART - JOINT TASK FORCE SEVEN

[redacted]

[redacted]

KEY PERSONNEL OF TASK GROUP 7.1

Unit or Section	Name
Commander	W. E. Ogle
Deputy for UCRL	Duane C. Sewell
	Walter D. Gibbins
Deputy for Administration	Duncan Curry Jr.
Advisory Group	
T-Division, LASL	J. Carson Mark
UCRL Scientific	Edward Teller
Radiological Safety	Russell H. Maynard, Captain, USN
Coordination	Earl A. Long
Safety	Roy Reider
Health	Thomas L. Shipman
	Thomas N. White
Classification and Technical Reports	Ralph Carlisle Smith
	Joseph F. Mullaney
J-1	Armand W. Kelly
	Larry W. Burns
	Robert B. Cruise, Lt Col, USA
J-3	Philip L. Hooper, Colonel, USA
	Walter T. Kerwin, Colonel, USA
	David V. Miller, Colonel, USAF
J-4	Harry S. Allen
	Robert J. Van Gemert
	John W. Lipp, Lt Col, USA
J-6	Robert H. Campbell
	Robert W. Newman
TU-1	Rodney L. Aamodt
Prog 11	Roderick W. Spence
	Harold F. Plank
	Charles I. Browne, Maj, USA

TABLE 3.1, KEY PERSONNEL - TASK GROUP 7.1

[redacted]

[redacted]

Prog 12 and 16	Bob E. Watt Stirling A. Colgate George L. Ragan
Prog 13	Gaelen L. Felt Herbert E. Grier
Prog 14	Leon J. Brown Wendell A. Biggers
Prog 15	Newell H. Smith Leland K. Neher John Malik Robert D. England
Prog 17	John M. Harding
Prog 18	Herman Hoerlin Harold S. Stewart
Prog 19	Lauren R. Donaldson Edward E. Held
TU-2	Herrick L. Johnston Nathaniel C. Hallett
TU-3	Stanley H. Ellison Byron G. MacNabb Dewey J. Sandell
TU-4	Marshall G. Holloway Jacob J. Wechsler
TU-6	John C. Clark
TU-7	John D. Servis, Maj, USA Ragnwald Muller, LCDR, USN William R. Kennedy Pasquale R. Schiavone
TU-8	Loris M. Gardner John D. Elliott Robert C. Crook

TABLE 3.1, KEY PERSONNEL - TASK GROUP 7.1 (Continued)

[redacted]

[redacted]

TU-9	James L. Gaylord, Lt Col, USAF
	James P. Warndorf, Lt Col, USAF
	Buford A. Mangum, Maj, USAF
TU-12	Arthur J. Hudgins
Prog 21	Kenneth Street
	Peter Stevenson
	William Crane
	Floyd F. Momyer
Prog 22	Stirling A. Colgate
Prog 23	William P. Ball
Prog 24	Stephen R. White
TU-13	Huntington K. Gilbert, Colonel, USAF
	Neil E. Kingsley, Captain, USN
Prog 1	Walton L. Carlson, CDR, USN
1.1	Casper J. Aronson
1.2a, 1.3, and 1.7	John M. Harding
1.2b	Julius J. Meszaros
1.4	William J. Thaler
1.5	J. W. Smith
1.6	John D. Isaacs
1.8	Edward J. Bryant
Prog 2	Edward A. Martell, Lt Col, USA
2.1	Robert H. Dempsey
2.2	Peter Brown
2.3	Thomas D. Hanscome
2.5a, 2.6a, and 2.6b	Edward F. Wilsey
Prog 3	
3.1	Laurence M. Swift
3.2	Robert B. Vaile, Jr.
3.3	Wallace L. Fons
3.4	James Murphy, Lt, USN

TABLE 3.1, KEY PERSONNEL - TASK GROUP 7.1 (Continued)

20

[redacted]

Prog 4	Edward P. Cronkite, CDR, USN
Prog 6	Donald I. Prickett, Lt Col,USAF
6.2a and 6.2b	Wesley A. Anderson, Colonel, USAF
6.4	George G. Molumphy, Capt, USN
6.5	Joseph C. Maloney
6.6	Albert Giroux, Capt, USA
6.1	Rockly Triantafellu, Lt Col,USAF
Prog 7	Paul R. Wignall, Colonel, USAF
7.1	J. A. Crocker
7.2	G. B. Olmstead
7.4	Walter Singlevich
Prog 9	Jack G. James, Lt Col, USAF
TU-14	Paul Byerly
TU-15	Herbert E. Grier Bernard J. O'Keefe

TABLE 3.1, KEY PERSONNEL - TASK GROUP 7.1 (Continued)

[redacted]

with existing AEC-CJTF policy agreements. Relations with the Task Force and with the other Task Groups were cordial, and the cooperation and support received from them were excellent.

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 members of the Task Group on technical problems. LASL T-Division representatives were particularly active at the test site and at Los Alamos after the [redacted] shot. Their recommendations resulted in the substitution [redacted] LASL Health Division representatives, in addition to their advisory functions, actually served in the Rad-Safe Task Unit and performed special functions in connection with accidental fallout on inhabited islands and conducted studies to improve fallout predictions. T. N. White of H-Division took part in several surveys of contaminated islands and was in charge of one of the surveys.

3.4 PLANNING AND TRAINING

3.4.1 Programs, Concepts, and Schedules

The first general statement of concept for Operation Castle was issued by CTG 132.1 in June 1952. It envisaged the testing of as many as three fission experimental weapons of the order of 50 kt in addition to one high yield thermonuclear experimental device [redacted] At that time, Castle was tentatively scheduled for September-October 1953. Bikini was being considered for the thermonuclear shot and Eniwetok for the fission shots.

