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VOLUME ONE
ANNEX I — PART 3

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classification "secret" or lower, to obviate an excess of duplication between different reports and to eliminate unnecessary detail. The unabridged reports will be found in the records of [redacted] Weapons Project.

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AND ELECTRONICS SECTION

Captain Christian L. Engleman, EDO, USN, on verbal instructions awaiting orders, reported for duty on the staff of Lieutenant General John E. Hull, USA, on 28 September 1947, at the Pentagon Building, Washington, D. C. Captain Engleman was appointed by Lieutenant General Hull as Chief of the Communications and Electronics Section of his staff (Communications Officer) and was informed that he would be required to plan and provide the communications and electronics facilities to support the forthcoming atomic studies at Eniwetok Atoll. Colonel Carl H. Hatch, Signal Corps, USA, Deputy Signal Officer, USARPAC, reported for duty on 1 October 1947 and assumed duties as Deputy to the Chief of the Communications and Electronics Section and as his special staff representative for the U.S. Army.

The Commanding General on 3 October 1947 outlined the proposed operation and directed that a general communications and electronics plan be formulated that could be used as basis for the preparation of initial requirements for equipment, personnel and shipping. In the absence of specific requirements from the agencies which were to participate (Army, Navy, Air Force and Atomic Energy Commission), only a very broad communications and electronics plan that could lend itself to expansion was considered. Certain assumptions founded on the information supplied by the Commanding General were made and these provided:

(1) That there would be no press coverage;

(2) That there would be no picture transmission for the press;

(3) That there would be no public information radio broadcast

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(11) That electronic facilities would be the responsibility of the Communications Officer would contribute to the

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endeavors of the Test Director in matters of technical advice, and the furnishing of requested government-owned material and technical personnel. Assignment of frequencies to all units of the task force would, however, be subject to the approval of the Communications Officer.

On the basis of the foregoing assumptions, a general communications and electronics plan was prepared. Certain preliminary steps based on the anticipated requirements of the various participating agencies were undertaken pending the submission of their specific requests for communication facilities. Among these preliminary steps were the alerting of long-haul radio stations at Washington, San Francisco, Hickam Field, Pearl Harbor, Fort Shafter, Guam and Kwajalein; the preparation of plans for the installation or increase of facilities at Eniwetok and Kwajalein; and the framing-up of some local and long-haul circuit networks with tentative lists of equipments required for these networks.

The task of the Communications Section naturally divided itself into Army, Navy, Air Force and Atomic Energy Commission branches. The Communications Officer therefore contacted the Department of the Navy, the Department of the Air Force and the Atomic Energy Commission and requested the assignment of officers from these officers was to be dual in that he would not only plan but also establish and supervise all those communications requested by his service. Complete coordination of these endeavors was planned so as to include joint use of

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facilities, interchange of personnel, aterial and services whenever required.

During the formative period of the operation, Captain Engleman and Colonel Hatch attended many conferences on general planning not only because of their knowledge of operations of similar type and scope, but also because of the necessity of keeping their plans abreast of the general plans which were as yet in a state of flux. At this time, both Eniwetok Atoll and northern end of Kwajalein Atoll were under consideration as possible sites for the operation. The Communications Officer went on record as stating that the selection of either of these possible sites would not materially influence the plans of the Communications and Electronics Sections.

Early in October the Communications Officer and his deputy met with representatives of the Atomic Energy Commission to determine the extent and type of communications this agency would need. The Communications Officer expressed his intention "to provide any and all communications which the Commission might desire and to render them maximum support within the resources available." This attitude was well received and encouraged the Atomic Energy Commission to formulate its plans without the fear that they might be at variance with the military plans, procedure or capacity. In this way, an outline of the Commission's ultimate needs was more quickly arrived at than might otherwise have been possible. All the requirements thus derived were accepted for execution.

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were favorable and the Communications Officer was directed to formulate a plan for the accomplishment of this project.

On 8 October 1947 Ensign Felix J. Jablonski, USN, reported for duty and was assigned as Cable Officer for the Communications Officer. On 13 October 1947, Lieutenant Commander Harry E. Rowand, U.S. Coast Guard, reported for duty and assumed overall charge of the submarine cable project. Lieutenant Commander Rowand was exceptionally well qualified for this assignment in view of his extensive knowledge of the types of cables then being considered for use and his life long association with submarine cable work. No officer of comparable experience or knowledge was to be found in any of the services. Lieutenant Commander Rowand began a study of the material, personnel and technical features of the problem preparatory to the formulation of his plan.

On 13 October 1947 Lieutenant Colonel C. A. Smith, USAF, reported as special Air Force representative on the staff of the Communications Officer. On the same date, Lieutenant Colonel J. E. Dupree, USA, reported as Communications Officer for Commander, Air Forces (Major General W. E.Kepner). The planning for Air Force communications which had been conducted heretofore by Captain Engleman, Colonel Hatch and Colonel John Bestic, USAF (on temporary duty pending arrival of permanent Air Force representatives), now passed to Lieutenant Colonels Smith and Dupree.

Commander R. J. Schmidt, USN, reported for duty on the staff of the Communications Officer on 24 October 1947. He was designated as the Assistant Communications Officer (Navy). Lieutenant (junior grade) T. V. Grant, USN, also reported for duty on 24 October 1947 and was designated as the Electronics Planning Officer (Navy). Prior to their reporting, the tasks awaiting assignment of an Assistant Communications Officer (Navy) had taken only the general proportions contained in the original assumptions for planning.

On 23 October 1947, Mr. R. W. Henderson, First Assistant Scientific Director of J-Division, Los Alamos Scientific Laboratory, assigned Mr. Louis A. Hopkins, Jr., of the Sandia Base Branch to be Communications Liaison Officer between J-Division and the Armed Forces. On 7 January 1947 Lieutenant Colonel John P. Scroggs, Signal Corps, of the 38th Engineer Battalion was chosen to aid Mr. Hopkins in this work. Mr. Hopkins arrived in Washington on 27 October 1947. He spent the first few days after his arrival with the Communications Officer and Washington representatives of the Atomic Energy Commission determining what measures had already been taken and what plans were still to be formed for the communications needs of the Atomic Energy Commission. The results of these and later studies were eventually incorporated into a letter from the Atomic Energy Commission to the Commander Joint Task Force "Switchman" entitled "Proposed Communications System for Operation "Sandstone," dated 12 November 1947.

With the arrival of an AEC member, the Communications staff was completely formed.

A brief resume of the early accomplishments of the Communications and Electronics Section will be made in the following paragraphs. Detailed accounts of the communications aspects of the entire operation follow as a series of separate reports made by each major sub-section of the Communications and Electronics Section. These reports supplement one another and when viewed together they give an entirely comprehensive record from an operational standpoint. A separate technical report on communications will be published concurrently with the last of this historical report and will contain all data, discussions, recommendations and records which are not suitable for inclusion in this history.

After reporting and orientation, each of the officers of the Communications and Electronics Section commenced plans for particular needs of the service which he represented by assembling more specific requirements than had heretofore been forthcoming. When sufficient information of this kind had been received an effort was made to resolve any resulting duplications into joint systems or circuits. In almost all cases it was possible to make arrangements of this kind. Those steps necessary to the procurement of equipment, supplies, personnel and assignment of voice calls, call signs and routing indicators were then undertaken. When these matters had been passed for execution to normal service or supply agencies, it was necessary to keep a check and supervise their progress. By the end of December, most of the officers of the Communications and Electronics Staff were engaged in numerous field trips required for the expediting of the business of each service. When such officers were away from the task force headquarters in Washington, they were required to submit weekly reports of their progress to the Communications Officer so that the headquarters might keep informed and maintain coordination amongst its scattered representatives. These weekly reports were submitted in consolidated form to the Chief of Staff of the task force for similar purposes.

In the months preceding December the Communications Staff was involved in the assembly and completion of its detailed plan. For this purpose it was necessary to gather more information, frame-up the various circuits, to assign frequencies and assemble all individual factors into a complete listing of channels. This data eventually formed the Communications and Electronics Plan (Annex F to Field

Order Number One, Joint Task Force Seven). This annex was published in final form on 6 February 1948.

An initial composite signal detachment was equipped an manned from USARPAC, CINCPAC and AACS sources and dispatched to Eniwetok in mid-November for the immediate installation of certain facilities and the commencement of construction for all the facilities required later on. By middle December this detachment was operating necessary initial circuits to Oahu from Eniwetok and had activated a complete tower control facility at the Eniwetok Atoll airfield. All plans for special installations on major naval vessels had been completed in early December and these ships had arrived at the different naval shipyards in the U. S. where the conversion work was begun. The Air Force neared completion in March of its installations of communications facilities at Kwajalein and Eniwetok although some delays were experienced.

All during this period the overseas and domestic arrangements necessary for the handling of Joint Task Force Seven traffic were being made with the communications organizations of the Army, Navy and Air Force. The Atomic Energy Commission made special arrangements at its facilities at Los Alamos, New Mexico, and elsewhere in the U. S.

During March all the major communications facilities to be used by Joint Task Force Seven achieved physical and administrative completion, and the major ships of the task force were enroute to the forward area fully equipped. During the months of February and March the weight of communications traffic was gradually shifted from Washington to the interim headquarters at Fort Shafter in Oahu, and the Eniwetok terminals were prepared for full operation as the main task force headquarters on 16 March 1948.

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be suitable for use in the forthcoming operation. For a time the possibility of contracting with some commercial cable company for the laying of the cable was under consideration, but this approach to the problem was discouraged by the strict security surrounding the operation. The only alternative was to undertake the project by use of military facilities and personnel. Insofar as the U.S. Coast Guard does much submarine cable work in the course of its normal operations, Lieutenant Commander H. E. Rowand, USCG, was contacted and questioned regarding the availability of a cable-laying ship and the suitability

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or problems of the types of cable which had been selected. The Coast Guard's cable ships were more than fully occupied with their present work, but Lieutenant Commander Rowand was able to supply much valuable information regarding cable types and characteristics. During the war Lieutenant Commander Rowand had been in charge of the program under which the 10-conductor cables had been manufactured.

An officer familiar with submarine cable work, its laying, splicing and other problems was definitely required if the Communications and Electronics Section was to fulfill its responsibility for the organizing and planning of a submarine cable project. No officer possessing these qualifications could be found amongst available Army or Navy officers. On 8 October 1947 Rear Admiral A. J. Wellings, USN, (JTF-7 Logistics Officer) sent a memorandum to the Commandant, U. S. Coast Guard, at the request of the Communication Officer. This memorandum requested the services of Lieutenant Commander Rowand and a splicing technician, Chief Electrician's Mate (T) William E. Magowan, USCG, for a limited period. At two periods later in the operation it was necessary to request extensions of these assignments and Lieutenant Commander Rowand and CEM (T) Magowan therefore served continuously with the task force from the date of their reporting until the completion of the tests conducted during Operation Sandstone.

Atomic Energy Commission plans at this time proposed that a barge be moored in a centrally located position in the lagoon and that cables extend from this barge to Parry Island (Control Station) and from this barge to the other islands which would be used. In this way the barge was to function as a junction point for the cables. It had been stated that the cable-laying program should reach completion by the 15th of March 1948.

Ensign Felix J. Jablonski, USN, reported for duty and was assigned as Cable Officer for the Communications Officer on 8 October 1947. He functioned in a liaison capacity with Lieutenant Commander Rowand and agencies of the Department of the Navy and Department of the Army until on 13 October 1947, when Lieutenant Commander Rowand reported for duty with the staff of the Communication Officer of JTF-7 and assumed over-all charge of the submarine cable project at which time Ensign Jablonski assumed duty as his assistant. Shortly thereafter, CEM(T) Magowan reported for duty and joined this section of the Communications Staff. Because of security restrictions, only vague information had been supplied to Lieutenant Commander Rowand previous to his reporting but he was then given all the information available on the subject. On the basis of this information Lieutenant Commander Rowand began making a study of the requirements for installing the cables in the amount,type and manner which had been suggested by the Atomic Energy Commission. Several ship types, their suitability for cable laying and availability, came under consideration. Estimates of time, personnel, supplies, equipment and cable quantity were made. Various possible methods of operation were considered. For a period of two weeks these preliminary estimates were in constant process of revision and amplification. The principal or noteworthy deliberations are recorded here as a guide to those who may encounter the same problem.

It was soon seen that splicing of the cable was the crucial factor in the submarine cable program. The speed with which the cable could be spliced would set the time schedule. The manner in which it was to be spliced governed the amount of space needed for a cable station ashore and influenced and the selection of a ship for laying. The soundness of the splicing would measure the success of the cable-laying program.

Hot splices (vulcanized and molded) of both the rubber jackets and plastic insulation were at first planned but these plans were abandoned when the technicians of the cable manufacturer (Simplex Wire and Cable Company) presented their plans for a reliable cold splice (special tapes and comments) which required less skill and less equipment. Their estimates of the time required for each cold splice indicated that the splicing would not prolong the cable project beyond 15 March 1947. Although CEM (T) Magowan was entirely familiar with splices of all kinds, it was felt that more trained splicers would be needed. A program for the training of three (3) Navy CEM's in splicing at the Simplex Wire and Cable Company in Cambridge Massachusetts, was therefore developed.

Three types of cable were to be ordered. The 10-conductor type 115P and the 3-conductor rubber covered type 104 had been asked for by the Atomic Energy Commission. A 3-conductor armor-covered type

113 cable was also being procured in limited quantity in case the rubber covered type 104 would encounter abrasion when landed over the coral reefs at Eniwetok. Sufficient quantities of these cable were located at Clearfield, Utah, through the Electronics Supply Section of the Bureau of Ships. All cable was ordered so as to provide nearly 100% spares. This large allowance for spare was predicated on the importance of the cable program and the desire to avoid any difficulty of resupply after the initial movement. Almost all of this spare cable was expended when the Atomic Energy Commission upped its cable requirements later on. Resupply had to be undertaken in the type115P when type 104 proved unsuitable and 115P was subsittuted for it. The heavy spare allowance proved entirely justified.

Before Lieutenant Commander Rowand reported to the staff, some consideration had been given to converting an LSM into a cable-laying vessel. This type of ship possessed several desirable characteristics. There was ample room in the tank deck for the loading and splicing of cable and the open overhead on this deck provided freedom for installation of booms, A-frames and tackle required in cable-laying operations. The high freeboard and low draft of this type occasioned some doubt as to its maneuvering characteristics. LCDR H. E. Rowand and Ensign Jablonski investigated the availability of other types of vessels for cable laying. The YN or net tender type could not carry sufficient cable for use in the forthcoming operation although they had engaged in cable-laying for harbor defense work during the war. One vessel designed and fitted as a cable layer was located, but this vessel was fit for coastal work only and could not put to sea for a protracted journey or independent operation. The method of loading the cable directly from the shore on to the cable ship and the scarcity of docking space at Eniwetok made the beaching abilities of an LSM highly desirable. It was finally decided to convert and use one LSM as the cable-laying ship. Toward this end plan booklets of an LSM were procured and the basic elements of the conversion were drawn up in descriptive terms.

Because of the extremely large amount of cable to be employed, extensive storage and working space was needed somewhere ashore. The requirements for a shore station were therefore drawn up. Personnel to operate the shore station and supplement the crew of the LSM were considered and lists of personnel for ship and shore were drawn up according to Navy Job Code in order to insure that personnel of the proper qualifications might be obtained.

On 24 October 1947 most general deliberations had crystallized and a letter from the Commander, Joint Task Force Seven (then called "Switchman") was drafted and sent to the Chief of Naval Operations. This letter outlined the cable-laying project stating certain specific requirements for the project and requesting implementation of those requirements. This letter constitutes an excellent record of the plans and details of the cable-laying project at that time and also gives a clear picture of the method used to execute those plans. It is therefore included here. Deletions are made of non-essential information.

(e) Notes on Splicing Submarine Cable

Encl: (A) Copy of reference (c).

(B) Copy of reference (d).

(C) Copy of reference (e).

1. In order to execute the requirements set out in reference (a), it will be essential for some one-million feet of submarine cable to be laid at the locale of the operation.

2. The services of a cable-laying craft will be required and it is proposed that an LSM as outlined in reference (a), be designated for this work. It is suggested that the Bureau of Ships be made the lead Bureau for this project and is so designated be instructed to make the necessary conversion. Enclosure (A) sets out the staff conception of this conversion.

3. In order to facilitate the work of laying the cable a submarine cable shore station will be necessary. With the Bureau of Ships as

as the lead Bureau and the Bureau of Yards and Docks assisting, it is suggested that the plan proposed in enclosure (B) be executed.

4. There will be a considerable amount of highly specialized submarine cable splicing performed at the operation site. It is requested that the instructions to the Bureau of Ships include this cable splicing requirement, the general instructions on which are set out in enclosure (C).

5. The cable ship must be made available at the operation site on or before 1 January 1948.

6. Cable and other material must be available for loading at Port Hueneme on or before 20 November 1947. Marking and shipping instructions may be obtained from BuSandA (Mr. W. C. Dudley, Code DM-121).

7. The cost of this project will be chargeable to funds made available to the Navy Department by the Atomic Energy Commission, detailed instructions of which can be obtained from the Fiscal Director of the Bureau of Supplies and Accounts (Captain W. W. Honaker, SC, USN Code DF).

FOR LT. GENERAL HULL:

cc: BuShips 440
BuSandA

/s/ Garlen R. Bryant
Garlen R. Bryant,
Lt. Col., AGD,
Adjutant General

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ENCLOSURE "A"

CABLE LAYING CRAFT

1. It is proposed to use an LSM for laying the cable assisted

by two LCM(6)'s, two LCPL's and 2 PPL's.

2. In order to load and lay the armored cable, which will be approximately 1⅛ inches in diameter with splices about 3 inches in diameter, and which weighs about one ton per thousand feet of cable, it will be necessary to provide a power-driven drum, and an "A"-frame, fairleads and short outriggers or booms. It is proposed to coil the cable on the main deck between frames 9 and 16 with the center of the coil midway between frames 12 and 13. It will be paid out through a block in an "A"-frame erected over the center of the coil, through a series of blocks on the superstructure deck, and a block near the end of a short outrigger projecting from the side of the vessel at frame 10, on the windward side. To provide these facilities the following modifications to the LSM are proposed.

(a) Cable winch. Install one cable winch equipped with a flat, flanged drum 48 inches in diameter and about 10 inches in width. The drum should be motor driven, with a variable speed in either direction of from 3 to 10 r.p.m. Power should be sufficient to provide a one ton pull on the cable at 3 r.p.m. Wedged shaped "shoes" should be provided for sliding the turns of cable across the face of the drum, when the drum is rotated in either direction. The drum shaft is to be supported on one side of the drum only to permit throwing bights of the cable around the drum. The drum and "shoes" should be similar in design to those provided by BuShips in making submarine cable laying modifications to AN (former YN) type net tenders in 1942. The winch should be mounted amidships at frame 9 on a platform running between and on the level of the two superstructure decks. The platform should provide working space for an attendant both fore and aft of the drum.

(b) "A"-frame. Install a suitably braced or self-supporting "A"-frame with its apex located amidships, midway between frames 12 and 13 and 20 feet above the main deck. It should be supported from the superstructure deck. A steel eye should be fitted on the under side of the apex for supporting a large snatchblock. A ladder or steps should be provided on the "A"-frame to permit access to the snatchblock. A second steel eye should be provided at the apex about 12 inches higher than the first, for attaching a small block for raising and lowering the snatchblock or cable.

(c) Install two short outriggers or booms mounted to project outboard about 4 feet from the superstructure deck on both port and starboard sides at frame 10. Outriggers to be so fitted that they may be stowed inboard when not in use. Facilities must be provided for locking them firmly in the outboard position. Each outrigger to be fitted with two large padeyes located on the forward and after sides about 4 inches from the outboard end, supporting large snatchblocks. Strength of all members must be sufficient to withstand cable laying strains which may reach a maximum of 8 tons.

(d) Install padeyes on both port and starboard superstructure decks for attaching snatchblocks at the following locations:

Approximately 6 inches from inboard edge of deck and about 2 feet aft of frames 10, 11, 12 and 13.

Approximately 6 inches from outboard edge of deck and about 2 feet aft of frames 10 and 13.

(e) Furnish 10 snatchblocks with sheaves not less than 15 inches in diameter with sufficient clearance to pass splices 3 inches in diameter without binding. Blocks to be equipped with swivels and shackles for attaching the blocks to padeyes.

3. The following material should be procured and placed on board the LSM at the yard which it is fitted out as a cable ship:

(A list of supplies including various tackle, pit logs, navigational equipment, special dunnage lumber and other supplies.)

4. Four portable radio sets (SCR-300) should be provided for communication between the LSM, the small boats and the landing party during cable laying operations.

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ENCLOSURE "B"

SUBMARINE CABLE SHORE STATION

1. A shore station will be required for storing, splicing and leading submarine cable. A flat plot of ground, preferably paved, not less than 100 ft by 200 ft in size will be required, located where an LSM can dock or beach for long periods of time. This area should be adequately floodlighted for nighttime operations and 110-120 volt, 60 cycle AC current must be available for the testing and splicing equipment. Not over 3KW will be required.

2. Transportation must be provided for transporting 332 reels of cable from the landing dock to the storage area. There are 8 84-in reels weighing approximately 14,000 lbs. each, 121 78-in reels weighing

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of similar design be supplied for this purpose:

Crane, revolving, truck, mounted, pneumatic two-engine drive, 8 to 12 ton, Class XI, Army Stock No. 78-2831.000-000

(c) One Weapons Carrier (four wheel variety sufficient) should be assigned the cable station for general utility use.

(d) One radio equipped jeep (SCR-608) should be provided both for utility use of the cable station and for reliable and readily available communications for transportation to any of the seven shore ends of the cables.

(e) One tool and supply shed (lighted) approximately 15' by 30' with shelves and a work bench should be built at the cable station.

(f) For construction of light rain-proof shelters:

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3 ea. Cable shafts and collars for Type 115-P cable

2 ea. D-93 vulcanizers, equipped with 2 C-111 splicing molds

3 ea. Batteries, storage, 6 volt-100 Ampere-hour, heavy duty

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4 ea. Cable reel jacks, -minimum capacity 2 tons-heads fitted to take 2-3/4" shaft, for 48-in reels

2 ea. Leeds & Northrup Type "U" Test sets complete with buzzer and headphones (Standard BuShips issue for cable testing)

2 ea. Multimeters (Standard BuShips issue for cable testing)

2 ea. Navy Model OBB Cable Detecting Equipment (Standard BuShips issue for cable testing) consisting of:

1 Type CZH-35034 Audio Oscillator

1 Type CZH-50152 Audio Amplifier

1 Pkg. Batteries

1 Box Spare Parts

2 Instruction Books

8 ea. Dry Cells, Navy Type 19031, 1.5 volts

4 ea. Dry Cells, Navy Type 19032, 67.5 volts

2 ea. Storage Batteries, 6 volt- similar to standard automotive type

40 ea. 10 pr. Cable terminal strips - any binding post type

1 Megger Test Set, 1000 volt - 0-5000 megohm range

(A list of miscellaneous hand tools for splicing and light construction work)

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ENCLOSURE "C"

NOTES ON SPLICING SUBMARINE CABLE

1. It is proposed to place a contract with the Simplex Wire and Cable Co., 79 Sidney St., Cambridge, Massachusetts, for splicing the cable. The contract should provide for the following:

(a) The contractor shall furnish all equipment, tools and supplies for making the following "cold" type splices in submarine cable:

254 straight splices in U.S.C.G. Type 104 Cable
156 straight splices in U.S.C.G. Type 115-P Cable
16 straight splices in U.S.C.G. Type 113 Cable
16 straight splices between Types 113 and 104 Cable

(b) The splicing will be accomplished as the cable is loaded on the cable-laying vessel. All labor for loading the cable and placing the ends in position for splicing will be furnished by the government. Ten electrician's mates will be furnished by the Government to assist in splicing operations.

(c) The contractor shall provide advance training in splicing methods at the factory for four Chief Electrician's Mates, who will report at the factory on or about 15 November 1947 for an instruction period not to exceed ten (10) days. The government will ship one 5000-ft reel of Type 115-P Cable to the factory to arrive on or about 15 November 1947 to be used for carrying out splicing instructions. Unused cable is to be returned subsequently to its original source.

(d) The contractor shall furnish one supervising cable splicer at the site of cable splicing operations to supervise and assist in actual splicing operations. It is estimated that this man will be re-

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2. In order to carry out the provisions of Paragraph 1 (c) arrangements should be made by BuShips for immediate shipment of 5000 feet (1 reel) of Type 115-P Submarine cable from Mechanicsburg, Pa., to the Simplex Wire & Cable Co., Cambridge, Massachusetts. This cable will be urgently needed at that point not later than 15 Nov. 1947. It should be marked for the attention of Mr. W. W. Davis, Chief Electrical Engineer.

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The Office of the Chief of Naval Operations approved the recommendations and requests made in the above letter and delegated action on these matters to Op-415. This office issued two letters, one on 4 November and one on 6 November 1947 to the various Bureaus of the Department of the Navy assigning each of them responsibilities (according to customary divisions of cognizance) for the procurement and shipping of all materials and issuance of the necessary directives for the conversion of an LSM. Shortly thereafter the Office Lieutenant General Hull was informed that the U.S.S. LSM-250 had been designated

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W. S. Maxwell, USN, and this office assumed responsibility for the conversion of the LSM. It also supervised or spear-headed all other matters pertaining to the cable-project. The design section of the Bureau of Ships met with LCDR Rowand and general design drawings were completed and sent to the Terminal Island Naval Shipyard early in November. They are available for reference in the files of the Bureau of Ships. Conversion of the LSM began shortly thereafter. LCDR Rowand made two journeys to the Terminal Island Naval Shipyard to supervise and inspect the conversion work in the latter part of November. During the first week of December the conversion was completed and operating tests were successfully conducted, laying and recovering one 5000 foot length of type 115-P cable off-shore in the Long Beach area.

At the request of Rear Admiral Denebrink, USN, who was to command the Naval Task Group of the task force, one additional LSM (U.S.S. LSM-378) was designated for conversion identical with that of the LSM-250 so that no engineering or other casualty could stop or defeat the cable program. This conversion was undertaken at the Pearl Harbor Naval Shipyard. All features incorporated in the LSM-250 were duplicated in the LSM-378 except in certain items of supply.

Late in October an inspection was made of the site for the operation by Lieutenant General Hull and Captain Engleman. During this inspection it bdcame evident that Eniwetok Island itself would be

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entirely too crowded to support the operations of the shore station as an independent activity on Parry Island. Additional assistance necessitated by this change was requested from the Chief of Naval Operations in a letter dated 4 November 1947. This letter was almost entirely a request for supply and shipping of a modified form of the Functional Component N2B from the Advance Base Initial Outfitting Lists NavSandA Publication #28. Action on this letter was almost identical to that which resulted from the letter of 24 Oct 1947.

The lists of personnel for the cable-laying project were painstakingly drawn up and then embodied in a request for personnel addressed to Op-01 of the Office of the Chief of Naval Operations. This letter was dated 5 November 1947. The personnel to be used in the cable-laying project were divided into two groups. One group was to report to the U.S.S. LSM-250 to assist that ship in cable work. It was comprised of one officer and fifteen (15) enlisted men of the following rates and qualifications:

(1) OFFICER

(a) one (1) Chief Boatswain, with experience similar to that required by Code 02111.

(2) ENLISTED PERSONNEL

(a) One (1) CBM, Code 02111

(b) One (1) CQM, Code 03111

(c) Two (2) BM2, Code 02111

(d) One (1) SF1, Code 42321

(e) Ten (10) S1 or S2, Code 01090

A second group was designated as "Navy Signal Unit Number One" (an arbitrarily selected title) in order to move it as a unit and for administration. It was to maintain and operate the shore station and was composed of two (2) officers and seventy-three (73) enlisted men of the following rates and qualifications;

(1) <u>OFFICER</u>

(a) One (1) Lt. or Lt. (jg) to act as Officer in Charge of the unit.

(b) One (1) Chief Boatswain or Boatswain to act as assistant Officer in Charge of the unit.

(2) <u>ENLISTED PERSONNEL</u>

(a) Three (3) CEM's, Code 28610 (men trained at Simplex Wire & Cable Co)

(b) Two (2) CBM's, Code 02111

(c) One (1) BM1, Code 02111

(d) Two (2) BM2, Code 02111

(e) Six (6) Coxswains, Code 02320

(f) Three (3) EM1 or EM2, Code 38610

(g) Three (3) EM3, Code 38610

(h) Two (2) MoMM1, Code 46111 (Truck "Crane Operators")

(i) Three (3) MoMM3, Code 48112 (One Bulldozer operator and two truckers)

(j) Two (2) SC1, Code 76210

(k) One (1) CM1, Code 45422

(l) One (1) CM3, Code 45410

(m) One (1) SF2, Code 42220

(n) One (1) Y1, Code 72210

(o) One (1) CPHM, Code 90200

(p) One (1) MM3, Code 32320

(q) One (1) SK1, Code 71100

(r) Two (2) S1, Code 76300

(s) One (1) S1, Code 76410

(t) Twenty-one (21) S1 or S2, Code 01090

(u) One (1) STM, Code 76900 (not white)

(v) Ten (10) S1, Code 01130

(w) Three (3) MoMM3, Code 35612

(x) One (1) WT2, Code 48512

The first group reported directly to the LSM-250 at Terminal Island Naval Shipyard and sailed with it to the forward area. Navy Signal Unit Number One was assembled at Port Hueneme, California, and sailed to the forward area aboard the transport U.S.S. PICKAWAY on 6 December 1947. No more than routine difficulties were experienced in assembling these two groups.

All the cable equipment and supplies which had been requested for the cable-laying project were to be shipped to Port Hueneme by 20 November 1947 and from that point directly to Eniwetok. Shortly before this material was loaded in the U.S.S. PICKAWAY and the U.S.S. WARRICK, both Lieutenant Commander Rowand and Ensign Jablonski visited Port Hueneme for inspection and check of all material for the cable-laying project. All material including that which came from the

the Simplex Wire & Cable Company was received and shipped to the forward area at that time.

During the month of November, three (3) Chief Electrician's Mates were sent to the Simplex Wire & Cable Company at Cambridge, Massachusetts, where they received a two-weeks course of instruction in the type of splicing to be used at Eniwetok. One reel of type 115-P cable was shipped to this same company for splicing training. Technicians of the Atomic Energy Commission who were located at the Massachusetts Institute of Technology also conducted certain preliminary tests on this cable in the laboratory of the cable company. Mr. Herbert J. Leupold, a test supervisor in the company, was put in charge of all business of the company with the Task Force and later joined the cable organization at Eniwetok. He participated there in an advisory capacity on matters of cable splicing and cable performance. All of these foregoing matters had been arranged through the contract proposed in the letter to the Chief of Naval Operations dated 24 October 1947.

During November, the Atomic Energy Commission changed its plan for the distribution system or layout of submarine cable. This change involved elimination of the barge as a junction point and provided for the landing of all cables on islands. This change did not materially influence the plans and arrangements which had been made for the laying of submarine cable. It did not significantly increase the amount of cable to be employed.

By 20 November 1947 all the plans for the submarine cable project were completed. This ended other than normal responsibility of the of the Communications and Electronics Section for this project. On the date mentioned above, formal transfer of responsibility for the laying of the submarine cable to the Commander Naval Task Group (Task Group 7.3) was effected. Commander Task Group 7.3 established Task Unit 7.3.6 (Cable Unit), and Lieutenant Commander Rowand assumed command of this unit which comprised the two LSM's and Navy Signal Unit Number One.

The Operations of the ships and personnel assembled for the laying of submarine cable are not hereinafter reported by the Communications and Electronics Section. However, technical information relating to the electrical characteristics and performance of the submarine cable, as well as noteworthy operational records and information, are contained in the technical report of the Communications and Electronics Section. Further information on operations may be had from Annex B of Commander Task Group 7.3 Operation Plan 1-48. In addition, a brief statement of the method of operation which was used by the Cable Unit is included below.

- -

GENERAL OUTLINE OF OPERATIONS:

The cable, on reels, was landed from the cargo ships, transported to the storage area, and located in orderly rows, spaced to permit jacking up of each individual reel.

The LSM landed at the dock or beach adjacent to the storage area (seaplane ramp on Parry Island). The cable was led from jacked-up reels through necessary fair-leads to the LSM, over a power driven

[redacted]

block in the "A"- frame and through fairleads to an outrigger near the bow. Laying speed was approximately 3 knots. If the LSM could not get in within 100 yards of the beach, sufficient cable was transferred into an LCM which carried it to the shore. Cable buoys were provided to float in the shore ends but this was never necessary. A tractor or winch would have been required in the latter case to haul in the shore end. The shore ends were secured to anchor logs buried in the sand to prevent the cable being dragged off-shore while laying or by surf action. The cables were led from the beaches underground to terminal boxes in the Atomic Energy Commission structures.

FOR OPERATION "SANDSTONE"

On 23 October 1947 Mr. Louis A. Hopkins, Jr., of the Sandia Base Branch, Los Alamos Scientific Laboratory was appointed to act in a liaison capacity in communication matters between J-Division of the Laboratory and the Armed Forces during the planning and operational phases of Operation "Sandstone." The duties of the Communications Section, Los Alamos J-11 (LAJ-11), were considered to be:

(1) Coordinate the communications requirements of J-Division with the Communications Section, Joint Task Force "Switchman" (later, Joint Task Force Seven);

(2) Coordinate the AEC communication facilities in the United States with the Armed Forces;

(3) Advise the Scientific Director in matters relating to operations and communications;

(4) Keep the Scientific Director informed as to the status and operations of the communication system provided by the task force.

On 7 January 1948 Lieutenant Colonel John P. Scroggs, Signal Corps, USA, of the 35th Engineer Battalion was chosen to aid Mr. Hopkins with this assignment. Lt Col Scroggs' primary assignment was the planning and supervision of Atomic Energy Commission message handling procedures and facilities.

During the planning stages of communications (which the remainder of report covers in detail) it was determined that the following

[redacted]

facilities would be required for the scientific phase of the operation:

(1) Telephone circuits (radio and wire) between the various shore installations and the three primary ships;

(2) Radio intercom facilities between the offices of the Atomic Energy Commission and main staff sections of the Joint Task Force;

(3) Radio teletype and coding systems to provide for transmission of Atomic Energy Act (AEA) "Restricted Data" messages between the primary ships and between the ships and the Atomic Energy Commission installations in the [redacted]

(4) Technical radio nets to back up the radio telephone system;

(5) Special radio nets required by the evacuation Radiological, Blast, Neutron and Radio Chemistry groups.

On 27 October 1947 after a general briefing on the purpose and status of the plan for the scientific phase of Operation "Sandstone" by Mr. Henderson (First Assistant Scientific Director, J-Division), a trip was made to Washington, D.C., and Boston, Massachusetts, to determine the communication and electronic requirements of the scientific groups operating from these locations and to meet the JTF-7 communications and electronics staff. The delineation of responsibilities within this staff provided that the Army would supply all ground communications, the Navy all shipboard facilities and the Air Force all air/ground and point-to-point communications concerning aircraft.

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[redacted]
primary communication network between principal points ashore and SCR-608 (10-channel voice) radio sets for voice communications between ships, and between ships and shore. Navy MBF radio sets were to be installed in the cabins of the Technical (later called Scientific) Directors and the General and Flag Officers of the Armed Forces to provide an intercommunication system for their exclusive use. Plans were also being made to provide radio teletype facilities for message handling between the forward area and the United States.

On 28 October 1947, first consideration was given to the possibility of installing AN/TRC-1 equipment on the main ships to provide VHF radio telephone and teletype service between the ships and between the ships and the Army shore system. This installation would permit an individual at any ship's service telephone to call his ship's switchboard and be connected to any ship's service telephone on the other ships or to any telephone at the main shore locations. The need for such a flexible radio telephone system interconnecting the U.S.S. ALBEMARLE (AV-5), U.S.S. CURTISS (AV-4), U.S.S. MT. MCKINLEY (AGC-7), Eniwetok Island, Control Island (Parry), and the three Zero Islands (Engebi, Aomon/Bijiiri/Rojoa and Runit) was discussed with all the principal scientific personnel concerned. They all agreed that these radio telephone circuits would be a highly desirable feature in the communications system.

The first written request for radio telephone service was made by the Atomic Energy Commission on 12 November 1947 and included listings of main points and the number of channels desired between each of them. Also contained in this letter was the initial request for telephone installations at the main island locations. The final request for these facilities differs only in detail and is listed later.

During a trip to Washington covering the period 13-21 November 1947, final requirements for the radio telephone system were determined. Decision on these final requirements involved estimates of the amount of traffic expected, the existing limitation of four (4) outside line drops on the AV switchboards, personnel and space restrictions aboard ship, limited planning and installation time for the ships, a possible increase in the number of drops on the AGC-7 switchboard from four (4) to ten (10), and the relocation of the main shore relay station from Parry to Eniwetok. The final Atomic Energy Commission radio telephone plan was evolved on 19 February 1948, just prior to actual operation of the system. The request included the following circuits:

a. AGC-7 and AV-5, 2 channels;

b. AGC-7 and AV-4, 1 channel;

c. AV-4 and AV-5, 2 channels;

d. AGC-7 and Eniwetok, 7 channels;

[redacted]
was devoted by the Communications Section to the selection of the fifty-two (52) frequencies required in the band of 70-100 megacycles. Plans and supervision of the shipboard installations were started during the first week in December 1947 with Lieutenant Commander Ralph L. Hildebrand, USNR, supervising the AV-5 installation at Norfolk, Virginia, and Lieutenant (junior grade) Thomas V. Grant, USN, supervising the AV-4 and the AGC-7 at Terminal Island Naval Shipyard, San Pedro, California. Inspection trips to these shipyards were made by Mr. Hopkins and by

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early February 1948, all these ships were docked at Terminal Island preparatory to departure in convoy to Eniwetok.

The final requirements for the land-line telephone system were laid down at a conference held at the Naval Research Laboratory on 16 December 1947. These requirements were plotted on maps of the planned island installations and included:

a. Eniwetok (no map)

(1) Radio Chemistry;

(2) Security;

(3) Others.

b. Parry (no map)

(1) Control Station (3);

(2) Telemetering Tower (LAJ-8 installation);

(3) Beach;

(4) Cable Terminal;

(5) Communications Building and Guard.

c. Each Zero Island

(1) Top of Tower (2);

(2) Tower Base;

(3) Timing Station (4);

(4) 400 ft. Station;

(5) 1000 ft. Station;

(6) Gamma "A";

(7) Gamma "B";

(8) Gamma "C" (Runit only);

(9) Beach;

[redacted]

(12) Causeway on Aomon/Bijiri;

(13) Blast Building (2);

(14) Blast Footings;

(15) Blast Footing Common.

Telephones had already been installed on the AV's in Shops No. 1, 2, 4, 5, 6, 7, 8, 9, 10, 11, 12 and 15, Admiral's Cabin and Flag Office. No further modification was therefore required.

A request for land-line telephone service to and from the two AV's while berthed at Terminal Island (15 February-1 March 1948) was made by memo from Mr. Henderson (Hopkins) to the Commanding Officer, Terminal Island Naval Shipyard. Due to misunderstanding, a plan for charging these calls to Atomic Energy Commission funds did not succeed and the few calls which were made were charged to the normal shipyard telephone appropriation.

Coincident with the decision to employ shipboard radio telephone circuits between ships and shore was the formulation of a plan for VHF carrier teletype between the three primary ships and between the AGC-7 and Eniwetok. The permanently installed HF radio teletype equipment would be used only to back up the VHF circuits and to provide communication with Hawaii during movements to and from the forward area. On 3 November 1947, after discussions with Mr. W. Moran, Atomic Energy Commission Security, and Mr. W. R. Williams, Atomic Energy Commission Communications, it was decided to employ the one-time tape

[redacted]

		Tape	Tape	Tape
(1)	600	AGC-7	AV-4	AV-5
(2)	600	AV-4	AGC-7	AV-5
(3)	600	AV-5	AGC-7	AV-4
(4)	200	AGC-7	Los Alamos	-
(5)	200	Los Alamos	AGC-7	-
(6)	400	AV-4	Los Alamos	-
(7)	400	Los Alamos	AV-4	-
(8)	400	AV-5	Los Alamos	-
(9)	400	Los Alamos	AV-5	-

Systems (1) through (3) were to be used for both three-way conference and classified messages between the ships. Systems (4) through (9) provided coding facilities for Atomic Energy Commission messages between the ships and Los Alamos. The number of tapes were based on an estimate of the amount of traffic plus a large safety margin. Half of the tapes in each system were ordered to arrive by 15 February 1948, the remaining half to be delivered by 1 March 1948.

On 20 November 1947 a request was submitted to the Atomic Energy Commission for a leased teletype line from Los Alamos to the Presidio of San Francisco, major relay station in the Army Command and Administrative Net (ACAN). This circuit was required to provide a continuous outlet for traffic to and from the forward area and to bypass the many relay points normally involved in passing messages into the Army

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Command and Administrative Net system from Los Alamos. On 2 December 1947 Dr. Froman submitted a request to the Manager, Sante Fe Directed Operations, that the Los Alamos Teletype Center remain open twenty-four (24) hours a day effective 1 March 1948 until completion of the operation. The teletype routing indicators to be used for Atomic Energy Commission messages were coordinated with the Armed Forces and promulgated to the Atomic Energy Commission installations on 16 February 1948.

The Technical Net consisting of SCR-608's installed at important stations within the task force was, until 28 October 1947, planned to be the primary intra-task force voice communication system. The decision to install AN/TRC-1 radio telephone equipment on the three main ships reduced the Technical Net to a "back-up" status. The communication requirements of the photographic group were obtained from Colonel Cullen on 5 November 1947, and it was decided that communications to the photo towers could best be supplied by their inclusion in this net. The final plan for the Technical Net called for the following stations:

(1) AV-4;

(2) AV-5;

(3) AGC-7;

(4) CVE-115;

(5) LSM-250;

(6) LSM-378;

(7) Boat Pool Base (LSD-19);

(8) LCM (6) Tank Control Boat;

(9) Each Zero Island;

(10) Parry;

(11) Eniwetok;

(12) Photo Towers at Aomon;

(13) Photo Towers at Runit;

(14) Photo Tower Aniyaanii;

(15) Photo Tower Coral-Head.

The requirements for the Radiological Net were determined in a conference on 6 November 1947 with Radiological Safety Staff (Colonel J. P. Cooney, Commander F. I. Winant, USN) and Commander R. J. Schmidt, USN. They planned to employ approximately twelve (12) radiological safety (RADSAFE) parties after the shot, operating from boats in conjunction with the scientific teams who would be returning to the Zero Island to gather their records and data. It was decided that each RADSAFE party would be equipped with an SCR-300 "Walkie-Talkie" enabling them to communicate with their respective boats. There, messages would be relayed from the boats by Navy TCS radio sets to the Radiological Safety Centers on the AGC-7 and CVE-115. Two (2) special SCR-608 circuits were to be provided between the Radiological Safety Centers. In addition, circuits were planned for communication between the Radiological Safety Centers, helicopters and a C-47 to be used in the initial radiological survey immediately following the shot.

On 4 November 1947 Dr. Hartmann of Naval Ordnance Laboratory stated a requirement for a frequency band of 150 to 160 megacycles to be used by six (6) blast telemetering equipments. Later, discussion arose concerning the possibility of employing six (6) channels in the vicinity

[redacted]

blast measuring equipment. One net was to have eight (8) SCR-300's and the other, thirteen (13).

The request for a Voice Time Signal Broadcast was received from Dr. Froman on 1 November 1947. The purpose of this broadcast was to inform all land stations, ships and aircraft of the exact time of the test. The original plan was to transmit the signals from the AGC-7 after they had been relayed from the Control Station on Parry Island over the radio telephone system. This was later changed to a direct broadcast from the Control Station for reliability considerations.