Holmes and Narver made a cursory reconnaissance of Bikini in September 1952, and started an extensive survey the following month. In November 1952, late in the Ivy operation, construction at Bikini started. At about the same time a considerable amount of preliminary Castle planning, including a rough outline of support requirements, went on between Task Group 132.1, Joint Task Force 132, and representatives of the AEC. At this time, the AEC decided to establish an AEC Base Facilities Task Group for Castle.

By February 1953 it had been decided that February 15, 1954, was the earliest possible date for the first Castle detonation. A tentative schedule shown in Table 3.2 was given limited distribution at

[redacted]

PAGES 52-72 WERE JUDGED IRRELEVANT AND WERE NOT COPIED ranged from LST's through fleet tugs to destroyers. The USS Belle Grove made two trips between atolls carrying loaded LCU's in order to move Holmes and Narver heavy equipment which could not be carried in other types of ships. Each time the LSD moved a shot barge, the extra space in the well was utilized to carry loaded LCU's between atolls.

3.7.8 Off-Atoll Activities

Owing to the expanded facilities at Eniwetok and the inclusion of Bikini Atoll in the Pacific Proving Grounds, off-atoll activities were reduced in comparison to the number of such activities in Operation Ivy. Of a total of nine off-atoll projects, eight were sponsored by DOD.

Five of the off-atoll projects required no active or continuous support from this headquarters other than notification of shot delays. In general these were concerned with long range effects and used existing facilities within their own organizations.

The projects involved in off-atoll activities were as follows:

a. Project 1.2 - Acoustic pressure signals in water, with various stations in the Atlantic and Pacific oceans.

b. Project 1.6 - Water wave studies, a project participating both locally and at stations at Midway, Wake, Guam and California.

c. Project 4.1 - Biomedical studies, which were established [redacted] at Kwajalein to study the effects of the inadvertant fall-out on the residents of Rongerik and Rongelap Atolls.

d. Project 7.1 - Electromagnetic Radiation Calibration, with stations in the United States, Hawaii, Alaska, Scotland, and Greenland.

e. Project 7.2 - Detection of airborne low frequency sound, with stations in Japan, Hawaii, Alaska, Greenland and Germany.

The four other projects operating off-atoll for which direct support was arranged by this headquarters were as follows:

a. Projects 2.5a, 2.5b - Fall-out Distribution Studies at Kwajalein, Ponape, Kusaie and Majuro.

b. Project 17.1 - Microbarography, with stations at Kwajalein and Ponape.

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c. Project 6.6 - Ionospheric Effects Studies at Rongerik.

The gross fall-out collectors of Projects 2.5a and 2.5b required no support during the operation and were collected [redacted] The microbarographic stations on Kwajalein and Ponape required weekly visits for rotation of personnel. Scheduled MATS airlift was used when possible, but an occasional special PBM or SA-16 flight was required to accomplish this rotation. Boat transportation to secondary stations, necessarily several miles removed from the base stations, was provided locally.

The greatest support difficulties were experienced in connection with Rongerik Atoll and Project 6.6, where LST 551 was damaged while unloading equipment on the beach in January and was out of commission during the critical build-up period. The station had to be abandoned in March owing to excessive fall-out from [redacted] and was only reactivated in April by providing off-shore support for the personnel in the form of a PC or DDE. The project people lived aboard the vessels and manned the station through expected shot times. The rotation of these people and those of Project 17.1 at Ponape was frequently hampered by critical shortage of aircraft space.

3.8 SHOT PHASE EVACUATION

3.8.1 Planning

As soon as it was determined that consideration of blast and radiological hazards would require complete evacuation of personnel except the firing party from Bikini Atoll for the first test [redacted], and probably for subsequent tests, planning for such evacuations commenced in the ZI to be sure that adequate facilities, especially seagoing vessels, were provided.

For planning purposes the monthly status reports of the projects yielded much information with regard to the location of instrumented stations, the numbers of people involved, and their distribution throughout the atoll. Because of the size and scope of the operation, it was planned to establish a chronological check list for each of the shots, listing the activities to take place during the five days prior to shot time. It was believed that this would provide for an orderly movement of personnel and equipment with minimum interference to experimental preparation during the critical period.

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After arrival of the various commands in the Forward Area, detailed planning was started. Conferences among JTF SEVEN and the several Task Groups were held to settle such matters as appointment of Transport Quartermasters, ship positions, ship movement, allocation of shipboard space to the various Task Groups, and muster. Planning by TG 7.1 was accomplished based on the information discussed at these meetings.

The [redacted] evacuation plan was the most detailed of those issued during Operation Castle since it was to cover the initial evacuation, establishing procedures which would be followed in subsequent evacuations. Each event description on this check list included the names of the people invloved, the times, and the support required. The final [redacted] plan was issued on February 20, as an appendix to TG 7.1, Operation Plan No. 1-53. It included information on ship positions, evacuation deadlines, instructions for the use of boats, helicopters, inter-atoll surface and air transportation, trailer movements, and other general subjects. As the events on this check list took place, they were checked by J-3 to insure completion. The check list was kept current by nightly conferences. It was necessary for the J-1 and J-3 Staff Sections to work in close cooperation to determine the disposition of the Task Group personnel aboard ship. It was agreed that as soon as an individual's contribution to the shot was completed, he would be evacuated either to Eniwetok Atoll or to one of the evacuation ships, depending upon the location of his required post shot activities. The operational functions of the principal evacuation ships were as follows:

USS Estes	-	Command, Staff and Advisors.
USS Curtiss	-	Weapons Assembly and shot barge support.
USS Bairoko	-	Radiological Safety and recovery parties.
USNS Ainsworth	-	Personnel required in the area but not assigned to other vessels.

Instructions issued to personnel to be evacuated for [redacted] included: disposition of classified documents, personal effects to be taken aboard, shuttle boat schedule between ship and shore, and the like. A passenger list for each ship was initiated on [redacted] corrected and final passenger lists were submitted to JTF SEVEN. Each individual at Bikini was issued a card indicating his assignment to a room aboard a specified ship.