The J-3 (Operations) section of the staff decided on 15 January 1948 that AVR air-sea rescue boats would be employed to evacuate the final personnel from the Zero Island before each shot.

[redacted]

[redacted] island party required to start the tank. VHF equipment was to be used between the LCM, helicopters and the CVE-115. The LCM was also equipped with an SCR-608 in the Technical Net for general communications.

The communications required by the Neutron Measurement Group

[redacted]
which did not arise until after commencement of the operation are described below.

It became evident soon after the main ships of the task force arrived at Eniwetok on 16 March 1948 that additional radio telephone circuits would be required between the two AV's and the Zero Island to be used for the first test in order to handle the large amount of ship to shore telephone traffic. Accordingly, two channels between

[redacted]

[redacted]

established.

(a) ALBEMARLE to Eniwetok, 1 channel.

(b) ALBEMARLE to Parry, 1 channel.

(c) CURTISS to Eniwetok, 1 channel.

(d) ALBEMARLE to MT. McKINLEY, 1 channel.

(e) CURTISS to MT. McKINLEY, 2 channels.

(f) CURTISS to ALBEMARLE, 1 channel.

A REPORT OF GROUND SIGNAL COMMUNICATIONS ON OPERATION SANDSTONE

By October 1947 certain requirements had been definitely decided upon, and it was desired that the construction necessary for the establishment of basic components of the eventual communications facility be commenced at Eniwetok. The first construction to be undertaken at Eniwetok would be the setting-up of equipment, antennas, communication center and crypto center for the operation of a radio teletype circuit to Oahu; the installation of switchboards and instruments for telephone service on the island of Eniwetok and the setting-up of two (2) CW circuits to Kwajalein, one of which was for Navy use and the other which was for Air Force use. A temporary AN/TRC (radio telephone) circuit to Engebi Island was needed until the major AN/TRC facility could be activated. The Air Force desired immediate activation of tower control facilities (AACS) at the Eniwetok airfield. Interim communications would be needed for the initial construction forces of the Task Force on arrival in late November. Thereafter, the remaining construction required for installation of the full communication system for this operation was to proceed rapidly in whatever order circumstances and later developments dictated.

Colonel Carl H. Hatch, Signal Corps, USA, concieved an advance signal construction and operation detachment to accomplish these plans and went forward to the headquarters, U.S. Army Pacific, to investigate its feasibility. By the date of his arrival on 18 October 1947, the Commander, Joint Task Force, ordered full logistic support for the operation from

USARPAC, particularly for initial requirements. It was also directed that the initial force be furnished from USARPAC personnel.

Conferences toward the execution of these directives were held with the Signal Officer, USARPAC, who was presented a copy of the initial requirements for communications equipment for the initial construction and operations at Eniwetok. (Initial equipment requirements, which were to be used only as a guide, are retained in corrected form in the files of the Signal Officer, USARPAC, along with lists of all signal materiel actually shipped with the initial force.

Major George F Rogers, USA, was designated Commanding Officer of the initial signal detachment to be supplied by USARPAC. Additional officers for radio, wire, construction, communications center, code room and supply were selected. These officers prepared lists of key personnel to make up the initial communications force and submitted the list to the Signal Officer, USARPAC (Colonel Joe J Miller) for approval. The problems and qualification considerations involved in the selection of personnel for this detachment will be discussed in the technical report of communications. It was evident that additional personnel would be required beyond the capacity of the Signal Service, USARPAC, and arrangements were made to obtain one radio officer and 10 ETM's from CINCPACFLT sources, an EM and the part-time services of a officer from Army Security Agency; the latter, in addition to his ASA duties was to serve as OIC Communications Center, and Crypto Security Officer. This group was further augmented by one officer and 24 technicians from the 71st AACS Group, commanded by Lieutenant Colonel Frank Bobulski. The complete roster of detachments officers and communications personnel comprising the initial force is summarized below:

Signal Corps

Grade	Name	ASN	Position
Major	George F Rogers	029544, Sig C	Signal Officer
Major	Paul H Rittenhouse	0451051, Sig C	Signal Depot
Capt	Howard Gale	01648063, Sig C	ASA Representative, OinC Comm. Center, Crypto Security Off.
Capt	Robert E Galloway	0900703, Sig C	OinC Transmitter Sta.
1st Lt	Earl D Hicks	01646146, Sig C	OinC Wire Section
1st Lt	August J Sable	0455224, Sig C	OinC Receiver Station
WOJG	Dale I Gearhart	W2126123, USA	OinC Message Center & Radio Control Section
WOJG	Ernest A Woodward	W2116009, USA	OinC Crypto
4	Master Sergeant		
4	Technical Sergeant		
6	Staff Sergeant		
4	T/3		
3	Sergeant		
6	T/4		
2	Corporal		
11	T/5		
30	Private and Private First Class		
Relec.	Leslie L Funston	452265	OinC AN/TRC Station
2	Electronics Technicians Mate Second Class		
8	Electronics Technicians Mate Third Class		

Grade	Name	ASN	Position
AACS			
1st Lt	Herold W Krouth	0578233	OinC
2	Master Sergeant		
1	Technical Sergeant		
4	Staff Sergeant		
5	Sergeant		
6	Corporal		
6	Private First Class		

On 25 October 1947, a group comprised of the Task Force Commander and staff officers of the various services departed to the forward area to survey the proposed site at Eniwetok Atoll. Captain Christian L Engleman, USN, and Colonel Hatch were included in this group and made inspections at Kwajalein, Eniwetok, Engebi and Parry Islands. Inspection of Eniwetok revealed that certain underground cables already existed there. These could probably be used with augmentation for the proposed telephone and cable systems for the construction forces and would also serve as the necessary interconnecting cables between Joint Communications Center, transmitter and receiving sites and the AACS installation at the airfield. Insufficient time was available to make any comprehensive tests of the cables nor were any records available as to this distribution system. Buildings for the various installations were selected and were earmarked for communications purposes. It was apparent from this survey that the existing power distribution system would not be adequate and that separate power plants would be required to all major signal or

[redacted] force together with the initial and supplementary lists of equipment required. It was evident that the Signal Service, USARPAC, would be able to furnish the majority of the equipment and supplies required

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initial Signal communications plan. Another conference was held with

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representatives of AEC at Sandia Base, Albuquerque, New Mexico, who agreed to send their communications representative to JTF-7 headquarters at Washington, D. C., to coordinate the communications requirements of that group.

After arrival in Washington on 1 November 1947, numerous conferences were held with various interested groups, services and agencies in an attempt to obtain from them as many communications requirements as were yet known in order to include those requirements in the communications and electronics plan and to prepare appropriate equipment lists for procurement purposes. Conferences were held with the Chief Signal Officer and Army Communications Service Division in regard to equipment requirements, frequencies and engineering. Every consideration was given to the project by Colonel Wesley T. Guest, Chief of Army Communications Service Division, Major A. O. McLand and Captain George H. Darwin, USA. Their assistance and cooperation was invaluable in the many engineering, procurement, procedural and radio frequency assignment problems that confronted the communications section.

Mr. Louis A. Hopkins arrived on 27 October 1947 from Sandia Base and presented additional communications requirements for the Atomic Energy Commission. These requirements together with those of Navy, Army and Air Force were consolidated in a tentative communications and electronics plan. This plan was the basis for requisitions of communications equipment and personnel from the Zone of Interior. Both the equipment and personnel lists were presented to Office of the Chief Signal Officer for check on availability so that if substitutions proved necessary, they could be made prior to submission of the firm lists through normal channels.

It was apparent that the amount of technical personnel available to the Office of the Chief Signal Officer was extremely limited; however, every consideration was given by that office within their capabilities. The balance of the personnel requirements were turned over to Army Ground Forces Liaison Officer with the Armed Forces Special Weapons Project, (Colonel H.C. Hine). Conferences were held with representatives of J-2 of the Task Force, G-2 of the Department of the Army and the Army Security Agency to advise them of the requirements for adequate cryptographic equipment and systems. It was decided that Captain Wilfred Washcoe, Army Security Agency representative and Commanding Officer of the MidPac Detachment, ASA, would be the issuing officer for cryptographic material. Captain Washcoe had previously been advised of the operation and alerted as to the possible requirements for the Task Force. The balance of the period at Washington, D. C. was spent in furnishing logistics information to the Transportation Corps and formulating plans for the handling of communications in the zone of the interior by all the services and Atomic Energy Commission.

The Deputy Communications Officer departed 1 November 1947 for Oahu. Conferences were held with the Army Security Agency representative, USARPAC, the Signal Office and his supply division in order to give them a thorough understanding of the requirements both from the standpoint of supply and operations. The cooperation of the Signal Service, USARPAC and ASA was outstanding in every respect.

The initial Signal Detachment departed from Iriquois Point, Oahu, 16 November 1947 aboard the USS LST 219 and arrived at Eniwetok 29 November

[redacted]

at the transmitter and receiver locations. (Charts of these areas are included in the technical report of communications). Construction of the numerous antennas was started by the wire constructions teams. The first circuit turned up to traffic was circuit No. 402, a radio teletype

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channel to Helemano, Oahu. In view of the high optimum work frequency forecast for the period of the test, it was decided that three element beam antennas would be used for long-haul teletype communications on the wire frequencies. Mr. Alton R. Hart, from the Office of the Chief Signal Officer, was furnished to assist in the installation of the beam antennas and to provide such technical assistance as was required in the construction of the balance of the antenna farms and in the testing of the radio transmitters. Mr. Hart gave invaluable assistance in the installation of the BC-339 transmitters used on the circuits to Oahu. At this time it was apparent that the power supplied by the engineers could not be relied upon due to the lack of voltage and frequency regulation and the impossibility of synchronizing the loads between any two generators in order to provide continuous power. The generators that were furnished were 75 KVA Caterpillars and were in very poor mechanical and electrical condition. It was therefore necessary to order additional power equipment incorporating output regulation and synchronization features for the transmitters, receivers, communications center and the VHF installations.

In accordance with the requirements of the construction forces on Engebi, and AN/TRC-1 was installed with a BD-72 and a PE-95 power supply so as to provide signal communications locally on Engebi and also between that island and Eniwetok. This initial installation was completed about 26 December 1947 and was later augmented by the installation of an additional AN/TRC-1 system and tower facilities including teletype and telephone cable installations. Similar installations were made in the following order: Runit, Aomon-Bijiiri and Perry.

The initial VHF (AN/TRC-1) installation was too small for ultimate requirements. It was decided to utilize a building adjacent to the Joint Communications Center and house all of the AN/TRC-1 and associated CF-1 and CF-2 equipment at that location. Established under the engineering direction of Mr. Jack Eggert, from Headquarters, Signal Corps Engineering Laboratories, Ft. Monmouth, N. J., this was probably the largest installation of its kind ever attempted by the armed forces.

During the period covered by this report, communications personnel were called upon to renovate their own housing area and the buildings that were to be occupied by communications installations. They were also called upon to install power poles and power and lighting distribution wiring. The construction for communications purposes at Eniwetok was further complicated by the necessity of blasting 95 percent of the holes for antenna poles. Sub-surface coral strata were continually being encountered.

Despite exceedingly long hours of work, the morale of the communications personnel was outstanding. On many occasions, it was necessary to order men off of their jobs so that they would obtain enough rest.

On 27 December 1947 the personnel furnished from Signal Corps sources in the U. S. arrived and were assigned as an augmentation of the existing initial forces. The balance of the personnel from Army Ground Forces arrived between 18-26 January 1948. A large proportion of the first group were recent graduates of the Signal Corps School. Schools were immediately established to provide on-the-job and classroom training in the equipments which they were expected to operate and maintain.

The Deputy Communications Officer frequently visited the forward area for the purposes of necessary liaison between the communications detachment, Atomic Energy Commission and engineers, and to provide such technical assistance as was possible in the installation of the various signal establishments.

From 20 December to 4 January, he was occupied in Oahu with negotiations with the Joint Task Force Seven Communications Officer, Army Security Agency, Army, Navy and Air Force for the completion of the communications and electronics plan and in expediting of new requests for equipment and supplies (especially crystals) which had been received from the forward area. The cryptographic portion of the plan provided, in addition to the tape relay facilities at Eniwetok, a shore-based crypto-center and Sigtot teleconference room adequate to the needs of Headquarters JTF-7, were it to move ashore. The normal Army and Joint crypto systems held were augmented by a number of on- and off-line Sigtot systems capable of carrying AEC Restricted Data, provided to link the shore-based installation at Eniwetok with the Task Force Flag Ship, Air Task Group, Ft Shafter, and Department of the Army and Air Force. Annex F of Field Order Number One, JTF 7, contained, as page F-IV-TAB1, an appendix showing this Cryptographic Plan.

Colonel Hatch returned from Eniwetok to Oahu 27 January 1948 in order to relieve Lieutenant Colonel Dupree and Lieutenant Colonel Smith as Signal representatives at the special Oahu headquarters of JTF-7. During this period, additional requirements were submitted in accordance with the FITZWILLIAM Project. Colonel Hatch took the necessary action [redacted] also prepared the cryptographic system that was used for the transmission of the timing signals in a secure manner.

On 1 March almost all members of the Communications Staff were assembled at Fort Shafter for a week of joint action on remaining problems before departing by ship and air in the movement of main headquarters to Eniwetok.

In the forward area all VHF circuits were completed to the outlying islands, and the wire teams had completed the installation of telephone exchanges at all locations. The cables and telephones used in connection [redacted] of personnel in equipment operation and procedures in the Joint Relay Station. Initial contact was made with the AGC-7 while still at sea and channel 402 was turned over to traffic on 15 March 1948.

The MT. McKINLEY arrived at Eniwetok on 16 March 1948 and efforts were made to activate the VHF radio telephone links to the shore. Considerable difficulty was experienced in establishing these links between ship and shore. This was caused principally by frequency congestion in the AN/TRC spectrum and by interference from other facilities in use aboard ship. Although these difficulties curtailed telephone communications between the ships and shore for a short period, there was never a complete absence of radio telephone communications. The MRC-2 equipment (channel 412) was also used as a back-up for the VHF teletype links during the shakedown and testing periods. Much effort had to be expended in deriving suitable frequencies and antennae. Vertically and horizontally polarized beams, dipoles and ground planes were

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maximum technical control of this network, it was considered desirable to install a BD-72 switchboard in the VHF building on Eniwetok to be used as

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[redacted] were monitored at Eniwetok and their reception was reported to the control station by use of this cable circuit.

Only one change was made in preparation for Xray Day. Extra PE-95

[redacted]

Field Order #2, Hq, JTF-7.

Plans were also made and construction was started for the communications installation for a garrison force. This installation required two (2) BC-610E transmitters and the necessary antennae to provide one manual simplex circuit to the Mariannas Sub-Area Commander at Kwajalein and a second similar circuit direct to Helemano on Oahu. These were the circuit requirements set forth by the Commanding General, USARPAC (CJTF-7). The receiving equipments were three (3) BC-779 Super-Pro receivers. Telephone facilities utilizing

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sisting of five (5) enlisted personnel in charge of Lt. Colton, Signal Corps, was furnished by Signal Service, USARPAC. The team arrived about 20 May 1948. It was felt that the employment of experienced packing

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personnel would minimize the time required by depot maintenance shops to return the used equipment to Class A condition. Proper packing would reduce breakage incident to shipping.

Major George F. Rogers and the Deputy Communications Officer departed for Oahu by air on 21 May 1948. Major Paul H. Rittenhouse remained behind, completing the roll-up and return of signal personnel and equipment.

In conclusion, it should be stated that from the Army standpoint, communications on Operation Sandstone functioned exceedingly well. The Joint Relay Station on Eniwetok during the course of the operation handled a total of approximately 7,000,000 groups of terminating and relayed traffic. Although this would appear to be a tremendous amount of traffic, the operation of the comprehensive radio telephone system effectively accomplished a great reduction in the volume of formal message traffic. Many favorable comments were received on the effectiveness of this telephone system in expediting all phases of the operation.

[redacted]

flagship would remain at Eniwetok if Task Force Commander was to be shore-based. The Commander Naval Task Group and Commander, Air Forces, would also be embarked in the task force flagship.

Flagship:

1. Administration............... 2 RTTY Duplex to Ft. Shafter.
   1 Manual Simplex to Pearl Harbor.
   1 Manual Simplex to Kwajalein.
2. Air Control.................. 1 RTTY to Kwajalein.
3. Air and Airways Communication Service............... 1 RTTY Duplex to Kwajalein.

4.	Distress	500/8280 Kc. Manual Simplex.
5.	Voice Tactical	TBS/MBF/SCR-608.
6.	Joint Task Force Commander Command	Manual Simplex.
7.	Commander Naval Task Group	Manual CW Tactical.
8.	Task Force Fox	
9.	To Test Director Afloat	1 VHF Voice.
		2 VHF RTTY Duplex.
		1 VHF Voice Duplex.
10.	General Warning	1 Voice Simplex.
11.	Air-Sea Rescue	1 VHF Voice Simplex.
		1 HF Voice Simplex.
12.	Boat Pool Net	1 VHF Voice Simplex.
13.	Technical Net	1 10-channel VHF Voice.
14.	Commander Air Force	1 HF Voice Simplex to Kwajalein.
15.	Ship to Air	5 VHF Voice Channels.
16.	AGC-7 to Joint Relay Station	3 VHF RTTY Duplex.
17.	AGC-7 to AV-4	1 VHF RTTY Duplex.
		1 HF RTTY Duplex.
18.	AGC-7 to AV-5	1 VHF RTTY Duplex.
		1 HF RTTY Duplex.
19.	AV-4 to AV-5	1 VHF RTTY Duplex.
		1 HF RTTY Duplex.

[redacted]

B. A submarine cable barge would be moored in a central position in the lagoon as a cable junction and patch point (later eliminated).

Cable Barge.

1. Technical Net...................... 1 10-channel Voice.

C. Radio communications would be needed at three (3) widely separated towers.

Zero Stations #1, #2 and #3.

1. Technical Net...................... 1 10-channel Voice System.

D. Radio communications would be needed at three (3) widely separated photography towers (in addition "C").

Photo Tower #1, #2 and #3.

1. Technical Net...................... 1 10-channel VHF Voice System.

E. The headquarters of the Atomic Energy Commission at Eniwetok and the Test Director would be located in the AV-5.

Test Director Afloat in AV-5.

1. Technical Net...................... 1 10-channel VHF Voice System.
   1 VHF Voice.
   1 VHF RTTY Duplex.
2. Boat Pool Net...................... 1 VHF Voice.

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3. General Warning........................ 1 HF Voice.

F. A Boat Pool Net would be operating from an LSD at Eniwetok.

Boat Pool.

1. Technical Net.......................... 1 10-channel HF Voice System.
   1 HF Voice to Boat Pool Boats.

G. Special Atomic Energy Commission communications circuits would be required for control and reporting channels, measurement channels and channels needed to link Atomic Energy Commission activities. All these would involve forces afloat.

Special Circuits.

1. Radiological Net....................... SCR-608/TCS/SCR-300.
2. Neutron Net............................ Share Other Circuits.
3. Drone Tank Control Net................. TDQ/RCK/SCR-608/SCR-300.
4. Technical Net.......................... SCR-608/SCR-610.
5. VHF Radio Link Telephone-Teletype System................................ AN/TRC-1.

It appeared desirable to immediately set forth the personnel requirements to allow ample time for procurement from fleet units and shore activities. The general personnel situation throughout the naval service necessitated keeping requirements to an absolute minimum and to state where possible the particular qualifications desired.

Since circuit and personnel requirements are closely linked, the following table was established to determine personnel requirements based upon assumed circuit requirements.

A. Flagship (U.S.S. MT. MCKINLEY AGC-7).

Circuit or Function	Officers	Enlisted Men	Job Classification
VHF Voice Tactical (TBS)			
HF Manual CW Tactical		3 RM2	
HF Manual Task Force Fox		3 RM3	
HF Voice General Warning		3 RM3	24241
HF Voice Air-Sea Rescue		3 RM2	24241
VHF Voice Air-Sea Rescue		3 RM2	24241
VHF Voice Small Ship			
HF Manual CW Distress		3 RM3	
HF Manual CW Distress		3 RM2	
Fleet Fox Series		3 RM2	
HF Manual CW Task Force Commanders		3 RM1	
Ship-Shore Net Series		3 RM2	
Weather 2 Manual CW Circuits		6 RM2	
PacFlt Task Force Commanders Radio			
Teletype		3 RM1	72811
VHF Boat Pool Net		3 RM3	

VHF Technical Net		3 RM2	
HF Voice Radiological Net		3 RM1	
HF Voice CW Air Track Group		3 RM2	
HF Voice CW Surface Track Group		3 RM2	
VHF Voice Air/Ground Net		3 RM2	
VHF RTTY Duplex, AGC-7 to AV-5		3 RM1-2	72811**
VHF RTTY Duplex, AGC-7 to AV-4		3 RM1-2	72811**
VHF RTTY Duplex AGC-7 to AV-4/AV-5		3 RM1-2	72811**
VHF RTTY Duplex AGC-7 to AV-5/AV-4		3 RM1-2	72811**
VHF RTTY Duplex AGC-7 to Shore		3 RM1-2	72811**
VHF RTTY Duplex AGC-7 to Shore		3 RM1-2	72811**
Manual Simplex Control Via VHF link		3 RM1-2	72811
Manual Simplex Control Via VHF link		3 RM1-2	72811
HF RTTY Duplex AGC-7 to Shore			
Supervisors		3 RM1	72811/24120**
		3 CRM	72811/24120**
Comm. Watch Officer	3 LT @		
	3 LTJG #		
Coding Officers	6 LTJG or ENS		
Comm. Yeoman		6 Y2	72311
Comm. Messengers		6 S2	
Telephone SwBd. Operators		6 S1	73311
ECM Repair		1 Man	38361

HF Manual CW Task Force Commanders		3 RM1	
VHF Voice Air/Ground		3 RM2	24211
HF Voice Radiological Net		3 RM1	
VHF Voice Technical Net		3 RM2	
VHF Voice Boat Pool Net		3 RM3	
VHF RTTY Duplex AV-4 to AV-5		3 RM1-2	72811**
VHF RTTY Duplex AV-4 to AGC-7		3 RM1-2	72811**
VHF RTTY Duplex AV-4 toAV-5		3 RM12	72811**
HF RTTY Duplex (Standby)			
Supervisors		3 ERM	72811/24120
		3 RM1	
Comm. Watch Officers	3 LT		
Coding Officers	4 LTJG or ENS		
Comm. Yeoman		6 Y2	72311
Messengers		6 S2	
Telephone Switchboard		6 S1	73311
Electronics Repair and Maint.	1 CHRELE &		
		1 CETM	21111
		2 ETM1	21111/21610
		2 ETM2	21111
		3 ETM3	21111

** Qualified Supervisor, including RTTY circuits.

& Graduates W.O.Elect. Maint. School.

¢ For special crypto training in SIGTOT crypto system.

C. Miscellaneous.

Circuit or Function	Officers	Enlisted Men	Job Classification
Radiological Survey			
(Parties and Survey Boats)		20 RM2	24251
Radiological Tracking Ships		9 RM2	
Boat Pool Electronics Maint.		2 ETM1	21111
		2 ETM3	21212
Shore Signal Station		1 CSM	
		3 SM2	
		3 SM3	
		1 S1	

2. In addition to the above officers and men, three key electronic officers were ordered to assist in electronics planning and to supervise the electronics installation on MT. MCKINLEY, ALBEMARLE and CURTISS. The Bureau of Personnel was queried on the availability of personnel trained in the operation and maintenance of VHF radio link equipment (AN/TRC). No qualified personnel were available since Navy use of such equipment is extremely limited, primarily during amphibious operation, and personnel who were familar with such equipment had been discharged from the service. Upon the recommendation of the Bureau of Ships, negotiations were opened with the Philco Corp.

to procure six (6) civilian engineers qualified in VHF radio link equipment. It was planned to assign two (2) to each of the three ships in which VHF link equipment was to be installed. The Bureau of Ships, after necessary negotiation of contracts, assigned six (6) civilian engineers, qualified in VHF radio link equipment to project Sandstone.

By memorandum from the Adjutant General's office, the Communication Section was directed to have available one (1) marine officer and four (4) enlisted men to serve as special couriers between elements of the task force. A request for the above personnel was submitted via the normal procurement channels.

Since considerable radar plotting would be necessary during this operation, the Bureau of Personnel was requested to provide or to increase existing CIC complements on the MT. MCKINLEY and BAIROKO in order that CIC be fully manned. The CIC complement for AGC-7 was prescribed as follows:

1 LCDR (OinC and F/O officers)

2 LT (Air Intercept Officers)

2 LTJG (Qualified in SP radar)

8 RM

12 RM (Operators)

4 RM (Plotters and Reliefs)

14 Seamen talkers and messengers

1 Radar material officer

Special Circuits.

In addition to the normal communications common to the operation of a purely naval task force, the Atomic Energy Commission required special circuits to cover the technical phases of the projected atomic weapons tests. After considerable discussion with representatives of the Atomic Energy Commission, requirements for the following circuits or nets were established.

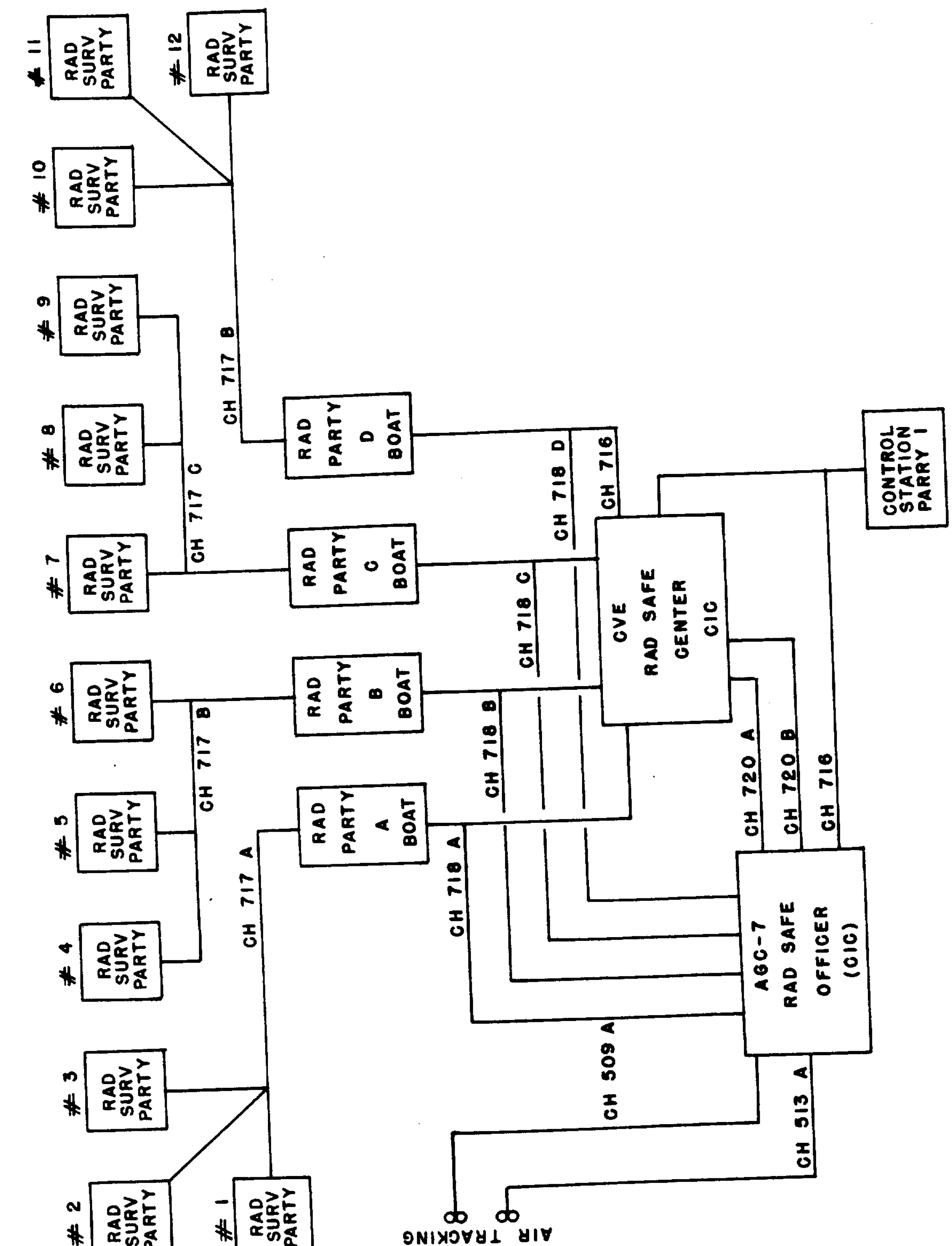
Radiological Net.

Since the safety of operations in the target area after the blast depends upon the reports of the various radiological safety monitors, this net was considered to be of prime importance. It provided a means of rapid voice communication between the 12 radiological safety parties and radiological safety centers located in MT. MCKINLEY and BAIROKO.

Two types of radio equipments were selected since both fixed stations and mobile stations were involved. The Model SCR-300 FM voice portable set weighing approximately 35 pounds was selected for the mobile radiological safety parties ashore and radiological safety personnel to the blast area. Each of the four landing craft, in addition to being equipped with an SCR-300, had installed one Model TCS crystal controlled HF voice transceiver used to transmit reports direct to the Radiological Safety Center in MT. MCKINLEY and BAIROKO. Model TCS or TDE to be employed in MT. MCKINLEY and BAIROKO.

Radiological safety monitors were also located in aircraft designated as "Cloud Chasers" to report movements of the radioactive cloud and radiological movements which would be reported directly to the Radiological Safety Center in MT. MCKINLEY. An HF voice circuit was provided to handle these reports. In addition to "Cloud Chasers" aircraft, one aircraft known as a "C47 Recon" to be operating in the target area after the blast would transmit radiological data direct to the Radiological Safety Center in MT. MCKINLEY. A VHF voice circuit was employed to handle these reports.

The Radiological Safety Centers in MT. MCKINLEY and BAIROKO required some means of exchanging safety data by direct circuit. Two Model SCR-608's were installed in each radiological safety center providing full voice duplex operation. A diagram showing the organization of circuits described follows.



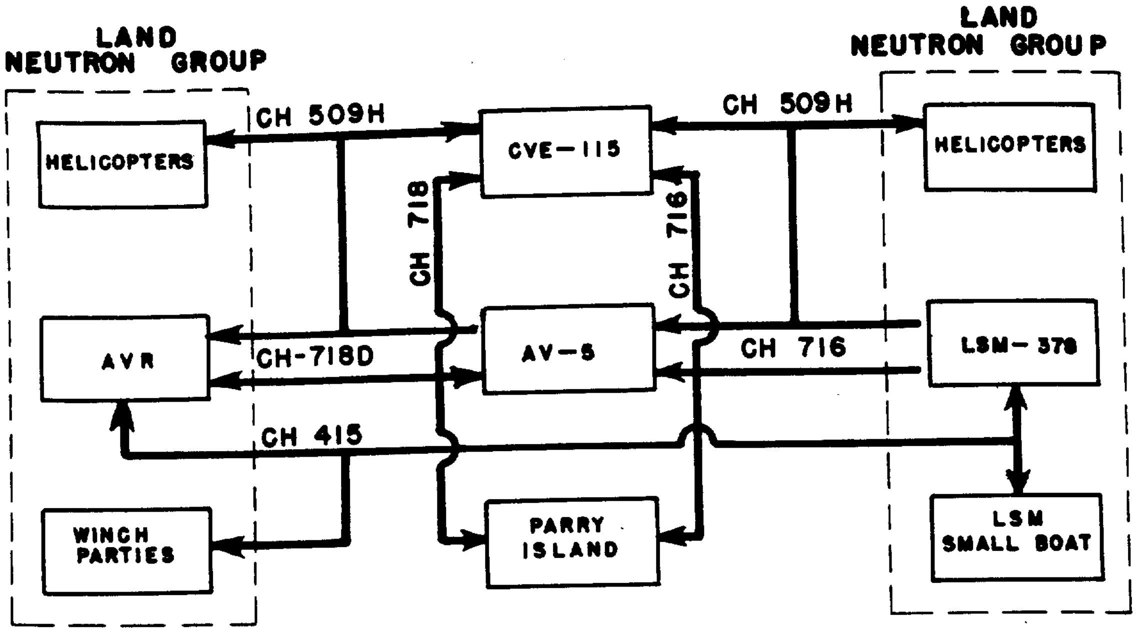
BASIC RADIOLOGICAL SAFETY NET

CHANNEL	FREQUENCY	SHIPBOARD EQUIPMENT	MOBILE EQUIPMENT
513	3.095mc	TBL	SCR-193 (Track aircraft)
716	3.485mc	SCR-608	SCR-608 (LCM Drone Tank Cont.) Control Station Parry Island
717	40.2mc		SCR-300 RadSafe Parties (2)
	40.6mc		RadSafe Party Boats (4)
	41.0mc		
	41.4mc		
	41.8mc		
718D	5.54mc	TCS	TCS RadSafeParty Boats (4)
720	35.8mc	SCR-608	
	36.0mc		

Neutron Net

The Neutron Group communication channels were established to provide a means of exchanging information between the land neutron group, the water neutron group, shipboard laboratories on the AV-5 and CVE-115 and Control Station at Parry Island. Actually, the neutron net did not involve new requirements in the way of equipment and personnel but shared communication channels used by other special Atomic Energy Commission activities.

The following diagram shows the actual stations involved in the net as well as prescribed equipments, frequencies and channel designations.

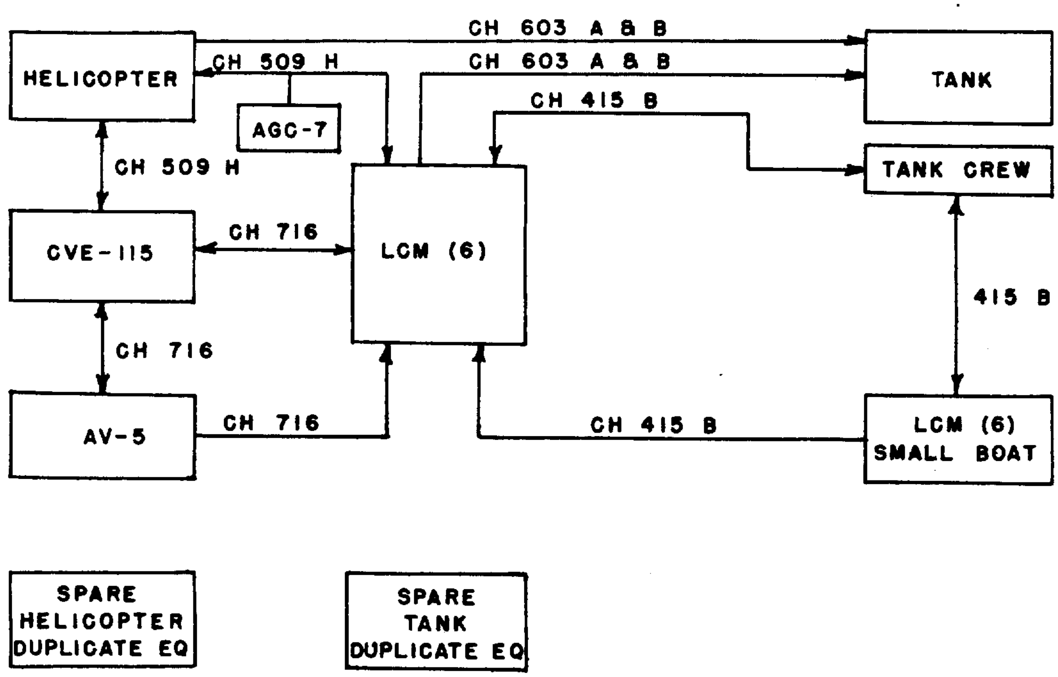


CHANNEL	FREQUENCY	SHIPBOARD EQUIPMENT	MOBILE EQUIPMENT
509H	146.16mc	TDQ/RCK	AN/ARC (Helicopters) AVR's-63' LSM-378
716	(On Tech Net)	SCR-608	SCR-608 (LSM 378) Parry Island Control Station
718D	5.545mc	TCS	TCS (AVR's (63')(Parry I Control Station)
415B	46.2mc	SCR-300	SCR-300 (AVR's (63') (Parry I Cont. Station) (Winch Parties (LSM 378)

<u>Drone Tank Control Net</u>

The drone tank control net was established to provide some means of passing information on the activities of the drone tank back to the laboratories on AV-5 and CVE-115 and to pass operational information between the primary control group (in helicopter and the standby group (in LCM 6)). An LCVP operating as a work boat for the LCM (6) was also included in this net.

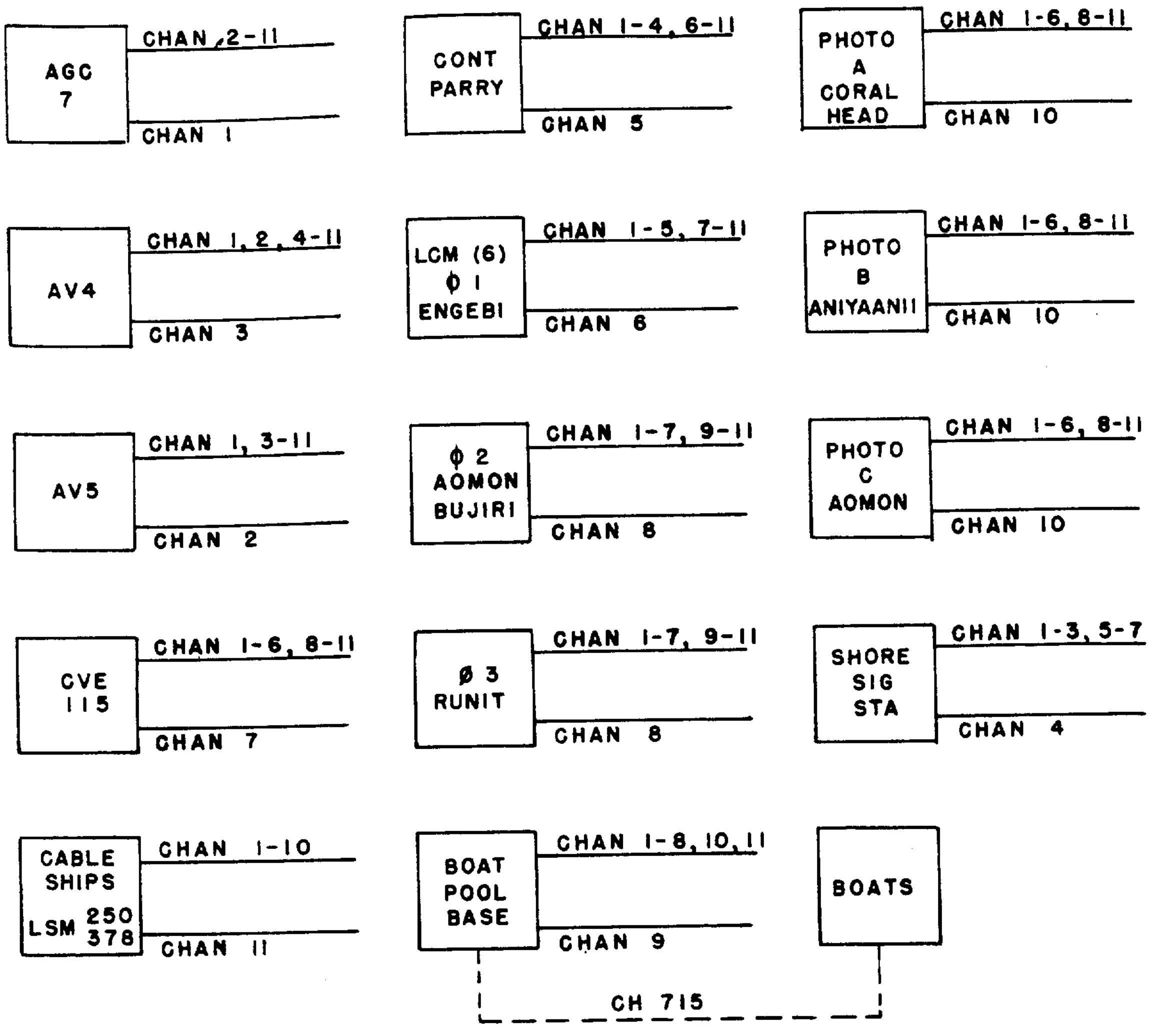
With the exception of the actual drone control circuits, these communication channels were shared with other Atomic Energy Commission activities. The following diagram shows actual stations involved, frequencies, channel designations and equipment installed.



CHANNEL	FREQUENCY	SHIPBOARD EQUIPMENT	MOBILE EQUIPMENT
415B	46.2mc		SCR-300 (LCM Drone Tank Control) (Drone Tank Crew LCM Small Boat)
509H	146.16mc	TDQ/RCK	AN/ARC1 (Helicopters) (LCM Drone Tank Cont.)
603	35.3mc		RC64/65 (Drone Tank) (Drone Tank Control)
716	(See Tech Net)	SCR-608	SCR-608 (Drone Tank Control)

<u>Technical Net.</u>

The Atomic Energy Commission required a communication network over which technical information could be exchanged between various Atomic Energy Commission activities. The SCR-608 10-channel FM voice transceiver was selected for this network in order to meet the multiple channel requirements and to provide the desired semi-duplex operation. The station requirements in actual location, channel designation and frequencies employed are shown in the following diagram.



Boat Pool.

All units except small boats operating from boat pool base and ship boats used SCR-608 equipment. Small boats from boat pool base and ships' boats were equipped with SCR-610 equipment.

TECHNICAL NET AND BOAT POOL NET		
CHAN.NO.		MC
CH 716A	1	FREQ 27.3
CH 716B	2	29.4
CH 716C	3	29.5
CH 716D	4	29.6
CH 716E	5	29.7
CH 716F	6	29.8
CH 716G	7	29.9
CH 716H	8	30.1
CH 716I	9	30.2
CH 716J	10	30.3
CH 716K	11	30.4
BOAT		POOL
CH 715		30.0

VHF Radio Link Telephone-Teletype System.

A rapid means of direct voice communications between individuals afloat and individuals ashore was considered to be a necessity by the Atomic Energy Commission. This requirement was concurred in by the military forces, considering the nature of the project and the scientific responsibility delegated to individuals within Atomic Energy Commission and the military organization.

After considerable study and investigation it was determined that the solution to this problem was in the employment of multi-channel single carrier terminal and transmission equipment providing duplex operation connected into the ship service telephone switchboard. Such equipment would also provide sufficient VHF RTTY channels

[redacted]

between ships and between the HQ ship and shore station to handle the military and Atomic Energy Commission plain and encrypted traffic for local distribution and for further relay by shore station on long haul HF RTTY circuits.

In order to fulfill the foregoing requirements, the AN/TRC-1 radio transmitting and receiving equipment was selected with combinations of the following terminal equipment: CF-1A carrier; CF-2B carrier; TH-1/TCC-1 and CF-7 hybrid adapter.

AN/TRC-1:

A frequency modulcated transmitting and receiving equipment that operates in the 70 to 100 megacycle band and specifically designed for use with carrier terminal equipment.

CF-1A Carrier Terminal Equipment:

An electronic device operating in the audio frequency range that provides for four full duplex channels that may be used for either telephone or teletype circuit. This channelization is accomplished by a system of hybrid coils and associated oscillators. In practice usually three channels are used for telephone circuits while the fourth channel is employed for teletype from a type CF-2B carrier equipment.

CF-2B Carrier Terminal Equipment:

An electronic device operating in the audio frequency range, that provides four full duplex teletype circuits. This channelization is accomplished by a system of hybrid coils and associated oscillators.