Subsequent evacuation planning at Bikini became a much simpler

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process owing to the waterborne nature of the operation after [redacted] With island camps no longer available, the movement of personnel and equipment between ships and islands was more subject to control, and preshot evacuation became largely a matter of moving the vessels out of the lagoon. Planning for these evacuations accordingly was simplified, and consisted of check lists for the final day's activities.

At Eniwetok a plan to evacuate the upper islands was prepared for [redacted] but the evacuation was halted when the shot was cancelled on [redacted] Most of the personnel and equipment were drawn out of the upper islands of Eniwetok Atoll, and the Ursula camp was abandoned soon afterwards. For [redacted] a similar plan was prepared and executed.

3.8.2 Personnel Evacuation and Muster

On [redacted] the evacuation to the ships began for this shot. J-1 representatives went aboard their respective ships prior to the embarkation of passengers to assist Task Group personnel in locating quarters, offices, etc. A majority of personnel moved to shipboard on the morning of [redacted] At approximately noon on [redacted] the vessels left their anchorages off the various islands and assembled at anchorage off Enyu. Here the remainder of the personnel were taken aboard, and personnel transferred as necessary to be located on the proper vessel. The ships then left the lagoon.

The plan for a complete sight muster involved assignment of Task Group personnel to 25 muster groups, each representing a specific organization or working unit. For each muster group a muster officer was appointed. Muster lists were prepared by J-1 and distributed to the muster officers, and at a predesignated time a sight muster of all Task Group personnel in the Pacific Proving Grounds was conducted.

Muster for [redacted] was taken simultaneously at both atolls on [redacted] at 1800 hours. Each muster officer turned into the J-1 representative at his location a signed muster sheet indicating that portion of his personnel he had sight-mustered. The J-1 representatives then reported that portion of the muster he had received to the Task Group muster officer for his atoll. The Task Group muster officers for Bikini and Eniwetok then consolidated the entire muster, accounting for all personnel in the Forward Area. Upon completion of the muster at Bikini, J-1 representatives were stationed at each ship's gangway to register personnel embarking and debarking. These arrivals and departures were then reported to the Bikini Task Group muster officer. A running account of the movement of each individual was kept and the muster was completed at about 1830 hours on [redacted] when all personnel were afloat.

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As a result of the [redacted] shot, the land areas of Bikini Atoll were closed except to work parties, and all personnel were quartered aboard ship, which simplified the personnel evacuation problems for subsequent tests. Since shipboard space was limited, the numbers of personnel at that site between shot times were reduced to half of the peak reached in the latter part of February. Similiarly, the numbers present at Bikini for muster at shot time were often only half that experienced for [redacted]. For shots subsequent to [redacted] mustering on the Estes, Curtiss and the Bairoko was accomplished personally by the J-1 representative aboard. On the Ainsworth, where the population was the greatest, a modified system of muster groups was used. Once the muster commenced, gangway checks were maintained to assure the complete accountability of all Task Group personnel. At Eniwetok the system used at [redacted] was continued throughout the operation.

After [redacted] exact muster times varied with each shot and depended upon existing conditions, but in general, a minimum amount of time was permitted for mustering purposes. Similiarly, not all musters were concurrently conducted at Bikini and Eniwetok. It is to be noted that for [redacted] a muster was conducted at Bikini only. Complete control of personnel movement to and from Eniwetok, close liaison with J-3, and good communications proved to be the solution to an easily completed muster.

3.8.3 Evacuation of Property

Both prior to [redacted] and thereafter as the occasion required, personnel of J-4 were stationed at strategic points during critical phases of evacuation and reentry to facilitate the expeditious handling of property of Task Group 7.1 requiring movement to and from various points both at Bikini and Eniwetok.

For [redacted] the original planning called for evacuation of all Task Group 7.1 property from sites Bokobyaadaa, Namu, Yurochi, Romurikku and Aomoen to sites Eninman and Enyu as well as movement on [redacted] day of a number of semi-trailers and certain special cargo from Bikini to Eniwetok by LST. In order to implement the above, J-4 personnel were stationed at Namu, Romurikku, Enyu and Eninman to see that the evacuation was carried out without difficulty, which was accomplished with the exception that it took three hours longer than planned to complete the off-loading and placement of final loads of vehicles evacuated to Enyu.

Original planning called for reentry and normal operation from ashore sites after [redacted]. After [redacted] when it was found that

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ashore operation was impossible, it became necessary to evacuate a large amount of Task Group 7.1 property from Eninman and Enyu to Eniwetok. There was a period of three weeks of unexpected shipping activity required by immediate evacuation of vehicles and operational support property no longer needed at Bikini, owing to afloat operation and the possibility of further damage to property not required for operational use which could be evacuated to Eniwetok. During this period over thirty semi-trailers and fifty motor vehicles of various types along with tons of other general property were moved from Bikini to Eniwetok. This movement was carried out by work parties from ships in the lagoon. There was only one point where an LST could beach and difficulty was encountered on several occasions because of LST grounding on a sandbar at beaching site. There was only one crane available for loading. No property was left behind but the operation was very limited in the amount of property that could be evacuated at one time. Subsequent to the evacuation of material following [redacted] only normal expected activity was encountered in connection with evacuation for the various scheduled shots.

3.9 OPERATIONS AFLOAT

For event [redacted] Headquarters, Task Group 7.1, was transferred to the USS Estes on February 28. With the advent of fallout and damage to the Eninman complex from [redacted] it became necessary to maintain TG 7.1 Headquarters on the Estes for the remainder of the Bikini Operation, which included all but the last shot, and to conduct operations from afloat.

The Bikini phase of the operation involved a total of five vessels, each with a special task. The USS Estes was the command ship fitted out for the control of aircraft used in tests. The USS Curtiss was especially suited for the support of the shot barges and classified material, while the USNS Ainsworth housed the bulk of the experimental and support personnel. The USS Bairoko and the USS Belle Grove provided helicopter and boat support respectively; in addition the USS Belle Grove also transported the shot barges from Eniwetok to Bikini Atoll. Besides these major vessels, there were a total of five ATF's, two LST's, four DDE's, one PC and assorted special purpose craft involved in support of lagoon experiments.

Operationally, the majority of the planning for each day's activities originated aboard the Estes where the commanders of the Task Units and representatives of service organizations were located. These plans were organized into missions which were then relayed to

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IRRELEVANT AND WERE NOT COPIED

[redacted]

70. The final shot of the Castle series, [redacted] was fired from the control room on Parry Island. This was the only detonation of the series made at Eniwetok Atoll.

During Operation Castle no misfires or other delays were encountered which were due to the arming or firing operations. Weather difficulties did interfere with the firing schedule, however, and these delays necessitated arming and disarming all but two of the devices more than once.

4.6 TASK UNIT 7, RADIOLOGICAL SAFETY

4.6.1 Introduction

TU-7, the radiological-safety unit for TG 7.1, was a continuation of the radiological-safety unit of TG 132.1. Preliminary to the Castle operational phases, personnel to staff the unit were requested from the Army, Navy and Air Force. The Army furnished 34 persons, and the Navy 11. Civilian technical advisors of Health Division, LASL, and the U.S. Public Health Service were added to the unit just prior to and during the overseas period.

4.6.2 Task Group Organization for Radiation Safety

Early concepts for Castle indicated a high requirement for radiation-safety monitors. In past operations these monitors were furnished from personnel of the radiological safety task unit. The continuation of this policy would have meant a large unwieldy organization and an expensive service. An alternative was proposed and accepted by the Task Group Commander. This alternative was to place radiation-safety responsibility with the commanders and project leaders and to require each project to provide its own trained monitors. Training of Rad-Safe monitors was to be accomplished by Rad-Safe task unit personnel. A reserve monitor pool was also to be established by TG 7.2 in case of emergency need. The monitor, from the unit concept, would act as radiation-safety advisor to the project leader.

Establishment of this policy enabled TU-7 to reduce its operational personnel to a small skeleton staff of 43 personnel supplemented by project monitors of LASL, UCRL, and DOD. The skeletal organization was divided between Eniwetok and Bikini along the following lines:

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[redacted]

Bikini Rad-Safe (Afloat)

1. USS Bairoko

   a. Control element for helicopter missions

   b. Laboratory elements of instrument repair, photo-dosimetry and records, and radiation analysis

   c. Personnel decontamination and supply sections

2. USNS Ainsworth (barge)

   a. Control element for boat missions

   b. Personnel decontamination and supply sections

3. USS Curtiss

   a. Control, personnel decontamination, and supply sections

4. USS Estes

   a. Information and administrative center

This organization resulted from the emergency [redacted] situation, wherein the field radiological-safety center Eninman was destroyed and prolonged shore-based operations became radiologically unsafe.

Parry Rad-Safe

1. Control element for boat and helicopter missions

2. Laboratory elements of instrument repair, photo-dosimetry and records, and radiation analysis

3. Decontamination elements for personnel and equipment

4. Supply base for Bikini and Eniwetok

The activities of these elements and various sections will be discussed in subsequent paragraphs.

4.6.3 Training

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[redacted]

An extensive training program was initiated by the unit some six months in advance of operations in order that a skilled group of technicians could be available to the unit. Four Navy electronic technicians attended a four-week instrument repair course at the U.S. Navy Atomic Defense School, three Navy medical technicians attended a special two-week radiochemical laboratory course at Evans Signal Laboratory (ESL), and eight Army photo-dosimetry technicians also attended a special one-week course at ESL.

The unit conducted several project monitor schools to qualify project personnel in the fundamentals and techniques of radiation-safety. The first school was conducted at the Nevada Proving Grounds in the second week of November, 1953. A second school was conducted at the Eninman Rad-Safe Center in the middle of February 1954. A third school was conducted at the Parry Rad-Safe Center early in April 1954. A total of some 275 AEC and project personnel were qualified as project monitors as a result of these courses and similar courses at NRDL, UCRL and EG and G.

A general indoctrination course was conducted for TG 7.1 and 7.5 personnel through the use of AFSWP training films covering basic physics of atomic weapons, medical aspects of nuclear radiation, and field decontamination. These films were shown along with the usual movie programs at all camps at Bikini and Eniwetok.

4.6.4 Control Element

The control element exerted supervision of TG 7.1 and 7.5 activities within radiologically-contaminated areas. Control stations were established at Parry, USS Bairoko, USNS Ainsworth, USS Curtiss and USS Estes. Radiological situation data was maintained in the form of situation maps at these stations. These maps were used to control activities in contaminated areas.

These stations constituted clearance stations for all working parties entering contaminated areas of 100 mr/hr or greater. Records of activities within contaminated areas were maintained as a check on film-badge exposures. In several cases personnel exposures were re-valued from information gathered from these preentry forms. Several instances were noted in which individual film badges had high readings of exposure but investigation revealed that the film badges had been left in highly contaminated areas and did not represent actual exposure.

The limitation of exposures to the test Maximum Permissable Exposure (MPE) of 3.9 r encountered many difficulties due to certain

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[redacted]

[redacted]

set policies of "burning up" personnel and then not using them in contaminated areas. The practice of using men continuously in contaminated areas until the records reached the MPE led to a high number of individuals with exposures between 3.9 r and 5.0 r. The practice of returning personnel to home stations before the completion of the operations necessitated a number of waiver requests for exposure of 3.9 r. A small number of TG 7.1 or 7.5 personnel exceeded a two-calendar quarter MPE of 7.8 r.