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[redacted] substantiate our assumptions. To further complicate this problem

[redacted]

the equipment did not become available until the last stage of the design work was nearing completion. This prohibited any attempt to rack-mount the component units.

The greatest problem that was presented in the initial stages of design was the type and orientation of the antennas to be used. The AN/TRC-1 was designed for use of horizontal beam array antennas. The instruction book recommended that no coasial cable run exceed 150 feet and that the antennas be spaced at least 50 feet apart. Oviously this was not feasible aboard the MT. MCKINLEY. Inasmuch as we did not have an equipment to experiment with we decided to stay within the recommended length of coaxial cable run and obtained our spacing, so as to reduce interference, by mounting vertical di-poles in such a manner that the receiving array is directly over the transmitting array and spaced around one and a quarter wave length. Using this orientation of antennas, frequency spacing (effectively physical spacing as far as mutual interference is concerned) over a band of 30 megacycles is possible. Thus by selecting the proper frequencies mutual interference was eliminated. The only available site for this type of an array consisting of five sets of antennas was the SG radar "pig stick" on the main mast. This brought to light another problem. Just forward of this site was an SK radar antenna which, with an old type of reflector would fire into the AN/TRC-1 receiving array. Permission was requested from the Bureau of Ships to replace the SK radar reflector with a smaller type. This permission was granted and the alteration cleared the receiving arrays.

[redacted]

channels.

In order to meet the requirements for VHF communications between the USS MT. MCKINLEY and the joint relay station at Eniwetok (channels 309, 310 and 311) the following equipment were installed; three AN/TRC-1, three CF-1 and three CF-2. This combination provides for nine speech channels (of which only six are used because of switchboard limitations) and twelve teletype duplex circuits (of which 2 are used). On U.S. naval vessels so equipped the switchboard will normally accommodate only four telephone circuits to and from the ship. In order to give the quantity of service desired in the task force, it was necessary to augment these switchboards' additional switchboard attendants cabinets so as to give a total of six

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additional circuits or a total of ten radio telephone link circuits, six to the shore VHF station, two to the USS ALBEMARLE and one to the USS CURTISS.

Automatic Radio Teletypewriter Equipments:

In order to handle the anticipated volume of traffic for the major units of the task force, maximum use of automatics was indicated. It was planned that the flagship act as a tape relay station, serving all elements aflat.

It was anticipated that one full duplex teletype circuit to each of the AV's would be sufficient. Each full duplex RTTY circuit was terminated using one model 19 combination and one model 15 teletype and one model 14 typing reperforator. To handle the anticipated traffic load to and from the moint relay station ashore, two full duplex circuits were planned with two additional circuits as standby, the standby circuits to be equipped with one model 19 combination and one model 15 teletypewriter. All of the above circuits were installed for normal operation with the VHF AN/TRC-1 equipment. H. F. FSK RTTY equipment was to be available for "back up" when the task force units were beyond VHF range.

HF RSK Radioteletype For Long Range Communications:

It was planned that all task force traffic to and from activities outside the Eniwetok area would be routed through the joint relay station Eniwetok (UHPJ) via VHF radioteletype. The Joint Relay Station Eniwetok would transmit and receive traffic via HF radioteletype circuits with Fort Shafter (USARPAC) (UHP).

It was desired that the task force have some means of transmitting and receiving task force traffic while en route to the operating area and also an alternate means of transmitting and receiving traffic at the operating area should the Joint Relay Station on Eniwetok or the Fort Shafter station become inoperative. Accordingly, arrangements were made with CNO, CINCPACFLT and COMMANDANT 14TH NAVAL DISTRICT to activate, as necessary, circuit Able 3 (USF 70B) between HQ JTF SEVEN (USS MT. MCKINLEY) and the Navy's major relay station PEARL HARBOR (BHP).

Circuit Able 3 (USF 70B) was established as Joint Task Force Seven channel #714.

<u>VHF Automatic Teletype Conference Facilities.</u>

The Atomic Energy Commission required teletype conference facilities between USS MOUNT MCKINLEY, USS ALBEMARLE and USS CURTISS employing the one-time-tape crypto system in order that Atomic Energy Act Restricted Data be exchanged.

Before equipment requirements could be set, it was necessary to investigate the possibility of manufacturing three instead of two one-time key tapes for use with SIGTOT. The Army Security Agency advised that the tapes could be manufactured. With this knowledge, equipment requirements were determined as three M 131 subscriber sets with associated teletypewriters and transmitter distributors for each of the AV's and the MT. MCKINLEY. The following is a breakdown of voice and radioteletype channels which were provided.

[redacted]

USS ALBEMARLE.

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Channel 352

1 VHF duplex voice channel between USS ALBEMARIE and USS CURTISS.

1 VHF duplex radioteletype channel between USS ALBEMARLE and USS CURTISS.

Channel 353

1 VHF duplex channel between USS ALBEMARLE and USS CURTISS.

1 VHF duplex radioteletype channel between USS ALBEMARLE and USS CURTISS.

Radio "Inter-Com" System

Requirement for a radio inter-communication system between certain key personnel of the scientific and military staffs was indicated. The U. S. Navy Model MBF voice equipment operating in the 60-80 megacycle band was selected. Equipments were installed as follows: On the USS MT. MCKINLEY one in the Task Force Commander's Cabin in the vicinity of his desk; one in each of the Deputy Task Force Commanders' Cabins in the vicinity of their desks and one in the Commander Naval Task Group 7.3 Cabin. Each of the AV's had one of these equipments installed in the Admiral's Cabin and one in the scientific personnel's main office. The USS BAIROKO had one installed in the Admiral's Cabin for the use of Commander Task Group 7.6. All equipments were planned to be operated on a common frequency.

Frequencies

All frequencies, other than those normally assigned to the U. S. Navy and currently listed in USF 70 (B), were authorized for use after coordinating action by the United States Joint Communications Board Frequency Allocation Committee. Coordination was also effected with Army and Air Force assignments, to prevent insofar as possible, interference between elements of the Task Force.

In addition to the special circuits or nets required by Atomic Energy Commission activities, normal naval and military task force communications were available. The majority of these normal communication channels were already established by frequency and usage and merely required extraction from the basic communication publications. Normal naval circuits available for use during Operation "Sandstone" were extracted from the Basic Rapid Communication Doctrine, U.S. Fleet, a registered publication.

The exact channels and frequencies used by Joint Task Force Seven may be found in sections F-I and F-II of Annex F (Communications and Electronics Plan) of Field Order #1, Joint Task Force Seven.

TRAFFIC ROUTING

LOCATION OF COMMANDS AND ACTIVITIES

(1)	CJTF SEVEN	WASHINGTON, D.C.
(2)	USARPAC	FT. SHAFTER, T.H.
(3)	USAEC HQ	WASHINGTON, D.C.
(4)	USAEC LOS ALAMOS	LOS ALAMOS, N.M.
(5)	USAEC SANDIA BASE	ALBUQUERQUE, N.M.
(6)	CDR NAVAL TASK GROUP (CTG 7.3)	PEARL HARBOR, T.H.

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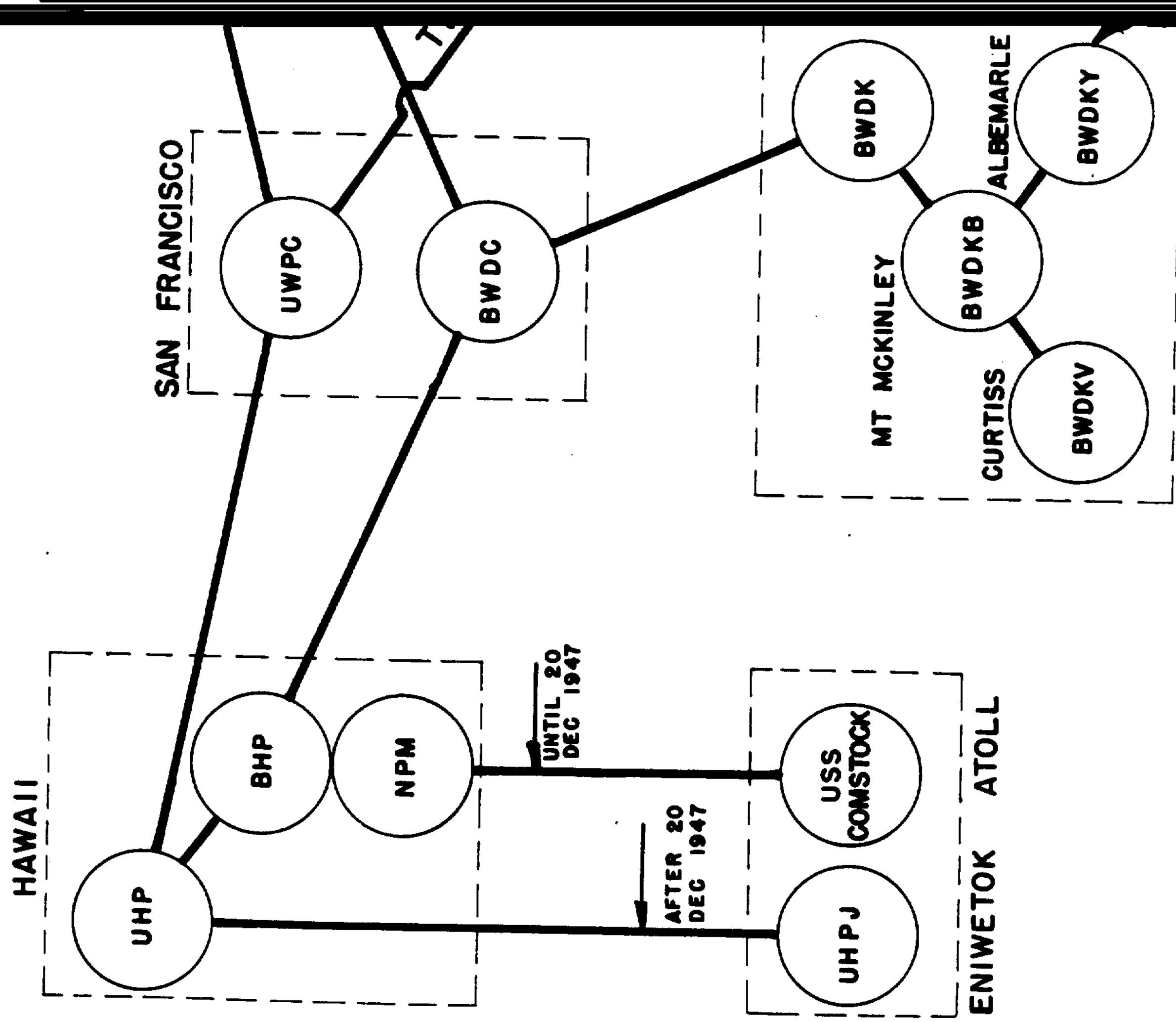
TRAFFIC ROUTING D

EFFECTIVE 15 OCTOBER 1947 – 15 F



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(7)	ISCOM ENIWETOK (CTG 7.2)	ENIWETOK, M.I.
(8)	COMGEN 6TH ARMY (PRESIDIO)	SANFRAN, CALIF.
(9)	USS MT. MCKINLEY	T.I. NAVSHIPYARD, CALIF.
(10)	USS ALBEMARLE	NORF. NAVSHIPYARD NORF., VA. UNTIL 5 JAN. THENCE TO T.I.
(11)	USS CURTISS	T.I. NAVSHIPYARD, CALIF.
(12)	USS COMSTOCK	ENIWETOK, M.I. (RADIO GUARD SHIP ENIWETOK)

CRYPTOGRAPHIC SYSTEMS AND CHANNELS

1. Normal military crypto channels and crypto systems were employed, plus special limited issue one-time-tape systems (SIGTOT) between Atomic Energy Commission Los Alamos and the USS MT. MCKINLEY, USS ALBEMARLE and USS CURTISS. The one-time-tape systems (SIGTOT) were the only system authorized by the Atomic Energy Commission for Restricted Data messages.

2. The authentication system as prescribed in the CSP 1270 series was not employeed. However, the "Shackle" authentication system was authorized for joint use on voice and CW circuits. The current edition of Pac. 6 was authorized for use.

3. In addition to the crypto systems prescribed in paragraph 1, a special issue key list used in conjunction with the joint rotors (CSP 5024/1592, SIGDFGB/SIGHCCP) was distributed to selected holders to be used when limited distribution of information was desired.

[redacted]

Call signs for special elements created for this project and operating under Naval control were covered by assignments from the spare blocks in the appropriate JANAP publications and so authorized by CNO and CINCPACFLT.

TESTS AND OPERATIONS

It had been planned that the additional and special communications equipment installed on the MT. MCKINLEY, ALBEMARLE, CURTISS and BAIROKO would be completely installed and ready for limited operational tests by 15 February 1948. Due to installation and logistics problems, it was not until 23 February that the equipment was ready for testing. During the testing period, it was necessary to observe radio silence during certain hours and in some instances, to employ dummy antennae so as not to interfere with domestic communication

[redacted]

daily practice in the use of the system was instituted using test tapes.

During the period of this report and until 29 February, there were daily arrivals of additional personnel previously ordered to

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supplement the complements of the ships involved. These personnel were immediately injected into the communication organization and their duties established insofar as was necessary at that time. A training program was instituted to familiarize those personnel lacking experience in automatics, tape relay and the other joint Army-Navy procedures and practices that would be encountered during the existence of Joint Task Force Seven.

After consultation with representatives of the various Army, Navy and Air Force agencies who would be served by the Navy Communication Center on the MT. MCKINLEY, a suitable joint message blank was designed. Reproduction of the selected form was accomplished by the MT. MCKINLEY reproduction facilities in sufficient quantities to provide blanks for the ALBEMARLE and CURTISS, as well as the MT. MCKINLEY.

While at Terminal Island, all communications to and from the MT. MCKINEEY, ALBEMARLE, CURTISS and BAIROKO were handled by land line teletype to the Minor Relay Station, Naval Base Terminal Island, California; the MT. MCKINLEY acting as the guard ship for the group. Since all of the ships were at one pier, delivery to and from the MT. MCKINLEY was accomplished by messenger. Normal crypto systems plus the SIGTOT one-time-tape system for Atomic Energy Commission traffic were employed for classified traffic.

Practically all of the electronics pool stock that had been requisitioned from naval sources and most of the items from Signal

[redacted]

the movement from Terminal Island to Eniwetok had been placed on board these ships. Late in February arrangements were made to air-ship to Pearl Harbor a few items which due to procurement and production difficulties could not be shipped to arrive at Terminal Island prior to departure of the naval compenent. Only a minor amount of air freight space was required since the items involved were small and of no consequence as to weight.

During the latter part of February, a message was sent to the Chief of Naval Operation (information to Commander-in-Chief, Pacific Fleet and Comandant 14th Naval District) requesting activation of one duplex HF RTTY circuit from the MT. MCKINLEY to Pearl Harbor (circuit Able 3 USF 70 (B)) in order to provide a primary communication channel to and from the flagship when the land line circuits at Terminal Island were discontinued. The Chief of Naval Operations advised that circuit A3 (USF 70 (B)) was not immediately available but authorized the use of circuit A6 as an interim channel. CNO

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company with the main body numerous tests were made of the special communications facilities.

this operation. The latter had been provided by Army Security Agency for use of CJTF-7. Additional electronics material and communications supplies previously ordered were received aboard the MT. MCKINLEY,

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Able 3) upon departure of the force from Pearl Harbor. This circuit was then available for exclusive use of the flagship and Pearl Harbor and would serve as the primary communication channel for the task force while en route to Eniwetok.

The MT. MCKINLEY (CJTF Seven and CTG 7.3 embarked) ALBEMARLE, CURTISS, BAIROKO and screening destroyers departed from Pearl Harbor

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[redacted] This, in addition to the selection of new frequencies (to

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and screening destroyers arrived at Eniwetok. The ALBEMARLE pro-
ceeded to the northern end of the lagoon, approximately 20 miles distant from the main body which anchored off Eniwetok Island.

The MT. MCKINLEY assumed NPM How Fox guard for all forces afloat and set up a General Message and Fox center for delivery to forces afloat. Press schedules were copied on the MT. MCKINLEY and were made available to all activities in the Eniwetok area. Press material was exchanged between major ships present and the Joint Relay Station in order to provide each a wide coverage. VHF RTTY/Voice communications to ALBEMARLE were satisfactory empoying the originally installed antennae.

On 18 March, the MT. MCKINLEY and CURTISS moved to the northern end of the lagoon and anchored in close proximity to the ALBEMARLE. At that time difficulties were again experienced in establishing reliable communications with the Joint Relay Station. These difficulties were primarily due to extremely high noise levels and were corrected by selection of new operating frequencies. Because of the swinging of the MT. MCKINLEY at its anchorage, the use of directional

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found necessary to relocate and install additional equipments in order to meet new requirements. In the process of testing, considerable interference between channels and with other equipments was encountered. It was also observed that at certain times transmissions from the continental U. S. interfered. When numerous adjustments of frequencies failed to eliminate the interference problem, it was found necessary to revise the entire frequency selection for the Technical Net and to reduce the original 10-channel system to a 4-channel system.

The Radiological Net required for the operation involved the use of a type of HF voice equipment already installed on the major ships. The radiological survey landing craft and an LCM drone tank control craft required HF voice equipments (TCS) which were installed at Eniwetok by personnel of the BAIROKO, CURTISS and ALBEMARLE. All of these equipments were crystal controlled. The installation and operation of these equipments presented no major problems. One channel of the Radiological Net was to be employed as an evacuation circuit for short periods prior to X, Y, and Z days. This necessitated installation of HF voice equipments (TCS) on the AVR-38 and

AVR-63. These installations were accomplished by personnel of the CURTISS and ALBEMARLE.

All planned operational air circuits were tested, including the special HF voice circuit from the Commander Air Forces on the MT. MCKINLEY to the Air Task Group Commander (CTG 7.4) at Kwajalein. Additional 10-channel VHF voice equipments were installed in the Air Operations room of the MT. MCKINLEY as standby and monitoring facilities. The Combat Information Center in MT. MCKINLEY, under the operational control of Commander Air Force, acted as the primary control center for all operational air circuits. The special HF voice command circuit to Kwajalein was controlled in the Air Operations room or from the Commander Air Force living quarters.

After arrival at the operating area and up to the day of the first test the volume of traffic handled increased daily. The majority of this traffic was encrypted and of fairly high precedence due to the nature of the operation. Approximately one week prior to the first test, a command post exercise was conducted. This exercise involved the injection of dummy messages into the communication system of the flagship, thereby simulating incoming and outgoing traffic and testing internal message handling.

All special communications were set up and operating, ready for immediate activation one day prior to each test. A watch was established on all radiological circuits in the Joint Operations Room. In addition, a remote position controlling one radiological circuit (which also served as the primary evacuation channel) was manned on the Flag Bridge. In order to provide the Scientific Director, who was embarked in the MT. MCKINLEY, with direct telephone service (primary and alternate channels) to the Atomic Energy Commission control station on Parry Island and the Zero Island, two portable field telephone sets were located on the Flag Bridge and patched directly into the carrier system on MT. MCKINLEY. By means of patching at the various shore-based switchboards, direct connections to Atomic Energy Commission control station and the Zero Island were accomplished. The General Warning circuit (HF voice transmitted from the control station) which provided test timing information, was received on the Flag Bridge and in the pilot house by remote speaker. The information received was relayed over the ship's general announcing system for the benefit of personnel throughout the ship. A receiver in the Combat Information Center also covered the General Warning circuit, where the information received was relayed to aircraft on a common VHF voice channel. This provided the aircraft with a secondary means of receiving test timing information since they were also guarding the HF voice General Warning circuit.

About four hours prior to the first test, a failure of the evacuation net remote control unit located on the Flag Bridge indicated the necessity of providing duplicate facilities. It was also discovered that the transmitter on the AVR carrying the evacuation party had been accidentally detuned and was off frequency. These difficulties

[redacted]

further difficulties were experienced. A modification in radiological survey party communications required that two additional landing craft be equipped with HF voice equipment (TCS) by the BAIROKO.

During the interval between the first and second tests all equipment on the AVR's were checked and new crystals were installed. A third circuit using VHF voice (SCR-300) was provided to be used in the event of failure of both HF voice channels.

A remote speaker amplifier covering the General Warning circuit was located on the level above the Flag Bridge to provide direct test timing information to observers and photographers. No communications difficulties were experienced during the second and third test periods.

To expedite the roll-up of communications, the electronics pool material not needed during the third test period was prepared in palletized form and loaded aboard the BAIROKO for subsequent return to the U.S. Electronics material installed in ships, and ships boats was to be repacked during the return trip and be ready for discharge upon arrival in the U.S. All remaining electronics material which could not be removed until after completion of the third test was then removed and transported to a central warehouse for packing and shipment by scheduled cargo runs established after departure of the main body.

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A REPORT OF AIR FORCE COMMUNICATIONS ON OPERATION SANDSTONE

After the arrival of Lieutenant Colonel Cornelius A. Smith, USAF, and Lieutenant Colonel James E. Dupree, USA, at the task force headquarters in the Pentagon Building, Washington, D.C., on 13 October 1947, these officers were briefed by Captain C. L. Engleman, USN, Joint Task Force Seven Communications Officer, on the general requirements, scope and nature of the operation. Colonel J. B. Bestic, USAF, of the office of the Air Communications Officer, U.S. Air Force, had been temporarily representing the Air Force on the Joint Task Force Communications and Electronics Staff until the arrival of Lieutenant Colonel Smith, who then assumed this position. Lieutenant Colonel Dupree who was to be Communications Officer for Commander, Air Forces, was instructed by Major General Kepner to work closely with Lieutenant Colonel Smith on the Joint Task Force Communications Staff in order to coordinate the planning and implementation of his requirements as Commander, Air Forces. Colonel Bestic had been participating in the collection of Air Force requirements and therefore passed to these officers whatever definite requirements had as yet been decided upon by the Commander, Air Forces.

Further discussions and investigation revealed that an Air Task Group (later designated Air Task Group 7.4) would be based on Kwajalein Island with some of its aircraft at Eniwetok Island. Major General Kepner would have his command post in the flagship. On the basis of this information, Lieutenant Colonels Smith and Dupree agreed that the following communications facilities would be required.

A. General.

1. A voice radio circuit for Commander, Air Forces, use between the Flagship at Eniwetok and the Air Task Group at Kwajalein;
2. Means of sending messages between Flagship and the Air Task Group at Kwajalein;
3. Message communications between the Flagship and Hawaii;
4. Message communications between the Flagship and Guam;
5. Message communications between the Flagship and the United States;
6. Activation of complete airdrome control and radio navigational aid facilities at Eniwetok;
7. Activation of control tower facilities on Engebi Island;
8. Augmentation of the existing control tower and radio facilities at Kwajalein to handle the expected increase in traffic there.

B. Specific.

1. Air Task Group.
   a. Air to Ground...(Voice and CW)
   b. Air to Air......(Voice and CW)
   c. Point to Point..(Voice and CW)
      (1) CW circuit between Kwajalein and Eniwetok;
      (2) Duplex radio teletype between the same stations;

[redacted]

2. Air and Airways Communications Service (AACS).

   a. Kwajalein Island.

      (1) Normal airways control requirements, already established but needing slight increase, with radio teletype to Eniwetok.

   b. Eniwetok Island.

      (1) Air/ground facilities;

      (2) Homing beacon;

      (3) Point-to-point CW..later RTTY:

      (4) Weather Intercept;

      (5) VHF/DF facilities;

      (6) Radio range station;

      (7) Radar beacons. **

   Note: * Later requirement but included here.
   **Late requirement with installation at three other islands in the atoll.

The activation of the Eniwetok airdrome facilities was an immediate requirement inasmuch as it was planned to set up a C-47 shuttle run between Kwajalein and Eniwetok in the near future. Accordingly, on 16 October 1947, after conference with the Air

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complete airdrome communications facilities on Eniwetok Island as soon as possible. Personnel and equipment requirements for this installation were obtained from the AACS and arrangements made for the necessary water shipment departing from Pearl Harbor on 10 November 1947. Arrangements were made by AACS to provide personnel and equipment for the initial activation of these facilities from the 71st AACS Group at Hickam Field, T.H. This to be supplemented as soon as possible by shipments of personnel and equipment from the United States. Control tower facilities were activated at Eniwetok on 22 December 1947.

The Joint Task Force meteorologist presented the following communications requirements for weather reporting stations:

(a) Weather reporting stations on Rongerik, Majuro and Kusaie;

(b) Radio teletype intercept of the Guam weather broadcast;

(c) Radio teletype weather communications between Kwajalein and Eniwetok;

(d) Air/Ground facilities for communications with B-29 long range weather reconnaissance aircraft.

The requirement for a reporting station on Kusaie subsequently was cancelled and Wake Island was added to the list.

After coordination with the Joint Task Force Communications Officer, the above requirements were submitted by the Air Weather

[redacted]

Service to the AACS for installation and operation. These and the foregoing matters were consolidated by the AACS into "AACS Plan 113" which is available in the files of the AACS.

The assistant Communications Officer JTF-7 (ARMY), Colonel Carl H. Hatch, Signal Corps, USA, had outlined his plan to send an advance detachment to Eniwetok, in order to start installation and construction there. His detachment was to include some Navy personnel from Pearl Harbor and it was deemed advisable that the Air Force also send some of their personnel in this party to install such communications as were not the responsibility of AACS. This advance detachment was to install all the communications equipment at Eniwetok and then a section of it was to be sent to Kwajalein where they would commence installations for the Air Task Group. These installations would then be operative before the arrival of the Air Task Group. This plan was generally agreed upon, and Captain Engleman and Lieutenant Colonel Smith recommended to the Air Communications Officer that other air communications personnel be included in the initial detachment. Although the plan received favorable consideration, no action was forthcoming due to the shortage of personnel and the higher priority demands of the 55-group program. An attempt was made to obtain personnel from the Strategic Air Command and 8th Air Force but was not successful. This plan for an initial Air Task Group detachment was therefore abandoned; Colonel Hatch, however, put his portion of the plan into effect.

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The Strategic Air Command was given the responsibility of providing the air components for the operation. They in turn designated the 8th Air Force as the agency to provide personnel and material for an Air Task Group. Major General Ramey, Commanding General, 8th Air Force, was designated to be the Air Task Group Commander.

On 23 October 1947 Lieutenant Colonel Dupree and Lieutenant Colonel Smith attended a meeting conducted by Major General Kepner. At this meeting it was requested that an officer of the Air Task Group be sent to Washington to review those plans for communications which had been made for the task group. At a later date Captain Goodreau, 8th Air Force, arrived in Washington with a supplementary list of equipment and personnel (4 officers, 85 enlisted) desired by the Air Task Group for the installations at Kwajalein. These requirements were coordinated with the requirements as seen by the AACS, and the resulting equipment lists were submitted to Major McLane and Lieutenant Colonel Klaproth, USAF, (A-4 Supply) for a check of availability. After this availability survey was completed, the equipment lists were submitted to Services, Supply and Procurement (through J-4) for approval. Supply action was then initiated by this agency.

Certain requirements for drone control and instrumentation frequencies were received from the Air Material Command and the First Experimental Guided Missiles Group, Eglin Field, Florida. The overall Air Force communications requirements were therefore adjusted and

[redacted]

in the interest of economy, certain duplications were consolidated in the joint facilities.

As all requirements were consolidated, work was begun on the preparation of the Air Communications Plan. The Air Force requirements were incorporated into the Joint Task Force Communications Plan. In view of the numerous radio frequencies required, a meeting was called with representatives of the Frequency Allocation Committee of the Joint Communications Board. These representatives were Lieutenant Commander L. R. Raish, USN; Mr. J. D. Corley, Signal Corps, USA, and Captain R. H. Service, USAF. It was agreed that all frequencies above 30 megacycles required for the operation would be selected by the Task Force Communications Officer without reference to the Frequency Allocation Committee. It was further agreed that Mr. Corley, in conjunction with Lieutenant Colonel Dupree, would work out the remaining frequency assignments for those needed under 30 megacycles. All frequencies were carefully chosen, both from the aspect of possible interference in the operating area and with reference to ionospheric predictions. The frequency problem involved can be appreciated from the fact that Joint Task Force requirements totaled 85 radio channels using 386 frequencies. Of these, the Air Force requirements were 32 channels and 104 frequencies. Annex F, Field Order #1, Headquarters, Joint Task Force Seven, contains a list of these channels and frequencies.

Page F-IV-Tab 1, Cryptographic Appendix, shows the cryptographic systems held by the crypto-center established at Headquarters, Air radio terminals ashore on Eniwetok Island. A standard joint teletype relay center was planned with radio teletype facilities to connect from there to Kwajalein and to Hawaii. In Hawaii, facilities were already existing for connection into the Army Command and Administrative Net (ACAN) for communication to the United States, Guam and other parts of the world. The Eniwetok center was to be linked to the Flagship by means of AN/TRC-1 equipment with provision for both telephone [redacted] in case of failure of the AN/TRC-1 equipment. Standby equipment was to be provided on the Flagship for the voice radio circuit to Kwajalein. In view of the ample radio facilities already installed on the Flagship, the U.S.S. Mt. MCKINLEY, it was not necessary to install additional facilities other than the AN/TRC-1 equipment in order to tions Squadron to meet the Commander, Air Forces' communications requirements on the Flagship and on Eniwetok Island. In a conference [redacted] U. S. Air Force, it was found that it would be impossible for the Air Force to provide any additional communications personnel over and above those planned for the Air Task Group and AACS requirements without seriously affecting the Air Forces' fifty-five-group program which had priority over Operation Sandstone. It was finally agreed by Captain Engleman that the Navy would be responsible for providing all communications personnel aboard the Flagship, and by Colonel Hatch that the Army Signal Corps would furnish personnel ashore on Eniwetok for all except AACS facilities.

The initial list of AACS equipment required for Eniwetok and Kwajalein had been previously submitted during October and this equipment arrived at Port Hueneme on 7 November 1947. A supplementary list of equipment for installation at the weather reporting stations on Rongerik, Majuro and Wake Islands was submitted and processed early in December. On 1 December 1947, a request was received from the Air Task Group for AN/CPN-6 radar beacons to be installed on Kwajalein, Eniwetok and each of the three zero islands for the purpose of providing navigational fixes for drone control aircraft. In view of the critical shortage of this equipment, an investigation was made to determine the suitability of the AN/UPN-4 radar beacon as a substitute, since the latter was in more plentiful supply. However, it was found that the range of the AN/UPN radar beacon was limited to approximately 30 miles. It was finally necessary to ask the Navy to provide two AN/CPN-6 beacons, with the Air Force supplying the remaining requirement of three. Arrangements were made to have this equipment air-shipped to the operating area. Two AACS civilian engineers were sent to the operating area for installation of the equipment.

Assistance was requested by the Air Material Command on the procurement of additional crystals for the AN/ARW-18 drone control transmitters inasmuch as they had no facilities for manufacture of crystals for these frequencies. Arrangements were made with the U. S. Naval Gun Factory to grind and supply the 54 crystals desired. Assistance was also requested by Air Material Command in an attempt

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rather poor condition. All of the transmitting antennas were being set up at the north tip of the island and all the receiving antennas were being set up at the south end of the island. As had been

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(a) Heavy rains and high gusty winds accompanying the fall season and blowing dust particles in the absence of rain;

(b) Damage to the equipment incident to shipping. Some of this equipment was damaged beyond repair and resupply made necessary;

(c) Soil condition of the island, i.e., the presence of sub-surface coral strata at many levels required that a great number of pole holes be hand-drilled and/or dynamited.

Because of the delays occasioned by the factors enumerated above, the Deputy Communications Officer (Colonel Hatch) decided that Lieutenant Colonel Smith should return to Washington and give the Communications Officer a report of progress and conditions in the forward area and to investigate the possibility of having a detachment of communications personnel from the Air Task Group 7.4 sent to Kwajalein as previously desired so that installation of communications facilities might commence for that group.

Lieutenant Colonel Smith returned to Washington, contacted Major General Kepner and then departed to Fort Worth, Texas. At Fort Worth, Major General Ramey; the Deputy Commander of Task Group 7.4 (Colonel Thomas DuBose) and the Commanding Officer, 18th

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Communications Section (Major Alvin Hascal) were informed of the necessity of sending this advance detachment and all of these officers agreed. It was determined that at least one (1) officer and six (6) enlisted men would be sent. Arrangements were made for their transportation from Oahu to Kwajalein, the 71st AACS Group, Hickam Field, granting use of their C-54 for this purpose.

Some time later a message was received from the Commander, Joint Task Force Seven (Main), in Washington which stated that the Commanding General, TG 7.4 had reversed his decision and would not send any communications personnel to Kwajalein early. The Communications Officer, 7th Air Force, was therefore contacted and arrangements were made to send one (1) officer and fourteen (14) enlisted men to Kwajalein to begin installation of telephones in the buildings being rehabilitated for Air Task Group 7.4 use by the Air Engineer, 7th Air Force.

On 26 January 1948, information was received that the SCR-277 radio range for Eniwetok arrived with the BC-467A transmitter damaged beyond repair. Action was initiated to have the Air Material Command effect immediate air shipment of a replacement transmitter.

The final shipment of AACS personnel to the operating area was completed during January. This brought the number of AACS personnel actively engaged in the operation to 125 persons.

The Office of the Commander, Air Forces, Joint Task Force Seven, was closed in Washington on 10 February 1948 and opened at Fort

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(h) VHF/DF 10 February 1948

Mr. Simpson and Mr. Meir, technical representatives from Headquarters, AACS, Washington, D. C., arrived on 16 February to begin installation of the radar beacons (AN/CPN-6) on various islands in the atoll. It was required that one beacon be installed on each Zero Island, one on Eniwetok Island and one on Kwajalein Island. Five enlisted men were sent from the Zone of Interior to aid in these installations. Mr. Meir and Mr. Simpson were well qualified individuals and the installations were completed quite rapidly. The dates of

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testing of circuits by 10 March.

About this time the Air Task Group was requested to furnish two BC-610's to be used in project "FITZWILLIAM" for the transmission

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of time signals. This group furnished, installed and maintained these transmitters. They also supplied the AACS with several BC-799's (Receivers) for use in their permanent station. The receivers in use by AACS at Kwajalein were in very poor condition. Attempts for replacements had been made through their normal supply channels, but with no success. The requirement was therefore given to the Communications Officer for Air, JTF-7. An attempt to have AACS Headquarters supply the new receivers was not successful since this equipment was needed for replacement of permanent facilities and would not be included in the roll-up. Lieutenant Colonel Herrick, Supply officer, JTF-7 (rear) wired that these items were very critical in the U.S. and if they were not to be returned, request could not be justified.

On 14 March, Lieutenant Colonel Smith and Captain Heaviside, AACS, flight-checked all the Communications facilities, including the radar beacons, at Kwajalein and Eniwetok Atolls. The check was accomplished in a B-29 aircraft from TG 7.4. All facilities gave excellent results.

By 15 March the following communications requirements of the Air Force had been completely installed:

1. Point to Point (Kwajalein & Eniwetok)
   - a. RTTY (AN/MRC-2)
   - b. RTTY (Wilcox 96-C)
   - c. CW (BC610)
2. Air/Ground (Weather aircraft & airways control)

a. AACS (T-4) Kwajalein

b. ATG (BC-610)

c. AACS (T-4) Eniwetok

3. Navigational Aids

a. Radar Beacons

b. VHF/DF (Kwajalein & Eniwetok)

c. Radio Range (Kwajalein & Eniwetok)

d. Homing Beacon (Kwajalein & Eniwetok)

4. Special Requirements

a. The Kwajalein terminal of the voice circuit for communications between Generals Ramey and Kepner. Equipment was a BC 610 (later replaced by Wilcox 96-C). The Eniwetok terminal was aboard the USS MT. MCKINLEY.

5. Weather Net.

a. Wake Island (SCR 399)

b. Majuro Island (SCR 399)

c. Rongerik Island (SCR 399)

d. Eniwetok Island (SCR 399)

In an attempt to keep weather reports constant, a back-up CW circuit was put in between Eniwetok and Kwajalein to provide a CW back-up if the RTTY circuit became inoperative. Minor changes were necessary in the method of relaying the weather information to the MT. MCKINLEY after it was received at Kwajalein from the weather aircraft in order to expedite its delivery to weather central on the MT. MCKINLEY. To this end, automatic teletype tape relays were provided

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CW circuits were not effected to the degree that the others were. Although there was some fading and other disturbance, the operators could generally read the transmissions. A complete check of equipment by competent enlisted and officer personnel as well as civilian technicians showed no malfunction. Tests on frequencies other than

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those assigned were undertaken, but no improvement resulted. A request for frequencies in the two and three megacycles band was dispatched to the Frequency Allocations Committee in Washington, D. C. In the interim, lower night frequencies (in 5 megs) were substituted for one RTTY circuit. The other RTTY circuit already had an assigned night frequency in five megacycles and was not changed. It was discovered that on numerous occasions, sporadic E-line transmission permitted the use of the day frequencies of 9 and 10 megacycles during entire 24 hour periods. It was not until after 1 April 1948 that firm communications were maintained by use of predicted frequencies.

In the meantime, the air/ground VHF and HF voice radio facilities on the flagship were activated and tested. Paragraph 6 of the Air Operations Order lists the channels and frequencies involved. The Gunnery and Landing Office on the Flag Bridge of the flagship was converted for use as the command post of the Air Commander, Joint Task Force Seven, during test days and was referred to as "Air Operations." The ship's intercommunications system and sound-powered telephone circuits were activated between this Air Operations Room and the Combat Information Center to facilitate the passing of information and instructions. A remote control unit in this room was assigned and connected to a Navy TDQ VHF transmitter for use on a special channel between Major General Kepner and the command aircraft. A long extension cord with head and chest set was provided in order that the Air Commander might be able to move freely about the Flag

Bridge during the operation. Two SCR-624 VHF radio sets were installed in the Air Operations Room for the purpose of monitoring all VHF channels in use and as a standby for the shipboard VHF equipment.

An additional remote control unit in the Air Operations Room was connected to the Kwajalein voice radio equipment for the purpose of using this facility for passing aircraft take-off times from Kwajalein.

Peter Xray Day was a scheduled rehearsal for Xray Day. During this rehearsal all Air Force communications functioned to the satisfaction of the Commander Air Forces and the Commander Air Task Group 7.4. However, the flagship was unable to make VHF contact with two PBM (Navy seaplane) air-sea rescue aircraft. These aircraft were at a distance of twenty-five miles at 1500 feet from the USS MT. MCKINLEY. Direct VHF communications were established with only one other air-sea rescue plane, but indirect contact with all air-sea rescue planes was made possible by using the Task Group 7.4 Command Aircraft as a relay. The cause of this difficulty was never satisfactorily determined.

On Xray Day, contact with all aircraft was established and maintained. During the period of H-hour minus ten (10) minutes to H-hour, severe fading of the AN/CPN-6 radar beacon on the Zero Island was noticed by all aircraft. This was later found to have been caused by a considerable drop in voltage in the generator phase supplying the beacon when Atomic Energy Commission measuring equipment was turned on. A standby generator was available for automatic change-over, but apparently the voltage drop was not great enough to cause the change-over relay to operate. Arrangements were made to provide another power source for the radar beacons. This source included the provision for automatic change-over in case of generator failure. The two SCR-624 radio sets installed in the Air Operations room were found to be quite valuable for monitoring purposes. Direct communications to aircraft from this location was used upon several occasions. An additional set was installed to enable three frequencies to be monitored simultaneously. At How Hour plus four minutes, one drone aircraft crashed into the sea. This crash was not attributed to failure of the radio controls from the mother aircraft.

In the period following Xray Day normal communications were maintained and no serious problems arose. The schedule for closing down circuits was discussed, but no firm dates could be decided until more information was obtained on the plans for a permanent garrison force. Just prior to Yoke Day a message was received from USARPAC stating that one of the task force's assigned frequencies (5650 kcs) was interfering with a Far Eastern Air Force circuit between Japan and Okinawa. They requested a reduction in the power output of the transmitter (this transmitter was part of the AN/MRC-2). Rather than reduce power, it was decided to change frequency back to the original frequency (6875 kcs).

Yoke Day closely duplicated Xray Day. All Air Force communication facilities operated satisfactorily with the exception of the radar beacon (AN/CPN-6) on the Zero Island. It appeared that there had been a power supply failure of the equipment at How minus ten (10) minutes. However, on checking with Mr. Hedberg of the Atomic Energy Commission, it was definitely determined that no power failure had

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Kwajalein; AACS, Eniwetok; Joint Relay Station Eniwetok; and to Task Group 7.4. This schedule stipulated the discontinuance of all circuits by Zebra plus 6 Day unless otherwise instructed.

Zebra Day was similar to Yoke Day in that all communications facilities functioned satisfactorily. The radar beacon on the Zero Island gave satisfactory operation up to the instant of the detonation. After the execution of this test, all equipment was dismantled as soon as no longer needed and packed for shipment back to supply depots. By Zebra plus 20 days all equipment had been loaded on ships for return. The equipment requisitioned from the U. S. was returned to the Signal Depot at Sacramento, California, and the equipment requisitioned from Oahu was returned to the Hawaiian Signal Depot.

Since the garrison force which was to remain at Eniwetok did not

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include any Air Force communications personnel, all AACS personnel of the Eniwetok detachment were returned to the direct jurisdiction of the 71st AACS Group, Hickam Field. They had been ordered to this project in conjunction with a permanent change of station to the 71st AACS Group. All operations and rollup were completed before their departure. The personnel of Task Group 7.4 were on temporary duty from units of the Strategic Air Command in the U. S. and were returned to these units.

A census of opinion among the commanders of the various Air Force units of the task force indicated that they were all pleased with the overall communications. General Kepner, Commander, Air Forces, JTF-7, had taken a rather keen interest in communications from the beginning of the project, and stated that all he had expected from communications had been fulfilled. It was considered, however, that improvements in operations of this type could be made, and that the technical reports of communications would be of vital interest to communication officers engaging in any future tests at the Eniwetok Atomic Energy Commission Proving Grounds.

METEOROLOGY

PART ONE

Planning and Preparation

1. **Mission:**

The mission of the meteorological organization is stated in the METEOROLOGICAL PLAN, Annex K, to Field Order No. 1, Headquarters Joint Task Force SEVEN as follows:

"a. To provide meteorological information to the JTF-7, to include cloud cover forecasts to meet the requirements of air and photographic operations, accurate winds aloft information to heights of 60,000 feet or higher for radiological studies and safety procedures, climatological information, and severe storm warnings.

b. To implement the scientific meteorological program."

2. **Organization:**

The Joint Chiefs of Staff decision number 1795/6 of 18 October 1947 had directed the organization of a Joint Task Force to construct a proving ground at Eniwetok and to conduct proof-testing of atomic weapons there. The Air Force participation had been announced by a message of 8 October 1947, which outlined the responsibilities of the various commands of the Air Forces. (see Appendix A) The Chief of the Air Weather Service, under the jurisdiction of the Air Transport Command of the Air Force, was directed to provide the necessary personnel and meteorological facilities for the SANDSTONE operation.

Colonel B. G. Holzman, USAF, was appointed to the Joint Task Force as the Staff Meteorologist 10 October 1947, per GO #2, Section 3, 18

October 1947. In addition to his duty with the Joint Task Force, Colonel Holzman served as a staff member to the Scientific Director, JTF-7. Colonel Holzman previously participated in the first atomic bomb test near Los Alamos and was Staff Meteorologist for Commander, Joint Task Force ONE for the CROSSROADS operation.

For a deputy, Colonel Holzman obtained the services of Major Delmar L. Crowson, USAF, of the Atmospheric Section of the Air Forces, and former Officer-in-Charge of the weather center at Kwajalein during operation CROSSROADS. Major Crowson acted as liaison officer between the Staff and the Air Weather Service, USAF, and acted as Staff Meteorologist in the absence of Colonel Holzman. Major Crowson also represented Colonel Holzman at the offices of JTF-7 forward at Fort Shafter when JTF-7 moved from Washington, D. C.

During the initial planning, it was deemed highly desirable to have the meteorological staff include an aerological officer from the U. S. Navy and a meteorologist from the U. S. Weather Bureau.

The meteorological staff would operate aboard a naval vessel and would require technical liaison with other floating aerological units of the Task Force as well as with the Aerology Section, Chief of Naval Operations, Washington, D. C. It would also be necessary for the Staff to work with the Navy Weather Centrals on the West Coast, at Pearl Harbor, and at Guam. All possible cooperation was offered by the Aerological Section, CNO, and Lt. Ernest Lilek, USN, was ordered to the Staff to act as an assistant Staff Aerological Officer and assigned to naval liaison duties in addition to staff technical duties. Lt. Lilek had been the Staff Aerological Officer for the Navy drone operations aboard the USS SHANGRI-LA during the CROSSROADS Operation.

The Chief of the U. S. Weather Bureau provided the services of Paul A. Humphrey, P-3, who was ordered to temporary duty with the Air Forces for further assignment to the meteorological staff of JTF-7. Mr. Humphrey, formerly, Lieutenant USNR, had served as assistant staff Aerological Officer for Operation CROSSROADS. He provided liaison with the U. S. Weather Bureau where, in collaboration with the Air Force, initial climatic studies of wind, weather and air trajectories were prepared and used for operational planning purposes.

A scientific program was planned and included documentation of all meteorological reports, observations on the rate of rise and height of the atomic cloud, volume of the cloud, microbarograph observations in order to obtain preliminary estimates of the bomb energy, energy estimates of the bomb from thermodynamic considerations, cloud trajectory calculations, atmospheric turbulent diffision, and other phenomena related to long range detection of the atomic bomb. The long range detection observations were ultimately eliminated from the meteorological program for various reasons.

Mr. Humphrey conducted some preliminary experiments at the Air Force All Weather Flying Division, Clinton County Airport, Ohio, to determine whether or not significant information might be obtained on atomospheric diffusion by releasing clusters of balloons and recording their separation by radar. A preliminary analysis of these tests indicated that the complexity of the experiment would not justify conducting these tests at Eniwetok, but that this project should have a high research priority in aiding to understand the mechanism of radioactive diffusion in the atmosphere for any future post SANDSTONE atomic tests. In addition to his

[redacted]

was begun on the establishment of a weather service which would be adequate for the exacting requirements of the operation. In November, the only weather stations in the operational area were Kwajalein and Wake; and these stations were not equipped or manned to observe and transmit the additional data which would be required from these locations for the SANDSTONE operation. It was at once apparent that the existing stations would have to be augmented and that additional island weather stations would be needed before reliable forecasts could be prepared. The meteorological staff recommended the establishment of weather stations at Eniwetok, Rongerik, and Majuro for the duration of the operation. Action was also taken to send Air Force weather personnel and equipment to Wake to assist the U. S. Weather Bureau personnel stationed there. The island weather stations would provide complete weather observations, including a minimum of four rawin sondes (radio and/or radar wind, temperature, and humidity soundings) per twenty-four hour period. All of the island weather stations would participate in a weather observational network, and in addition, Kwajalein and Eniwetok would provide a forecast and briefing service for local commanders and transient aircraft as well as aircraft of JTF-7. The island stations would also provide a relaying service whereby all weather information including flight reports and flight summaries would be collected and forwarded to the Mt. McKinley for use by the staff.

The major ships of the Task Force, the Mt. McKinley, the Curtiss, the Albemarle, and the Bairoko, were each equipped with complete aerological offices. The U. S. Navy agreed to furnish these ships with men and supplies for a complete surface observational service, including helium sufficient for four rawins (radar wind soundings) and two radiosondes per day. Upon arrival in the test area, it was decided that with the ships centrally located, four (4) rawins and two (2) radiosondes daily from each ship was unnecessary and a rotation of soundings was established whereby four (4) rawins and four (4) radiosondes were to be received from the shipboard units. In addition, the Mt. McKinley was furnished with weather facilities and personnel so that it could function as a floating weather center for the collection and analysis of data. Observations from the Albemarle, Curtiss and Bairoko guaranteed complete and continuous weather data in the test area, where it would be most needed in theevent Eniwetok was evacuated.

The weather reconnaissance network was considered one of the most important parts of the weather service network. It was realized that the accurate forecasts made during Operation CROSSROADS would not have been possible without the dense network of reports made by aircraft. It was further appreciated that weather reconnaissance units would be vital in the tracking of invisible atomic clouds. In this connection, the weather reconnaissance unit performed an all important auxiliary mission for the long range detection program which will not be commented on in this report. It was realized that four (4) airplanes might be required to fly simultaneous missions over different tracks for weather coverage during the critical [redacted] naissance Squadron located at Guam. This squadron is used mainly for typhoon reconnaissance. However, for the period of the SANDSTONE operation, the occurrence of typhoons is at its lowest frequency for the Guam area and it was believed that no serious typhoon warning difficulties would be encountered by assigning the bulk of the squadron to Kwajalein to the support of SANDSTONE. Thus eight (8) aircraft were placed under the operational control of the Air Task Group Commander 7.4 with Major Fackler commanding the Task Unit (weather, air reconnaissance). The Staff Weather Officer to the Air Task Group Commander, TG 7.4, Major Gazzaniga was charged with the responsibility of the mobile weather stations at Wake, Rongerik, Eniwetok, and Majuro, as well as technical control over the weather air reconnaissance unit.

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[redacted]

Designation	Location	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Task Force WX Centr Col B G Holzman, USAF Maj D L Crowson, USAF Lt E F Lilek, USN Mr. P A Humphrey, USWB	USS MT. McKinley	2	1	1	0	9
WX Detachment Maj L H Pribble, USAF	Eniwetok	3	0	0	24	0
Staff WX Section 7.4 Maj L A Gazzaniga, USAF	Kwajalein	3	0	0	4	0
WX Detachment Capt R H Elmendorf, USAF	Majuro	1	0	0	26	0
WX Detachment Capt E L Buss	Rongerik	1	0	0	29	0
514th Detachment of WX Recon Sqdn Maj P A Fackler, USAF	Kwajalein	41	0	0	113	0
WX Detachment Capt O O Singer	Wake Island	1	0	5	18	0
Ships of JTF-7 BAIROKO - Ens E L Snopkowski, USN		0	1	0	0	7
ALBEMARLE - Lt T P Mullins, USN		0	1	0	0	8
CURTISS - CAER L D Blakely, USN		0	1	0	0	7

Note: The USAF has three (3) officers and twenty (20) men assigned to permanent duty at Kwajalein. These men worked with the Staff Meteorological Organization, but they were not officially part of the organization.

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thorough collection of scientific data than was possible for the CROSSROADS operation.

At first the staff weather officers were concerned with the solution of problems associated with operating a Weather Center aboard the Flagship. Previously any such operation had used the facilities of a land based unit such as the weather central at Kwajalein. It would be necessary to collect and analyze several times the usual amount of data available to a ship's aerological office. The Mt. McKinley, the Flagship, had serious space limitations in the aerological office. Also, it was realized that weather communication traffic would necessarily have to be kept to a minimum because of the heavy load of other traffic that would be present at critical operational periods. The communication dilemma was partially overcome by plans to put a radio-teletype in the aerological office so that throughout the day the radio-teletype boardcast from Weather Central Guam would by-pass the communicators and come directly to the plotters of the weather charts.

Another plan which would increase the data available for forecasts without adding appreciably to the duties of the weather or the communication personnel was to place radio-facsimile machines aboard the ship so that weather charts could be transmitted directly from Fleet Weather Centrals Pearl and Guam. The Navy Aerology Section arranged for two facsimile machines, technicians, and supplies to be put aboard the Mt. McKinley and arranged a broadcast schedule especially suited to the needs of the Task Force. One surface weather chart and two upper air charts were broadcast from each station daily. Messages from the local weather network were to be handled through normal communication channels. Southern hemisphere data, not found consistently on the Guam radio-teletype broadcast was obtained by copying a CW broadcast from Nandi, Fiji Islands, Guadalcanal, or Townsville, Australia.

One problem difficult to overcome since the weather center was to be aboard the Flagship was the loss of personal contact with flying weather observers and reconnaissance crews. Post Flight discussions of weather encountered are very helpful in the detailed analysis techniques necessary to such an operation. This difficulty was, in the main, overcome by the transmission of a verbal summary of the weather encountered during the daily flights, by voice conferences with Kwajalein, and by an early morning voice contact with the aircraft flying over Eniwetok. The contact with the aircraft would insure immediate reports on all significant weather in the operational area; and if any unfavorable weather threatened operations, it would be tracked and reported as necessary.

Planning by the meteorological staff also included the study of all available climatological data, the writing of a climatic study, and the compilation of upper wind records. The climatological report and the wind records were prepared by the staff with the cooperation of the Air Weather Service, and copies for distribution were made by the U. S. Weather Bureau.

The logistical problem for ship-board weather units was of little consequence; however, the island weather stations required considerable logistical support. The movement and logistical support of island weather stations and the 514th Weather Reconnaissance Squadron are contained in the historical reports to be submitted by the sub-commands of the Task Force. At the termination of planning, Annex K to Field Order #1 was published, outlining the responsibilities of each of the various units involved in SANDSTONE.

4. Training in the Zone of Interior:

Weather personnel and reconnaissance crews required no special training for the operation. Except for the staff, weather personnel would not be expected to perform observational and administrative duties for which they were not experienced. The staff meteorologists collected and reviewed the latest available information on tropical meteorology and the meteorological physics of such phenomena as might be expected during the operation. Also, the staff practiced the preparation of some of the charts which would be used in the daily briefings. Weather flight personnel were already experienced in tropical operations and observational techniques, and no training flights were required.

5. Movement to the Operating Area:

The movement of the staff meteorologists to the operating area was as follows:

a. Colonel Holzman - by air to Eniwetok, arriving 29 March 1948.

b. Major Crowson - by air to the West Coast for conferences with personnel going into the forward area, then by air to Fort Shafter, on February 12, 1948, and from there to Eniwetok aboard the Mt. McKinley.

c. Lieutenant Lilek and Mr. Humphrey - by air to Terminal Island and from there to Eniwetok aboard the Mt. McKinley.

The aerelogical office aboard the Mt. McKinley was in operation prior to departure from Terminal Island, and Lt Lilek prepared operational forecasts for Commander, TG 7.3 between the West Coast and Pearl Harbor. Between Pearl Harbor and Eniwetok, daily forecasts were prepared for convoy operations and all commanding officers were given personal weather briefings. During the voyage, one series of formal weather briefings was given on the expected operational weather at Eniwetok so as to simulate the kind of conferences on weather and radiological safety which would be required for actual test days.

No problems worthy of mention occurred in connection with the movement or clearances of weather personnel.

METEOROLOGY

PART TWO

The Task Force Weather Center

1. Introduction

A Task Force Weather Center was established aboard the Mt. McKinley. On instructions from the Chief of Naval Operations, ComFairWestCoast assigned eight aerographers mates to the USS Mt. McKinley to aid in fulfilling the requirements of the Staff Meteorologist of Joint Task Force Seven. These men, selected on the basis of technical qualifications and past performances, formed the nucleus of the technical meteorological group on the USS Mt. McKinley and were assigned to specialized technical duties in processing and analyzing surface and upper air observations. By the 20th of March, all meteorological communication facilities had been installed. The technical procedures for the collection of the weather observations, the analysis of the data and the formulation of the forecast and briefing presentations had been tested by this time and the Weather Center was in routine operation.

2. Responsibilities

The mission of the Weather Center was identical to that assigned to the over-all meteorological organization of JTF-7. The Weather Center was established for the purpose of providing all weather information necessary to carry out the mission of the commanders of JTF-7.

3. Sources of Meteorological Data

The collection of basic meteorological data for Operation SANDSTONE

[redacted]

		the Mt. McKinley by RTTY from Eniwetok
Data from Pacific (areas other than network established [redacted] for SANDSTONE)	Collected and transmitted by Pearl and Guam	Radio-teletype aboard ship located in the Aerological Office [redacted]
Radio Facsimile charts	Pearl WX Central Guam WX Central	Direct intercept on the Mt. McKinley
Weather south of the equator	ZKA, Nandi broadcast	Direct intercept on board the Mt. McKinley

Figure 1, is a diagrammatic presentation of Table #1, and shows the communications circuits established for the collection of weather data for Operation SANDSTONE. On the circuits illustrated in Figure 1, a total of 50,000 groups per day were routinely handled with a traffic precedence of "Operational Priority." It is to be noted that two teletype circuits terminated in the Aerological Office, and thus avoiding a source of delay by the elimination of the transmission relays of normal ship administrative traffic.

The facsimile weather maps transmitted by the Fleet Weather Centrals at Guam and Pearl Harbor were received regularly and with consistently good definition. The area covered by the charts was, however, inadequate. Although an effort was made to alter the manner of presentation to be of greater usefulness for Pacific Ocean forecasting, time did not permit pursuing this question further. (See comments and recommendations for further discussion on this point.)

Data received aboard the USS Mt. McKinley from the weather reconnaissance flights was received originally at Kwajalein and relayed over a radio teletype circuit to Eniwetok, and then on to the USS Mt. McKinley. This series of relays delayed the reports on the average of one half to one hour. This complicated scheme of transmission was necessary inasmuch as the planes based at Kwajalein had to maintain contact with Kwajalein for Air-Sea Rescue purposes. Figure 2 shows typical tracks of the Weather Reconnaissance aircraft. These tracks were planned specifically for Operation SANDSTONE. The choice of tracks varied with the weather situation.

In addition to the above facilities, a detailed weather warning network for the immediate area of Eniwetok was established. This network was for the purpose of forecasting the time of beginning and ending of showers as well as their speed and direction, development and dissipation. The sources of data for the forecasting were weather reconnaissance aircraft reports, radar reports from these aircraft, and the radar reports from the Task Force ships including the Mt. McKinley.

Wind observations in the local area were taken very frequently. The Eniwetok weather station was equipped with an SCR 584 radar in addition to the SCR 658. Hydrogen generators supplied the bulk of the gas for the balloons, but because of the frequency of balloon runs, the hydrogen supply was augmented by bottled helium. Upper air winds were observed as frequently as every two hours for the critical days to insure adequate information for the radiological safety units. To get high altitudes, 1500 gram balloons were included in the equipment supplied to the stations. These balloons proved to be extremely useful. Frequent ascents reaching heights of 100,000 feet and above were obtained at certain stations. A schedule of the wind runs in the local area during the critical periods follows:

TABLE #2

XRAY MINUS ONE YOKE MINUS ONE ZEBRA MINUS ONE PRACTICE DAYS MINUS ONE (ALL TIMES ARE LOCAL)	XRAY DAY YOKE DAY ZEBRA DAY PRACTICE DAYS (ALL TIMES ARE LOCAL)
1200 Albemarle	0100 Bairoko

1400 Eniwetok (584)

1500 Eniwetok (584)

1600 Bairoko and Eniwetok (584)

1700 Curtiss

1800 Eniwetok (584)

1900 Albemarle

2000 Eniwetok (584)

2100 Eniwetok (658)

2200 Albemarle and Eniwetok (584)

2300 Curtiss

2400 Eniwetok (584)

0200 Curtiss-Eniwetok (584)

0300 Eniwetok (658) (high level) and Albemarle

0400-0700 No soundings due to aircraft operations in the area

0800 Eniwetok (high level) (584)

0900 Eniwetok (658)

1000 Albemarle

1200 Eniwetok (584)

1500 Eniwetok (658) after 1500, assume routine schedule unless otherwise directed

4. Analysis of the Collected Data

To analyze the data collected, it was necessary to choose a series of charts upon which the information could be plotted and easily analyzed. Table 3 is a summary of the charts used.

TABLE #3

CHART	MAP USED	TIME	INFORMATION ENTERED	PURPOSE
Surface synoptic chart	H C 5556	0000 1200 Zebra	Standard information and aircraft reports	Location and movement of weather systems
UPPER AIR CHARTS				
850 Mbs				

[redacted]

Reduced version of H O 5556	indicated under upper air charts
Documentary charts for weather data	Special forms prepared for the recording of weather observations from stations established for SANDSTONE
Time Cross Sections	Special time cross sections of wind, weather and humidity
Adiabatic diagrams	Plotted for five stations to determine stability and air mass characteristics
Voice conferences and contact with weather reconnaissance aircraft	First hand information on weather in local area including soundings to 10,000 feet
Radio facsimile charts	Not analyzed locally, however, served as an additional check on local analysis

5. Forecast Preparation

A conference was held each morning among the forecasters on the Staff of JTF-7. During this conference, each forecaster presented his analysis of the present weather situation and expected developments. After thorough consideration of the analyses, a weather forecast was formulated.

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Of paramount importance in the preparation of forecasts was a careful analysis of the comprehensive, highly detailed observations of weather conditions as reported by the weather reconnaissance aircraft. These planes reported such items as cloud cover at all levels, the temperature and humidity, winds at flight altitude, and winds at the surface. An example of the tremendous amount of detailed data is shown in Appendix E.

In forecasting the velocity of the winds from the surface to 10,000 feet, the pressure gradient at the surface between Wake and Eniwetok proved helpful. This gradient when of the order of three millibars produced winds of twelve (12) to fifteen (15) knots; and as long as the gradient maintained itself, there was little chance of the winds becoming light and variable. Light and variable wind conditions were an important consideration because a detonation under these conditions could result in a serious radiological hazard.

Upper air charts drawn twice daily for 0300 and 1500 Zebra for the 850, 700, 500, 300, and 200 millibar surfaces were found to be very helpful in forecasting upper winds to 60,000 feet. In nearly all cases it was possible to maintain an adequate history of troughs and ridges. These troughs and ridges influenced the winds as well as the weather. Much of the information on the movement of systems used in the preparation of the 72 hour outlook, was obtained from the upper air charts.

A careful three (3) hourly, compilation of the winds and weather from each of the stations composing the network established for SANDSTONE was made. These data sheets permitted a quick check on the sequence of weather events at each station and afforded a check on the accuracy and consistency of observations made at the various stations.

After the formulation of the forecast, a radio conference with the Staff Weather Officer of Task Group 7.4 was held. The purpose of this conference was to discuss the forecast, exchange forecast ideas and insure that all commanders were briefed on the same forecast.

The length of the forecast period varied from four (4) days to one and one half (1½) hours. The four (4) day forecast was an outlook, and the one and one half (1½) hour forecast was for the benefit of the local commanders in ascertaining if local shower activity was sufficient to warrant cancellation of scheduled operations.

6. Forecast Presentation

After preparation of the forecast, the necessary briefing charts were prepared for presentation to the Commanders, JTF-7. On other than operational days, informal weather briefings were held. The following charts were used in the briefings:

TABLE #4

(A)	2 surface weather charts	0000 1200 Zebra	Charts had inked isobars and locations and distances to systems were spotlighted for easy reference
(B)	Weather distribution chart		This chart derived from the data collected from the WX reconnaissance aircraft. Areas were delineated as follows: Clear or White - Up to 4/10ths Blue hatched - 4/10ths to 6/10ths clouds

Red hatched - More than 6/10ths clouds

(C) Forecast cross section Kwajalein to Eniwetok via Wotho.

(D) Trajectory charts showing movement of air parcels at various altitudes from the Eniwetok area.

(E) Detailed forecast of winds and weather in the Eniwetok area.

A comprehensive briefing schedule was established by JTF-7 Operational Order No. 5. This order called for briefing as follows:

P- X Y Z MINUS 3 - - 1300 LOCAL

P- X Y Z MINUS 1 - - 1100 "

P- X Y Z MINUS 1 - - 1800 "

P X Y Z - - 0230 "

P X Y Z - - 0445 "

[redacted]

1. Extended Forecasts

[redacted]

Because of the vagaries of tropical weather and the incomplete understanding of the mechanism of atmospheric processes in the tropics, extended forecasts for periods of beyond twenty-four (24) hours cannot be prepared with any appreciable degree of reliability. This is especially true when detailed forecast information on the structure of winds to great heights and cloud patterns are required.

Peter X-Ray Day was scheduled for 8 April with "H" Hour at 0621M. On Peter X-Ray Day minus three (3), a seventy-two (72) hour period forecast, was considered mainly as a planning outlook, even though the prediction for cloud and winds was made in some detail. It was emphasized that in no case was the meteorologist, on the basis of scientific principles, justified in declaring with any degree of confidence seventy-two (72) hours in advance that Peter X-Ray Day would have either favorable or unfavorable weather conditions for the operation. At best, only trends toward good or poor weather could be indicated. It was possible, for example, to indicate that the next twenty-four (24) or thirty-six (36) hours would have very favorable weather (or poor weather) and the Task Force Commander would thus have some indication as to the desirability for altering the target date of the operation.

Thus on Peter X-Ray minus 3 days, the outlook forecast was presented.

On Peter X-Ray minus one day and Peter X-Ray Day the weather predictions were made with greater and greater detail and presented with increased and significantly greater confidence.

2. Operations

During the morning of Peter X-Ray minus three (3), the outlook forecast for Peter X-Ray Day was prepared. A well defined pressure trough was located over the Japanese Empire. The trough was predicted to move slowly eastward, migrating to about 300 miles to the west of Eniwetok by "H" Hour. Although considerable amounts of middle clouds are usually associated with the approach of these westerly troughs, no significant increase in cloudiness was forecast. The reason for this was that the pressure trough was expected to weaken considerably. However, with the anticipated weakening of the pressure trough, a rather thick zone of light and variable winds was expected between the trade winds in the surface layers and the anti-trades at the higher altitudes. As a result, the weather forecast called for typical tropical weather of 3-4 tenths of scattered low cumulus clouds and 4 tenths of high scattered cirrus clouds and unfavorable winds from the radiological point of view.

At the briefing on 5 April at 1500M, the above weather trends were explained, and the outlook weather forecast for Peter X-Ray Day was presented. The next formal weather briefing was scheduled for Peter X-Ray minus one. However, during the interim, the Commander, JTF-7, and his staff were kept advised of the current weather situation and any modification in the forecast as originally given on Peter X-Ray minus 3 days.

No changes were made in the forecast since the weather situation had been developing as had been anticipated at the Peter X-Ray minus 3 day briefing.

At the 1100M briefing on Peter X-Ray Day minus one, (7 April), the forecast of expected cloud conditions was not changed. The wind prediction was altered slightly to indicate that a somewhat greater decrease in velocity was expected during the next 24 hours. It was further stated that the winds in the lower levels were expected to continue light and variable. This wind situation imposed a marked radiological hazard and from the radiological point of view, was not acceptable for an operation.

At the 1600M briefing, the weather forecast was again altered slightly to indicate a great amount of cloudiness. This change was based largely on the reports of the weather reconnaissance aircraft which indicated that the amount of cloudiness associated with the pressure trough was greater than originally forecast. Accordingly, the Peter X-Ray minus 3 day forecast was amended by adding 3 tenths middle clouds and lowering the base of the cirrus clouds from 34,000 to about 30,000 feet.

Since showers at the time of the explosion, especially if the showers were to occur over the zero point, would jeopardize some of the experiments for measuring the various phenomena associated with the explosion, the radar plan for observing the presence, the development and migration of local showers, was explained at this briefing. The plan called for making maximum use of ship and aircraft radars for spotting and tracking all

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in the first report when arrived in the area. Very dark and difficult to estimate cloud cover.

0300 Altitude 17,500 feet MSL
Estimate 3 tenths low clouds, tops 5000 feet some middle clouds about 2000 feet thick, no showers visible on the radar scope.

0400 Altitude 30,000 feet MSL
No showers, presently over an area that has less than 1 tenth cloud cover, low and middle clouds not visible. Passed through an estimated 3 tenths clouds at 25,000 feet, estimate these clouds to be 200 feet thick.

At 0400M on Peter X-Ray Day, the shower reporting network was used to determine if any showers existed. The radar reports from ships, aircraft, and the Mt. McKinley indicated that no showers were present in the immediate vicinity.

At the 0445 M briefing, the above information was presented to the Task Force Commander. The winds which had been forecast to be light and variable, were in excellent agreement with the latest observed winds. The cloud conditions were also in good agreement with the forecast conditions.

3. Actual Weather

The winds were reported as light and variable from the surface up to 25,000 feet with the usual anti-trade winds above this level. The cloud pattern was very much like the forecast with the exception that scattered middle clouds were not present as forecast. Tables 5, 6, and 7 show the weather observations for Peter X-Ray Day.

4. Comments

a. Although the Peter X-Ray Day exercise was carried on as a full dress rehearsal, simulating an actual test day, it would not have been possible to fire on this day. The cloud conditions were suitable for the drone operations, but a significant amount of interference would have resulted in the scheduled photography. The latter, however, was expected on almost any firing day because clear skies rarely prevail in the Marshalls. The upper air winds would have prevented the operation because of the low velocities and variability in direction. A firing under this condition would expose the entire Eniwetok Atoll area and ships in the Task Force to hazardous wind-borne radioactive debris.

b. Because the upper wind conditions were so critical, it was decided to make more frequent balloon soundings. Since the frequency of wind soundings by the weather station at Eniwetok was limited by the capacity of their hydrogen generators, a supply of helium was made available to the weather station by the USS Albemarle for the purpose of allowing a greater number of wind runs to be made.

c. Because of engine trouble, the weather reconnaissance aircraft scouting the weather in the zero area during the early hours prior to "H" Hour returned to base, and the atmospheric sounding to a scheduled height of 30,000 feet was not obtained.

d. The position of the weather reconnaissance aircraft was not always reliably known and hence the reports were not representative of the local area. Future procedure will be to orbit on a circle of 15 to 20 miles radius from the zero point in order to maintain a good "fix" on the exact location of the observed cloudiness and showers.

e. Very close monitoring of the communications systems was maintained to insure the early and timely receipt of all weather information that was being taken for Peter X-Ray Day. The receipt of all weather data was satisfactory.

TABLE #5

Peter X-Ray Day

ATMOSPHERIC SOUNDING

PPP - Pressure (Mb)
hhh - Height (Ft)

TT - Temperature (Ft)
U - Relative Humidity (%)

uu - Mixing Ratio
X - Missing

DATE: 8 April 1948

TIME LOCAL

0400					0400					1000				
PPP	hhh	TT	U	uu	PPP	hhh	TT	U	uu	PPP	hhh	TT	U	uu
1010	000	24	79	14.9	1008	000	25	77	15.5	1012	000	25	70	14.7
1000	370	X	X	X	1000	280	25	80	17.9	1000	360	25	70	13.8
879	3900	18	50	8.5	970		25	90	18.4	938	2300	20	60	10.6
850	4870	20	20	5.1	914		18	90	12.6	880	4000	16	70	9.8
848	4900	20	20	4.8	880		18	80	11.3	850	4970	21	20	4.1
714	9700	10	10	1.9	850	4950	21	X	X	793	7000	17	60	4.0
700	10260	09	10	X	836		22	X	X	729	9500	12	10	2.1
500	19170	-06	10	X	794		18	40	6.5	700	10360	11	10	X
400	24800	-16	10	X	760		15	40	5.5	500	19280	-05	10	X
378	26200	-18	10	X	736		12	40	5.4	450	21900	-10	10	X
					700	10320	11	X	X	400	25900	-16	10	X
					600		04	X	X	323	30200	-27	X	X
					500	19270	-05	X	X	300	31780	-30	X	X
					458		-08	X	X	268	34400	-36	X	X
					444		-11	X	X	200	40800	-52	X	X
					400		-15	X	X	160	45300	-64	X	X
					344		-23	X	X	145	46700	-66	X	X
					300	31830	-30	X	X	128	50200	-72	X	X
					200	40880	-51	X	X	100	54530	-75	X	X
					154		-68	X	X	083	58000	-78	X	X

TABLE #5

Peter X-Ray Day (Cont'd)

ATMOSPHERIC SOUNDING

PPP - Pressure (Mb)
hhh - Height (Ft)

TT - Temperature (Ft)
U - Relative Humidity (%)

uu - Mixing Ratio
X - Missing

TIME LOCAL 2100				
PPP	hhhh	TT	U	uu
1011	000	24	69	12.9
1000	290	23	70	12.2
936	2200	17	70	10.6
915	2800	16	40	5.9
875	4000	19	10	2.6
850	4880	17	20	3.8
813	6100	15	40	5.6
785	7100	13	30	3.6
775	7800	13	20	3.1
700	10230	09	10	X
606	14300	01	10	X
520	18300	-05	20	1.2
500	19290	-07	30	1.5
484	20100	-09	50	2.1
455	21800	-12	20	0.9
400	24900	-18	X	X
350	27500	-24	X	X
300	31750	-33	X	X
257	35300	-42	X	X
200	40660	-55	X	X
193	41400	-56	X	X
183	42500	-57	X	X

TABLE #5

Peter X-Ray Day
(Cont'd)

AIRCRAFT SOUNDING

PPP - Pressure (Mb) TT - Temperature (C) U - Relative Humidity (%)

TIME LOCAL 0200		
PPP	TT	U
960	23.8	83
900	19.9	87
850	18.9	59
800	18.0	38
750	15.6	10
700	10.4	10

SECRET

DIR - Degrees VEL - Knots

TIME LOCAL	0000		0000		[redacted]
HEIGHT	DIR	VEL	DIR	VEL	
SURFACE	040	02	100	02	
2000 Ft	220	05	000	00	
4000 Ft	040	02	000	00	
6000 Ft	310	10	280	04	
8000 Ft	280	06	260	02	
10000 Ft	250	02	140	06	
12000 Ft	160	06			
14000 Ft	130	11			
16000 Ft	120	08			
18000 Ft	090	09			
20000 Ft	050	07			
25000 Ft	220	08			
30000 Ft	270	09			
35000 Ft	270	24			
40000 Ft	260	42			
45000 Ft	230	42			
50000 Ft	240	33			
60000 Ft	020	15			
70000 Ft					
80000 Ft					
90000 Ft					

[redacted]

SECRET

TABLE #7

Peter X-Ray Day

SURFACE OBSERVATIONS

DATE: 8 April 1948

Time Local	Sky	Sea Level Pressure(Mb)	Temperature (F)	Dew Point (F)	Wind Direction	Wind Velocity	Press. Tendency	Net 3 Hour Press.Change	Amount-Type Low Cloud	Height Low Cloud	Amount-Type High Cloud
0030	20S	1011.0	82	71	CALM		9	0.4	.2Cu	E20	
0130	40S20S	1010.3	82	72	CALM				.2Cu	E20	
0230	S/60S	1009.0	82	72	CALM				.2Sc	E60	.2Cs
0330	S/	1009.1	80	72	CALM		5	1.9	.1Sc		.2Cs
0430	S/	1008.7	82	72	NNE	1					.1Cs
0530	S/40S	1009.7	81	71	CALM				.1Sc		.1Cs
0630	B/20S	1010.2	81	71	CALM		2	1.1	.3Cu	E20	.8Ci Cs
0730	B/20S	1010.9	82	72	CALM				.4Cu	E20	.7Ci Cs
0830	B/20S	1011.5	79	69	ESE	2			.1Cu	E20	.9Ci Cs
0930	B/20S	1011.9	81	73	CALM		3	1.7	.1Cu	E20	.9Ci Cs
1030	B/20S	1012.2	84	73	CALM				.1Cu	E20	.8Ci Cs
1130	B/20S	1011.9	85	72	ENE	3			.3Cu	E20	.6Ci Cs
1230	B/20S	1011.5	86	73	E	5	9	0.4	.3Cu	E20	.8Ci Cs
1330	B/20S	1010.1	86	73	ENE	2			.3Cu	E20	.8Ci Cs
1430	B/20S	1010.3	86	72	ENE	4			.2Cu	E20	.7Ci
1530	B/20S	1009.3	86	72	ENE	4	8	2.2	.1Cu	E20	.7Ci Cs
1630	B/20S	1008.6	85	71	ENE	2			.2Cu	E20	.7Ci Cs
1730	B/20S	1009.0	85	71	CALM				.2Cu	E20	.7Ci Cs
1830	B/20S	1009.6	84	73	CALM		3	0.3	.3Cu	E20	.7Ci Cs
1930	B/20S	1010.4	80	70	CALM				.1Cu	E20	.6Ci Cs
2030	S/20S	1011.1	80	70	NE	2			.2Cu	E20	.3Ci
2130	S/20S	1011.7	79	69	E	2	3	2.1	.2Cu	E20	.3Ci
2230	S/20S	1011.9	80	69	E	2			.2Cu	E20	.3Ci Cs
2330	S/20S	1011.9	80	69	E	2			.2Cu	E20	.3Ci Cs

SECRET

PARAPHRASE NOT REQUIRED. HANDLE AS SECRET CORRESPONDENCE

PER PARA 51i AND 60a (4) AR 380-5

HQ USAF AFOPO

Col Spencer 5191

6 November 1947

COMGENSAC Andrews Field Md

COMGENAMC Wright Field Dayton Ohio

COMGENAPGC Eglin Field Fla

Nr: WARX 89894

From AFOPO signed CSAF reourad WARX 88186 dated 8 October 1947

See Para 1 D CG ATC will also provide weather service and communications necessary thereto for the operation. Such mobile units as may be needed to augment the existing weather facilities in the area will be attached to SAC for TDY with Air Task Group for 180 days. Upon completion of this period they will revert to their appropriate commands.

End

AF 67

ORIGINATOR: AF

CM OUT 89894 DTG 070029Z rb

SECTION XII

SECRET

PARAPHRASE NOT REQUIRED, HANDLE AS SECRET CORRESPONDENCE

PER PARAS 51i and 60a (4) AR 380-5

HQ USAF AFACC Col Large 5316

8 October 1947

COMGENSAC Andrews Fld Md

COMGENAMC Wright Fld Dayton Ohio

COMGENAPGC Eglin Fld Fla

From AFACC signed CSAF

The decision has been made that the USAF in conjunction with the Army and Navy will support the Atomic Energy Commission in an atomic proof-test to be held in the western Pacific sometime during the early summer of 1948. In implementation of this decision it is directed that

(1) CG SAC organize, man, equip and train and Air Force Task group to be part of the Armed Service Task Froce as discussed with CG SAC.

(2) CG AMC support CG SAC.

(3) CG AFGC support CG SAC by providing an appropriate drone task unit.

(4) CG ATC support CG SAC by providing necessary air lift and weather acft for the operation. Manning and equipping of the Air Force Task group will be accorded a priority immediately below that of the 55 group program.

Maj Gen W E Kepner, Chief of the Special Weapons Gp of the Off Deputy Chief of Staff, Materiel, this Hq has been designated Deputy

Task Force Commander for the test. His office will monitor the operation for the Air Force. Code word designations for this test which are classified "SECRET" are as follows: Task Force "SWITCHMAN"; Operation "SANDSTONE."

End AF 141

ORIGINATOR: AF

DISTRIBUTION AND/OR APPROPRIATE ACTION: AF(ATC)

CM OUT 88186 (Oct 47) DTG 131807Z

[redacted]

Day approached, the weather slowly deteriorated. This was due to the approach of an eastward travelling trough, marking the advance of a mass of air having its origin over the Asiatic Continent. The weather associated with the trough consisted of mostly overcast low and medium clouds with rain and showers. About noon on Sunday, the 11th of April, the stormy weather associated with the trough arrived in the Eniwetok area.

2. Operations.

X-Ray Day was scheduled for Thursday, 15 April, and H Hour for 0617M.

On Monday, X-Ray minus three days (12 April) rain was still falling, however, the main storm system had passed over Eniwetok and was located some hundred miles to the south. In the wake of the storm, considerable cloudiness at all levels and occasional showers continued to persist.

It was, however, anticipated that the Eniwetok weather should improve within 36 hours after the passage of the trough. The outlook forecast for X-Ray Day called for favorable cloud conditions for drone operations, with the tops of the clouds not expected to exceed 9,000 feet. However, appreciable interference to photography was expected because of the cloud amounts which were forecast to be present in a random pattern over at least half of the day.

With the passage of the trough, the upper winds becmae unfavorable due to the northwesterly component in the levels between 20,000 and 30,000 feet. These winds were forecast to shift in direction, so that a southwesterly to southerly component would exist from the surface to thirty thousand feet. The wind speeds were forecast to be light but sufficiently strong enough to keep a constant direction and thus eliminate any threat of variable winds which would not be acceptable to the radiologist.

The first formal briefing for X-Ray Day was scheduled for 1300M on X-Ray minus three, the time having been changed from 1500M by J-3, JTF-7. The outlook forecast was presented at this time.

The Commander, JTF-7, requested a supplementary briefing on X-Ray minus two, the time to be fixed by the meteorologist. The meteorologist suggest 1700M. This new time allowed for thorough digest of the weather reconnaissance reports, and the preparation of amendments to the original forecast.

On X-Ray minus two the briefing was held and the forecast was not changed from that originally given on X-Ray minus three. At this briefing, the Commander, Air Forces, requested that a check be made on the weather during the early morning hours of Wednesday, 14 April, to test the weather reconnaissance procedures. Of principal concern was the accuracy with which clouds could be observed on a totally dark night. The aircraft reported scattered low clouds with tops to 15,000 feet and some isolated thunderstorms and indicated that the clouds could be observed with moderate ease against the dark background of the sea at altitudes of 10,000 feet and higher.

By the morning of X-Ray minus one, the weather was again of a typical tropical nature, four to five tenths cumulus, tops below 10,000 feet, some cirrus and scattered rain showers. It appeared that the weather had improved considerably and would continue slow improvement as had been forecast.

At the 1100M briefing on X-Ray minus one, (14 April), the middle clouds originally predicted were eliminated from the forecast. The prediction of winds continued to call for winds rather low in velocity and directions from the south and southwest in the lower levels.

Three weather reconnaissance aircraft were used on X-Ray minus one day. These planes flew weather missions to the north and west and east of Eniwetok. On X-Ray minus one, a summary of aircraft weather reports indicated the weather was definitely improving and there was every expectation of suitable weather for the X-Ray firing.

During the afternoon briefing at 1700M on X-Ray minus one, the forecast of clouds was unaltered from the previous one. The wind fore-

[redacted]
to make emergency landing.

0310M The standby aircraft was instructed to assume the position formerly occupied by the aircraft making the forced landing.

0330M Weather to the NE is located about one hundred miles from zero point. All tops of clouds in this area are below 12,000 feet.

0430M Scattered showers are beginning to form in the local area, all cloud tops are below 12,000 feet

0530M No change since the last report.

SECTION XII

~~SECRET~~

The informal 0230M briefing was held in the meteorological office. The significance of the reconnaissance reports were indicated at the briefing. The development of showers in the morning was reiterated.

At the 0445M briefing, the immediate weather observations of the weather reconnaissance aircraft were again discussed. It was pointed out that shower activity was beginning in the area and would continue until after dawn. The location of showers was graphically shown on a chart and paths of travel indicated. Also stressed at this time was the fact that showers were forming in a random manner and were being tracked by the radar on the ship. If evidence on the radar scope indicated a heavy shower at zero point at the scheduled H Hour, the Commander, JTF 7, requested that he be notified in order to take appropriate action.

3. Omitted.

4. Omitted.

5. Comments.

a. Two aircraft in the air reporting detailed observations every half hour presented a complicated problem of weather interpretation. The bulk of the observations were duplications. Therefore, for Yoke Day, aircraft contacts were limited to one per hour. One aircraft will be used as the primary source of data and the second aircraft will be directed to particular areas for special observations as the need arises.

b. The high level balloon sounding taken during the morning of

X-Ray Day was quite successful, the run reaching 80,000 feet. The coding of the winds for transmission at 5,000 foot intervals above 20,000 feet was deemed inadequate; first, because the exact location of the sheer level was important and second, the rate of lateral diffusion and the subsequent visual character of the atomic cloud could only be predicted by detailed upper wind observations. Instructions were therefore issued to code all levels of the balloon runs in 1,000 foot intervals during the period from noon of the previous day to noon of the day of the scheduled shot. In addition, high level balloon runs were scheduled for subsequent firings at H Hour minus three and H Hour plus two.

c. A tendency was noted to believe the weather observations taken one to three hours before explosion time would be representative of the weather at zero time. Cloud masses in the lower westerly winds can, as a rule, be expected to migrate with these winds and the future positions of any significant cloud areas can be fairly accurately extrapolated. However, in the X-Ray situation where nearly clear skies prevailed at night, it had been previously noted that this condition appeared to correlate with the rapid development of showers at dawn, and this development could obviously not be reported by the aircraft. The need exists for an alertness on the part of the meteorologist for new weather developments which will not be reported by aircraft reconnaissance no matter how comprehensive and current the local weather observations may be.

~~SECRET~~

TABLE #10

X-Ray Day

SURFACE OBSERVATIONS DATE: 15 April 1948

Time Local	Ceiling (Hunds Of Ft.)	Sky	Sea Level Pressure (Mb)	Temperature (F)	Dew Point (F)	Wind Direction	Wind Velocity	Press. Tendency	Net 3-Hour Press. Change	Amount Type Low Cloud	Height Low Cloud	Amount-Type Middle Cloud	Height Middle Cloud	Amount-Type High Cloud
0030		S/20S	1012.2	81	77	E	1	0	0.7	.1Cu	E20			.3Ci
0130		20S	1012.4	82	75	E	3			.3Cu	E20			
0230		20S	1011.8	82	75	E	3			.3Cu	E20			
0330		20S	1011.4	80	77	ENE	3	8	0.8	.3Cu	E20			
0430		20S	1011.0	81	77	E	4			.3Cu	E20			
0530	E20	B	1011.7	81	77	ENE	7			.9Cu	E20	OBSCD		OBSCD
0630	E20	S/B	1011.8	81	76	ENE	7	4	0.4	.7Cu	E20			.2Ci
0730		S/20S	1012.3	81	76	E	6			.4Cu	E20	.1-Ac	E80	.1Ci
0830		S/20S	1013.2	81	75	ESE	8			.4Cu	E20			.2Ci
0930		S/20S	1013.0	83	76	ESE	4	0	1.2	.3Cu	E20			.2Ci
1030	E20	S/B	1013.3	84	79	ENE	4			.6Cu	E20			.1Ci
1130	E15	B	1012.8	84	79	ENE	7			.7Cu	E15			
1230		S/18S	1013.1	84	77	E	9	4	0.1	.5Cu	E18			.2Cs
1330		S/20S	1012.0	84	76	E	9			.2Cu	E20			.4Ci
1430		S/20S	1011.4	84	76	E	10			.4Cu	E20			.1Ci
1530		S/20S	1010.1	84	75	E	9	8	3.0	.3Cu	E20			.1Ci
1630		S/20S	1011.4	84	75	E	10			.3Cu	E20			.2Cs
1730		S/20S	1011.4	84	75	E	9			.2Cu	E20			.2Cs
1830		S/20S	1011.7	83	75	E	9	4	1.5	.2Cu	E20			.1Cs
1930		S/20S	1011.8	82	75	E	11			.2Cu	E20			.2Ci
2030		Clear	1012.1	82	75	E	10							
2130		20S	1012.7	82	75	E	12	3	1.0	.2Cu	E20			
2230		20S	1013.5	81	75	E	10			.1Cu	E20			
2330		20S	1013.4	82	75	E	14			.1Cu	E20			

~~SECRET~~

METEOROLOGY

PART FIVE

Yoke Day

1. Introduction

On the days following X-Ray Day, the weather situation was characterized by a slow change from the prevailing southeasterly flow of the equatorial air in the lower atmospheric layers to a more normal easterly and northeasterly flow. The trade winds blew with moderate velocities of 15 to 18 knots but the anti-trades above 30,000 feet occasionally reached speeds of 80 knots. There was also a high frequency of occurrence of west-northwest winds in the anti-trades at levels between 20,000 and 30,000 feet, a not unusual condition for this season in the Marshalls. Although the weather conditions for the days preceding Yoke Day were normal and typical, the existence of west-northwest winds in the anti-trades would cause a possible hazardous radioactive fall-out if firing were attempted under these wind conditions. Prior to Yoke minus three, there was eleven impossible firing days because of wind conditions, these being April 19 through 29th. There had to be a definite change in the winds before the Yoke Day detonation could take place.