4.6.5 Laboratory Element

The laboratory element acted to provide technical service to all agencies of the Task Force and consisted of the following:

1. Radio-chemical Section. The center of operations for this section was a Signal Corps radio-chemical laboratory trailer located on the hanger deck of the USS Bairoko. A smaller installation was operated at the Rad-Safe building on Parry for analysis of samples obtained at Eniwetok Atoll. This section received, prepared, and assayed solid and liquid samples submitted by other elements of the JTF as well as those samples arising from the activities of this Task Unit. Results were furnished in accordance with the request of persons submitting the sample and included such information as decay rates, specific activities, beta energies, gamma energies, and particle size determinations of air-borne and water-borne activities.

2. Photo-dosimetry and Records Section. Two film badge processing points were established and ran concurrently during the entire operation. The photo-dosimetry section afloat operated in a laboratory type trailer adjacent to the radio-chemical trailer on the USS Bairoko. The photo-dosimetry section ashore operated in the Rad-Safe building, Parry. Film badges were calibrated against Cobalt 60 and only gamma dosages were recorded. DuPont packet 559 was used; controls and standards were developed with each batch of film processed. At the completion of the operation a master list of exposures was prepared. A report of exposure for each civilian participating was sent to his home station, while in the case of military personnel this report was made to the appropriate military organization. The final repository for the records of exposure will be the AEC Division of Biology and Medicine.

3. Electronics Section. This section supported the activities of the above sections by the repair and maintenance of densitometers, voltage regulators, scalers, count-rate meters and scintillation counters. Individual survey type instruments were repaired as soon

[redacted]

as practicable after breakdown. In addition instruments issued and utilized by this task unit were calibrated and serviced at regular intervals throughout the operation.

4.6.6 Decontamination Element

The Task Unit operated personnel decontamination stations at Parry and aboard the Bairoko, Ainsworth, and Curtiss. No significant skin contamination was noted in personnel processed through these stations.

Equipment decontamination became a major activity at Parry following [redacted] Vacuum cleaning, water washing, and steam cleaning were accomplished in a newly-constructed decontamination area. Decontamination of various items from survey instruments to laboratory trailers was practically accomplished. Equipment was released to using agencies when decontaminated to 15 mr/hr.

It was noted during these decontamination procedures that the current instruments were only measuring about one-half of the total radiation present. It was also noted that the protective clothing was absorbing approximately one-half of the total incident radiation. The extremely low energy of the residual radiation made sealing practices very acceptable.

4.6.7 Supply Element

Supply stations were originally set up on both atolls, Parry Station on Eniwetok and Eninman on Bikini Atoll. In addition to its normal functions, Parry supply was responsible for shipping, receiving and recording all supplies and keeping supplies moving to Forward Areas as required. Eninman station was a base supply and its function was to maintain sufficient stocks on hand in case additional substations were required to cope with the operational situation.

After [redacted] shot, the Eninman supply station was contaminated and therefore eliminated as a supply point. A sea-going barge was procured and set up as a Rad-Safe Control and Supply Station. The construction aboard the barge consisted of two squad tents and portable salt water showers. One tent was jointly utilized by control and supply element; the other was a dressing and change station. Two transportainers were procured for storage purposes and a wooden hot locker constructed for radiac instruments. The barge was tied up alongside the USNS Ainsworth during recovery and salvage operations.

A table of equipment for this operation was set up and contained a total list of supplies and equipment for this unit. The majority of items listed therein were shipped from Los Alamos and processed thru J-4. These articles arrived on dates due and in good condition. Military items of issue were placed on LX-orders, to be furnished by the Supply Officer of TG 7.2.

Facilities for laundering contaminated clothing at Parry were adequate.

4.6.8 Radiological Situation Data Summary

1. [redacted]

A partial Rad-Safe survey was conducted on [redacted] Day with incomplete results. Results of this initial survey were conclusive enough to cancell all activities for [redacted]. The first complete survey was conducted on [redacted]. As a result of wind conditions during [redacted] areas had become "spotty" in nature so the extrapolated values representing the H + 4 hr readings can only be considered approximate. These extrapolated values are based on a $t^{-1.2}$ decay whereas laboratory analyses indicate a $t^{-1.8}$ decay during this period, thus indicating values in excess of those noted in the table.

Lagoon contamination, of consequence, was confined to lagoon areas containing suspended sediment. For the first few days this area was confined to the western quarter of the lagoon. This radioactive sediment washed over the western reef, out through the southwest passage, or settled to the bottom of the lagoon in a period of three days.

No alpha activity was detected in swipes about the living areas of the Task Group.

2. [redacted]

A partial Rad-Safe survey was conducted on [redacted] Day with incomplete atoll results. Results of this survey indicated no extensive recontamination of the atoll except within the Bokobyaadaa-Kamu chain. An unforseen fall-out of ra[redacted] material less than 5 micr in size did occur on the night of [redacted] This fall-out covered th atoll and raised radiation levels by approximately 100 mr/hr. Because of the late period of fall-out this radiation level would have corres-

[redacted]

3

[redacted]

Island	Extrapolated H + 4 hrs	[redacted]	[redacted]
Enyu	40.-60.	1.0-3.0	0.38-0.40
Bikini	70.-125.	6.0-9.0	0.8-2.1
Aomoen	25.-180.	1.2-9.0	0.75
Romurikku	400.	20.	0.90
Yurochi	600.	30.	1.0
Namu (Sta 1200)	125.	6.0	0.45-0.6
Crater		0.1	0.02
Bokonejien	1500.	75.*	
Bokobyaadaa	280.	15.	2.0
Spit south of Bokobyaadaa (Sta 1341)	65.	3.0	
Airukiiji thru Bokoeoeyuru	6.0-10.	0.1-0.22	0.025-0.035
Bairoko (30 mi SE of Enyu)	0.25		

All readings with radiac instrument AN/PDR-39.