2. Operations

Yoke Day was scheduled for 30 April with H Hour at 0609M. On the 26th of April, the low, medium and high cloudiness increased rapidly and frequent moderate showers covered the entire Eniwetok area. This stormy situation appeared to have no previous discernible history. The cause of this storminess was found to be in the development of a zone of converging winds. The northeast trade winds from more northerly latitudes were colliding with easterly winds from equatorial latitudes resulting in a zone of heavy cloudiness and showers. The stormy area was expected to move westward with the trade wind flow.

The 27th of April was scheduled as Yoke minus three. Considerable amounts of low, medium and high cloudiness was present on this day, but the main stormy area had passed westward as expected. The outlook forecast for Yoke day was prepared. Suitable cloud conditions not to exceed 5 tenths for Yoke day were anticipated. There would be a few widely scattered showers but no interference to the operation was expected. The wind structure was forecast to be a normal trade and anti-trade flow. It was not possible to indicate at this time with certainty whether this wind flow would or would not be suitable for firing. Should the northerly component in the anti-trades continue to persist, Yoke Day as scheduled would be non-operational. This information was presented at 1300M, 27 April (Yoke minus three) to the Commander JTF 7 and his staff at the scheduled formal briefing.

Due to the critical nature of the winds, the Commander JTF 7 requested a supplementary weather briefing for Yoke minus two at 1700M. There was no change in the original outlook forecast indicated at this weather presentation.

On the following day 29 April (Yoke minus one) there was only

[redacted]

were gradually assuming a persistent southerly component. Thus at the 1100M briefing, 30 April, a forecast of favorable cloud and wind conditions was presented and the operation for Yoke Day was on.

The weather reconnaissance aircraft observations during the day confirmed the forecast for favorable cloud and wind conditions for Yoke day, a considerable dimunution of the moisture content had been noticed in the lowest 10,000 feet and this virtually guaranteed a minimum of cumulus activity for Yoke day.

At the 1800M briefing on Yoke minus one the favorable weather

0540M There is little change in the previous observation. Estimate about four tenths clouds, tops to 6,500 feet.

0550M Nothing new to report.

As the weather information became available from the aircraft it was summarized and presented to the Commander of JTF 7. At both [redacted]

An estimate of the forecast drift of the atomic cloud was presented at the Yoke minus one day 1800 briefing. The picture indicated that the upper part of the cloud would move rapidly and

SECRET

[redacted]

These planes were especially equipped with very sensitive radar gear. During the interval before the shot, numerous radar fixes fromthese craft were reported, but it was difficult to evaluate whether the fixes were showers or heavy moisture clouds.

[redacted]

8000	080	14	100	09	120	09	150	12	130	06
9000	090	12	110	11	100	10				
10000	090	10	110	11	100	10	140	10	130	10
11000	090	08	100	09	100	09				
12000	090	08	080	08	090	07	130	08	100	06
13000	080	08	060	09	070	06				
14000	070	07	050	10	060	05	120	12	050	06
15000	060	06			020	03				
16000	080	04	030	05	340	02	140	04	090	05
17000	100	04	030	03	280	02				
18000	120	04	040	02	220	05	020	08	130	03
19000	140	05	140	02	240	08				
20000	170	07	230	04	230	10	070	16	260	06
21000	190	09	230	07	220	17				
22000	210	12	220	11	220	20				
23000	220	15	220	15	220	16				
24000	230	17	210	19	200	25				
25000	220	20	210	23	200	22			210	16
26000	220	22	210	24	200	24				
27000	220	22	200	24	200	18				
28000	210	21	200	23	220	14				
29000	210	19	210	22	230	24				
30000	220	21	210	18	230	31			220	24
31000	220	25	210	28	230	37				
32000	220	31	210	27	230	42				
33000	220	45	220	40	220	45				
34000	220	48	230	44	220	51				
35000	220	48	240	42	220	46			220	45
36000	220	49	250	24	220	43				
37000	210	51	250	20	220	44				
38000	210	53	250	30	220	46				
39000	210	53	240	33	210	48				
40000	210	54	230	33	210	43			210	65

TABLE #11

Yoke Day

DD - Wind Direction (Degrees)
VV - Velocity (Knots)

UPPER WINDS — DATE: 1 May 1948

Time Local	0000		0200		0300		0300		0400	
	DD	VV	DD	VV	DD	VV	DD	VV	DD	VV
Height in Ft.										
41000	210	57	220	36	220	37				
42000	220	48	210	35	220	38				
43000	220	38	200	34	220	49				
44000	230	35	200	34	230	44				
45000	220	36			220	38				
46000	230	31			230	40				
47000	240	28			230	40				
48000	240	26			220	36				
49000					210	38				
50000					200	48				
51000					200	45				
52000					200	45				
53000					200	40				
54000					200	31				
55000					200	35				
56000										

TABLE #11

Yoke Day

DD - Wind Direction (Degrees)
VV - Velocity (Knots)

UPPER WINDS DATE: 1 May 1948

Time Local	0900		1000		1200		1500		1600	
	DD	VV	DD	VV	DD	VV	DD	VV	DD	VV
Height in Ft										
SURFACE	070	13	080	16	070	11	080	12	070	16
2000	070	18	070	18	070	15	060	18	060	13
3000	070	16					060	15		
4000	090	10	080	14	070	09	060	11	010	08
5000	170	06					090	08		
6000	180	08	120	06	160	02	210	10	010	04
7000	120	28					200	12		
8000	130	29	190	10	190	12	200	12	010	13
9000	150	33					200	11		
10000	150	34	200	10	180	10	220	07	010	12
11000	110	34					170	04		
12000	090	27	100	02	110	05	090	02	130	03
13000	090	33					070	03		
14000	080	36	080	08	070	04	090	02	170	03
15000	090	25					180	02		
16000	100	24	140	06	130	13	170	02	270	03
17000	110	30					160	04		
18000	180	30	180	02	170	06	170	05	170	03
19000	190	36					190	07		
20000	170	37	170	14	190	09	190	06	190	07
21000	170	51					240	08		
22000	170	61					250	12		
23000	180	63					240	14		
24000	210	61					210	12		
25000	250	61	210	12	200	11	210	10	220	06
26000	270	45					200	13		
27000	300	48					190	17		
28000	280	53					210	23		
29000	270	44					210	23		
30000	270	41	200	18			210	28	210	29
31000							210	33		
32000							210	45		
33000							210	48		
34000							210	53		
35000			210	38	230	42	200	54	210	50
36000							210	52		
37000							210	40		
38000							210	51		
39000							210	49		
40000			210	36	200	24	210	46	190	56

TABLE #11

Yoke Day

UPPER WINDS

DD - Wind Direction (Degrees) DATE: 1 May 1948
VV - Velocity (Knots)

Time Local	0900		1000		1200		1500		1600	
	DD	VV	DD	VV	DD	VV	DD	VV	DD	VV
Height in Ft										
41000							210	53		
42000							210	57		
43000							220	55		
44000							220	45		
45000			200	50			220	50	210	51
46000							220	47		
47000							220	46		
48000							220	46		
49000							220	42		
50000			210	46			220	39	240	31
51000										
52000										
53000										
54000										
55000										
56000										

[redacted]

23000	'	320	09
24000	'	300	09
25000	'	140	17
26000	'	170	17
27000	'	210	20
28000	'	210	24
29000	'	210	26
30000	'	210	30
31000	'	210	40
32000	'	210	48
33000	'	220	46
34000	'	220	45
35000	'	220	52
36000	'	210	55
37000	'	220	56
38000	'	220	52
39000	'	220	46
40000	'	220	36

~~SECRET~~

~~SECRET~~

TABLE #11

Yoke Day

UPPER WINDS

DD - Wind Direction (Degrees)
VV - Velocity (Knots)

DATE: 1 May 1948

Time Local	2000		2100	
	DD	VV	DD	VV
Height in Ft				
41000			220	45
42000			220	52
43000			220	56
44000			220	46
45000			220	49
46000			220	52
47000			210	45
48000			200	39
49000			200	38
50000			200	38
51000				
52000				
53000				
54000				
55000				
56000				

~~SECRET~~

SECRET

TABLE #12

Yoke Day

ATMOSPHERIC SOUNDING

PPP - Pressure (Mb)
hhh - Height (Ft)

TT - Temperature (C)
U - Relative Humidity (%)

uu - Mixing Ratio
X - Missing

DATE: 1 May 1948

TIME LOCAL 0300 PPP	hhh	TT	U	uu	0900 PPP	hhh	TT	U	uu	PPP	1000 hhh	TT	U	uu
1011	000	28	81	17.2	1010	000	28	72	17.3	1011	000	27	77	17.
1000	320	26	80	16.7	1000	300	27	70	16.7	1000	320	26	70	16.
850	4950	16	80	11.9	949	1800	22	80	15.2	952		22	80	15.
814	6300	12	70	8.2	867	4300	18	60	9.5	860		17	70	10.
792	6900	13	20	3.4	850	4740	17	60	9.8	850	4950	16	70	9.
732	9100	12	10	2.2	809	6300	15	70	10.3	780		14	30	3.
700	10300	10	10	X	790	7000	13	50	6.1	753		14	50	7.
674	11300	08	10	X	773	7600	14	20	2.8	740		13	10	
659	11900	08	20	2.6	760	8100	14	40	5.6	700	10290	11	X	
610	14000	04	10	1.6	726	9300	12	10	2.2	670		09	X	
574	15600	01	10	X	706	10100	12	10	X	662		10	X	
545	16500	-01	20	1.5	700	10320	11	X	X	500	19260	-03	X	
537	17300	-02	30	2.2	573	15700	01	20	1.5	460		-06	X	
500	19220	-05	20	2.5	547	16900	00	30	2.1	446		-06	X	
480	20200	-07	20	1.1	500	19250	-05	20	1.3	400		-14	X	
400	24800	-17	10	X	468	21000	-09	X	X	300	32020	-28	X	
300	31690	-32	X	X	445	22200	-10	X	X	200	41240	-48	X	
258	34900	-40	X	X	400	24900	-16	X	X	140		-66	X	
200	40680	-53	X	X	313	30800	-30	X	X	128		-73	X	
100	54190	-84	X	X										
295	55100	-84	X	X										

SECRET

TABLE #12

<u>Yoke Day</u>

ATMOSPHERIC SOUNDING

PPP - Pressure (Mb)
hhh - Height (Ft)

TT - Temperature (C)
U - Relative Humidity (%)

uu - Mixing Ratio
X - Missing

DATE: 1 May 1948

TIME LOCAL 1500					2100				
PPP	hhh	TT	U	uu	PPP	hhh	TT	U	uu
1008	000	30	65	17.6	1009	000	27	75	17.0
1000	240	28	60	17.2	1000	270	26	70	16.2
982	720	24	60	13.3	953	1700	22	80	14.1
907	3000	19	70	10.9	932	2400	22	70	12.8
879	3900	19	60	9.8	879	3900	20	70	12.2
850	4870	17	60	9.5	850	4900	18	70	11.8
768	7700	13	50	7.1	819	5900	16	70	10.5
757	8100	13	50	6.7	794	6600	16	30	5.2
735	8900	10	20	2.9	746	8600	12	60	7.5
719	9500	10	20	2.9	700	10280	10	X	X
700	10240	09	10	X	642	12600	06	X	X
679	11000	08	X	X	626	13300	06	X	X
669	11400	09	X	X	500	19190	-05	X	X
500	19170	-06	X	X	480	20300	-07	X	X
400	24800	-16	40	1.1	469	20900	-07	X	X
300	31710	-32	X	X	400	24800	-17	40	1.0
265	34500	-36	X	X	300	31650	-32	X	X
200	40720	-52	X	X	279	33300	-36	X	X
122	50600	-76	X	X	200	40610	-54	X	X
					130	49200	-73	X	X

[redacted]

500	-1.6	38	050	12
450	-5.5	16		
400	-9.2	36		
350	-14.5	21		
322	-16.1	24	190	38

~~SECRET~~

TABLE #13

Yoke Day

SURFACE OBSERVATIONS

DATE: 1 May 1948

Time Local	Sky	Sea Level Pressure(Mb)	Temperature (F)	Dew Point (F)	Wind Direction	Wind Velocity	Press. Tendency	Net 3 Hour Press.Change	Amount Type Low Cloud	Height Low Cloud	Amount-Type Middle Cloud	Height Middle Cloud	Amount-Type High Cloud
0030	S/20S	1010.4	80	76	ENE	13	3	0.4	.2Cu	E20			.3Ci
0130	S/20S	1009.5	80	74	ENE	10			.3Cu	E20			.4Ci
0230	S/20S	1008.8	80	74	ENE	12			.3Cu	E20			.4Ci
0330	S/20S	1008.8	80	74	ENE	10	6	1.6	.3Cu	E20			.4Ci
0430	S/20S	1008.0	80	74	ENE	10			.3Cu	E20			.4Ci
0530	S/20S	1008.1	80	76	ENE	7			.3Cu	E20			.4Ci
0630	S/20S	1008.6	80	76	NE	13	5	0.2	.5Cu	E20			.4Ci
0730	S/20S	1008.9	81	74	ENE	9			.3Cu	E20			.4Ci
0830	S/20S	1009.6	81	74	ENE	6			.3Cu	E20			.3Ci
0930	S/20S	1010.2	81	75	ENE	12	3	1.2	.3Cu	E20			.3Ci
1030	S/20S	1010.1	81	74	ENE	14			.2Cu	E20			.4Ci
1130	S/20S	1009.8	82	74	ENE	10			.2Cu	E20			.3Ci
1230	S/20S	1009.1	83	75	ENE	7	9	1.2	.1Cu	E20			.3Ci
1330	S/20S	1008.5	83	75	ENE	10			.2Cu	E20			.3Ci
1430	S/20S	1008.1	83	75	ENE	7			.2Cu	E20	.2Ac	E170	.3Ci
1530	S/20S	1007.7	83	75	NE	9	8	1.4	.2Cu	E20	.1Ac	E100	.4CiCs
1630	S/20S	1007.1	82	75	ENE	9			.2Cu	E20	.2Ac	E100	.2Ci
1730	S/20S	1007.2	81	75	NE	10			.3Cu	E20	.1-Ac	E100	.2Ci
1830	20S	1007.4	81	74	NE	10	6	0.3	.3Cu	E20			
1930	S/20S	1008.3	81	75	ENE	7			.3Du	E20			.3Ci
2030	20S	1008.7	81	75	NE	10			.2Cu	E20			
2130	18S	1009.2	81	75	NE	9	3	1.8	.2Cu	E18			
2230	18S	1009.1	81	75	ENE	10			.2Cu	E18			
2330	18S	1008.6	81	75	ENE	15			.2Cu	E18			

METEOROLOGY

PART SIX

ZEBRA DAY

1. Introduction

From Yoke Day, 1 May, up through Zebra minus four days (11 May) the weather deteriorated slowly. During this period there were greater amounts of middle clouds and cirro-stratus overcasts frequently prevailing. All evidence indicated that the Intertropical Convergence Zone was moving slowly northward.

The wind structure from 1 May to 11 May was one of slowly diminishing wind velocities in the lower 15 thousand feet. The pressure gradient between Wake Island to the north and Eniwetok and Rongerik to the south was gradually diminishing and there was very little evidence to believe that this situation would change appreciably for Zebra Day. The winds at levels from 25 to 50 thousand feet were southerly in the Kwajalein area and were westerly in the Eniwetok area. This clash of winds and the resulting convergence suggested a possible explanation of the large amount of cirrus cloudiness being observed.

On Zebra plus five (10 May) there was a well marked trough located just off the coast of Japan. In the past, troughs of this nature had moved slowly toward the Eniwetok area and had affected the wind structure and weather, so as to make operations, when under the influence of such a pressure trough, hazardous from a radiological safety point and questionable for drone and photographic missions.

A statistical check on the speed of these pressure troughs was made. A series of five troughs were studied and the results indicated that at this season, the time for traversing the distance from the Japanese coastal areas to Eniwetok, a distance of approximately 2100 nautical miles, varied from 5 to 7 days. It was concluded that if the trough continued to travel on 10 May at a normal rate, a prediction for its arrival in the Eniwetok area on the very day that Zebra day was scheduled was justified. However, before recommending to the Commander, JTF 7 that Zebra should be advanced one day, the staff meteorologists agreed to scrutinize the development of this trough for another 24 hours. The reason for this was the fact that the trough had shown some indication of weakening, which would retard its eastward migration considerably. This was confirmed on the subsequent weather charts and no recommendation to advance Zebra day was made.

The considerable amounts of high clouds in the Eniwetok area on Zebra minus four indicated strongly that the Intertropical front was not too far to the south. The weather reconnaissance on Zebra minus four flew track five and six and the observations indicated heavy cloudiness extending in a broad east-west belt at all levels from Kwajalein area southward.

2. Operations

Zebra day was scheduled for 15 May and "H" Hour for 0640M. By Zebra minus three (12 May) the pressure gradient between Wake Island

and Eniwetok had diminished to less than 2 millibars and the winds were becoming light and variable in the zone from 3,000 to 10,000 feet.

Although considerable amounts of medium and high clouds were present during the days prior to Zebra day, by noon of Zebra minus three the solid cirro-stratus began to show signs of dissipation and the heavy haziness of the sky disappeared. There was a weak trough extending from the NE to the SW in the vicinity of Wake Island with some evidence of an incipient atmospheric wave passing Wake Island during the night of Zebra minus four. It was expected that this wave would intensify only slightly because of the lack of a well defined cold air source.

The weather predictions presented at the formal weather briefing for the Commander Joint Task Force Seven on 1300M of Zebra minus three called for improving cloud conditions with the lower trade wind conditions to remain light in velocity but having southerly components in direction so as to be favorable for the radiologist.

On Zebra minus two (13 May) there was little change in the overall weather situation. The surface pressure gradient from Wake Island to the Marshalls had changed very little and was still 1-2 millibars. Consequently, the winds continued very light in the lower 15,000 feet. The weather reconnaissance aircraft reported four tenths cumulus and considerable cirrus.

On Zebra minus one during the morning, the weather was ideal in the Eniwetok area there being a few low clouds and some very high widely scattered cirrus. However, the weather reconnaissance aircraft dispatched to the north and west of Eniwetok reported large amounts of low and medium clouds. The wind structure was improving despite the fact that the surface pressure gradient had not changed appreciably.

The critical nature of the winds made it necessary to start the accelerated balloon run scheduled early. Instead of starting at noon on Zebra minus one, the schedule was altered to start at 0600M. With additional sounds at 0830M and 1000M. This permitted the receipt and analysis of three soundings prior to the formal briefing at 1100M and Zebra minus one.

At the 1100M briefing on Zebra minus one the weather forecast remained essentially unchanged.

After a careful analysis of the weather reconnaissance report prior to the 1800M briefing on Zebra minus one it was decided that continued favorable cloud conditions would exist for "H" hour. The wind structure had continued to improve during the afternoon of Zebra minus one and by 1800M a definite stabilization and slight increase in velocity was evident and as a result favorable wind conditions for Zebra day were forecast with considerable confidence.

Thus at the formal briefing at 1800M with Commanders, Joint Task Force Seven, the cloud forecast was not changed. The wind prediction called for E to SE directions below 7000 feet and W to WNW from 7000 to 50,000 feet.

During the early evening there was considerable cloudiness on the southern horizon. To the northwest and west, the sky, except for a few scattered high clouds, and occasionally low scattered scud type cumulus, well wind blown and dissipating, was clear.

By 0015M Zebra day, the first of two scheduled weather reconnaissance was in the local area. From this time on, radio voice contact was made with this aircraft every hour on the hour. A summary of the information passed during these contacts follows:

0015M Take off from Kwajalein accomplished at 2200M, in showers. Enroute, variable amounts of low middle and high clouds. Average wind to Wotho 115° 13 knots. Local area, weather, few low scud type flat cumulus, no middle clouds, some currus. Cirrus seems to be increasing to the NW. Middle clouds end about 40 miles south of Eniwetok.

0044M (Second weather reconnaissance aircraft 70 miles out of Eniwetok) Second aircraft reports lightning to South of course estimated 100 miles away.

0100M Weather report 5/10s cumulus tops 2500 feet few tops to 7000 feet. 3/10s middle cloud very thin at 11,000 feet. Lightning to the SE of Eniwetok, cloud to cloud type. No apparent movement of middle clouds or increase since previous report.

0200M No change in previous cloud condition report. Still see lightning to south. Cumulus in patches, none over Eniwetok lagoon at present time. Cirrus clouds are above us, present altitude 30,000 feet true. Cirrus appear to be below 35,000 however.

0300M Position 20 miles south of Eniwetok at 20,000 feet. Now estimate 6-7/10s low clouds, no middle clouds, and 3-4/10s cirrus. Radar reports no rain showers.

0400M Can still see lightning to south. Radar reports no showers. Local weather over lagoon, 4-5/10s small flat wind blown cumulus in patches. No middle clouds, cirrus 3/10s to W and N.

0500M Lightning still to south but infrequent. Cloud cover same as last report, no rain showers on radar scope. Few buildups of tops to 5000 feet remainder tops 3000 feet.

0530M Local area still the same with 4-5/10s low clouds. No showers on radar scope. This last report until "H" hour.

At 0215M the time having been fixed by the Commander, JTF 7, an informal briefing for members of the staff was held. The purpose of this briefing was to forestall the take off of the drone aircraft in the event that inclement weather or winds had developed or were forecast that might require a decision to delay the operation.

On the basis of the weather briefing at 0215M the operation was on. At this time, the previous forecast of a few widely scattered showers was abandoned, first due to the lack of development of the low clouds, and secondly no inversion was developing in the lower layers from which showers might be formed by radiotional cooling.

At the 0445M weather briefing the winds had now become southwesterly from 6000 to 45,000 feet. The weather was essentially the same as briefed at 1800M and 0215M. The decision to continue the operation was made, and the Zebra day test was conducted according to schedule.

4. Comments

The preparation of a study on the movement of troughs from the Japanese Empire to the Eniwetok area was of great aid in formulating the outlook forecast for Zebra day. With the results obtained from this elementary type study, a positive evaluation of the weather influence resulted in a decision that Zebra day should not be advanced by one day.

SECTION XII

TABLE #14

Zebra Day

DD - Wind Direction (Degrees)
VV - Velocity (Knots) UPPER WINDS DATE: 15 May 1948

Time Local	0000		0200		0300		0300		0400	
	DD	VV	DD	VV	DD	VV	DD	VV	DD	VV
Height in Ft										
SURFACE	090	09	080	08	080	08	100	01	070	08
1000	070	09	090	08	090	13	080	16	080	10
2000	090	09	100	11	090	11	080	16	090	12
3000	110	10	100	11	100	09	090	16	100	13
4000	120	12	110	09	130	07	110	08	110	11
5000	140	10	130	07	160	06	120	12	150	06
6000	160	07	140	08	170	05	120	12	160	06
7000	190	06	160	11	180	07	170	08	190	12
8000	200	07	180	13	190	11	180	08	190	12
9000	210	10	210	11	220	11	160	08	200	12
10000	230	14	220	12	220	11	170	16	220	13
11000	220	16	190	14	220	14				
12000	220	17	200	15	220	14	210	14	170	08
13000	220	17	210	14	220	10				
14000	230	14	230	11	220	08	220	16	200	07
15000	230	08	230	07	220	07				
16000	240	08	220	08	230	10	210	16	240	12
17000	250	10	230	13	240	16				
18000	240	13	230	19	240	18	230	12	250	19
19000	230	13	230	17	250	17				
20000	240	12	240	16	250	19	230	10	250	17
21000	250	13	250	09	250	20				
22000	250	17	250	20	250	21				
23000	240	18	250	19	250	23				
24000	230	17	250	18	250	22				
25000	240	16	240	19	250	21	230	12	230	26
26000	240	20	240	24	250	26				
27000	250	21	240	27	260	30				
28000	250	23	250	27	260	35				
29000	260	27	260	28	260	38				
30000	260	30	260	30	250	41	240	10	250	27
31000	250	33	250	35	250	44				
32000	240	45	250	40	260	42				
33000	250	43	250	44	260	38				
34000	260	43	260	46	260	45				
35000	260	46	260	48	250	50	230	16		
36000	260	52	260	48	280	54				
37000	260	50	250	48	280	54				
38000	260	49	260	48	280	54				
39000	270	50	270	49	280	63				
40000	280	51	280	52	280	67				

[redacted]

UPPER WINDS

DD - Wind Direction (Degrees)
VV - Velocity (Knots)

DATE: 15 May 1948

Time Local	0000		0200		0300		0300		0400	
	DD	VV	DD	VV	DD	VV	DD	VV	DD	VV
Height in Ft										
41000	270	53	280	54	270	54				
42000	270	54	280	56	270	51				
43000	260	56	270	58	260	45				
44000	260	54	270	62	260	40				
45000	260	53	270	64	260	44				
46000	270	51	270	65	270	50				
47000	280	50	260	56	270	55				
48000	280	50	260	51	270	52				
49000			260	49	270	56				
50000					270	64				
51000					260	57				
52000					250	51				
53000					250	50				
54000					250	50				
55000					260	47				
56000					260	41				

~~SECRET~~

TABLE #14

Zebra Day

UPPER WINDS

DD - Wind Direction (Degrees)
VV - Velocity (Knots)
DATE: 15 May 1948

Time Local	0600		0800		0900		1000		1200	
	DD	VV	DD	VV	DD	VV	DD	VV	DD	VV
Height in Ft										
SURFACE	080	09	100	08	090	08	120	12	090	10
1000	080	12	110	13	090	13	110	16	120	12
2000	100	15	110	14	100	15	110	16	120	16
3000	110	19	110	14	110	16	120	20	120	18
4000	110	19	110	13	110	15	120	16	120	17
5000	130	11	110	13	110	12	110	16	140	16
6000	130	08	120	11	140	13	110	12	150	13
7000	180	11	120	09	160	07	130	12	160	13
8000	200	15	180	07	060	08	140	12	160	13
9000	200	11	200	09	200	08	160	08	160	09
10000	220	11	190	10	200	12	210	12	190	07
11000	220	15	190	11	200	14			190	08
12000	230	15	190	12	210	15	200	16	190	11
13000	270	08	200	13	220	15			200	12
14000	240	06	230	10	230	10	210	12	210	10
15000	270	12	240	06	240	07			220	08
16000	270	16	250	07	260	10			220	05
17000	260	19	250	10	270	12			230	07
18000	250	16	250	10	270	14			240	10
19000	240	18	250	11	260	20			240	14
20000	240	18	250	17	260	21			230	16
21000	240	22	240	24	250	19			230	18
22000	240	25	240	22	250	22			230	20
23000	250	25	250	20	250	24			240	20
24000	240	25	260	20	240	29			250	22
25000	250	27	260	25	250	31			260	23
26000	250	26	250	26	270	33			260	24
27000	260	27	250	23	270	36			270	26
28000	260	32	260	26	270	37			270	28
29000	270	39	260	30	270	39			270	33
30000	270	43	260	39	270	38			270	36
31000	240	46	260	42	260	38			270	36
32000	260	46	260	41	260	36			270	36
33000	270	40	260	40	270	36			280	34
34000	280	41	260	40	280	35			290	36
35000	280	43	260	40	290	38			290	39
36000	280	49	270	41	290	45			290	42
37000	280	46	280	43	300	50			280	46
38000	280	58	290	44	290	54			270	46
39000	270	61	290	44	290	55			270	44
40000	270	72	290	42	290	49			260	38

TABLE #14

Zebra Day

UPPER WINDS

DD - Wind Direction (Degrees)
VV - Velocity (Knots)

DATE: 15 May 1948

Time Local	0600		0800		0900		1000		1200	
	DD	VV	DD	VV	DD	VV	DD	VV	DD	VV
Height in Ft										
41000	270	61	280	49	280	47			270	39
42000	270	50	280	54	270	47			270	40
43000	270	36	280	49	270	46			270	40
44000	270	35	280	42	270	47			260	35
45000	270	35			270	48			250	31
46000	260	34			280	48			250	30
47000	260	38			280	42			260	30
48000	260	43			270	41			270	30
49000	270	42			260	45			280	36
50000					260	48			270	30
51000					260	49				
52000					260	51				
53000					260	54				
54000					260	59				

TABLE #14

Zebra Day

UPPER WINDS

DD - Wind Direction (Degrees)
VV - Velocity (Knots)

DATE: 15 May 1948

Time Local	1500		1600		2100	
	DD	VV	DD	VV	DD	VV
Height in Ft						
SURFACE	090	06	090	09	080	09
1000	100	11	090	10	080	17
2000	100	11	100	11	090	17
3000	110	13	130	16	090	16
4000	140	07	140	21	100	12
5000	140	13	140	11	110	10
6000	140	13	140	09	130	07
7000	160	11	140	11	140	05
8000	180	07	160	08	140	06
9000	180	05	200	05	160	09
10000	180	06	180	08	100	10
11000	180	11			170	07
12000	190	13	200	10	200	09
13000	190	07			190	08
14000	190	05	180	09	100	06
15000	190	05			220	04
16000	210	07	210	20	240	07
17000	220	13			240	11
18000	220	16	220	23	230	14
19000	240	15			230	15
20000	250	16	260	15	230	15
21000	240	17			230	14
22000	230	19			240	14
23000	240	20			250	15
24000	240	21			260	15
25000	260	25	250	24	220	18
26000	270	27			290	22
27000	270	23			280	24
28000	280	35			260	25
29000	270	32			270	22
30000	260	30	270	43	280	20
31000	260	30			280	26
32000	280	28			270	26
33000	300	37			260	28
34000	300	44			260	31
35000	300	40	260	30	270	33
36000	280	38			270	34
37000	270	44			280	32
38000	280	41			280	34
39000	260	36			260	32
40000	260	35			270	35

TABLE #14

Zebra Day

UPPER WINDS

DD - Wind Direction (Degrees)
VV - Velocity (Knots)

DATE: 15 May 1948

Time Local	1500		1600		2100	
	DD	VV	DD	VV	DD	VV
Height in Ft						
41000	260	35			280	28
42000	270	38			290	22
43000	270	39			290	43
44000	280	44			290	49
45000	290	50			290	52
46000	280	53				
47000	280	56				
48000	280	50				
49000	260	47				
50000	250	44				
51000	220	42				
52000						
53000						
54000						
55000						

TABLE #15

Zebra Day

ATMOSPHERIC SOUNDING

PPP - Pressure (Mb)
hhh - Height (Ft)

TT - Temperature (C)
U - Relative Humidity (%)

uu - Mixing Ratio
X - Missing

DATE: 15 May 1948

TIME LOCAL 0300					0600					0900				
PPP	hhh	TT	U	uu	PPP	hhh	TT	U	uu	PPP	hhh	TT	U	uu
1008	000	27	84	19.0	1008	000	27	81	18.4	1010	000	29	76	19.
1000	240	26	80	17.9	1000	XXX	26	80	17.8	1000	300	28	70	18.
889	3600	20	70	12.3	850	4850	18	50	8.7	850	4970	19	60	9.
850	4880	18	50	9.2	766	7800	15	50	7.7	746	8600	14	20	3.
745	8600	12	30	4.6	700	10240	10	40	5.1	700	10370	11	50	5.
700	10240	10	50	6.2	675	11200	08	60	6.7	673	11400	09	60	7.
677	11200	08	60	6.7	534	17400	-01	40	3.1	626	13400	05	40	4.
650	12200	06	50	5.5	500	19170	-05	50	2.9	699	14600	05	20	1.
635	12900	07	20	1.9	465	21300	-08	50	2.6	531	17700	-01	50	3.
510	18700	-05	20	1.3	450	21900	-08	20	1.2	500	19340	-04	60	3.
500	19170	-05	10	X	400	24800	-15	10	X	400	25000	-14	20	0.
400	24800	-15	X	X	335	29100	-25	X	X	300	32010	-27	X	
300	31790	-30	X	X	324	29900	-24	X	X	269	34100	-34	X	
264	34700	-37	X	X	300	31700	-29	X	X	200	40700	-52	X	
200	40850	-52	X	X	263	34700	-37	X	X	106	43400	-80	X	
100	54420	-83	X	X	200	40750	-52	X	X					
088	56800	-78	X	X	128	49700	-74	X	X					

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TABLE #15

Zebra Day

ATMOSPHERIC SOUNDING

PPP - Pressure (Mb) TT - Temperature (C) uu - Mixing Ratio
hhh - Height (Ft) U - Relative Humidity (%) X - Missing

DATE: 15 May 1948

TIME LOCAL

1000					1500					1600				
PPP	hhh	TT	U	uu	PPP	hhh	TT	U	uu	PPP	hhh	TT	U	uu
1010	000	29	76	19.3	1008	000	33	61	19.5	1006	000	26	78	16.7
1000	290	28	70	18.8	1000	240	30	60	17.1	1000	220	26	80	16.5
923	X	21	80	14.0	993	500	27	60	14.8	850	4890	20	60	10.4
850	4980	16	80	10.8	850	4920	19	50	9.7	776	X	18	60	9.9
842	X	15	80	10.6	820	5900	17	40	7.2	700	10320	11	70	7.9
817	X	15	40	6.2	728	9200	13	30	4.2	660	X	08	70	6.8
776	X	13	50	7.1	700	10300	11	60	7.4	590	X	03	X	
716	X	11	X	X	661	11900	08	60	6.2					
700	10280	10	X	X	637	12800	07	10	1.9					
565	X	00	X	X	575	15700	02	30	2.4					
500	19190	-05	X	X	500	19260	-05	60	3.7					
400	X	-15	X	X	455	22000	-08	40	2.2					
300	31790	-28	X	X	415	24000	-13	20	0.9					
268	X	-32	X	X	400	24900	-15	X	X					
					300	31920	-28	X	X					
					276	X	-33	X	X					
					200	40990	-51	X	X					
					118	51900	-75	X	X					

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TABLE #15

Zebra Day

ATMOSPHERIC SOUNDING

PPP - Pressure (Mb) TT - Temperature (C) uu - Mixing Ratio
hhh - Height (Ft) U - Relative Humidity (%) C - Missing

DATE: 15 May 1948

Time Local
2100

PPP	hhh	TT	U	uu	PPP	hhh	TT	U	uu
1008		28	78	18.8	1010	000	28	81	19.5
1000	200	28	70	18.2	1000	290	27	80	19.0
878	4000	19	70	11.8	950	X	22	80	15.5
850	4920	18	70	10.4	850	4950	16	70	10.3
783	7200	15	50	7.1	760	X	13	30	3.9
761	8000	15	40	6.2	732	X	10	30	4.1
700	10300	10	50	6.3	700	10250	08	50	5.4
675	11300	09	60	6.7	643	X	04	80	6.3
616	13700	04	X	X	618	X	03	30	2.9
MISDA					500	19100	-08	70	3.1
555	16500	-01	X	X	447	X	-13	100	3.1
500	19220	-06	X	X	438	X	-15	90	2.5
400	24800	-19	20	0.5	425	X	-15	60	1.6
300	31660	X	X	X	400	X	-19	X	X
274	33600	-37	X	X	394	X	-19	X	X
200	40680	-31	X	X	380	X	-20	X	X
162	45100	-26	X	X	300	31520	-33	X	X
					200	40420	-55	X	X
					150		-69	X	X

TABLE #15

Zebra Day

AIRCRAFT SOUNDING

PPP - Pressure (Mb)   U - Relative Humidity (%)

TT - Temperature (C)

DATE: 15 May 1948

TIME LOCAL 0100			0145			0200		
PPP	TT	U	PPP	TT	U	PPP	TT	U
960	23.5	87	650	7.0	14	550	-1.1	39
900	20.8	71	600	5.0	13	500	-1.6	20
850	18.2	72	550	1.0	30	450	-4.0	24
800	17.0	34	500	-2.0	29	400	-6.5	12
750	13.2	59	450	-6.0	16	350	-11.8	10
700	10.2	58						
650	7.4	25						
600	4.4	31						

Time	
003	[redacted]
013	
023	
033	
043	
053	
063	
073	
083	
093	
103	
113	
123	
133	
143	
153	
163	
173	
183	
193	
203	
213	
223	
233	
SEC	

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Rongerik, Majuro, Wake, Kwajalein and Eniwetok and returned to the Air Weather Service, Gravelly Point, Washington 25, D. C.

There were no problems worthy of mentioning in connection with the roll up of the ship aerological units, of the Joint Task Force, the USS Mt. McKinley, USS Albemarle, USS Curtiss and the USS Bairoko.

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METEOROLOGY

PART EIGHT

Comments

1. Introduction.

Much of the meteorological planning for project SANDSTONE was based on the experiences and recommendations of the meteorological unit that participated in Project Crossroads. The participation of some of the key personnel from Crossroads in Sandstone made the problem of planning and operating a Weather Center and the establishment of the attendant meteorological network easier by providing through past experience a clearer understanding of the overall meteorological problems involved.

2. Mission.

The mission of the meteorological unit as stated in Annex K to Field Order Number 1 was found to fulfill the requirements placed on the Meteorological Section by operating agencies of Joint Task Force Seven.

3. Organization.

Eniwetok has been designated as a permanent atomic weapons proving ground. The responsibilities of maintaining the area as a post Sandstone requirement have been delegated to CINCPAC.

It is suggested that any post Sandstone meteorological requirements be made known to the weather agencies normally serving the of the Pacific. It is further suggested that requests for any meteorological service be placed on the 43rd Weather Wing inasmuch as this Air Force Agency controls most of the land weather stations in the Pacific area. In addition they have attached as an integral part of their organization, complete aerial weather reconnaissance facilities.

4. Planning.

a. From a meteorological point of view, the choice of the site of Eniwetok Atoll as a permanent atomic weapons proving ground is not a particularly good one. From a meteorological standpoint, there are three basic requirements for a suitable site for atomic bomb experiments. These are:

(a) There should be a reasonable frequency of occurrence of cloud or weather conditions to meet the operational requirements for the experiment. Thus, if it is essential to have clear skies for the test, a reasonable percentage of clear sky rays should be recorded in the climatic record for the site. Or if it is desirable to explode the bomb in a rainstorm, a reasonable frequency of occurrence of rainstorms should be recorded.

(b) Wind conditions from the surface to stratospheric levels should be such that there can be no possibility of subjecting personnel to radiological hazards or

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operation was the Able-day test at Bikini. For this test, a minimum cloudiness was almost mandatory. A bomb drop would have been impossible had the average Marshall Island cloudiness prevailed on Able-day. In the practice days leading up to Able-day, bomb dropping aircraft frequently aborted for failure to see the target because of clouds. The fact that Able-day was successful does not alter the fact that for an average expectancy, the mission should have failed and that a

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long postponement may have occurred before a suitable day for the mission would have arrived.

(b) The wind conditions in the Marshall Islands have a complex structure which tends to complicate the radiological safety pattern. Winds blow from the east from the surface to near 20,000 feet, then shift to the west above this level to heights of 50 or 60,000 feet, and then again blow from an easterly direction in the stratosphere. This complex upper wind structure, when interpreted into diffusion of radioactive debris, requires a readiness for evacuation of personnel by Navy ships for every test.

(c) There are no known satisfactory methodologies for forecasting in tropical areas. The nature of atmospheric processes is incompletely understood and as a result, the prediction of winds, clouds and rain cannot be accomplished with a reliable accuracy.

Further, because of the paucity of existing weather stations in the Marshall Islands, an undertaking of an atomic bomb experiment in this area requires the support of a very sizeable meteorological force. The existing weather stations require augmentation by personnel and specialized equipment for making very high level atmospheric soundings. New stations have to be established generally on uninhabited atolls. For the SANDSTONE Operation, approximately three hundred thirty (330) officers and men were required for meteorological support. Despite this number of men, there can be no high assurance that the predictions for twenty-four (24) hours and beyond for critical test days will be accurate because of the incomplete understanding of tropical meteorology.

In considering a possible site in the United States for atomic bomb experiments, it would appear that the most cogent requirement would be one of safety. This requirement can be easily met by choosing a climatic region where the winds to stratospheric levels show a consistent direction such that there can be little or no probability of radioactive debris unintentionally contaminating personnel and surrounding land and water areas. Because the United States is predominately under the influence of prevailing westerly winds, it seems obvious that the eastern coast areas of the United States may provide a suitable site. For example, the coastal areas of North Carolina are influenced by prevailing west to northwest winds to at least 50,000 feet throughout all seasons of the year.

Along the coastal areas of North Carolina, there are frequent storms, but these alternate with periods of fair weather with small amounts of cloud. Predictions of weather and winds can be made generally with high accuracy for twenty-four (24) hours and with moderate accuracy for as much as six (6) days in advance. There is also the important advantage of the existence of an adequate meteorological network which can provide high level soundings with a minimum expenditure of effort. It is suggested that the meteorological deficiencies be thoroughly considered before any future atomic weapons test be again conducted at Eniwetok.

b. The meteorological observation stations established for the Sandstone operation were based on the experiences gained during the Crossroads operation. The Crossroads tests, although planned for spring of 1946, were finally conducted during the summer months. The problems of stating requirements of a meteorological observing network are not simple, due to the present inadequate knowledge of tropical weather.

The observational weather stations should be land based to insure a continuous reporting network of upper air sounding to maximum altitudes. Present shipboard aerological units are handicapped by the lack of proper radar equipment for making upper air soundings to high altitudes unless major capital ships are employed. The use of large ships obviously can not be justified solely for meteorological purposes. Therefore it is apparent that the meteorological installation must be made on available islands.

The weather stations which should be considered for future operations in the Eniwetok area are: Eniwetok, Wake, Kwajalein, Tarawa, Naru, Kusaie, Truk, Marcus, Howland, Palmyra, a base in the Ellice Islands, a base in New Guinea, a ship (Bird Dog) located 12 N. and 178 E.

This network of stations would be suitable for meteorological services during any season of the year, and the data collected would be of tremendous value for tropical weather researches.

The network would still necessarily need to be supplemented by weather reconnaissance aircraft. The detail and amount of weather data observed by aircraft cannot be duplicated in any presently known manner. The tracks of the weather reconnaissance will of course need be adjusted for the season, type of aircraft, base and maintenance facilities.

c. Space considerations aboard a ship greatly limit the activity and amount of man power that can be gainfully employed at any time. From experience at both Crossroads and Sandstone, it is concluded that space aboard the USS Mt. McKinley allocated to aerology is inadequate. It is suggested that in the future the weather organization be land based, or that more space aboard the ship, in addition to the aerological office be made available. This space should adjoin or at least be convenient to the aerological office.

5. <u>Meteorological materiel.</u>

Each of the meteorological stations established for Sandstone was equipped with SCR 658 Rawinsonde apparatus. This permitted wind observations to 60,000 feet or higher. To insure wind soundings to even higher levels, especially near the critical times of detonation, a few 1500 gram balloons were included in the equipment of the land based stations. The heights in some cases were purportedly indicated to have reached as high as 165,000 feet. It is generally conceded that these runs probably exceeded 100,000 feet, but exact height to which these balloons may have reached will require further study. The performance of these balloons was not entirely satisfactory. A large number were defective and burst at elevations below 60,000 feet.

The Eniwetok station was also equipped with SCR 584 Radar set. This set was originally scheduled for diffusion experiments. However, previous runs when evaluated indicated that these measurements would not supply the answers desired. As result, the radar was available for use at all times for wind soundings. This radar set was able to make wind soundings to 60,000 feet every two hours.

The ships of the task force were equipped with standard ship radar gear. These radar installations were not too well suited for making wind runs. The ships were equipped with the standard type radiosonde apparatus, and with some modifications were able to secure soundings equally well as the land based stations.

Where practicable helium should be substituted for hydrogen generation equipment. This substitution is suggested as being advantageous from several different points, one, it is less dangerous, secondly it is much more convenient to handle than the chemicals, requiring less men.

Some consideration might be given to developing equipment for shipboard operation to read the wind direction and velocity directly.

6. <u>Communications</u>.

Weather influences from the Southern Hemisphere unquestionably affect Eniwetok. However, inadequately meteorological reports from the southern hemisphere were received to study these effects. Considerable effort should therefore be made to collect as much of the southern atmosphere weather data as possible in order to analyze and chart the atmospheric perturbations which result in stormy tropical weather.

In areas where there is a predominance of air transport operations, much emphasis is placed on securing data in the strata where the transport planes operate. Because of this there has been an emphasis on prompt transmission of upper air data only to levels below 20,000 feet. For an operation such as Sandstone, it is suggested that all rawinsonde data be transmitted in their entirety to the highest levels obtained.

7. Analysis of Collected Data.

a. Radio facsimile transmission from Guam and Pearl were received with consistently good definition and clarity, in spite of frequent atmospheric interference. None of the copies received was useless. In every case the weather analyses were read with ease. This is in contrast to the normal type radio teletype transmissions which when garbled, are generally completely useless.

The contents of the surface charts from Pearl and Guam contributed very little as a forecasting aid. The contents of the upper air charts contributed nothing. In the main this was due to the small area covered by the transmitted charts. Only a fractional portion of the original manuscript chart which is usually drawn for the entire Pacific was transmitted. It would seem that this procedure caused a minimum amount of work for the weather centrals. But by clinging to archaic thinking in believing that the field meteorologists must have a large scale map, a wonderful opportunity to demonstrate the complete usefulness of facsimile transmissions was completely lost. The entire Pacific surface analysis, and if possible hemispheric analyses should have been transmitted from these centrals.

The upper air charts were scientifically impossible as a forecasting aid. Here again large scale maps were transmitted with many of the charts having only 2 or 3 iso-height lines showing only a fraction of any significant upper-air analysis. Further no temperature analysis or relative topography was indicated and without this information these upper air charts were of casual interest but utterly worthless in forecasting.

Written information on the transmitted charts indicating the reliability of the analysis, estimated frontal intensities, the speed and development of troughs and waves, or implications from other charts used in the analysis such as pressure change charts, thermodynamic consideration and etc., can and should be indicated on the facsimile transmitted maps.

When the facsimile concept is recognized whole heartedly by meteorologists, only then will it be possible to demonstrate its great usefulness. It is estimated that four aerographer's mates out of a

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reports in full detail. The charts were printed on good quality paper and used for making supplementary analyses for such parameters as moisture content, cloud heights and stream lines.

A special need was found for an overall base chart to cover a sufficient portion of the North and South Pacific to be adequate for forecasting at the Eniwetok area. The Navy Hydrographic Office chart (HO 5556) which was used for surface synoptic analyses is too small a scale and does not sufficiently cover the South Pacific. The Air Force WRC series 5-3 is of sufficiently large scale but does not adequately cover the area to the north or to the west. The ideal base chart for forecasting in the Eniwetok area should extend from the Philippine Islands to Hawaii and from the Aleutians to twenty degrees south latitude on a 1:10,000,000 scale.

The use of a greatly reduced in scale base chart of the Hydrographic Office series (HO 5556) was employed to advantage in analysing upper air data.

9. <u>Weather Reconnaissance</u>.

The weather reconnaissance code was found to be deficient in

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significant. Since an affirmative or negative operational decision could depend on a difference of one tenth of cloudiness, this was important.

Also coding instructions are needed for the visibility element. At present, unless the aircraft is flying below clouds near the surface, this code figure has no significance.

The AFRWX FORM 5D provides for coding the surface wind direction to eight points. With experienced observers, the surface wind direction can be determined to thirty-six points and for streamline analyses, this refinement of technique is very desirable. Therefore, a six figure group "66ddff" was added to the end of the regular coded message on all weather reconnaissance flights ordered by the Staff Meteorologist.

Also to assist in determining broad areas of convective activity such as might be formed due to a convergence of winds, it was decided

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to have the observer estimate the degree of cloud forming activity between each point of observation. The values in the table represent average conditions.

Conv 0 - Clear
Conv 1 - Wind blown cumulus, small ragged edges.
Conv 2 - Scattered well formed cumulus.
Conv 3 - Isolated showers and medium cumulus.
Conv 4 - Scattered showers and medium cumulus.
Conv 5 - Showers and medium cumulus.
Conv 6 - Frequent showers and scattered active large cumulus.
Conv 7 - Masses of large swelling cumulus fused together and showers.
Conv 8 - Cumulonimbus such as the equatorial front.
Conv 9 - Active thunderstorm.

This code table is not recommended for general use as it has value only when it is part of a coordinated system of particular analyses.

The position of the wind and convective code groups are incorporated in the following message:

VULTURE FIVE TWELVE 00051 66047 32133 ... ... 58038 62222 660805 CONV 2.

The contribution of the weather reconnaissance effort to the preparation of accurate forecasts cannot be over-emphasized.

10. <u>Forecast Preparation</u>.

With the present state of knowledge of tropical meteorology, the preparation of the forecast was all too frequently a carefully chosen gamble. There are several very important researches which should have priority in further tropical studies.

The wind structure was the most important single parameter required for the safe conduct of the atomic weapon tests. Without the correct winds, the resulting atomic cloud might lead to a great risk of radiological contamination. Because of the scarcity of wind data to very high levels, i.e., 60,000 to 80,000 feet, the problem of forecasting winds to these altitudes is a difficult one.

A few significant forecasting aids were noted which may be helpful in further studies of tropical weather forecasting.

a. During the presence of much middle or high cloudiness, the amounts of low clouds are usually quite small.

b. Convergence zones form between winds of NE and ENE, ENE and E, and E and ESE directions. In general, these zones tend to stay relatively stationary. Occasionally however, they move in the direction of the resultant wind. When the clash of winds disappear, the convergence zone dissipates rapidly.

c. Cold fronts in the Eniwetok area are usually characterized by series of lines of convergence. No solid cloud deck of wide extent was noted such as is generally encountered in temperate latitudes.

d. Cirrus clouds appear to prevail during all seasons. The cause of the cirrus is not known. During both the SANDSTONE and CROSSROADS Operations, none of the weather reconnaissance aircraft ever reached the cirrus level. It is thus concluded that this cloud deck must be very high and generally above 35,000 feet. During the Y-day test, a veil of cirrostratus was located to the east of Eniwetok.

e. One of the best measures of the intensity of the trades

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rates of diffusion and dilution in the atmosphere as well as the physical fall-out of radioactive debris.

ADJUTANT GENERAL'S REPORT - OPERATION SANDSTONE

1. On 3 October 1947 the Commanding General, Joint Task Force Seven, at the first meeting of his Planning Staff assigned verbally to the Adjutant General, the following primary tasks which he desired be accomplished at the earliest possible date:

a. To develop first, together with J-2, the necessary security procedures for the handling of documents.

b. Then, to develop the necessary joint procedure for the flow of information to and from the laboratory and the flow of information within Washington. In the words of the Commanding General this was considered a work of major importance if the whole planning phase was not to bog down.

c. The Adjutant General was cautioned that he would serve in the dual capacity as Adjutant General and Flag Secretary. In this capacity his office was to keep the necessary records, documents, etc. to provide the historical information for later compilation of the reports on this operation.

2. The Adjutant General, Lieutenant Colonel Garlen R. Bryant, AGD, Department of the Army, had reported for duty on that date. The task of organizing an Adjutant General's Section - Flag Secretary's office, as well as carrying out the directives of the Commanding General posed numerous problems of a difficult nature. Of these problems, the following demanded immediate solution:

a. The establishment of the section from scratch. This involved the procurement of personnel, office equipment, telephones, office space

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to handle AEA Restricted Data was made available at once. By 17 October three (3) officer assistants; Major Arthur Raney, USA, Major Raymond E. Hickman, USAF, and Lieutenant James Harper, USN, and the four (4) Clerk Typists, had reported for duty. The other enlisted specialists, however, much as they were needed, were not made available until the end of October. This involved a delay in organizing the section properly and resulted in individual job assignments being changed later. At the end of October, Master Sergeant Fred J. Robison, reported as Chief Clerk to handle the message center and radio traffic, Master Sergeant Joel H. Cohen,

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as Personnel Sergeant Major, T/3 James W. Kelly, as Chief File Clerk and Staff Sergeant Lamoyne W. Leyda, as Stenographer.

4. The problem of procurement of necessary office equipment, office space, telephones and office supplies was solved largely with the assistance of the P & O Division, U.S. Army, General Staff. One of the first mistakes made by the Headquarters was the failure to provide a full time Headquarters Commandant and instead relied on the services of one of the Assistant Adjutant Generals, whose duties as administrative officer precluded him from devoting the necessary time to this secondary important function.

5. The highly classified nature of the operation necessitated the preparation of many blank forms such as receipts, disposition forms and necessary registery logs for classified materiel. Since it was necessary to maintain an accurate record of all incoming and outgoing documents, separate "IN" and "OUT" logs were maintained for Restricted Data and for documents classified under a straight military classification such as Top Secret, Secret and Confidential.

6. In conjunction with J-2, security regulations were published for the handling of documents and the necessary physical security regulations were promulgated. These were issued in the form of Staff Memorandums, numbered consecutively and authenticated by the Adjutant General.

7. In conjunction with the Test Director's Office, Officer Messenger channels were established by the Adjutant General for the delivery of AEA Restricted Data. Classified documents were delivered by officer messenger

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to be used in the dissemination of material by Registered mail. The assembly and routing of courier pouches was also a function of this office and the forwarding of these courier pouches was handled either by members of the Task Force traveling to the forward area or by the regular Security Service, Department of the Army.

8. Another time consuming matter was the establishing of the Adjutant General's files and the procedures adopted to insure that all documents coming into the Headquarters, many of which were hand-carried by officers of high rank, were first registered with the Adjutant General and copies provided for the historical files before action was assigned to the appropriate staff section. In this connection the assignment of action to staff sections on incoming letters, radios and other communications was a function largely left to the discretion of the Adjutant General. In establishing the files it was determined that the Dewey-Decimal System followed by the Army and the Air Forces would best be utilized since the officer and enlisted men assigned to these duties were most familiar with this function.

9. Dissemination of administrative instructions in the preparation of letters, other correspondence, and radios to the enlisted and civilian personnel utilized by the various sections of the Headquarters was another

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Section XIII

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policies. While it was highly desirable that interested parties be informed of the policies and directives of the Joint Task Force Commander, and that request for services be disseminated to the proper agencies without delay, it was necessary that strict accounting for each document and each copy of each document be maintained. This involved numbering copies of publications and obtaining receipts for each copy, resulting in some time lag.

13. The need for fast radio communication channels between Headquarters Joint Task Force Seven and the Forward Echelon, which was established on 20 October in Oahu was intensely acute. This problem was solved by having the Traffic Coordination Section, Office of the Chief Signal Officer handle all electrically transmitted communications on an "Eyes Only" basis and utilizing code words. This method provided excellent results and was reflected in expeditious receipt and dispatch of messages with a minimum of communications personnel involved.

14. It was necessary to obtain certain types of forms, particularly for the J-2 Section which did not lend themselves to mimeographing but required printing. This was accomplished through personal contact with the Administrative Services Division of The Adjutant General's Office, Department of the Army.

15. As soon as practicable the Strength Accounting Branch of the Adjutant General's Office was visited to determine if morning reports and rosters were required. The decision was reached that since the Joint Task Force Headquarters was a provisional organization, the submission of

rosters and formal morning reports was not required. This Office, however, maintained a morning report for historical purposes and for strength accounting purposes. In this connection strength reports were submitted monthly to the J-1 Section on all officers, enlisted and civilian personnel on temporary duty (Navy TAD) with Headquarters Joint Task Force Seven and with the Office Commander Air Forces, Joint Task Force Seven.

16. After J-1 had promulgated policies on the publication of orders and had made initial contacts within the various departments it was the task of the Adjutant General's Office to obtain written orders for the travel of all individuals on temporary duty and TAD with the Headquarters, the Office of the Commander, Air Forces and Task Groups 7.1, 7.5, and 7.6. This was a major task and one officer's entire time was utilized in obtaining these orders. It was early decided that The Adjutant General's Office, Department of the Army would issue orders on all individuals either civilian or military. This involved the issuance of orders pertaining to Air Force and Naval personnel as well as Army personnel and involved orders pertaining to members of the Public Health Service, The Coast Guard and many invitational orders to civilians under contract to the Atomic Energy Commission. The cooperation and help rendered by the Assignment Branch and the Operations Branch of The Adjutant General's Office, Department of the Army aided immeasurably in the completion of this administrative chore.

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Shafter, T.H. in less than a week. Later, on 1 February 1948, APO 187-1 was established at Kwajalein for Joint Task Force Seven personnel on temporary duty with Task Group 7.4, while Navy personnel continued to receive their mail through the Navy Fleet Post Office channels.

19. To alleviate the requirements of the Department of State that civilian employees of the armed services and contract employees who desired to reenter the country must have passports, it was agreed that identification cards issued either by the Department of the Army or Navy would suffice. To expedite issuance, the Department of the Army Identification Card was issued to Army and Air Force employees and Navy Identification Cards to civilians employed by the Navy. To expedite issuance of identification cards to the Atomic Energy Commission Employees, these cards were procured from The Adjutant General' Office, Department of the Army, in sufficient number and issued directly th these employees through this office.

20. At the outset, the classified nature of the operation and the fact that the recommendations of the Joint Proof Task Committee as to the formation of a Joint Task Force were still pending approval of the Joint Chiefs of Staff, it was necessary to use the heading on all letters and documents, "Office of Lieutenant General Hull, P & O Division, U.S. Army General Staff, Room 5B-319 the Pentagon, Washington 25, D.C.." This was subsequently changed to "Headquarters Joint Task Force" and then to Headquarters Joint Task Force Seven", which created some confusion and delay in the receipt of mail.

21. Headquarters Joint Task Force Seven (Forward) was established at Fort Shafter, Oahu, T.H. late in October. 1st Lieutenant Lannis W. Temple, AGD, on duty with Headquarters, USARPAC, was designated as the

Adjutant General for the Oahu Echelon. His constant devotion to duty and hard work in that position was outstanding. He was assisted by CWO Allen Freeman and five (5) enlisted men who joined the section as the volume of work increased there.

22. During November a turn over in officer personnel necessitated the securing of replacements for the Air and Army officer representatives in the Adjutant General's Section. There was, as can be expected, a time lag in obtaining these replacements which created some problems. The Air Force replacement for Major Raymond E. Hickman became ill after only two days duty and was hospitalized and in turn 1st Lieutenant Francis L. Zinkand, USAF, was received in his place. Major Dwight T. Hamersley reported on 25 November as replacement for Major Arthur Raney. Early in December one (1) Officer Courier, Captain Cowan S. Hill, was placed on temporary duty with this office to transmit documents classified Top Secret and those containing Restricted Data, between Washington and Oahu and the Forward Area. In December it became necessary to send two (2) enlisted men forward to Fort Shafter to assist Lieutenant Temple there. In January Major Hamersley and T/3 Kelly moved to Oahu, and the remainder of the section moved forward as individuals, with Lieutenant Colonel Garlen R. Bryant, reporting to Oahu, 14 February, the day prior to the opening of the Headquarters at Fort Shafter and the establishment of Headquarters Joint Task Force Seven (Rear), in the Pentagon, Lieutenant Colonel John F. Taylor, AGD, had reported on 22 December and he functioned

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24. As had been the custom in Washington, the Adjutant General drafted all orders and submitted them to the Adjutant General, Headquarters, USARPAC, whose problem consisted of merely cutting the stencils and producing the necessary number of copies. It was necessary to have orders published for all officers and enlisted personnel at Fort Shafter, scheduled to move to Eniwetok on the USS Mt. McKinley or by air. It was also necessary to have orders issued on many civilians under contract to the Atomic Energy Commission.

25. Upon reporting aboard the USS Mt. McKinley on 8 March, the Adjutant General's Office assumed the additional duties of Flag Secretary and the Section functioned accordingly. By this time the Adjutant General's Section was divided as follows: Lieutenant Colonel Taylor and two (2) enlisted men remained in the rear echelon in Washington;

Lieutenant Temple, CWO Freeman and three (3) enlisted men were working in the Oahu Echelon; four (4) officers, one (1) warrant officer, CWO Ralph Chambers, USA, who had joined the Task Force on 1 March, and twelve (12) enlisted men composed the Office of the Adjutant General - Flag Secretary on board the USS Mt. McKinley.

26. One important item to be stressed here was the deviation from Navy procedure on the handling of communications. The Communications Section, Headquarters Joint Task Force Seven, delivered all incoming radios to the Adjutant General's Section and it was the responsibility of the latter to ascertain that proper assignment of action was made and distribution accomplished. Outgoing radios were delivered to this Section in duplicate, one (1) copy being immediately released to the Communications Section and the second copy retained until the message had been dispatched and sufficient copies delivered to this Section for distribution. This is a departure from the Navy system but worked very successfully in the Joint Staff. It was the policy of the Headquarters to make a complete distribution of all incoming and outgoing messages except those classified Top Secret or Eyes Only, to all Staff Sections. This procedure served to keep each Staff Section abreast of the situation and conversant with the activities of other Sections.

27. Upon arrival at Eniwetok a downgrading committee was appointed for the downgrading of publications eminating from Headquarters Joint Task Force Seven. Many letters, orders and other documents were downgraded

and the fact that these documents had been so reclassified was disseminated to the recipients thereof. This function was performed by this section in conjunction with J-2.

28. The preparation of efficiency reports pertaining to officers of the Army and Air Forces and fitness reports for Naval officers was a function of the Adjutant General's Office. When a report became due this section only required that a work sheet in pencil be prepared by the rating and/or indorsing officer. This report was then typed in finished form in this section. This proved to be of great assistance to all other sections of the Headquarters.

29. After arrival at Eniwetok the Adjutant General's Section issued all orders involving travel by air of all personnel from Headquarters Joint Task Force Seven, Office of the Commander, Air Forces and Task Groups 7.1, 7.3, 7.5 and 7.6. This was a major undertaking but resulted in orders which were standard in format and proved of material assistance to the Task Groups concerned. This involved not only the issuance of necessary orders for Special Officer Couriers returning to Los Alamos, New Mexico and Wasnington, D.C. and many others traveling in the Pacific Ocean Area in connection with operation SANDSTONE, but also involved the issuance of necessary orders returning personnel by air to Fort Shafter. Oahu, T.H. and to the Zone of the Interior, upon completion of operations in the forward area.

30. Upon the return of the Headquarters to Fort Shafter an officer from this section was detailed as the recorder of the Awards and Decorations Board, which processed all recommendations for awards to

members of the Task Force. All recommendations were initially received by the Adjutant General, recorded and hand-carried to the Decorations Board. After the Board had taken necessary action the recommendations were returned to this section for additional processing.

31. In consonance with a directive from the Joint Chiefs of Staff, all records of the Headquarters, histories and reports (except 201 files) were transferred to the Armed Forces Special Weapons Project. The latter served as a permanent repository of these records. 201 files were transferred to The Adjutant General, Department of the Army, the Adjutant General, Department of the Air Force and to the Bureau of Personnel, Navy Department, for personnel of the Army, Air Force and Navy, respectively.

32. The following observations are submitted in the hope that they may be helpful to any future Adjutant General and/or Flag Secretary of a Joint Task Force.

a. Personnel for the section must be selected at the outset of the operation if the Adjutant General is to afford the numerous services demanded of the section during the organizational stage. It is essential that these be trained specialists. Both officers and key enlisted personnel must possess initiative since many problems will arise for which there is no prior policy or precedent.

b. Disseminate to the staff sections of the Headquarters as soon as possible the format for letters, memorandums and other correspondence.

c. Establish the office along functional lines as soon as possible as it is especially important that the files and message center be established at once.

d. Above all, imbue the personnel of the section with a "can do" attitude. Insist that they function at all times with the paramount thought that their mission is to be of assistance to the other staff sections of the Headquarters and to the lower echelons of the Task Force.

REPORT OF THE STAFF
SURGEON

1. The Task Force Surgeon was assigned to Headquarters, Joint Task Force SEVEN on a temporary additional duty status from the Bureau of Medicine and Surgery. He reported for duty on 17 October directly to Lt. General Hull. The office of the Surgeon was placed directly under Rear Admiral Wellings, J-4 Section of Joint Task Force SEVEN.

2. The primary mission of the surgeon's office was to establish a medical plan which would encompass the wide spread medical problems of the task force both ashore and afloat. This plan, which provided for the establishment of hospital facilities sufficient to provide for a thousand men on Eniwetok and to augment the existing Navy facilities on Kwajalein to provide for two thousand men, was later expanded to include the addition of medical officers to the four principal ships of the task force. The AV-4, the AV-5, and the CVE-115 were provided with an additional flight surgeon and the AGC-7, an additional surgeon on a temporary duty status.

3. For Eniwetok, the Naval Medical Supply Depot, Oahu, supplied a Naval Medical G-7 Unit (dispensary, 25-bed) which was to be put in place and operated by the medical detachments of the U.S. Army Engineer Battalion. The G-7 Component arrived on the atoll on 28 November 1947 together with the 1220th Provisional Engineer Battalion with its attached medical detachment consisting of two medical officers, one dental officer, and eight enlisted personnel. The medical detachment was later augmented on 28 December by the arrival of the 532nd Engineers and

attached medical personnel consisting of three medical officers, one dental officer, one MSC officer, and twenty enlisted. A complete hospital was established including operating room with facilities for sterilization, X-ray, laboratory, etc. Because of the wide-spread activities of the engineer troops, however, it was found necessary to place a medical officer on the islands of Engebi, Aoman, and Runit, and a Chief pharmacist's mate from the U.S.S. ASKARI on Parry. This decentralized the medical personnel but made it possible to maintain the hospital with two medical officers employing the outlying medical personnel in reserve in case of emergency.

4. At Kwajalein, a Navy Medical G-5 component (hospital dispensary, 50-bed) furnished by the Navy Medical Supply Depot, Oahu, arrived on 15 January. The medical personnel furnished by the Eighth Air Force started to arrive on 5 February and on 24 February, totaled three medical officers, one dental officer, and twenty-five enlisted medical corps personnel. An additional medical officer and four nurse corps officers arrived about the middle of March. A dispensary was set up in the area of Task Group 7.4, The Air Task Group, which operated independently of the Naval hospital and some of the Army medical personnel was loaned to the hospital to augment the staff. The working agreement between the Island Commander and the Commander, T.G. 7.4 is attached as Enclosure A.

5. The Task Force Surgeon made a tour of inspection of the medical facilities and sanitary conditions of the forward areas from 7 to

19 January 1948. He joined the Forward Headquarters of the Joint Task Force at Fort Shafter on 18 February and made a second trip of inspection of the advanced areas from 25 to 29 February. No formal report of this trip was made since both medical and sanitary conditions were very satisfactory and no recommendations were indicated. A verbal report was submitted to Admiral Wellings.

6. During the stay on Oahu, consultations were held with the District Surgeon, 14th Naval District, the Medical Officer, ComServPac, the Commanding and Executive Officers, U.S. Naval Hospital, Aeia, and the Surgeon, USARPAC. These conferences were for the purpose of making available on short notice, large quantities of type "O" whole blood together with transfusion apparatus for air shipment to the target area in case of emergency. Contact with the Blood Doner Center in Honolulu was avoided for reasons of security. Satisfactory arrangements were concluded with the above mentioned agencies and theemergency blood bank placed in a "stand-by" state. Confirmation of the state of readiness of this blood bank was received in the form of a letter dated 12 April 1948 from ComServPac to CJTF-7.

7. During the operational phase preceding and following the tests, there was little to do beyond normal medical operations. Sanitary conditions throughout the Atoll were satisfactory except for a brief period in late April when the fly problem got out of control temporarily and required some concentrated effort. Water supply was excellent throughout the period due to the presence of a water ship. The food was uniformly excellent, the general health above average, and venereal disease,

of course, non-existent. There were no epidemics, no diarrheas and even fungus infections were minimal.

8. In connection with the sanitary problems, one point was overlooked which threatened to become important. A few people were required to remain on the zero islands right up to the evening of D-1 and required housekeeping equipment up to that time including galley and head facilities. These facilities were demolished by the blast and the garbage and sewage pretty well spread out. The radioactivity appeared to have only a beneficial affect on the flies and by D x 4 they had taken over the area and a special project to spray the island with DDT was necessitated. This condition was corrected on subsequent shots.

9. Looking forward to possible long range effects of minor radiation and to possible future legal complications involving the Government or the AEC, it was decided to forward a permanent record of all exposed civilian personnel to the AEC and of all military personnel to the respective Suregon's General.

10. All medical officers of the task force were invited to attend a series of three meetings. The first was a discussion of the effects of the atomic weapon, exclusive of radiation. It was held aboard the AGC-7. The second was held aboard the AV-4 and covered radiation. It was conducted by 7.6 and consisted of a lecture by Col. James P. Cooney and discussion by Lt. Col. Karl Hougnton, Dr. James Nolan, Dr. Whipple, Dr. Scoville, and others.

11. The third conference was conducted aboard the CVE-115 by Cmdr.

Andrews, USPHS, and covered instrumentation and detection and an inspection of the workshops and laboratories. It is believed that these conferences were very well received and created considerable interest. A series of slides showing the blast, burn, and radiation effects on some of the survivors in Japan were of particular interest.

12. The "Evacuation Plan" required that two AVR's stand by at assigned stations in the lagoon as rescue boats in case of air accident. The plan required that a medical officer be aboard one of these. Since each of the target islands had had a medical officer throughout the preparatory phase, it was decided to assign the target island medical officers to the AVR on his target date. This plan worked out very satisfactorily and it was surprising to find that there was a considerable rivalry for the job. The stand-by medical force at the hospital on Eniwetok Island was limited to two medical officers and two trained enlisted technicians in order to keep to a minimum the number of personnel who would have to be evacuated from the island in case of emergency.

13. Late in April a further change in original roll-up plans was necessitated when it was considered essential to establish a permanent garrison on Eniwetok Island. The question of how much of the medical supplies and equipment should be left and how much "Rolled up" was settled in a conference with Rear Admiral Wellings. In view of the distance to Kwajalein and possible interference with air transportation in case of emergency, it was decided to leave the hospital unit intact. This decision was in keeping with the general policy of the entire

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ing for future experiments of this kind, provisions be made for weekly air spraying of all areas with D.D.T. The flies seemed to increase in alarming numbers even in areas where there was no discoverable breeding area. No disease or epidemic resulted but the flies were a constant source of annoyance ashore.

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the A.T.S. Dispensary or in the Naval Dispensary, as the situation dictates.

b. One Dental Officer (3170) will perform his duties in the A.T.S. Dispensary. He will be available to the Naval Dental Clinic for purposes of consultation as the situation demands.

SECTION XIV

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be made available as the patient load demands. Two Nurses will be utilized in the A.T.S. Dispensary on the Holding Ward, one of whom will be made available to the Naval Dispensary as the situation requires.

d. All Medical Officers and Nurses of A.T.G. 7.4 will be available for duty in the Naval Dispensary in case of emergency.

e. Enlisted specialists will be made available in the following categories: One X-ray technician, one laboratory technician, one sanitary technician, two surgical technicians, and one surgical ward attendant. In addition there will be two ambulance drivers to operate A.T.G. 7.4 ambulances loaned to the Naval Dispensary for use.

3. This agreement may be revised in the event subsequent instructions to either Task Group Commanders are received from higher Headquarters.

/s/ T. J. DuBose

/t/ T. J. DuBOSE
Colonel, USAF
Commander, ATG 7.4 (Prov) Fwd

/s/ J. P. W. Vest

/t/ J. P. W. VEST
Captain, U.S.N.
Commander, Task Group 7.7

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involved.

The Section was organized about 1 October 1947. At the outset it was composed of Captain C. G. DeKay, SC, U.S.N., Lt. Colonel K. N. Gray, U.S.A.F., and Lt. Colonel W. C. Workinger, F.D. These officers represented interests of the Navy, Air Force, and Army respectively, in fiscal matters of the Joint Task Force. The first two weeks were filled with late working hours in an attempt to obtain estimates of the funds the Armed Services would need in order to pay for their part in the operation. On 15 October Commander R. M. Whittemore, SC, U.S.N.,

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reported, and shortly thereafter relieved Captain DeKay as Fiscal Officer for the operation.

Basic fiscal agreements between the Departments of the National Military Establishment and the Atomic Energy Commission were arrived at in the first week after orders to the Task Force Commander were issued. It was determined that the Atomic Energy Commission would advance funds to the Navy Department by appropriation transfer. The Navy Department would in turn advance funds to the Department of the Army and the Department of Air by cash transfer under the appropriation. It was agreed that expenditures would be reported by object classification to the Navy Department which would make a monthly consolidated report to the Atomic Energy Commission of all expenditures for the three Departments. The decision as to which expenditures for the operation would be chargeable to funds to be made available by the Atomic Energy Commission posed an initial problem which was heightened by secrecy which limited the discussion to a very small group in each Department. In theory authorization of expenditures for an operation of this nature would be approved by the heads of all Technical Services and Bureaus in each Department. The time available and the secrecy of the operation did not permit such action.

Finally, on 20 October, the Fiscal Agreement (Appendix A) was issued. In general terms this paper, with its enclosures, indicated what expenses would be borne by the Armed Services and what ones by

Atomic Energy Commission and for what purposes.

On 23 October the Atomic Energy Commission transferred five million dollars to the Navy Department, and on 31 October fifteen millions more. By this time nearly all of the Staff Sections were clamoring for funds to get started. Particularly important items were funds for long distance telephone calls and travel expenses. The twenty million dollars were distributed by the Bureau of Supplies and Accounts, Navy Department as follows:

Agency	Travel	Other	Total
Army	$152,500	$ 4,394,833	$ 4,547,833
Navy	88,500	3,415,980	3,504,480
Air Force	259,000	4,797,584	5,056,084
Unassigned (Held by Navy)	-0-	6,891,603	6,891,603
	$500,000	$19,500,000	$20,000,000

The only limitation on the money was that for travel expenses. Originally only $500,000 was allowed for travel expenses, although it had been estimated that $718,000 would be required. The Atomic Energy Commission increased the limitation to $600,000 on 8 January in order to partially meet a revised travel estimate of $1,268,600.

From the beginning plans changed frequently. New projects were added and existing ones were financed differently than originally

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The first routine monthly report of obligations and expenditures (for November) was received on time (5 January). About half a million

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had been expended and three quarters of a million obligated. The report for December showed slightly over seven hundred thousand dollars expended and just over two million two hundred thousand obligated.

Throughout the planning and organization stages it was made standard procedure that requests for funds not covered in the estimates would be submitted in writing via the appropriate Army, Navy, or Air Force agency to the Atomic Energy Commission and Commander, Joint Task Force Seven for approval.

Lt. Colonel Gray made a trip of three weeks to Hawaii in December, visiting Air Force activities there and on the West Coast, to establish liaison and discuss funding problems. Commander Whittemore moved forward to the Headquarters at Ft. Shafter, T. H., early in February. Lt. Colonel Workinger remained in Washington to handle fiscal matters there.

It was determined in December to establish an Advisory Audit Team to instruct the various property officers at Kwajalein and Eniwetok in the desired methods of accounting for Atomic Energy Commission, Army, Navy, and Air Force property. This was deemed necessary so that at the time of roll-up all property worth returning could be consigned to the owning agency. Major C. D. Waldecker, F.D., reported to Headquarters in Washington on 2 December from USARPAC, and after a period of discussions returned to the Forward Echelon at Ft. Shafter, T. H. The Advisory Audit Team was later augmented by Lieutenant G. W. Dorfmeier, SC, U.S.N., and Chief Warrant Officer C. W. Wallis. Major

Waldecker and C.W.O. Wallis visited the forward areas in January and early February to assist property officers in establishing their records. It was learned that considerable difficulty was being experienced by the property officers in obtaining copies of War Shipping Documents, Navy invoices, etc., necessary to establish proper accountable records.

CHAPTER II

PHASE - PLANS AND ORGANIZATION (CONTINUED)

At the time the Headquarters (Main) shifted from the National Defense Building in Washington to Ft. Shafter, T. H., (16 February) Commander Whittemore and Lt. Col. Gray were at Ft. Shafter. Lt. Col. Workinger remained in Washington and became the Fiscal Section's representative with the Rear Echelon. Lt. Col. Gray returned to Washington the end of February. On 15 March Lt. Col. Workinger was relieved by Lt. Col. A. L. Toups, FD, due to illness.

Toward the end of January the Atomic Energy Commission requested that a report be submitted at the earliest practicable date indicating how much money, based on actual expenditures and obligations plus estimates, would be required for the Operation. This was necessary for budgetary reasons so that plans could be made to utilize the funds returned or steps be taken to earmark additional funds if required. It was to further this end and also to obtain estimates of possible fiscal year 1949 fund requirements that the following action was taken in the hope that the desired figures might be obtained by the end of March

1. The Army, Navy and Air Force were requested to issue instructions for all activities to which Sandstone funds had been allocated to submit a carbon copy of each monthly report of obligatio and expenditures via Air Mail to the Headquarters at Ft. Shafter immediately upon preparation; this to commence with the reports for the month of February. In doing this the Fiscal Section would obtain the obligation and expenditure data about four weeks ahead of the routine reports prepared by the Bureau of Supplies and Accounts, Navy Department.

2. The Rear Headquarters was requested to obtain estimates as of 1 March from Army, Navy and Air Force activities in continental United States of funds required to complete the Operation, including roll-up; these to be broken down into amounts required for fiscal years 1948 and 1949. The Headquarters at Ft. Shafter would obtain similar estimates for the Hawaiian and forward areas. Assumptions were drawn up in order to assist the activities concerned in arriving at their estimates.

The fiscal report for January, prepared by the Bureau of Supplies and Accounts, Navy Department, showed slightly over four million dollars had been obligated of which expenditures had been made amounting to one million five hundred thousand dollars.

The members of the Advisory Audit Team were at Ft. Shafter during most of this period. CWO Wallis left for the forward area towards the end of February to continue assisting the property officers at Eniwetok and Kwajalein in setting up their property records. In view of the fact that the property officers in the forward area were not receiving information so they could indicate on their records whether equipment belonged to the Army, Navy, Air Force or AEC it was realized that steps would have to be taken to make this information available. It was originally contemplated and so planned that the War Shipping Documents and Navy invoices would carry this information. However, in the case of the Army and Air Force-furnished items, due to the high security classification which was required of all correspondence at the time shipments were initiated, the instructions issued apparently never filtered down to the working levels. Therefore, the War Shipping Documents did not contain the required information. The Navy invoices contained the information but a large percentage of them either did not reach the property officers or were not properly utilized when they did. The mission of the Advisory Audit Team was expanded to cover the providing of this information to the property officers so that they would be in a position to make proper disposition of the property when it was no longer required for the Operation. (Service-furnished items of equipment charged to AEC funds would become property of the AEC and would be disposed of in accordance with the Commission's wishes, and Service-furnished items not charged would revert to the supplying Service upon roll-up.) Major Waldecker made arrangements through the Rear Echelon at Washington to have lists of the Army and Air Force furnished items which were charged to the AEC funds sent to the forward

Headquarters. These lists were to contain items of a consumable nature when an individual item cost over $5,000.00 (Object Class 08), all items of equipment (Object Class 09), and all items of land and structures (Object Class 10). It was agreed by the AEC that this would serve their property accounting requirements. The Navy accounting system lent itself better to our peculiar needs than did that of the Army and the Air Force, and Lieutenant Dorfmeier, through visits to West Coast and Hawaiian Naval activities and documents on hand, was able to work up lists of Navy-furnished items. Where issues had been made of Naval Stock Account material as a charge to AEC funds the property then belonged to the AEC. Where issues had been made from the Appropriation Purchases Account, AEC funds were not reduced and, consequently, the material still belonged to the Navy.

CHAPTER III

PHASE - OPERATIONS AT SITE

The beginning of this phase of the Operation for the Fiscal Section found Commander Whittemore, Major Waldecker, Lieutenant Dorfmeier and CWO Wallis in the forward area.

The report requested by the AEC which was mentioned in Chapter II was completed, only after considerable difficulty in obtaining the numerous parts of which it was made up, on 10 April and forwarded to the Rear Echelon in order to obtain concurrences and/or comments of the Army and Air Force Fiscal representatives on the Staff and the Bureau of Supplies and Accounts. After minor adjustments in the report a dispatch was sent to the Chief of Staff, U. S. Army recommending that action be initiated to inform the AEC of the revised estimates and to request the three Departments to return a total of $8,000,000 to the AEC immediately and to be prepared to turn back an additional $2,000,000 towards the end of May when so advised. Each Department was to turn back the following amounts initially:

Department	Amount
Army	$1,000,000
Navy	4,500,000
Air Forces	2,500,000
Total - - - - - -	$8,000,000

The return of the $8,000,000 was concurred in by the Joint Chiefs of Staff and steps taken to effect the transfer. It was accomplished in the reverse of the order in which it was received, i.e., through the Department of the Navy which had initially received the original transfers from the AEC.

The report completed 10 April, containing the modifications by the Rear Echelon, showing what the fund requirements were expected to be, is summarized as follows:

Object Classifications 01, 03, 04, 05, 06, 07, 08, 09 and 10

	FY 1948	FY 1949
Army	$2,162,587.54	$ 841,244.00
Navy	4,535,283.28	201,600.00
Air Force	1,346,929.80	1,185,000.00

Totals - - - -	$8,044,800.62	$2,227,844.00

Object Classification 02 (Travel)

	FY 1948	FY 1949
Army	$283,767.82	$100,000.00
Navy	138,883.00	21,000.00
Air Force	470,000.00	110,000.00
Totals - - - -	$892,650.82	$231,000.00

Totals - All Object Classifications

	FY 1948	FY 1949
Army	$2,446,355.36	$ 941,244.00
Navy	4,674,166.28	222,600.00
Air Force	1,816,929.80	1,295,000.00
Totals - - - -	$8,937,451.44	$2,458,844.00

Total for Operation

Army	$3,387,599.36
Navy	4,896,766.28
Air Force	3,111,929.80
Totals - - - - - - - - - -	$11,396,295.44

In view of the fact that the above figures represented obligations, expenditures and estimates as of 29 February it was realized that there might very well be substantial expenses develop in the ensuing months which could not be anticipated at such an early date. Then too, it could not be determined with any degree of accuracy how much would be required for each of the two fiscal years involved. Therefore, the

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made amounting to $3,540,000. The report for April showed a cumulative

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total of $7,979,000 obligated for the Operation of which expenditures had been made amounting to $4,508,000.

The cumulative obligation and expenditure figures shown in this and preceding chapters are tabulated below. The totals for April are the latest ones available at the time of submission of this report (27 May).

	Expenditures*	Obligations
November	$ 475,000	$ 715,000
December	704,000	2,221,000
January	1,542,000	4,033,000
February	2,204,000	4,977,000
March	3,540,000	7,500,000
April	4,508,000	7,979,000

*Expenditures are included in obligations - not in addition to.

The work of the Advisory Audit Team in assisting the property officers with their accounts was completed early in April and CWO Wallis was released from Joint Task Force Seven on 7 April and ordered to return to his permanent duty station. Major Waldecker and Lieutenant Dorfmeier devoted their time to developing information as to what Service-furnished property had been charged to AEC funds so that the responsible property officers could be advised of what belonged to the AEC. Also, in that there was considerable Navy property in Army hands it was necessary to list that to the property officers concerned. Major Waldecker returned to Oahu about the middle of April, being relieved by Major C. P. Law, FD, on 22 April. As property was determined to belong to the AEC it was entered on a form giving all the pertinent data available. The form was addressed to the Task Group Commander concerned and to the unit within the Group held responsible for the property. A copy was sent to the AEC Property Representative so that disposition instructions could be provided to the property officer having the material. From there on the Fiscal Section considered itself completely out of the picture. The onus was on the AEC Property Representative upon being notified that certain property belonged to the AEC and on whose records it was being carried, to issue instructions as to what was to be done with it. With a few exceptions, the listing of the Navy-furnished items of property charged to AEC funds and the items of Navy-owned property in the hands of other Services was completed by 24 April. At this time Lieutenant Dorfmeier was ordered to return to Oahu and the West Coast to check recent issues of property for the Operation from Naval sources and to advise the forward area of information developed. After a long series of dispatches back and forth with the Rear Echelon most of the information required to identify Army and Air Force furnished items charged to AEC funds was obtained. Major Law had a difficult job to perform as he stepped into the poistion at a very critical time with little chance to learn what had happened to date and what would be expected of him. The AEC Property Representative needed to know what had been charged to them so that disposition instructions could be issued, and the various property officers had to know what belonged to the AEC so that it could be properly disposed of upon roll-up.

CHAPTER IV

PHASE - ROLL-UP

Shortly after the last test Commander Whittemore and Major Law left the forward area and returned to the Headquarters at Ft. Shafter, Oahu, T. H. Commander Whittemore returned to Washington early in June to make final preparations for dissolving the Fiscal Section.

Data being received from the various agencies of each Department giving obligations and expenditures as of 30 April and estimates for the balance of the fiscal year 1948 indicate that it will most likely be possible to return the additional $2,000,000 of AEC funds as contemplated in Chapter III. However, at the time of submission of this report all the data necessary to make the decision has not been received.

Roll-up plans for the Fiscal Section were started early in the Operation and continued on through the succeeding stages. Plans for turning back excess funds to the AEC, closing out allotments which had served their purpose, obtaining estimates of funds for the coming fiscal year, and recommending considerations for the Post-Sandstone Fiscal Agreement were all part of the Fiscal roll-up.

It is contemplated that AEC funds will be required by all three Departments for at least the first quarter of the fiscal year 1949 in order to recondition equipment, deactivate and reconvert ships, and complete projects which must be carried to a conclusion. It is expected that the routine reports will continue to be prepared on a monthly basis by the Army and Air Force, forwarded to the Navy Department, combined with the Navy report, and submitted to the AEC. This will go on for a number of months until all expenditures are cleared. It is expected that there will be adjustments of charges which will be necessary and will take considerable time to straighten out and will be handled between the Department concerned and the AEC directly.

CHAPTER V

COMMENTS AND CONCLUSIONS

FISCAL ESTIMATES

Fiscal estimates for any future operation of this nature should be arrived at well in advance of the date funds will be required by a high level board appointed by the Joint Chiefs of Staff and the Atomic Energy Commission. The fiscal estimates for Operation SANDSTONE were somewhat hurried and, although the over-all total was reasonably accurate, the amounts required for each Military Department and the purposes for which the funds were to be expended did not follow the estimates closely. It is believed that the Budget Officers of the Military Departments with all the facilities they have at their disposal could arrive at better estimates and much more quickly than members of the Joint Task Force Staff.

INITIAL TRANSFER OF FUNDS

The actual transfer of funds for any future operation of this nature should be accomplished well in advance of the time they will be

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and in a workable form prior to the assembly of the Joint Task Force Staff.

FINANCIAL REPORTS

It is believed that in any future operation of this nature a clear-cut agreement between the AEC and the Military should be drawn up at the outset stating exactly what financial reports will be required for the entire operation, and this agreement adhered to. The fiscal side of this operation was complicated by the necessity to collect

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information that was not originally contemplated would be provided.

PROPERTY ACCOUNTING

It is recommended that in any future operation of this nature, if funds are to be provided by the AEC and utilized for similar purposes as in this operation, that property accounting measures be thoroughly established at the outset and mutually agreed upon by the AEC and the Military.