*AN/PDR-18

DELETED

TABLE 4.1 [redacted] RADIATION SUMMARY IN ROENTGENS PER HOUR

[redacted]

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ponded to 3.5 r/hr fall-out at H+2 hr.

Because of small particle size this fall-out was much more difficult to decontaminate than the macroscopic particles of [redacted]

Secondary fall-out levelled off between 0700 - 0800M, R+2. Residual topside levels on ships were: Ainsworth - 8 mr/hr, Estes - 12 mr/hr, and Bairoko - 30 mr/hr. Maximum levels were 20 to 45 mr/hr.

Lagoon contamination covered the western quarter of the lagoon with levels comparable to those of [redacted] Lagoon flushing through the southwest passage materially increased background radiation levels in the vicinity of Ourukaen, Bokoaetokutoku, and Bokororyuru.

3. [redacted]

A partial Rad-Safe survey was conducted on [redacted] Day with incomplete atoll results. Results of this survey did indicate that Bokobyaadaa, Namu, Eniirikku, Bikini, and the Yurochi-Aomoen chain were materially contaminated. Reentry and recovery were accomplished to a large degree on shot day. No secondary fall-out was detected as results of this shot.

Lagoon contamination was restricted to a V-shaped pattern with apex at Eninman and tips covering the Bokobyaadaa-Aomoen area. A reading of 100 mr/hr was obtained over the Eninman anchorage at H+4 hr. Enyu anchorage was clear of contamination while Bikini anchorage showed traces of contamination at H+4 hr.

[redacted] crater was materially different from that of [redacted] in that radiation levels within the crater were dependent on "shine" from the lip of the crater and surrounding "sand dunes."

4. [redacted]

A damage and radiation survey was conducted on [redacted] Day. This survey covered the eastern and northern islands of the atoll and was conclusive enough to limit reentry to Enyu, Bikini, and Airukiiji on the first day. The survey on [redacted] day indicated that recontamination was limited to the Yurochi-Aomoen and the Bikini-Enyu sequence of islands. No material secondary fall-out was encountered at Bikini as a result of this detonation.

Lagoon water was materially contaminated with radioactive sediment. Readings of 4.2 r/hr were obtained at an altitude of 500 ft

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Island	Extrapolated H+4 hr	[redacted]	[redacted]	[redacted]
Enyu	0.03	0.03	0.06	0.03
Bikini	0.20	0.12	0.14	0.12
Aomoen	0.80	0.80	0.60	0.22
Romurikku	1.6	1.7	0.75	1.1
Uorikku	0.8-1.4	1.4	0.85	1.2
Yurochi	0.8-1.0	1.3	1.0	1.3
Namu	2000.		100.	0.6
Bokobyaadaa	1000.	50.0 ‡	55.	1.2
Ourukaen	0.04	0.10 *	0.16 *	0.04
Arriikan	0.02	0.40 *	0.32 *	0.02
Eniirikku	0.005	0.005	0.05	0.01
Airukiiji	0.02	0.01	0.08	0.01
Eninman	0.012	0.012	0.06	
Crater		1100 (at 300 ft)		
Ships			0.02-0.04	

‡ 200 ft altitude

* Radiation shine from water in southwest passage

Underlined islands indicate contamination by [redacted] shot

TABLE 4.2, [redacted] RADIATION SUMMARY IN ROENTGENS PER HOUR

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Island	Extrapolated H+4 hr	[redacted]		
Enyu	0.03	0.03	0.03	0.03
Bikini	5.0	0.67	0.07	0.10
Aomoen	20.0	2.5	1.6	0.35
Romurikku	10.0	1.6	0.80	0.50
Uorikku	5.0	1.0	0.60	0.47
Yurochi	5.2	1.0	0.60	0.45
Namu	250.	30.0	16.0	1.5
Bokobyaadaa	600.		16.0	9.0
Ourukaen	0.60	0.08	0.02	0.012
Arriikan	0.50	0.07	0.01	0.008
Eniirikku	210.0	2.4 I	1.8	0.008
Eninman			0.02	0.010
Airukiiji	.02	0.02	0.02	0.018
Crater	5000.	50.*	60.	

I Reading at 100 ft

* Reading at 200 ft

Underlined islands indicate those contaminated by [redacted] shot

TABLE 4.3, [redacted] RADIATION SUMMARY IN ROENTGENS PER HOUR

[redacted]

Island	Extrapolated H+4 hr	[redacted]		
Enyu	0.75	0.10	0.03	0.01
Bikini	70.	8.5	0.80	0.03
Aomoen	140.	15.0	2.0	0.40
Romurikku	140.	15.0	2.4	0.40
Uorikku	85.	10.0	1.0	0.36
Namu			1.0	2.5
Yurochi	85.	10.0	1.0	0.40
Bokobyaadaa		1.2	2.2	4.0
Ourukaen		0.01	0.50 I	0.01
Arriikan		0.01	0.60 I	0.01
Eniirikku		0.06	0.10 I	0.90
Eninman Crater		6.5	4.0	100.
Airukiiji		0.01	0.01	0.01
Crater	4.2 *		0.01	0.00

* Reading at 500 ft

I Shine from contaminated water

Underlined islands indicate islands contaminated by [redacted]

TABLE 4.4, [redacted] RADIATION SUMMARY IN ROENTGENS PER HOUR

39

[redacted]

over ground zero. This contamination moved to the west and southwest so that small boat operations could be conducted in the area. Lagoon flushing through the southwest passage materially increased radiation levels in the vicinity of Ourukaen, Bokoaetokutoku, and Bokororyuru.

5. [redacted] DELETED

DELETED A damage and radiation survey was conducted at H+4 hr on [redacted] day. This survey covered the islands of the atoll and was conclusive enough to limit reentry to Enyu and Airukiiji on the first day. This survey indicated that recontamination was extensive throughout the atoll and lagoon both to the east and west. No significant secondary fall-out was encountered at Bikini as a result of this detonation.