It is believed highly desirable that the AEC assign personnel from the start of the operation who are thoroughly familiar with the property accounting requirements and who will work with the Military throughout the entire operation and be present in the forward areas as the operation progresses.

The AEC funds to be charged for Navy-furnished items during the Operation were distributed to nearly thirty different Naval activities as the requirements became known. In view of the fact that the vast majority of the items to be furnished by the Navy were to be in Army or Air Force custody, it was believed that the charges should be made to a final expenditure account when issued. It is believed that for a future operation of this nature a special Navy accounting office should be temporarily established at Pearl Harbor to which the charges could be invoiced for final expenditure by that office. This would eliminate the need for numerous small allotments and permit a much tighter control of the funds. Of course, there still would be a requirement for a few well-placed allotments and/or project orders at the more important activities involved. The accounting office would move to the forward area as the operation progressed and the scope enlarged to include property accounting for the Navy-supplied materials ashore in the forward areas. An organization such as this would permit the use of standard procedures throughout the supply channels which, it is believed, is so essential to a smooth running operation.

The Army and Air Force assigned property officers in the forward areas, which is standard procedure, and the arrangements worked out satisfactorily. The difficulty came in determining what Army and Air Force-supplied items had been charged to AEC funds. It is believed that if all the supplying activities had indicated on the War Department Shipping Documents the items which had been charged all would have worked out well. However, the high security classification assigned to the Operation was an obstacle which apparently could not be overcome. It is recommended, therefore, in any future operation of this nature that a great deal of effort be expended at the outset to insure that all supplying activities understand exactly what is expected of them.

PERSONNEL

There are two considerations in regards to personnel which it is felt should be mentioned for the benefit of any future operation of this nature:

1. The first consideration is that an officer should not be assigned to the operation unless it is known that he will be available until his phase of the work in completed, barring an unforeseen difficulty.

2. The second consideration is that great care should be given to the detailing of officers who have the proper qualifications for the positions to which they are to be assigned. Specifically, the officers in the Fiscal Section should be budget and fiscal specialists. If at all possible, they should also be graduates of the Armed Forces Staff College or some other post-graduate school giving instruction in staff work and/or joint operations.

APPENDIX A

HEADQUARTERS
JOINT TASK FORCE
Washington 25, D. C.

121 20 October 1947

SUBJECT: Fiscal Agreement, Operation "Sandstone"

To: See Distribution

1. Pursuant to agreements reached by representatives of the Atomic Energy Commission and the Department of Army, Navy and Air Force, the instructions enunciated below will obtain on fiscal matters for Operation "Sandstone".

a. Funds are being advanced from the AEC to the Department of the Navy by an appropriation transfer warrant. The appropriation title for the Department of the Navy will be "Appropriation Sandstone" and an appropriation number yet to be assigned. All expenses for the operation, as agreed to by the joint agreement between the Armed Services and the AEC covered in inclosure "1", will be charged by the Department of the Navy direct to this appropriation. The Budget Division, Bureau of Supplies and Accounts, Department of the Navy, will grant allotments to all Naval activities which may be required to obligate funds for this operation. The Task Force Commander or the AEC will advise the Fiscal Director, Bureau of Supplies and Accounts, Department of the Navy, of any authorized expenses not covered by inclosure "1".

b. The Department of the Army will establish a working fund from advances by the Navy from the appropriation referred to above.

[redacted]

ties. Every effort will be made to obtain the equipment from excess stocks which will not require replacement.

d. Fiscal operating and reporting procedures will conform to the established fiscal procedures of each of the Armed Services. Only one fiscal project number will be assigned for obligation and expenditure in connection with Operation Sandstone within the Departments of the Army and the Air Force. In addition to normal reporting procedures, Technical Services of the Army and USAF will render a report of obligations monthly as of the end of the month to the Chief of Finance, Army,

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[redacted] obligations or expenditures are required.

FOR THE COMMANDING GENERAL:

C. B. FERENBAUGH
Brig. Gen., USA
Chief of Staff

Section XV

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expenditures:

(1) All construction costs, including laying of cable at the site. All contracts for construction to be carried out by other than military personnel will be subject to approval by AEC. It is further understood that prior AEC approval will be required for construction projects by military personnel in those instances where charges will be made to the AEC.

(2) All travel including mileage and/or per diem or additional overseas pay for military personnel where travel involved is on temporary and/or additional duty directly concerned with this project.

(3) Administrative expenses including salaries and overtime for additional civilian personnel which may be required for the accomplishment of this project.

(4) All civilian expenses incurred in forward areas except for those civil service personnel who are regularly employed by the armed services and who may participate in this project. Overtime or other extra pay for these civil service personnel will be charged to the AEC.

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[redacted]

(8) Packing and handling charges for above supplies, together with transportation charges except where transportation is by military air or surface vessels.

(a) Passenger and cargo space on regularly scheduled Army vessels and passenger and cargo ships which can be made available by the Army without the acquisition of additional substitute vessels or resort to commercial shipments to handle normal Army movements, will be made available without reimbursement from AEC in accordance with priorities agreed upon. Army vessels which must be replaced with substitute vessels or through utilization of commercial facilities will require reimbursement from AEC at the following rates which cover minimum operating expenses:

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expenditures:

(1) All pay and allowances of military personnel.

(2) All subsistence and clothing for military personnel.

(3) All transportation costs of military and civilian personnel on government-owned ships or aircraft.

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(4) All costs for tests which may be conducted by the armed services which are not planned or requested by the AEC.

(5) Motor vehicles required for transportation of military personnel in forward areas.

(6) Costs of all recreational facilities and equipment in forward areas.

(7) All costs for fuel oil, lubricating oil, gasoline, and other operational expenditures of ships and aircraft required in this project.

2. The decision for the interpretation of allocation of specific costs in accordance with the above agreement will be the responsibility of the Task Force Commander or authorized members of his staff. In the event that additional major expenditures should develop in the implementation of this project, the allocation of costs will be the subject of further agreements between the AEC and the armed services.

3. The financial procedures with respect to fiscal and property accounting and disbursement of funds will be in conformity with established procedures of the services involved. Detailed instructions covering special procedures will be jointly agreed to by the services involved and the AEC and such instructions will be disseminated by the fiscal branch of each service.

INCLOSURE 2 TO APPENDIX A

COST ESTIMATES

10 Land and Structures

Army	$1,601,000
Air Force	830,000
Navy	1,911,200
	$4,342,200

08 Supplies and Materials

Army	$ 490,000
Air Force	1,525,000
Navy	775,000
	$2,790,000

03 Transportation of Things

Army	$1,815,000
Air Force	2,052,250
Navy	433,800
	$4,301,050

02 Travel

Army	$ 211,333
Air Force	379,334
Navy	127,333
	$ 718,000

01 Personal Service

Army	$ 30,000
Air Force	30,000
Navy	30,000
	$ 90,000

04 Communication Service

Army	$ 10,000
Air Force	10,000
Navy	10,000
	$ 30,000

07 Other Contractual Services

Army	$ 10,000
Air Force	10,000
Navy	10,000
	$ 30,000

09 Equipment

Army	$ 300,000
Air Force	300,000
Navy	300,000
	$ 900,000

RECAPITULATION

10 Land and Structures	$ 4,342,200
08 Supplies and Materials	2,790,000
03 Transportation of Things	4,301,050

02 Travel	718,000
01 Personal Service	90,000
04 Communication Service	30,000
07 Other Contractual Services	30,000
09 Equipment	900,000
	$13,201,250
Department of the Army	4,467,333
Department of the Navy	3,597,333
Department of Air Force	5,136,584
	$13,201,250

DEPARTMENT [redacted]

UNITED [redacted]

01 PERSONAL SERVICES	
Pay of Civilian Personnel	$ 30[redacted]
02 TRAVEL	
Troop Travel	$ 168[redacted]
Officer Travel & Per Diem	33[redacted]
Civilian Employees	10[redacted]
03 TRANSPORTATION OF THINGS	
Packing & Crating	$ 300,[redacted]
Handling Charges	15,[redacted]
Transportation	900,[redacted]
Resupply Costs	100,[redacted]
Chartering of Vessels	*500,[redacted]
04 COMMUNICATION SERVICES	
Long Distance Telephone Calls	$ 10,[redacted]
07 OTHER CONTRACTUAL SERVICES	
Cable Splicing, etc.	$ 10,[redacted]

[redacted]

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DEPARTMENT OF THE ARMY (Cont'd.)

	UNITED STATES	ENIWETOK	TOTAL
08 SUPPLIES AND MATERIALS			
Chief of Engineers	$10,000	$400,000	
Chief Signal Officer	10,000		
Quartermaster General	10,000		
Chief Chemical Corps	10,000		
Surgeon General	10,000		
Chief of Ordnance	10,000		
	20,000 (Modification of Vehicles)		
Chief of Transportation	10,000		
	$90,000	$400,000	$490,000
09 EQUIPMENT			
Special Equipment required for tests or which must be replaced.	$300,000		$300,000
10 LANDS & STRUCTURES			
Chief of Engineers *Civilian Contracts	*$525,000	$951,000	$1,601,000
Chief Signal Officer		125,000	
		TOTAL.......	$4,467,333

RECAPITULATION

	01	02	03	04	07	08	09	10	TOTAL
Chief of Engineers	$ 5,000					$410,000	$100,000	$1,476,000	$1,991,000
Chief Signal Officer	5,000			$10,000	$10,000	10,000	100,000	125,000	260,000
Quartermaster General	5,000					10,000			15,000
Surgeon General	5,000					10,000			15,000
Chief of Ordnance	5,000					30,000	100,000		135,000
Chief of Transportation	5,000		$1,815,000			10,000			1,830,000
Chief of Finance		$211,333							211,333
Chief Chemical Corps						10,000			10,000
TOTALS	$30,000	$211,333	$1,815,000	$10,000	$10,000	$490,000	$300,000	$1,601,000	$4,467,333

[redacted]

01 PU[redacted]
Pa[redacted]

02 TR[redacted]
Tr[redacted]
Of[redacted]
Ci[redacted]

03 TR[redacted]
Pa[redacted]
Ha[redacted]
Tra[redacted]
Res[redacted]

04 CON[redacted]
Lon[redacted]

07 OTH[redacted]
Cab[redacted]

08 SUP[redacted]
Air[redacted]
Con[redacted]

09 EQU[redacted]
Spe[redacted]
Tes[redacted]

10 LAN[redacted]
Air[redacted]

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DEPARTMENT OF THE NAVY

	U. S.	HUENEME	PEARL HARBOR	KWAJALEIN	ENIWETOK	TOTAL
01 PERSONAL SERVICES						
Pay of Civilian Employees	$ 30,000					
	$ 30,000					$ 30,000
02 TRAVEL						
Troop Travel	$ 84,000					
Officers Travel & Per Diem	33,333					
Civilian Employees	10,000					
	$127,333					$ 127,333
03 TRANSPORTATION OF THINGS						
Packing, Crating & Handling Charges	$ 45,000					
Transportation	100,000					
Resupply Costs		$262,800	$ 20,000			
Loading A.E.C. Supplies		6,000				
	$145,000	$268,800	$ 20,000			$ 433,800
04 COMMUNICATION SERVICES						
Long Distance Telephone Calls	$ 10,000					
	$ 10,000					$ 10,000
07 OTHER CONTRACTUAL SERVICES						
Cable Splicing, etc.	$ 10,000					
	$ 10,000					$ 10,000
08 SUPPLIES AND MATERIALS						
Bureau of Supplies and Accounts	$425,000			$50,000		
Conversion of Vessels	300,000					
	$725,000			$50,000		$ 775,000
09 EQUIPMENT						
Special Equipment Required in Tests or which must be Replaced	$300,000					
	$300,000					$ 300,000
10 LAND & STRUCTURES						
Bureau of Supplies & Accounts						
Engineer		$361,200	$1,000,000	$50,000		
Signal					$500,000	
		$361,200	$1,000,000	$50,000	$500,000	$1,911,200
					GRAND TOTAL.....	$3,597,333

Section XV

[redacted]

Force, will not be charged to the special funds unless:

(1) It requires replacement for immediate use elsewhere by supplying source, Army, Navy or Air Force.

(2) Procurement is required to make such an item available and it is in addition to the normal requirements of the Army, Navy or Air Force.

b. Other equipment furnished by the Armed Forces which is to be used by Service personnel, and is expected to be returned upon completion of the operation, with only normal wear and tear incident to use, will not be charged to these funds. Allowances for equipment which is

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damaged beyond repair, destroyed, or for some other reason is not returned, and charges for repairs to damaged equipment will be subject to agreement between the Atomic Energy Commission and the Armed Services. If purchase is required in order to provide the equipment, or to provide necessary replacement for equipment currently in use, charges to the special funds may be made.

3. Paragraph 1 (a) (2) of inclosure 1 to referenced letter is modified by the deletion of the words, "or additional overseas pay". The elimination of the additional overseas pay of military personnel attached to the operation as a charge to the funds made available by the Atomic Energy Commission was recommended by the Atomic Energy Commission and concurred in by the Joint Chiefs of Staff.

FOR THE COMMANDING GENERAL:

C. B. FERENBAUGH
Brigadier General, USA
Chief of Staff

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Operational Report

Engineer Section

Introduction

This report of engineer operations covers a period of six months from 3 October 1947 to 3 April 1948. During this interval of time, all necessary steps were taken to plan, mobilize, equip, transport and supply a small but complex working force which brought to successful completion the construction of an atomic energy proving ground on Eniwetok Atoll.

No attempt is made either to accentuate or minimize the problems encountered. It is sufficient to say that, though many appeared formidable at the time, in retrospect none proved to be real.

There follows in brief outline the record of engineer operations. It covers the organization, planning mobilization and construction phases of these operations, and includes sufficient statistical data to define accurately the scope and nature of the work.

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Operational Report

Engineer Section

Organization of the Engineer Staff Section

The Engineer Section of Joint Task Force Seven began functioning on 3 October 1947. Its final organization and the chronology of its expansion are illustrated in the accompanying chart.

Only one officer was asked for by name by the Joint Task Force Engineer. Others were selected from the record. Such key personnel as Lt. Cols. Kennedy, Stevens, and Frye and Captains Waits, Hoffmann, and Richards came ideally equipped by virtue of past background and association to play their important parts in executing a staff plan which, being dependent upon a maximum of decentralization, demanded a high degree of individual initiative.

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ENGINEER SECTION
JOINT TASK FORCE SEVEN
(Organization Chart)

ENGINEER

DEPUTY ENGINEERS

ADMINISTRATIVE SECTION — MAPPING AND SURVEY SECTION — SUPPLY SECTION — OPERATIONS SECTION

NAME	DUTY	JOINED	DEPARTED
Col. David H Tulley, GSC, 0-16075	ENGINEER	3 Oct 47	
Lt. Col. Arthur H Frye, Jr., CE, 0-19176	Deputy Engr for Operations	7 Oct 47	3 Apr 48
Lt. Col. Wilbur A Stevens, CE, 0-30365	Deputy Engr for Operations	3 Oct 47	27 Mar 48
Col. Keith Barney, CE, 0-16377	Deputy Engr for Operations (Kwajalein)	20 Oct 47	1 Jan 48
Lt. Col. Daniel Kennedy, CE, 0-469535	Deputy Engr for Mapping and Survey	14 Oct 47	19 Dec 47
	Rejoined as civilian	3 Feb 47	3 Apr 48
Maj. Guyton Kempter, CE, 0-825518	Asst Engr for supply	20 Oct 47	3 May 48
Capt. Earl B. Fauber, CE, 0-1100537	Asst, Supply Section	27 Oct 47	
Capt. Otto W. Hoffmann, CE, 0-1116462	Asst, Operations Section	27 Oct 47	
Capt. George B Richards, CE, 0-1103881	Asst Engr for Administration	17 Oct 47	
Capt. Joseph A. Waits, CE, 0-918028	Asst Engr for Operations	31 Oct 47	
1st Lt. Harry G. France, CE, 0-1112700	Asst, Supply Section	27 Oct 47	3 May 48
M/Sgt. Arthur A. Padgett, RA6734494	Administrative NCO	17 Nov 47	2 Apr 48
Cpl. Bernard T. Witkowski, AF39019223	Draftsman	1 Dec 47	9 Mar 48
T/5 John B. Benn, RA17209695	Clerk-typist	28 Nov 47	
Pfc George Cardenas, RA18319448	Clerk-typist	18 Nov 47	12 May 48
Pfc Robert E. Morris, RA19266946	Draftsman	13 Dec 47	3 May 48
Pfc Raymond J. Murtaugh, RA13254095	Clerk-typist	20 Oct 47	3 May 48
Pfc Howard L. Thurmand, RA19250796	Draftsman	13 Dec 47	12 May 48
T/5 Edward Przybyloski, AF	Draftsman	15 Dec 47	3 Feb 48

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and facilities of the Western Ocean Division of the Corps of Engineers.

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[redacted]

Task Force. The organization and [redacted] forces were responsibilities of the Task Force Engineer.

Invitation to participate in the tests was extended by AEC to the Corps of Engineers, the Medical Department, the Chemical Corps, the Bureau of Medicine and Surgery, and the U. S. Coast and Geodetic Survey. Details of their participation were worked out in consultation with representatives of AEC and incorporated into the test construction plans.

The housing and utility requirements of each operating agency, together with their requirements for any special field construction, were developed as part of the housing and utilities program.

The period 3 October 1947 through 7 November 1947 was one of mobilization of staff and construction forces and assembly of engineer requirements. One group of the Task Force Engineer's staff worked closely with AEC engineers and participating services in developing test construction designs and accompanying bills of material. Another group concerned itself with construction and materials estimates for housing and utilities and the formulation of construction equipment lists. A third group developed and put into operation the engineer procurement plan. Still another group developed the mapping and survey requirements of the operation and organized the field forces to accomplish this work. The Task Force Engineer was occupied with the selection and equipping of the field construction forces and operational planning.

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Kwajalein.

On the 6th and 7th of November a series of conferences were held in Washington with members of the Scientific Test Director's Staff and representatives of participating services for the purpose of reviewing all engineer requirements and expediting their finalization. Agreements reached in this series of meetings operated to effectively coordinate all future work and formed a lasting and mutually satisfactory basis for the coordination and control of all subsequent construction operations. They laid the ground work for the test construction directive by adopting a plan to incorporate in a series of general layout maps, cross referenced to detailed drawings, all test construction requirements. To this end, from 8 November 1947 forward all efforts were directed toward completing the detailed designs for test construction, procuring the necessary equipment and supplies, and completing arrangements for the scheduled departure of operating units.

By 12 November 1947 plans for camp construction on Kwajalein were completed and approved.

The 1220th Provisional Engineer Battalion departed from Oahu on 17 November, arrived at Eniwetok on 28 November to undertake the rehabilitation of housing and utilities and preparation of Eniwetok Island to serve as a base of operations. The necessary supplies and equipment to support initial test construction operations accompanied this unit.

On 1 December 1947 the Task Force Engineer and an advance party arrived at Eniwetok to begin test construction.

Operational Report

Engineer Section

The Construction Phase (1 Dec 47 - 3 Apr 48)

A. Plans - Preliminary Operations - Organization.

The Engineer Plan of operations as of 7 November 1947 called for camp construction and rehabilitation at Eniwetok to start on or about 28 November, camp construction and rehabilitation at Kwajalein to start on or about 1 January 1948, and test construction at Engebi to start on 3 December. These dates were based upon the planned dates of arrival at base sites of construction personnel, equipment, and supplies.

The 1220th Provisional Engineer Battalion arrived at Eniwetok on 28 November 1947, where it immediately began the unloading of supplies and equipment and the rehabilitation of island facilities.

Plans contemplated that one ship, the LST 45, would, after discharging part of its cargo at Eniwetok, move north on 3 December 1947, beach at Engebi and serve as a hotel and supply ship for test construction forces. The loading of this ship at Pearl Harbor and the arrival of advance survey and construction personnel at Eniwetok had been planned accordingly. One hitch developed. The ship moved north on 3 December 1947 as planned, but could not beach at Engebi due to coral heads and shallow approaches not fully evaluated by earlier reconnaissance. Three days were lost perfecting arrangements to overcome this situation, so it was not until 6 December 1947 that test construction operations got under way.

During the month of December all test construction and survey crews were based on the LST 45. This ship moved anchorage from Engebi to Aomon to Runit as demanded by operations. All planned tasks were successfully completed. By 26 December 1947 tower foundations on Engebi, Aomon, Runit, and Aniyaanii had been completed, survey operations had progressed to a satisfactory degree, and preparations had been made for reception of the main construction forces which were beginning to arrive. Camp rehabilitation at Eniwetok had progressed to the point where facilities were available to take care of the main body. The 18th Engineers were fully established at Engebi.

The period 26 December 1947 to 12 January 1948 was largely consumed by unloading operations, supplemented by construction and rehabilitation of facilities at Eniwetok, Parry, Aomon, Runit, and Engebi Islands and mobilization of construction forces. During this period all personnel, equipment and supply essential to prosecution of test construction were assembled and readied for operation, and by 12 January 1948 work was in full swing.

This is a good place to outline briefly the construction mission and describe the organization which accomplished it.

Housing and base facilities were needed at Kwajalein to accomodate an Air Force Task Group of some 2000 men and officers. The services of Colonel Keith Barney and two companies of his command, the 926th Engineers, were secured to plan and execute this task, in accordance with specifications approved by the Deputy Task Force Commander for Air. Troop labor was supplemented by contract labor furnshed by the Byrne

Corporation under Navy contract.

Colonel Barney was designated Deputy Task Force Engineer in charge of all construction at Kwajalein and carried this import task through to successful completion. In all respects, save during the initial planning and procurement phase, he operated independently of the Joint Task Force Engineer, thereby releasing the latter for supervision of work on Eniwetok Atoll.

Operations at Eniwetok Atoll required housing and base facilities for a force of approximately 2600 officers and men, and test construction to meet specifications determined by the Atomic Energy Commission and by the using services of Army, Navy and Air.

Aside from initial planning and procurement, the Joint Task Force Engineer had little to do with the camp construction and rehabilitation work. This phase of construction was accomplished by engineer troop labor under the direction and supervision of island commanders concerned. It involved the rehabilitation of existing structures and installation of supporting utilities on Eniwetok Island to care for some 1500 officers and men, and similar efforts on Engebi, Aomon, Runit, and Parry Islands to accommodate garrisons of 300, 200, 200, and 100 respectively.

The test construction specifications had been incorporated into a series of special maps selected to fit geographical sites and cross referenced to detailed plans, charts, and diagrams. In this form they were issued by the Joint Task Force Engineer, through his designated Resident Engineers, as construction directives to operating commanders.

Test construction activities were necessary on eight separate islands of Eniwetok Atoll and at three different sites in Eniwetok Lagoon. Their scope and relationship to each other made it logical to divide this work between four Resident Engineers and charge each with direct supervision and control of specific construction projects. Operating personnel were organized on somewhat the same basis, with the exception of contract labor, so that the Resident Engineer and his operating commander formed a permanent team for prosecution of the work.

All construction, with the exception of tower erection and sheet pile construction, was performed by troop labor.

Tower erection was performed by contract with Morrison Knudsen-Peter Kiewit Companies. This contract was negotiated by Brigadier General Ludson D. Worsham, Division Engineer of the Western Ocean Division of the Corps of Engineers. It included the test erection of one 200-foot tower at Sandia, New Mexico, and the final erection of three 200-foot towers and four 75-foot towers at the test site. Work under this contract was supervised by Colonel Lynn C. Barnes of the Corps of Engineers and directed by Mr. Norman Kelly of MK-PK. It was carried to conclusion on schedule and in a highly satisfactory manner.

A steel sheet pile cause-way and three pile foundations were constructed in Eniwetok Lagoon by the Hawaiian Dredging Company. The contract for this work was negotiated by the Public Works Officer of the 14th Naval District. Work was directed by Mr. Bill Smith of the Hawaiian Dredging Company and supervised by Mr. Gratz of the 14th Naval

District. It was successfully accomplished, in spite of numerous occupational hazards, in scheduled time.

Construction performed by troop labor in addition to that already referred to included 211 acres of clearing and grading, 16,605 sq yds of bituminous paving, 89,190 sq yds of oiling, 30,000 sq yds of cement soil stabilization, fabrication of 27,566 sq ft of forms, pouring 2,534 cu yds of concrete, placement of 222,655 lbs of reinforcing steel, quarrying 1,069 cu yds of coral aggregate, placing 156 three to six ton precast concrete cubes, construction and stabilization of three liaison plane landing strips, and backfilling 7,643 cu yds of earth.

For these operations, troop construction forces consisted of an Engineer Construction Battalion comprising four provisional construction companies, a maintenance company, and battalion staff. One company was established on Engebi, one on Aomon, one on Runit, and one on Eniwetok. The Runit company performed work on Aniyaanii. The Eniwetok company performed work on Parry. The maintenance company was set up at Runit Island in the center of construction activities and supported operations from there.

Broad construction policy was established by the Joint Task Force Engineer and transmitted to Resident Engineers and to the Battalion Commander. Detailed working arrangements were developed by Resident Engineers in consultation with respective Island Commanders.

A senior AEC representative, Dr. Jack Clark, accompanied the Joint Task Force Engineer to Eniwetok on 1 December to make on-the-spot decisions for AEC. This greatly facilitated the progress of construction and precluded any misinterpretation of specifications. Dr. Clark continued throughout the construction period to be the point of contact between the Joint Task Force Engineer and AEC personnel. His background and knowledge of scientific operation plans proved invaluable assets during the construction phase.

Representatives from using services timed their arrival at construction sites to fit in with construction schedules established by the Joint Task Force Engineer. These men worked directly with pertinent Resident Engineers to insure strict compliance with service requirements.

Coordination between using agencies and construction forces was maintained through a series of weekly meetings, inaugurated by the Joint Task Force Engineer, at which AEC representatives, troop commanders, and Resident Engineers would reconcile differences and plan the subsequent week's operations. The meeting place was rotated from island to island to encourage comparison of methods being used to perform like tasks. They proved very helpful to all concerned.

The Joint Task Force Engineer established his headquarters at Eniwetok adjacent to those of the Construction Battalion Commander and the AEC representative. His administrative and supply sections, working closely with those of the Troop Commander, supported field operations in such a manner as to free Resident Engineers from supply worries and enable them to concentrate their time and efforts on the technical aspects of the construction program.

[redacted]

CONTRACTORS:

Morrison-Knudsen Co., Inc, and Peter Kiewit's Sons, Inc.
Contract let by Western Ocean Division, Corps of Engineers, for the erection of Zero and Photo Towers.
Project Manager: Mr. Norman Kelly
Area Engineer: Col. L. C. Barnes

Hawaiian Dredging Company, Ltd.
Contract let by Public Works Officer, 14th Naval Dist. for the construction of a causeway from Aomon to Biijiri and for construction of one photo tower foundation, one generator house and one triangulation pier in the lagoon.
Project Manager: Mr. Bill Smith
Navy Inspector: Mr. L. N. Gratz

US C&GS PARTY

Lt. Cmdr. R. L. Pfau
7 civilian surveyors

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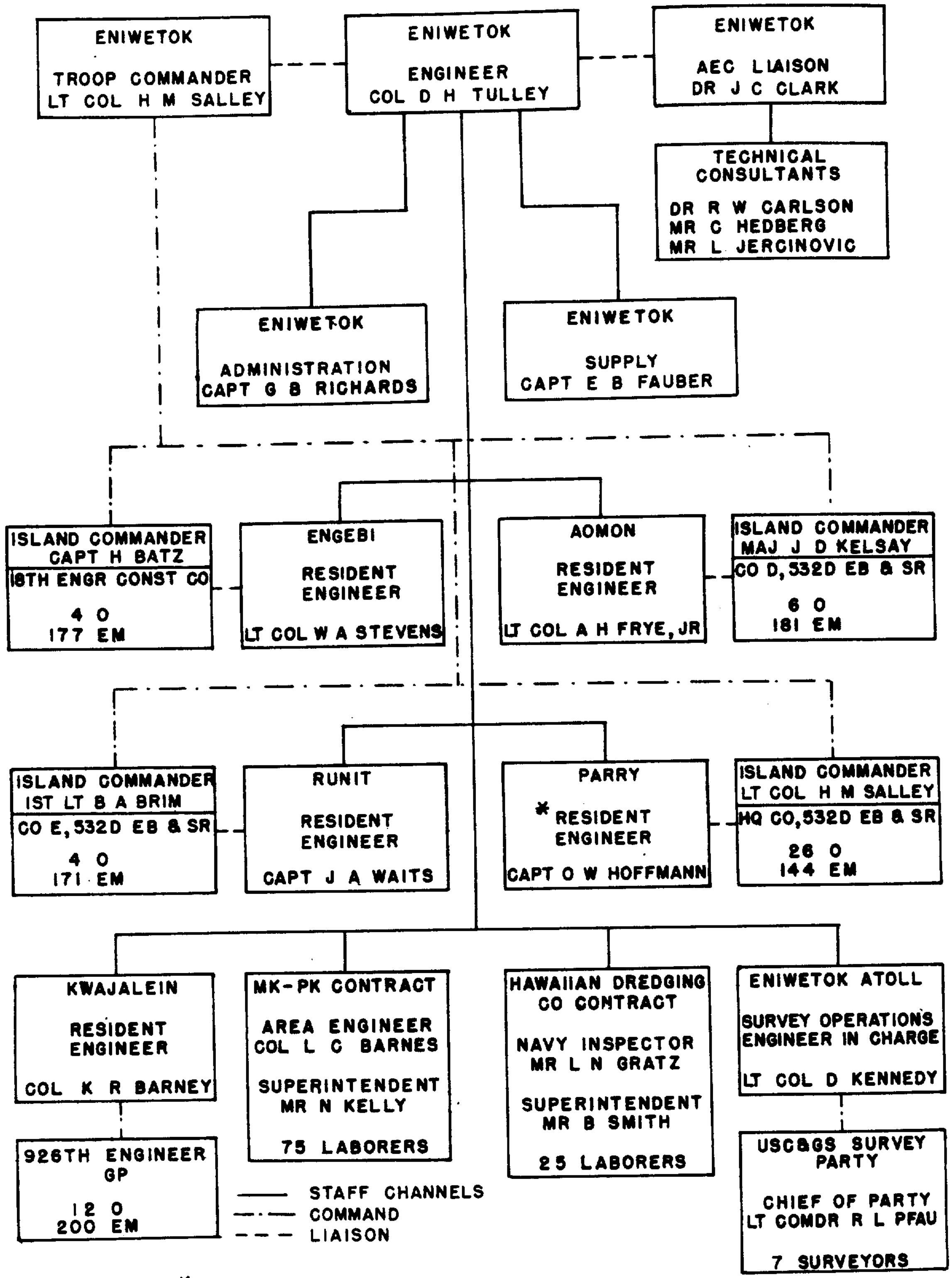
ORGANIZATION FOR CONSTRUCTION PHASE OF OPERATION



*INCLUDES SUPERVISION OF CONSTRUCTION ON ENIWETOK, CAUSEWAY, CORAL REEF AND TOPO PIER.

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Numerous changes in detailed construction plans originated with field construction forces, AEC representatives, and using services. These were issued in the form of Change Orders to Resident Engineers concerned. The fullest leeway was permitted Resident Engineers in controlling their projects and in no case was this confidence abused. It developed an initiative and interest in achievement which got things done on time.

One essential feature of the construction program has been touched upon only by merest reference. An early requirement for a first order triangulation net to cover the test construction called for an immediate solution. The services of Lt. Col. Daniel Kennedy, Engr. Res., of the Army Map Service were obtained to organize and direct the mapping and survey activities of the JTF. Within a few short weeks Lt. Col. Kennedy completed negotiations with the U. S. C. & G. S. for the loan of a highly qualified field party. This group accompanied the Joint Task Force Engineer to the site of operations on 1 December 1947, where, under the direction and control of Lt. Col. Kennedy, they accomplished the preliminary construction survey and finally the first order triangulation.

Major DeBardeleben and Mr. Linthicum, technical representatives of the Chief of Engineers, in addition to supervising the construction of their service test structures, volunteered to set-up and operate a central concrete control laboratory to serve all job requirements. Due to their efforts adequate field control was established and maintained over all concrete construction. A report of results obtained is included in Paragraph B of Section IV of this report.

So much for the general outline of the construction mission and organization. The latter is graphically portrayed by the accompanying charts. There follow the detailed reports of the Resident Engineers, which, when supplemented by exhibits contained in Section IV B of this report, give the complete story of engineer operations.

B. Reports of Resident Engineers.

Engebi Island - Lt. Col. W. A. Stevens. Construction on Engebi Island started on 6 December 1947 with the arrival there of the survey party, the foundation crew of the MK-PK Company, and 14 non-commissioned officers and men from the 18th Engineer Construction Company. On this date, excavation of the Zero Tower footings was started by the MK-PK Company, and the soldiers began clearing and initial grading for the main control line between the Zero tower and the timing station sites. Until 24 December all construction personnel, civilian and military, lived aboard the LST 45 or the LST 219 which were alternately anchored offshore to serve as a "floating hotel." Pending the arrival of the remainder of the 18th Engineers from Eniwetok, the Resident Engineer, JTF, directed the activities of the advance party of general duty soldiers. Later, when the entire company arrived at Engebi, Capt. Herbert Batz, Company Commander, was in direct charge of construction operations.

From the start of construction, and practically until its completion, one of the major activities, from a standpoint of man-hours required, [redacted] more than two of these units, with the remainder for standby use.

On 24 December, the remainder of the 18th Engineers arrived from Eniwetok. On Christmas Day dinner was served in the mess hall and was proclaimed an overwhelming success by all the participants. On this day an inspection would have revealed that the main generator bank of four 50-KW diesel units was performing satisfactorily and providing an ample supply of current to the entire island; the drinking water was sufficient, it tasted good, and it was medically acceptable; quarters, set up in existing buildings, were airy and clean with sufficient space per individual for personal comfort; a motor repair shop was in operation; a dispensary, manned by a medical officer and enlisted aidman, was ready to render first aid and allied treatment, other cases to be evacuated to Eniwetok. Other communal facilities provided during the

[redacted]

plants, etc. Storage for two weeks' supply of all types of fuel was pro-

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vided on the island. This supply was replenished at regular intervals by means of an LCM fuel boat from Eniwetok.

The 18th Engineer Construction Company consisted of 181 officers and men, of whom 135 were engaged in construction. Except for the fact that an additional six carpenters would have facilitated holding construction schedules and, perhaps could have bettered the completion dates by a few days, the personnel contained in the company was well distributed as to occupational specialties. Good leadership by the officers of this company together with the superior attention to duty of a really excellent group of non-commissioned officers in many ways offset the fact that this company lacked somewhat in experience in this particular type of construction. With regard to the latter, the Task Force Engineer and his staff provided assistance in planning and supervising the actual construction.

Because of the scattered locations of buildings, blast footings, slabs, and aprons to be built of concrete, it is believed that material saving in time would have resulted from the use of transit-mix concrete trucks, hauling from a central batch plant. However, this particular type of equipment was not available on the atoll. Other than this, the construction equipment was well selected as to number, type, and condition.

Generally all items of construction were completed on or before the dates set forth in a completion schedule which had been prepared by the Joint Task Force Engineer and accepted by the AEC prior to the start of construction. The MK-PK Company started actual steel erection

[redacted]

tion was selected and material was crushed and screened for use in the concrete at Engebi and the other islands. Concrete beams and cylinders were made, the former tested in a field testing laboratory which was set up by the OCE representative at Engebi, and the latter shipped by air to the Honolulu District Engineer for correlation with field test beams. A tabulation of laboratory tests was maintained by the Joint Task Force Engineer and it was found that strengths attained greatly

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for all islands. Where construction schedules permitted, forms stripped from buildings at Engebi were sent to the other islands for reuse.

Participating services of the Army and Navy designed and requested construction and placing of certain structures. Each of these organizations furnished the required materials. The following of their representatives assisted in the supervision of the construction or installation of the items in which they were interested:

Office, Chief of Engineers	Major J. M. DeBardeleben Mr. R. C. Linthicum
Bureau of Yards and Docks	Lt. Cmdr. J. A. Erickson
Bureau of Ships	Lt. Vicars
Bureau of Medicine and Surgery	Capt. H. Draeger

On 14 March 1948, with the work substantially (98%) completed, 2 officers and 48 enlisted men of the 18th Engineers departed Engebi. The balance of the company was held for housekeeping, assisting AEC personnel in the installation of technical equipment and services, and completing the final cleanup of the island. On 6 April 1948, the remainder of all construction and maintenance personnel was removed from Engebi Island and the construction phase was completed.

Appended to this report are the following statistical data pertaining to the construction of Engebi Island:

1. Table of Organization, 18th Engineer Construction Company.

2. Tabulation of Equipment and Equipment Hours.

3. Progress Chart of Construction.

4. Tabulation of Man Hours.

TABLE OF ORGANIZATION - 18TH ENGINEER CONSTRUCTION COMPANY

Commanding Officer	1
Platoon Leader	3
Administrative NCO	2
Clerk, General	1
Mess Sergeant	1
Butcher	1
Baker	1
Cook	6
Supply Sergeant	1
Supply Clerk	2
Parts Clerk	1
Dispatcher	1
Truck Driver	16
Construction Machine Operator	22
Surveyor	4
Draftsman	1
Operation NCO	1
Crane Operator	3
Water Distillation Operator	5
Electrician	12
Motor Sergeant	1
Diesel Mechanic	3
Construction Foreman	12
Tool Room Keeper	2
Carpenter	8
Duty Soldier	63
Plumber	3
Demolition Specialist	4
TOTAL	181

Aomon-Biijiri-Rojoa - Lt. Col. A. H. Frye, Jr.

The initiation of construction on these islands was delayed until the 22d of December on which date the Navy completed the evacuation of some 142 native inhabitants. It was possible, however, to complete enough of the initial survey work prior to 22 December to enable tower erection crews to start construction promptly on that date and to complete all foundation work in time to receive steel erection crews early in January.

By 5 January, "D" Company of the 532d Engr. Boat and Shore Regt. was established ashore and construction activities were in full swing. The Hawaiian Dredging Company was getting set up ashore on Biijiri Island to begin construction of a steel sheet pile causeway to Aomon Island and MK-PK's personnel were sorting steel for tower erection.

Simultaneous construction on three separate islands introduced a large and time consuming transportation problem. LCTs, LCMs, and LCVPs were utilized successfully for transporting large pieces of equipment and quantities of supplies, and a DUKW detachment solved the constant movement back and forth of personnel, tools, and minor equipment and materials.

The clearing and grading, which involved a total of 135 acres, was started on Aomon on 1 January 1948. The topsoil, averaging a foot in depth on both Aomon and Biijiri, is a very fine, almost powdery black dirt, which made all clearing and grading of these islands very difficult because of the large quantities of dust. Rojoa is practically all sand and there was no dust problem.

[redacted]

across the island. Most of the smaller roots were left in the ground and this network of small roots was a problem throughout subsequent grading and excavating.

The debris from the clearing on Aomon was piled up against the trees remaining on the seaward side of the island. It was later found that this dried out debris would constitute a fire hazard at the time of the test. There, the imflammable material was burned out of the piles and the remainder, consisting mainly of the palm logs which would not burn, was buried in dozer dug ditches.

During January large quantities of materials, equipment and supplies arrived from the United States and Hawaii, the unloading of which involved many man hours. Because of this test construction did not get underway until 19 January.

The remainder of this report pays no attention to chronology nor

[redacted]

is it intended to be a narrative of the construction operation. Chronology can be traced from the progress charts which are a part of this report, and narrative is sacrificed to pertinent comments on type construction.

The bases of all the reinforced concrete buildings were poured using a mix of 6 bags of high early strength cement, 14 cubic feet of local sand, and 14 cubic feet of coarse coral rock from the Engebi crushing and screening plant. Because of the poorly graded aggregates the resultant concrete had a cement content of 7 bags per cubic yard. Concrete was handled by crane from mixer to forms using locally constructed bottom dump buckets as the buckets shipped out were too large and heavy for the cranes available. There were only two difficulties encountered in this phase of the work. It was necessary to resort to rather elaborate spread footing supports consisting of a metal plate and a concrete block to hold the reinforcing steel up off the sand. There were insufficient vibrators available and the two in use both broke down on the base of Gamma A. The most unusual feature was the use of 0.05% of sugar to cement content by weight in the concrete for the base of Gamma C. The delay in setting time caused by the added sugar permitted the concrete for this base to be mixed on Biijiri and transported across the lagoon by DUKW to Rojoa. This same technique was used for all concrete, including the special concrete, poured on Rojoa.

Early in this period work was started on the placing of the Bureau of Yards and Docks reinforced concrete cubes. The original plan called for these cubes to be placed along the arcs of the several radii from the tower. Because of practical difficulties, it was agreed with the using service that they would be set on the chord rather than the arc of the various radii and each cube would be set individually so its face was perpendicular to a radius from the 200-foot tower. The second line on Aomon was relocated because it originally fell on the liaison airstrip. The only difficulties encountered with this phase of the work resulted from losses of material from the original shipment of the prefabricated timber structures and the reinforced Quonset hut. Plywood was substituted for the sheathing in the construction of the two timber structures, and special drills were fabricated to replace those lost with the tool kit shipped with the reinforced Quonset hut.

Based on experience with the bases for the reinforced concrete buildings the aggregate content of all subsequently poured concrete was increased to 16 cubic feet of sand and 16 cubic feet of coral rock to produce a 6 bag mix rather than a 7 bag mix.

Pouring of the timing station and the blast structure presented no difficulties except around the door frames. It was necessary to cut a 4" x 4" opening in the bottom of this frame and place the concrete by hand. Because of time limitations the forms were removed from the timing station on the third day and from the blast structure on the seventh day after pouring. The only honeycomb of consequence occurred in the timing station around one bank of pipes on the front wall and this was thoroughly cleaned and grouted. Both side walls of the timing station developed vertical hairline cracks from top to bottom, as did

[redacted]

To insure complete mixing of the cement in the mixer, it was necessary to spread the cement in a layer over the limonite and add the scrap iron on top of it. The heavy iron pieces were not run through the mixer but were poured into the crane handled bucket simultaneously with the concrete as it came out of the mixer. When the bucket was dumped over the forms, the heavy iron pieces were distributed satisfactorily as the concrete fell through the reinforcing steel. Additional heavy iron was hand placed under the slots through holes in the bottoms of the slot forms.

Based on experience at Runit and Engebi, some of the wall steel was left out around the door and hatch frames and around the slots to provide more opening for the special concrete to flow under and around these obstructions. A one foot layer of the mix without nuts, bolts, and heavy iron was poured first. This was followed by another one foot layer of the regular mix without the heavy iron pieces.

The removal of the inside forms and the slot forms of all the Gamma Buildings was extremely difficult because of the small interiors.

The only honeycomb occurred on the east inside wall of Gamma B and this was cleaned and filled with special cement grout.

Instrument racks were set in all Gammas by an AEC technician assisted by a small crew. In all cases, a cushion of cement and limonite only was placed in the slot first. This was followed by concrete similar to that used for the Gamma buildings, except that the heavy iron pieces were replaced by 3/4-inch and smaller steel balls. The outside form was left open at the top, and a metal plate laid in over the rows of pipes in the instrument racks was employed to chute the concrete to the rear of the slot. After the slot had been filled to the level of the first form section, the metal plate was removed and another form section added. The balance of the concrete had to be placed in small quantities over the top and along the sides of the rack. When no more concrete could be added, the last section of the form was placed. This section was fitted along its lower edge, but was angled out at the top to provide a trough parallel to and extending above the opening yet to be filled. Concrete was placed in the trough and worked into the opening until the trough was filled to a height above the top of the slot. This excess was allowed to remain in the trough and about four hours later the top form section was removed and the excess concrete chipped off. Following this, the form was replaced over wet burlap to cure the concrete.