Lagoon water was heavily contaminated with radioactive sediment. Readings of 1 r/hr were obtained at 100 ft altitude in the vicinity of zero point on [redacted] +1 day. Floating objects revealed readings of 1 to 3 r/hr on shot days. Small boats and barges in Bikini-Enyu anchorage were contaminated to a moderate degree (1-6 r/hr). Lagoon flushing through the southwest passage materially increased radiation levels in Eniirikku-Bokororyuru areas.

6. [redacted] DELETED

DELETED A damage and radiation survey was conducted at approximately H+4 hr [redacted] day. This survey covered the islands of the atoll and was conclusive enough to limit reentry to the southern and eastern islands of the atoll. This survey indicated that radioactive contamination extended north of a line from Bogallua to Piraai. Secondary fall-out amounting to 2 mr/hr was experienced at Parry on the evening of [redacted] day.

Lagoon water was moderately contaminated in the vicinity of the chain Bogallua-Teiteiripucchi and cleared within two days.

4.6.9 Laboratory Data Summary

The bulk of the samples analysed by the radiation analysis section of TU-7 were water samples. The specific activities in microcuries/milliliter of approximately 675 lagoon and drinking water samples were determined during the course of the operation. Lagoon sampling was carried on to insure that ships' anchorages were not excessively contaminated. As the operation progressed it became evident

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Island	Extrapolated H+4 hr	[redacted]		Background
Enyu	18.	2.0	0.44	0.02
Bikini	225.	25.	2.0	0.32
Aomoen	50.	6.	0.80	1.0
Romurikku	65.	7.5	1.2	1.0
Uorikku	95.	12.	2.0	0.25
Yurochi	95.	12.	4.0	1.0
Namu	10.		1.0	0.80
Bokobyaadaa			0.95	3.0
Ourukaen	3.5(?)	0.50*	0.12*	0.01
Arriikan	1.3	0.60*	0.10*	0.08
Eniirikku	0.18	0.01	0.01-1.0	0.03
Airukiiji	0.505	0.01	0.01	0.01
Crater		1.0***		
Lagoon			80 (west)	

*Radiation shine from water in southwest passage
**Final aerial survey
***Reading at 100 ft

TABLE 4.5, [redacted] RADIATION SUMMARY IN ROENTGENS PER HOUR

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Island	Extrapolated H+4 hr	[redacted]	
Eniwetok	0	0	0
Parry	0	0	0
Japtan	0	0	0
Chinimi	0	0	0
Aniyaanii	0	0	0
Chinieero	0	0	0
Runit	0	0	0
Piraai	0.05	0.006	0.006
Aaraanbiru	0.08	0.01	0.01
Rojoa	0.10	0.01	0.01
Bijiri	0.12	0.014	0.01
Aomon	0.17	0.02	0.02
Eberiru	0.17	0.02	0.02
Rujoru	0.10	0.012	0.02
Aitsu	0.14	0.016	0.02
Yeiri	0.17	0.02	0.02
Bokonaarappu	0.17	0.02	0.02
Kirinian	0.35	0.04	0.04
Mack	0.42	0.05	0.06

TABLE 4.6, [redacted] RADIATION SUMMARY IN ROENTGENS PER HOUR

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[redacted]

Island	Extrapolated H+4 hr	[redacted]	
Engebi	0.70	0.08	0.08
Bogon	0.98	0.12	0.14
Bogairikk	?	0.22	0.60
Teiteiripucchi	60.0	6.8	7.0
Cochiti	70.0	8.0	12.
San Ildefonso	75.0	8.4	1.0
Ruchi	8.0	0.80*	0.36
Bogombogo	3.9	0.44	0.36
Bogallua	2.2	0.26	0.28
Rigili	0	0	
Giriinien	0	0	
Ribaioni	0	0	
Pokon	0	0	
Mui	0	0	
Igurin	0	0	

* Period preceded by heavy rainfall

TABLE 4.6, [redacted] RADIATION SUMMARY IN ROENTGENS PER HOUR (CONTINUED)

[redacted]

that excessively contaminated water could be observed as a result of the sediment deposited in the water and could be evaluated adequately using only a PDR/39 survey-type meter. The maximum contamination encountered in the lagoon anchorages was 8.4×10^{-3} microcuries per milliliter. The average activity varied from 1×10^{-4} to 3×10^{-4} microcuries per milliliter. No ship's drinking water was found to contain any detectable radioactive material.

Air samples collected in fall-out areas by vacuum-type air filters and cascade impactor slides constituted another type of sample analysed in the field laboratory. Upon those occasions when fall-out was detected on board the USS Bairoko portable air samplers were periodically turned on as a means to determine whether fall-out was still occurring. The entire filter paper was counted and the activity noted in cpm/ft^3 of air. Air samplers were also used by the initial survey party. A cascade impactor, installed in the radiac repair shop on board the Bairoko, was utilized to evaluate the inhalation hazard associated with the radioactive particulate matter by determining the percentage of the total activity associated with particles less than 5 microns in diameter. The air samples collected on March 1, when the USS Bairoko received a substantial fall-out from [redacted] indicated activities ranging from 455 to 2740 cpm/ft^3 of air. The only cascade impactor data was also obtained during the fall-out that occurred on the Bairoko. An average of 65 per cent of the activity was found to be associated with particles less than 5 microns in diameter.

Decay rate measurements and energy determinations were made on various types of samples throughout the operation in an effort to obtain detailed information on the fundamental properties of the radioactive particulate matter. Gamma energies were difficult to obtain accurately due to the low counting efficiency of GM tubes for gamma radiation and the apparent low energies involved. The latter also made beta energy determinations more difficult. Gamma energies measured on very active samples varied from 600 to 25 kev. The low gamma energies measured were somewhat surprising. Beta energies varied from 0.2 to 2.2 mev.

Log-log plots of cpm vs time after detonation were utilized to obtain decay rate data. Samples studied included fall-out samples on the Bairoko; water samples from the lagoon and drinking water samples from Rongelap; crater samples; and air samples. The following results represent a cross-section of the different types of samples studied and the calculated slope of the line obtained by plotting the log of the activity versus the log of the time after detonation.

Fall-out sample on flight deck Bairoko - [redacted] - 1.62

[redacted]

Lagoon sample collected 1220 7 April - [redacted] - 1.03 + 8 days
1.31 + 25 days

Air sample collected 26 April [redacted] - 1.19

The six drinking water samples from Rongelap indicated an average slope of -1.48 from [redacted] and a slope of -1.80 until last counted.

Miscellaneous tasks assigned to the radiation analysis section included the analysis of urine samples for tritium content; examination of food, soil, and water samples obtained on a resurvey mission to Rongelap and Uterik; a study of the decay characteristics of contaminating material on vans being shipped to the United States; and analysis of water samples obtained during a water survey following [redacted] event.

4.6.10 Conclusions and Recommendations

1. Conclusions

   a. The present maximum permissible exposure of 3.9 r per thirteen week test period is not a realistic MPE in consideration of heavy work loads in extensively contaminated areas. The use of waivers to cover exposures in excess of this MPE becomes a needless routine without much significance when operations are conducted in large contamination areas without much interval between detonations. A large number of individuals did exceed 3.9 r but very few exceeded 6.0 r.

   b. The utilization of project personnel as monitors proved itself with few exceptions.

   c. Procurement and clearance of personnel must be accomplished at least four months in advance of operations in order that selection and training can be completed and in order that the unit can be completely assembled prior to movement overseas.

2. Recommendations

   a. Test MPE should be based on calendar quarters of 3.9 r and should consider the preparatory phases as well as

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[redacted]

[redacted]

the operational phases of the overseas test.

b. A pool of experienced monitors must be made available to the Rad-Safe Unit to support independent construction operations and supplement project monitor activities.

c. Personnel procurement planning should be initiated at least one year prior to operations and personnel should be selected for training at least four months prior to operations.

4.7 TASK UNIT 8, TECHNICAL PHOTOGRAPHY

The following were the assigned responsibilities of TU-8 during Operation Castle:

1. To make all negatives necessary to provide full report coverage for TG 7.1 scientific programs, units and staff sections in black and white and color, still and motion picture.

2. To provide construction, accident, and general record coverage.

3. To make technical documentary records in still and motion pictures of each operation.

4. To provide facilities and aid to scientists in the processing of scientific photographic records.

5. To store, issue, process, and account for technical documentary film in accordance with security and classification instructions.

These responsibilities were fulfilled. To implement the necessary coverage 17 men were phased in and out of the Forward Area from Graphic Arts in Los Alamos. Individual phasing cycles approximated six weeks. In addition to these men, six military men were assigned to TU-8 Forward. After the first shot two photographers operated under a section leader from the ships based at Bikini.

Statistics are as follows:

4200 black and white negatives were made and two prints made from each negative.

[redacted]

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[redacted]

700 color transparencies were made. This figure includes those made at Kwajalein for Project 4.1.

15,000 feet of 16mm stock footage was made.

TU-8 processed many units of scientific records, and provided darkroom space, equipment and supplies to many scientific groups.

4.8 TASK UNIT 9, DOCUMENTARY PHOTOGRAPHY

4.8.1 Mission

Operation Castle was documented on film, both still and motion picture, aerial, ground, and underwater, as a basis for a photographic record for historical purposes and subject matter for a considerable number of motion pictures depicting the scope and conduct of various phases of Operation Castle.

4.8.2 Organization and Command Relationship

The Joint Chiefs of Staff at the request of CJTF SEVEN established a military requirement for the USAF Lookout Mountain Laboratory to support Operation Castle, and Headquarters USAF approved its employment to organize and support a technical photographic unit (TU-9) as part of TG 7.1.

4.8.3 Requirements

1. Preliminary Requirements

    a. Photography of General Clarkson, Dr. Graves, Admiral Bruton and General Estes delivering security lectures was taken and used for showing in the Forward Area to all Task Groups.

    b. Thirty security trailers emphasizing the need to guard against carelessness were made for the purpose of showing to Task Groups in the Forward Area.

    c. Operation Tigercat

    Documentary coverage was made of the TG 7.4 dress re-

[redacted]

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[redacted]

hearsal for Operation Castle at San Diego, California, in October 1953.

2. Final Requirements

a. Complete documentary motion picture and still coverage of Operation Castle was required and obtained to produce the following:

(1) Six "Quickies" (one for each shot). Each "Quickie" contained a description of the device used, major instrumentation utilized, operational difficulties encountered, anticipated results, and actual results. Narration in all cases was restricted to Major General P. W. Clarkson, Dr. Alvin C. Graves, or a member of TG 7.1. These "Quickies" were primarily intended to be a method of informing the top officials of the AEC and White House of the progress made in the Forward Area and Classification was Top Secret Restricted Data. This program was sponsored by JTF SEVEN and print distribution was limited to two prints for DMA, Washington, D.C., and one print for the Commander JTF SEVEN.

(2) Task Force Commander's Report

This was a consolidated factual report narrated by Major General Clarkson and Dr. Graves summarizing the operational problems, expectations, and results of Operation Castle. Classification was Secret Restricted Data. This program was sponsored by JTF SEVEN and exact print distribution is to be determined later.

(3) Department of Defense Picture

This was sponsored by JTF SEVEN with emphasis on military participation and military effects as related to high yield devices. It was intended as a training film. Classification is Secret Restricted Data and exact print distribution will be determined later.

(4) Public Release Picture

This was sponsored by AEC and was Unclassified. The

[redacted]

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