The blast footings were constructed individually utilizing a small crew. Wooden strip templates were employed to hold all bolts and pipe sections at the top and a mat of reinforcing steel was welded to the bottoms. The steel mat was in turn held in place by welding it to form ties. The concrete was poured easily through the templates to rough finish the concrete. After the concrete had its initial set, the templates were removed and the surface was finished. The front and back slope of the fill around these footings was stablized by putting on a ½" layer of a 1 to 4 premixed grout.

After the timing station generator shelter had been constructed of lumber and corrugated metal, it was decided to use pyramidal tents for those at the 200 and 75 foot towers to save manpower and material. Marston matting floors were provided in all these shelters.

The causeway was constructed from Biijiri toward Aomon and when the causeway reached the middle of the lagoon the southwest tip of Aomon began to erode. As the causeway approached Aomon, this erosion became increasingly serious to Gamma A and the last blast footing on Aomon. The Hawaiian Dredging Company moored a barge parallel to and along side of the west causeway wall shortly after the mid-point of the lagoon had been reached and this reduced the erosion. However, on 24 February higher tides and the shorter gap of about 75 feet produced currents in the lagoon which increased the erosion. On that day, the Hawaiian Dredging Company was requested to and did start a sheet pile jetty on Aomon. This 30-foot jetty, completed the next day, stopped the erosion.

Work on the causeway tank road and curbs was started early in March, but traffic and cable laying interfered, so night work became a necessity. To provide the fill behind the curb, additional sand was placed in the causeway and pushed over to the sides of the causeway with a grader and a dozer. The balance of the fill required was placed by clamshell.

[redacted]

sand strip 100' wide was laid from the stabilized area at Gamma A to the 400' station and from the stabilized area at Gamma B to the Aomon - Biijiri lagoon. The 5 to 8 ton roller and the disc harrow used for the soil cement work could not be used in the soft sandy areas because the roller dug itself in, and the harrow penetrated too deeply. In these areas, mixing was done by hand and the soil cement was rolled by truck.

In addition to the above construction, during the period of 1 March to 6 April, assistance was given to the various AEC technical groups in setting up their installations. This assistance consisted of interior wiring, ditching for cables, laying some cables, erecting tent workshops, unloading material, providing covered storage space, and furnishing small crews to work directly with the scientists and technicians.

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Based upon experience of this particular job, certain conclusions have been reached which can be applied to similar future projects. These are:

1. The clearing and grading would have been simplified it small tractors such as the rubber tired type used in farming had been available to snake out fallen trees.

2. The early establishment of an airstrip paved with Marston matting would have relieved the company of the maintenance of the water stabilized strip.

3. The construction could not have been accomplished without DUKWs which were invaluable because of their amphibious characteristics for inter island transportation.

4. Concrete vibrators were essential but too few had been provided. This job should have had a 100% safety factor.

5. The interior forms for confined structures were unsatisfactory because of the difficulty in removing them. Forms which could have been left in place should have been provided.

6. A rubber-tired wobbly-wheel roller and a smaller wheeled disc harrow should have been provided for the soil cement work.

[redacted]

	(1)	533 demolition NCO
	(1)	547 diver
	(1)	838 boatman
	(1)	812 weapons sgt
050 Carpenter const	25 men	
	(4)	050 carpenter const
	(3)	060 cook
	(1)	732 amph tractor driver
	(2)	838 boatman
	(2)	835 supply clerk
	(2)	035 carpenter bridge
	(1)	345 trk driver (light)
	(2)	202 carpenter ship
	(1)	3736 amph tank crewman
	(2)	839 engineman, diesel
	(1)	189 rigger
	(1)	745 rifleman
	(1)	511 armorer
	(1)	2736 med tank crewman
035 Carpenter bridge	4 men	
	(1)	035 carpenter bridge
	(1)	050 carpenter const
	(1)	189 rigger
	(1)	437 winch operator
100 Cement finisher	6 men	
	(1)	050 carpenter const
	(1)	533 demolition NCO
	(1)	059 const foreman
	(1)	837 amph track mech
	(1)	521 basic soldier
	(1)	070 draftsman

013 Diesel mech	3 men	
	(3)	013 diesel mech
014 Auto mech	4 men	
	(2)	014 auto mech
	(1)	082 stationery engr (steam)
	(1)	055 clerk gen
024 Blacksmith	2 men	
	(2)	256 welder combination
081 Air compressor oper	4 men	
	(2)	319 mech const equip
	(1)	533 demolition NCO
	(1)	087
078 Electricians	2 men	
	(1)	729 engr basic
	(1)	060 cook
345 Trk driver (light)	18 men	
	(1)	838 boatman
	(6)	345 trk driver (light)
	(3)	934 amph trk driver
	(1)	477 mech, marine engine
	(1)	013 diesel mech
	(3)	839 engineman, diesel
	(1)	677 military police
359 Const mach super & oper	13 men	
	(4)	359 const mach super & oper
	(1)	837 amph track mech
	(1)	014 auto mech
	(1)	838 boatman
	(1)	473 winch oper
	(1)	345 trk driver (light)
	(1)	236 telephone oper
	(1)	189 rigger
	(1)	931 hvy trk driver
	(1)	590 messenger
189 Rigger	17 men	
	(3)	838 boatman
	(1)	050 carpenter const
	(1)	035 carpenter bridge
	(1)	248
	(1)	641 field lineman
	(2)	732 amph tractor driver
	(1)	747 airplane & engine mech
	(1)	473 winch oper
	(2)	590 messenger
	(1)	114 machinist, auto

	(1)	839 engineman, diesel
	(1)	188 laborer, jack hammer oper
	(1)	934 amph trk driver
188 Laborer, jack hammer oper	8 men	
	(1)	188 laborer, jack hammer oper
	(1)	060 cook
	(1)	805 crytographic tech
	(1)	838 boatman
	(1)	055 clerk gen
	(1)	677 military police
	(1)	934 amph trk driver
	(1)	345 trk driver (light)
319 Mech const equip	1 man	
	(1)	359 const mach super & oper
064 Crane & shovel oper	2 men	
	(2)	064 crane & shovel oper
164 Plumber	1 man	
	(1)	050 carpenter const
838 Boatman	1 man	
	(1)	838 boatman
931 Hvy trk driver	1 man	
	(1)	931 hvy trk driver
182 Hi voltage lineman	1 man	
	(1)	345 trk driver (light)

III. Administrative assignments based on the average present for duty strength.

502 Administrative NCO (1st Sgt)	1 man	
	(1)	502 adm NCO
824 Mess steward	2 men	
	(2)	mess steward
542 Message center chief	1 man	
	(1)	020 Band leader
821 Supply Sgt	1 man	
	(1)	821 supply sgt
566 Duty NCO	2 men	
	(1)	837 amph track mech
	(1)	927 amph tank driver

814 Operations Sgt	1 man	
	(1)	814 operations sgt
060 Cook	6 men	
	(6)	060 cook
022 Barber	1 man	
	(1)	059 const foreman
405 Clerk typist	2 men	
	(1)	405 clerk typist
	(1)	189 rigger
727 Water dist unit oper	4 men	
	(3)	838 boatman
	(1)	189 rigger
055 Clerk general	6 men	
	(2)	055 clerk gen
	(1)	405 clerk typist
	(2)	533 demolition NCO
	(1)	821 basic soldier
242 Tool keeper	3 men	
	(1)	745 rifleman
	(1)	189 rigger
	(1)	188 laborer, jack hammer oper
062 Food Handler	4 men	
	(3)	062 food handler
	(1)	boatman
511 Armorer	1 man	
	(1)	511 armorer
296 Artist	1 man	
	(1)	805 cryptographic tech

VEHICLES AND EQUIPMENT

Quantity	Type of Equipment	T/O & E	Above T/O & E	Accumulated Equipment Hours
1	Compressor, Air Trk Mtd	1	0	681
1	Compressor, Air Trl Mtd	1	0	290
1	Crane, Trk Mtd	1	0	834
1	Crane, Crawler	1	0	733
1	Crane, Non-rvl 20 Ton	1	0	333
2	Grader, Road, Mtzd	1	1	1151
1	Harrow, Disc	0	1	98
2	Mixer, Concrete	0	2	364
1	Roller, 5 to 8 Ton	1	0	135
1	Semi-trl low-bed 20 Ton	1	0	186
2	Scraper, Road, Twd Type	2	0	366
3	Tractor, D-8	2	1	2692
6	Trk, 2½ Ton 6x6	6	0	3871
4	Trk, ¼ Ton 4x4	4	0	800
3	Trk, 1½ Ton 6x6	3	0	1800
1	Trk, 6 Ton Prime Mvr	1	0	707
1	Trl, ¼ Ton	1	0	200
1	Trl, 1 Ton	1	0	200
2	Trl, Water, 250 Gal	2	0	600
2	Welder, Arc	0	2	930
	DUKW DETACHMENT			
*6	Trk, 2½ Ton Amphibian (Dukw)			1800

*This figure is an average. Maximum on hand during early construction period was eight. Minimum was four during the latter stages of construction.

PROGRESS AND MAN HOURS

Nomenclature	Date Started	Date Completed	Man Hours
Pier-dump & initial grading & clearing			
(a) Aomon	1 Jan 48	26 Jan 48	1000
(b) Biijiri	19 Jan	30 Jan	900
(c) Rojoa	26 Jan	1 Feb	200
200 foot Tower			
(a) erection	24 Dec 47	3 Feb	(civilian)
(b) paving	11 Feb 48	14 Feb	120
75 foot Tower	23 Jan	9 Feb	(civilian)
Timing Station			
(a) base	8 Feb	13 Feb	408
(b) walls & roof	17 Feb	22 Feb	975
(c) interior installation	1 Mar	16 Mar	435
Gamma Station A			
(a) base	5 Feb	9 Feb	257
(b) walls & roof	17 Feb	28 Feb	652
Gamma Station B			
(a) base	9 Feb	16 Feb	232
(b) walls & roof	23 Feb	6 Mar	697
(c) interior installation	12 Mar	22 Mar	72
Gamma Station C			
(a) base	9 Feb	16 Feb	170
(b) walls & roof	23 Feb	28 Feb	223
Messenger cable & back guy anchors	4 Feb	4 Feb	60
Blast Structure			
(a) base	2 Feb	6 Feb	426
(b) walls & roof	2 Mar	10 Mar	388
(c) interior installation	17 Mar	22 Mar	120
Blast footings & film badge stakes	10 Feb	12 Mar	1156
Generator shelters			
(a) timing station	8 Feb	13 Feb	133
(b) 75' tower	14 Feb	16 Feb	18
(c) 200' tower	16 Feb	20 Feb	20

Communications building	19 Jan	23 Jan	200
Causeway			
(a) piling & fill	27 Dec 47	11 Mar 48	(civilian)
(b) curb & roadway	9 Mar 48	3 Apr	900
1000 foot station	2 Mar	31 Mar	20
400 foot station	2 Mar	31 Mar	9
Range poles	12 Feb	17 Feb	50
Neutron cable "A" & winch			
(a) base	2 Feb	7 Feb	213
(b) winch	8 Feb	8 Feb	23
Neutron cable "B" & buoy	15 Mar	20 Apr	(Navy)
(a) buoy			
Concertina fence	3 Apr	5 Apr	48
BuY&D installations			
(a) test cubes	2 Feb	28 Mar	1123
(b) test bldgs	25 Feb	31 Mar	1602
Bu S installations	26 Mar	20 Apr	(using service personnel)
Bu Med & S installations	26 Mar	20 Apr	
Tower & pylon lights			
(a) floodlights	16 Feb	9 Mar	117
(b) pylon lights	15 Mar	20 Mar	6
Ditches - floodlights	18 Mar	18 Mar	8
Ditch 75' tower to 400' station	17 Mar	17 Mar	10
Ditch zero generator building to 200' tower	25 Feb	27 Feb	8
Ditch 200' tower to timing station	8 Mar	18 Mar	114
Ditch communications	9 Mar	11 Mar	4
Ditch telephone lines	17 Mar	22 Mar	(signal personnel)
Ditch east-west blast & blast bldg to timing	10 Mar	31 Mar	128

Ditch submarine cable	10 Mar	12 Mar	6
Tank revetment	2 Feb	13 Feb	281
Soil stabilization	26 Mar	4 Apr	960

Runit Island - Capt. Joseph A. Waits. Runit Island is roughly two miles long, averaging about 500 feet in width. The long axis bears approximately N 30° W. It is of typical coral formation with an over-burden of coarse sand and occasional outcropping of coral rock. Pre-construction soil tests showed the water table from six to twelve feet below surface, and coral bed rock at same depth. Soil bearing tests average 1500 pounds per square foot without compaction in loose soil, and 4000 pounds after ½-inch compaction. Average temperature is around 80° to 90° F during daylight hours and drops to approximately 75° F at night.

Actual construction was performed by Company E, 532d EB & SR, less one platoon, in accordance with plans and specifications drawn up by the staff of the Joint Task Force Engineer and under direct supervision of a Resident Engineer of that staff. The project as originally planned included the items of construction scheduled as shown by Inclosure No. 1. In accomplishing its mission, Company E used two pioneer platoons consisting of two officers and 35 enlisted men for construction work, a heavy equipment platoon of one officer and 25 enlisted men, and the following heavy equipment:

1 Compressor, air, trk mounted, 105 c.f.m.
1 Compressor, air, trl mounted, 310 c.f.m.
2 Grader, road, mtzd.
2 Scraper, road, towed, 8 cu. yd.
1 Crane, revolving, trk mounted
1 Shovel, crawler mounted
2 Crane, crawler mounted, w/clamshell
1 Trailer, lowbed, 20 ton
2 Trailer, 10 ton
3 Tractor, crawler, w/bulldozer
6 Trk, cargo, 2½-ton, 6x6
6 Trk, dump, w/winch, 2½ ton 6x6
1 Trk, prime mover, 6 ton, 6x6

Survey and layout was accomplished by a first order survey team from the United States Coast and Geodetic Survey under the supervision of Mr. Daniel Kennedy of the Army Map Service.

Erection of a 200-foot steel tower and a 75-foot photo tower, both located on the north end of the island, was accomplished by contract with MK-PK Company, under the supervision of Col. L. C. Barnes, Western Ocean Division, Corps of Engineers. This contractor also erected the photo tower on Aniyaanii Island.

Panel forms for all concrete structures were prefabricated on Engebi Island and transhipped to Runit by a detail of five enlisted men. Reinforcing steel and hardware such as nails, bolts, tie wire and form ties were unloaded from ships at Engebi Island, sorted, and transhipped to Runit. Heavy equipment, cement and special concrete aggregates were unloaded directly off ships and stored in warehouses on the north end of Runit. All other construction material was unloaded and stored in an Engineer Dump at Eniwetok Island and was requisitioned by the Island Commander as needed.

Clearing of approximately fifty acres of coconut trees and moving of 50,000 cubic yards of earth was necessary before surveying, layout of structures, and construction work could begin. This clearing and grading was begun on 29 December when the first contingent of Company E came ashore with two bulldozers and began clearing an airstrip for light aircraft. The remainder of the Company moved ashore on 5 January, started rehabilitation of existing structures, established a water point, and set up a camp. Members of the MK-PK Company, who had com-

[redacted]

the base slabs for all structures were completed Saturday, 7 February. Meanwhile, wall and roof forms and reinforcing steel were being set in place at the timing station. All forms were completed by Friday, 13 February, and a monolithic pour of 83 cubic yards of concrete was made using local beach run coral aggregate graded at approximately 65% passing a ½ inch sieve and 35% passing from 2½ to ½ inch sieve. The mix was 1:2:5 by volume. The above specifications were followed as closely as possible for all other coral concrete.

Gamma Station C was next on the schedule of concrete pouring and was ready Saturday, 14 February. Particular attention was given to this structure as the concrete was of heavy scrap steel and limonite. No previous experience with this type of concrete had been encountered, and the problem of handling such heavy aggregate was plainly a job for heavy equipment. The aggregate consisting of nuts, bolts, and other scrap steel was proportioned out by weight and batched into 55-gallon steel drums modified so as to be readily picked up by cranes and dumped into the mixer skip. Limonite and cement were added in the ship. Because of the heavy weight, $\frac{1}{4}$ cu. yd. was set as the maximum mix for any one batch. The use of this method proved very satisfactory and no difficulties occurred other than usual minor stoppages. The 8 cu. yds. of concrete in the walls and roof of this structure were poured in two and one half hours.

The inside wall forms were stripped from the timing station on 18 February in order to allow representatives of Dr. Krause's AEC group to begin building a lead brick box, part of the technical installation. The concrete was in excellent condition and no temperature cracks were visible. Meanwhile forms and steel were being placed in position at the blast building, Gamma Station B, and five type A and two type B blast footings. Permission was obtained to use slotted inserts, where bolts could be placed later, in all blast footings, and the seven that were ready were poured on 20 and 21 February using coral concrete. Gamma Station B was poured on 25 February. This structure, like Gamma

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The installation of inside utility power wiring and power generators for the Timing Station was completed 3 March and Dr. Grier's MIT group

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of 6 men moved in 4 March to install air-conditioning and technical equipment. This work was finished Saturday, 13 March. Two members of this group remained behind in order to service and maintain the equipment. In order to have the inside electrical wiring of all structures finished before the main body of scientists arrived, this work was given first priority and rushed to completion by 13 March, except for the wiring inside the Zero Tower cab which was done by two electricians of the AEC group from Los Alamos.

In accordance with paragraph 2c, Change Order No. 2, beach sand was hauled and spread along a strip 100 ft. wide, extending from the 400ft. station to Gamma Station C. Nine thousand cu. yds. of sand were hauled in this operation which began on 8 March and extended over a period of 14 days. After the sand was in place, it was decided that an area of 100,000 sq. ft. around Gamma Stations A and B should be stabilized, using the soil cement method, (see Change Order No. 4, par 2b) in an attempt to control the dust that would rise after the blast.

Outside power distribution wires were placed around the Timing Station, Gamma Station B and blast building, Monday, 8 March, under the direction of Dr. Clark and Mr. Hedberg of AEC. This proved to be a very simple task as care was taken to label each wire as it was placed. All other outside wiring and floodlight installations were finished during the week ending 13 March.

Most of the week ending 20 March was spent removing excess supplies from three 40 ft x 100 ft quonset huts on the north end of the island near the Zero Tower, and in general police and clean up around all structures. Also during this week a 38 ft. square concrete slab 4 inches thick was poured underneath the Zero Tower. This was the last concrete to be poured for any AEC structure and all work up to this time was one week ahead of schedule. However, there still remained four concrete bases to be poured for seismograph instruments; two located on this island, and two to be precast for Parry Island. This work was finished during the next week and Mr. Cloud of the U. S. Coast and Geodetic Survey, who arrived 24 March, began installation of the seismograph equipment. The seismograph installations were completed on 31 March.

Some minor changes in plans of finished structures were requested by Dr. Hartmann and Dr. Krause when they visited the island on 18 and 19 March. These changes are incorporated in Change Order No. 4, Par 1a and 1b, along with an additional requirement (par 1c). For the latter, a salvaged 150 cu. ft. refrigerator and a 175 cu. ft. Navy pontoon cube were used, located south of the Tank Shelter, buried 4 ft. in the ground and backfilled on three sides and top so as to form a complete shelter. This was a minor job completed Monday, 29 March. The ramps in front and rear of the Hartmann blast footings consisted of earth fill pushed into place by bulldozers and finish graded by hand. The ramps were then wet compacted and grouted over with a mixture of 1 part cement and 4 parts sand to a thickness averaging 1 inch. This job was finished Friday, 26 March, and on Saturday, 27 March, the east ditch along the footings was opened in preparation for Dr. Hartmann's cable laying crew who came in Monday, 29 March. The work was finished on 30 March, and both east and west ditches were backfilled.

A detail of one Officer and 10 EM of Company E moved to Aniyaanii Island Tuesday, 23 March, and in one week completed the erection of a generator shed, seismograph shed, servicing and installing two 15-KW generators, and the laying of 25,000 sq. ft. of pierced plank to complete the Light Aircraft Landing Strip which had been cleared and graded previously.

The week ending 3 April was spent doing final cleanup work, most of the working crews assisting various AEC groups. With the exception of soil stabilization and minor details, the entire Runit Island project was completed 3 April.

From 29 Dec 47 to 3 April 48, approximately 14,250 man hours were used by Company E in completing its mission. The man hours shown with other statistics in the attached chart are only those used in actual construction of the planned project and do not include those used in housekeeping, construction of quarters, or assisting the scientific groups.

Many small problems arose as the work progressed, but were solved without causing serious delay in the work schedule. Of great assistance in this respect was the mobile heavy maintenance shop established on this island at an earlier date. Shortages, such as form tie bolts and other machining jobs were fabricated quickly by the machine shop. Heavy equipment was very much in demand throughout the construction period, and at times there was a shortage of mobile cranes. Inter-island transportation was accomplished mostly by LCMs supplemented by DUKWs. There was an acute shortage of the LCMs which at times caused delay in the construction program.

The following recommendations are offered for any future project of this type:

a. That more time be allowed for the initial planning phase and procurement of supplies.

b. That all concrete forms be prefabricated Stateside and shipped to the project site by package.

c. That all other structures or parts of structures be prefabricated insofar as possible.

d. That if structures such as the instrument stations A, B, and C are used, the slots be eliminated and instruments incorporated into the initial concrete pour.

e. That communications be supplemented by public address systems and radios.

f. That water transportation facilities be land based at the site of each project, under the direct control of the Island Commander, in sufficient quantity to maintain a smooth flow of traffic between islands.

Parry - Eniwetok - Lagoon. Capt. Otto W. Hoffmann

This report covers construction by Hawaiian Dredging Co., Ltd, and by engineer troops on Parry and Eniwetok Islands for technical requirements only. For details of work to satisfy housing, messing, and other administrative requirements on these islands, see the report of the

Base Operations (S-3) Section, Task Group 7.2. The work falls into three general categories as follows:

By Hawaiian Dredging Co., Ltd.,
- Triangulation station in lagoon.
- Aomon - Biijiri causeway.
- Photo tower and generator platform foundations in lagoon.

By engineer troops on Parry Island,
- Control station and reflector tower.
- Telemetering laboratory and antenna tower.
- Seismograph installations.

By engineer troops on Eniwetok Island,
- Drone operation requirements, including:
  - Radio - Chem laboratory,
  - Drone arrester gear and parking slots,
  - Drone control installations.

- AEC vault.
- Photographic equipment storage space.

More detailed information on the various construction projects is presented below.

<u>Construction by Hawaiian Dredging Co., Ltd.</u>

Negotiations with this firm were handled by the Public Works Officer, 14th Naval District, Pearl Harbor, T. H. Work was performed in accordance with Navy Contract NOY 15124. Superintendent for HD Co. was Mr. B. Smith. All work was under the supervision of Mr. L. N. Gratz, Navy Inspector of the 14th Naval District.

Aside from reconnaissance and preliminary survey, actual work began on 1 Jan 48 when the barge YCV-17 was towed from Eniwetok Island and moored off Biijiri. By 5 Jan a temporary landing had been constructed and a Northwest D-80 crane, bulldozers, carry-alls, and air-compressors had been taken ashore. After unloading necessary material and equipment at Biijiri, the YCV-17 was moored at successive lagoon sites for the construction of the triangulation station and the photo tower and generator platform foundations. Construction of the causeway was carried on concurrently with the work at the lagoon sites, approximately one-half of the crew working at each site.

Triangulation Station. The position of the station at longitude 162° 17' 10" East, latitude 11° 32' 25" North, near "Buoy 15," (reference Sheet No. 6033, Eniwetok Atoll, U. S. Navy, Hydrographic Office) had been selected as satisfying the requirements for first-order triangulation. The exact site was located by inspection, and was such that a minimum of clearing of coral heads would permit a small boat to land men and instruments under all tide and weather conditions. The YCV-17 was moved to the site on 7 January 1948, but rough water and high winds prevented driving of sheets until two days later. On that day, two 25-foot long M112 sheets were driven. About 8-foot penetration was obtained. These piles had sufficient holding power to permit lacing of the remaining 34 sheets of the cell. Three days later all piles had been set and driven, even though rough water and 25 to 30 knot winds hampered operations. Penetration of the remaining sheets averaged four feet. Six days were required for placing all bracing, pouring concrete, providing an access ladder, and blasting a clear channel to the cell. The triangulation station was inspected and accepted on 19 Jan 48. (For detailed plans, see Drawing E-50.)

Photo Tower and Generator Platform Foundations. The location of the photo tower at longitude 162° 15' 0" East, latitude 11° 33' 0" North (indicated as a 2½-fathom shoal on Sheet No. 6033, Eniwetok Atoll, U. S. Navy, Hydrographic Office) was selected as this point could provide, with proper orientation of the tower, adequate photo coverage of all three Zero Islands. On 19 Jan 48, the YCV-17 was moved to the tower site, anchors were set, and the following day two H-beams were driven. Penetration was 15 feet and 28 feet, respectively. The next nine days saw a recurrance of bad weather, and no further pile driving was possible. This period was spent in fabricating clamps and bracing, and splicing piles for future use. On 30 Jan 48 two piles, spliced to a length of 65 feet each, were driven to refusal. A penetration of 21 feet was obtained. Three days later two 50-foot H-beams were driven as batter piles for the generator platform foundation, and the following day the remaining two batter piles were set and driven. Approximately 15 feet of penetration was obtained on all batter piles. Installing of beams and girders, horizontal and cross-bracing was carried on concurrently on the two foundations. Concreting of the tower foundation piles was started on 8 February, completed on the 11th, and the following day MK-PK started erection of the photo tower. Fabrication of tower sections and the use of the Northwest D-80 crane with its 80-foot boom on the deck of the YCV-17 permitted erection of the photo tower in record time; less than 1½ working days. Work on the generator platform continued until 19 February, when the YCV-17 was moved to the causeway site. Early in March it was decided to cut off the horizontal bracing within the tide range to eliminate vibrations due to wave action. This work was done on 9 March, and an additional concrete cover was poured around all steel

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tion period (1 January to 9 January), the C & GS survey party staked out the center line on the Zero Tower - Timing Station line, the pile line for a 30 foot wide causeway, and established elevations for the pile cut-off line. Clearing of an area on Biijiri for a borrow pit was started by the contractor. On 10 January unloading and general preparations had progressed sufficiently to permit driving of a test pile. After 15 minutes of driving, the MZ38 pile had penetrated only 1½ feet of sand and about 1 foot of an underlying rock ledge. The test pile was pulled, and preparations were made to crack the ledge with dynamite. This was successful, and 10 feet of penetration was obtained when pile driving was resumed, although driving continued to be hard. Blasting was not again required until the line of piles reached the Aomon shore, where another rock ledge was encountered. Work continued at an even pace; driving of 25 or 26 piles on two successive days, and placing of tie rods and whalers, advancing the fill, the resetting the pile frame on the third day. Actual progress, therefore, averaged only 17 piles per day. In an effort to speed the operation, which had been hampered by high winds, it was decided to advance the fill and haul dirt from the borrow pit at night. The hauling of fill material was carried on continuously throughout the construction; a total of 4500 cubic yards being used in the causeway. Another delay occured when it became necessary to drive a temporary wall of 30 pile stubs to protect installations on the Aomon shore. The current increased tremendously as the channel became narrower, and the resultant scour threatened to undermine buildings near the water's edge. Work progressed rapidly after 19 February, when the YCV-17 was moved to a position alongside the causeway. The remaining 250 piles were driven by 4 March. Placing of whalers, completing the fill and reloading of equipment and surplus material took until 12 March, and the following day the barge was moved to a mooring off Eniwetok Island. The installation of a tank curb on the causeway was performed by engineer troops; for details see the report of the Resident Engineer, Aomon Island. For detailed plans of the sheet steel causeway, see Drawing No. E-50.

Construction on Parry and Eniwetok Islands. Construction on these islands was performed by detachments from Hq. Co., 532d EB and SR, stationed at Eniwetok Island. Technical requirements were relatively few and simple. Pressure of time did not ordinarily permit the drawing and reproduction of detailed plans, and work was carried out by means of pencilled sketches, verbal instructions, and on-the-spot decisions. As most of the work was not critical with regard to holding to precise dimensions, this arrangement worked well and resulted in considerable saving of time. Such plans as were prepared are attached as inclosures to this report. A brief description of each project, together with references to the attached compilation of starting and completion dates, man hours expended, and plans, is deemed sufficient to present the picture.

Control Station (Parry Island). Requirements existed for the

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Navy survey tower, string strands of co-axial cable to the top of the tower, and placing a 22-foot wooden antenna mast atop the 100-foot tower.

Seismograph Stations (Parry Island). Two stations (see Drawing No. E-47A) were placed on the island as far apart as was possible geographically. The azimuth to Runit Zero tower was computed. Both stations were tied into the Control Station by ditched 2 conductor wire, involving about 7800 feet of ditching.

Drone Operation Requirements (Eniwetok Island). The drone operation requirements consisted of a radio-chem laboratory, drone arrester gear and parking slots, and drone control installations.

The work on the radio-chem laboratory consisted of rehabilitating an existing Quonset hut, installing work benches, utility outlets, generators, and a water supply.

The drone arrester gear consisted of a series of ditches across the north end of the main runway, and also required installation of a series of deadmen on the sides of the runway for the attachment of nylon

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tion of three 200-foot Zero Towers and four 75-foot Photo Towers at various sites in Eniwetok Atoll, and prescribed trial erection of one 200-foot tower in Z. I. for experience purposes.

Trial erection at Albuquerque, New Mexico, was completed during the period 13 October 47 - 2 November 47, and 15 November all tower parts had been disassembled, marked and put in transit to port of embarkation.

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combined into a concrete test laboratory by Maj. J. M. DeBardeleben and Mr. R. C. Linthicum, the representatives of the Office, Chief of Engineers. Concrete tests were made for all other types of concrete on the entire project as well as those for the CCE test buildings. Dr. Roy W. Carlson, consultant for the AEC, frequently used the laboratory

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for trial mixes during batch design and for material quality tests.

Laboratory Equipment. The principal laboratory equipment available and used consisted of:

Third-point loading beam testing machine
(American Beam Testing Co.)

300 pound capacity platform scales (½ oz. accuracy)

One-half and one-tenth cubic foot measuring buckets

Standard metal beam and cylinder molds

Slump cone and rods

Standard fine and coarse aggregate sieves and
sieve shaking machine

100 gram balances (1 cg accuracy)

Gasoline stove, oven, and drying pans

Calibrated glass flasks

Procedure. Trial mixes for the various types of concrete required were made and recommended mixes determined. The trial mixing included an analysis of the aggregates, (stone, coral, iron, sand, or coral sand) for specific gravity, gradation, absorption, etc., and then combination of materials in the most satisfactory proportions. In the case of mixes where sugar was added for delaying the time of set, trial mixes using different percentages of sugar weight were made and tested for workability. When proper workability at desired time delay was obtained, sufficient packages of sugar for the necessary number of batches were accurately weighed out and distributed.

Concrete test beam molds (made of steel) were distributed to the various island commanders with instructions for preparation of test beams in the standard manner. On mixing concrete for all the various pours, several test beams were made and shipped to the field laboratory for tests. At the laboratory, the curing of the beams was continued until time of test at 3, 7, 14, 21, or 28 days, depending on the conditions required for control or correlation with test cylinders. Each beam was broken twice under three-point beam loading and normally at successive intervals.

Also, concrete cylinder molds made of steel were distributed and standard concrete test cylinders were made at the same time beams were made. These were shipped to the District Engineer, C. E., in Honolulu, T. H., for testing in compression. Results of these tests were correlated with the beam tests from the same pour.

Tests in Concrete Laboratory, Honolulu, T. H.. To supplement the field laboratory tests, the facilities of the District Engineer, C. E., Honolulu, T. H., were made available for making desired compressive tests of concrete cylinders and check tests on some of the aggregates. Compressive tests were made and results returned to the field laboratory for correlation with beam test results and tabulation.

Results. A complete record of concrete mixes and corresponding strengths was maintained during the construction period and a tabulation summary thereof is attached. Some 75 beams and 30 cylinders were tested.

Because so little technical information is available on coral concrete, it is believed that the test work accomplished and the records maintained will prove to be of considerable value, especially if future tests of this nature are conducted in the Pacific area, or if the concrete work in the present operation need ever be analyzed.

The data on heavy iron aggregate concrete is important since pratically no information is available on this new type concrete which will become increasingly important.

<u>Survey Operations - Lt. Col. Daniel Kennedy</u>. The purpose of this introduction will not be to state the methods used or the technical requirements of surveying for this operation, which will follow later, but to brief the reader on the conditions surrounding the problem as they existed in October 47 and to follow the trend of procedure from then until field operations started.

It is necessary to emphasize that in the beginning the operation was classified Top Secret. This necessitated getting non-military personnel when people could not be told where or when they were going; getting them to leave the country just before the holiday season; having them cleared by the F. B. I. in time to board waiting planes; of obtaining the necessary medical inoculations; all these in the initial three weeks with a rapidly dwindling time allowance for the completion of the project. The fact, too, that the site was over six thousand miles away did not simplify matters. Secrecy and speed are not synonymous.

The Engineer in charge of the section was a civilian on 13 October and a military man 14 October. Between 16 and 30 October a trip was made to Eniwetok with a stopover in Honolulu for conferences with various groups. Three days were spent checking existing survey control and reconnoitering the islands.

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Navy Hydrographic Office which furnished the charts. Shipping arrangements were concluded. On 25 November, the Task Force Engineer, two Deputy Engineers, and the survey party left for Eniwetok. The job had started.

The section consisted of one Lt. Col Engineer Officer, in charge, (with staff status as Deputy Task Force Engineer) one Lt. Cmdr., Coast & Geodetic Survey, one Geodetic Engineer, and six field assistants. In addition, there was one military survey party in charge of a sergeant surveyor, which worked with the section along with other duties.

The office work consisted of gathering the control notes of the Navy Survey of 1944, arranging with the Army Map Service and Navy Hydrographic Office for sufficient copies of all their maps and charts covering the area of Eniwetok and vicinity. Overtime work by these organizations was required in order to complete new map and chart com-

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In addition to the triangulation and traverses required for the original structures, the section was called upon for other types of survey work. This consisted of furnishing azimuths and distances for seismograph stations, locations of buoys, requesting aerial photography,

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lines have been satisfied. The base line used in the triangulation has a probable error of 1 part in 2,100,000. The zero-timing lines varied from a probable error of 1 part in 350,000 to 1 part in 800,000. The tie-ins of other lines to these were of third order, or 1 part in 5,000.

The building of station "Reef" in the lagoon so that it could be occupied during triangulation made it possible to achieve the first order work.

The use of the LSTs during the initial stages of the survey provided excellent quarters, and gave the party the desired mobility. Officers and crews of these ships were most cooperative.

The operation of the section progressed as planned. During the months of December and January, the section missed its staff representation when the section engineer was recalled to Washington, but this situation was corrected in February by his return.

Much of the work done by this section will be available and useful for future experiments. The technical parts of this report should be given careful custody, both here on Eniwetok and in the future. A

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suggestion is hereby made that they be sent to the Army Map Service in Washington, where they will be available to those authorized and required to have them.

Th- use of highly trained topographic and geodetic engineers on this project materially cut down on the time element, and produced an excellent order of accuracy.

Kwajalein. The report of the Resident Engineer at Kwajalein Island is not included in this report as it has been previously submitted to the Commanding General, Joint Task Force Seven.

C. Construction Directive, Statistics, Maps, Charts, and Detailed Designs.

Construction Directives. The basic construction directive of Operation Sandstone was Appendix 1 to Annex E to Field Order Number 1, Headquarters, Joint Task Force Seven. It directed construction on Kwajalein and on the islands of Eniwetok Atoll in accordance with plans furnished to the Island Commanders. A copy of this directive will be found elsewhere in the report of Joint Task Force Seven. The plans and drawings are attached to this report and indexed in a subsequent part of this section.

Subsequent to the issue of Field Order Number 1, certain changes in construction requirements occurred which were consolidated into a revised set of drawings prepared by the Los Alamos Laboratories and issued to the Task Force on 9 January 1948.

Changes which occurred during the construction phase of the operation were approved verbally by the Task Force Engineer or his representatives, and were confirmed in a series of Change Orders issued by the Task Force Engineer. Four such Change Orders were issued.

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was used in all concrete except the OCE test structures, and in the 270 lb per cu ft concrete. All curing was with salt water.

BLAST BUILDING

Drawing Number E-16
E-19
E-20
E-29
E-47

Number Constructed: 3

Material for one Structure:

Concrete	155.4 cu. yds.
3/4" Ø reinforcing steel	10494 lbs
1" sq reinforcing steel	4216 lbs
2" pipe	9'
Forms	2536 sq ft

BLAST FOOTING TYPE "A"

Drawing Number E-16
E-24
E-26

Number Constructed: 26

Material for one Structure:

Concrete	3.6 cu yds

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Number Constructed: 9

Materials for one Structure:

Concrete	1.3 cu yds
5/8" reinforcing steel	161 lbs
Forms	49 sq ft

BLAST FOOTING TYPE "D"

Drawing Number E-13

Number Constructed: 2

Materials for one Structure:

Concrete	1.2 cu yds
5/8" ∅ reinforcing steel	150 lbs
Forms	56 sq ft

GAMMA STATION A

Drawing Number E-16
E-21
E-25
E-25A
E-26
E-34
E-35

Number Constructed: 3

Materials for one Structure:

Concrete 150 lbs/cu ft	16.7 cu yds
Special Concrete	30 cu yds
5/8" ∅ reinforcing steel	5555 lbs
2" pipe	38'
Forms	567 sq ft

GAMMA STATION B

Drawing Number E-16
E-22

E-25A
E-26
E-34
E-35

Number Constructed: 3

Material for one Structure:

Concrete 150 lbs/cu ft	16.1 cu yds
Special Concrete	39 cu yds
5/8" Ø reinforcing steel	9253 lbs
1" pipe	2'
½" pipe	2'
Forms	931 sq ft

GAMMA STATION C

Drawing Number E-16
E-23
E-25
E-26
E-34
E-35

Number Constructed: 3

Material for one Structure:

Concrete 150 lbs/cu ft	5.6 cu yds
Special Concrete	8 cu yds
5/8" Ø reinforcing steel	3167 lbs
Forms	326 sq ft

OCE TEST STRUCTURE "A"

Drawing Number E- 8
E- 9
E-11
E-12
MJ 3202

Number Constructed: 2

Materials for one Structure:

Concrete (w/stateside sand, aggregate, distilled water)	70 cu yds
5/8" Ø reinforcing steel	10340 lbs
Forms	1480 sq ft

OCE TEST STRUCTURE "B"

Drawing Number	E- 8
	E-10
	E-11
	E-12A
	MJ 3202

Number Constructed: 2

Materials for one Structure:

Concrete (w/stateside sand, aggregate, and distilled water)
33.4 cu yds

5/8" ø reinforcing steel	6733 lbs
Forms	1294 sq ft

TIMING STATION

Drawing Number	E-16
	E-17
	E-18
	E-20
	E-29
	E-32
	E-47
	NuC-273
	NuD-180A

Number Constructed: 3

Material for one Structure:

Concrete	67.5 cu yds
3/4" ø reinf steel:	16103 lbs
1" sq reinf. steel:	10211 lbs
6" pipe	6'
4" pipe	2'
2" pipe	85'
Forms	1311 sq ft

WINCH BASE

Drawing Number	E-16
	E-27
	E-31

Number Constructed: 3

CONTROL STATION

Drawing Number E-51

Number Constructed: 1

Materials for one Structure:

- 9 pcs 6" x 6" x 16'
- 10 pcs 2" x 12" x 20'
- 5 pcs 3" x 12" x 16'
- 32 pcs 2" x 12" x 16'
- 5 pcs 2" x 10" x 12'
- 14 pcs 2" x 6" x 12'
- 40 pcs 2" x 6" x 12'
- 10 pcs 2" x 4" x 16'
- 1345 sq ft 4' x 8' x 3/4" plywood
- 3 pcs 6 lite sash 24" x 30"
- 1 door std. 40" x 7'
- 2 rolls roofing - 108 sq ft per roll
- 15 gal grey deck paint

Construction of Major Items on Each Island Giving Starting Dates, Completion Dates, and Man Hours.

ANIYAANII

ITEM	NO. BUILT	STARTING DATE	COMPLETION DATE	MAN HOURS
Airstrip	1	23 Mar 48	29 Mar 48	405
Generator Shelter	1	23 Mar 48	29 Mar 48	108
Seismograph House	1	24 Mar 48	25 Mar 48	78

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	BUILT	DATE	DATE	HOURS
Blast Building	1	2 Feb 48	25 Mar 48	814
Blast Footing A	6	12 Feb 48	25 Mar 48	800
Blast Footing B	3	11 Feb 48	5 Mar 48	200
Causeway (curb & road)	1	13 Mar 48	5 Apr 48	964

AOMON-BIIJIRI-ROJOA

ITEM	NO. BUILT	STARTING DATE	COMPLETION DATE	MAN HOURS
Clearing		26 Dec 47	23 Apr 48	2130
Concrete slab under "O" tower	1	12 Mar 48	12 Mar 48	400
BuY&D Shapes		2 Feb 48		
BuY&D Quonset	1	6 Mar 48	5 Apr 48	527
BuY&D Timber Bldgs	2	26 Feb 48	27 Mar 48	825
Ditching		12 Mar 48	5 Apr 48	141
Gamma Station A	1	5 Feb 48	20 Mar 48	804
Gamma Station B	1	10 Feb 48	25 Mar 48	929
Gamma Station C	1	10 Feb 48	20 Mar 48	495
Generator Shelters	3	9 Feb 48	19 Feb 48	218
Grading		26 Dec 47	23 Apr 48	660
Guy Line Anchors		4 Feb 48	11 Feb 48	140
Range Poles	3	12 Feb 48	17 Feb 48	50
Soil Stabilization		14 Mar 48	23 Apr 48	1618
Tank Revetment	1	2 Feb 48	6 Feb 48	281
Timing Station	1	12 Feb 48	20 Mar 48	1828
Winch Base	1	2 Feb 48	9 Feb 48	213
400' Station	1	5 Mar 48	2 Apr 48	21
1000' Station	1	5 Mar 48	2 Apr 48	25

ENGEBI

ITEM	NO. BUILT	STARTING DATE	COMPLETION DATE	MAN HOURS
Blast Building	1	13 Jan 48	3 Mar 48	1198
Blast Footing A	9	16 Jan 48	5 Mar 48	903
Blast Footing B	3	15 Jan 48	5 Mar 48	257
Blast Footing D	2	1 Mar 48	6 Mar 48	282
BuY&D Shapes	75	24 Feb 48	5 Mar 48	431
Clearing		26 Dec 47	3 Apr 48	1000
Concrete slab under "O" tower	1	16 Feb 48	3 Mar 48	613
Ditching		20 Feb 48	26 Mar 48	850
Gamma Station A	1	15 Jan 48	4 Mar 48	955
Gamma Station B	1	15 Jan 48	4 Mar 48	1473
Generator Shelters	2	13 Feb 48	5 Mar 48	372
Grading		26 Dec 47	13 Jan 48	368
Guy Line Anchors		14 Feb 48	15 Feb 48	96
OCE Structure A	2	14 Jan 48	10 Mar 48	2703
OCE Stracture B	2	14 Jan 48	10 Mar 48	2522
OCE Strcture C	2	13 Feb 48	8 Mar 48	648

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Antenna Tower	1	22 Mar 48	24 Mar 48	22
Control Station	1	16 Feb 48	25 Feb 48	524
Reflector Tower	1	23 Mar 48	24 Mar 48	85
Seismograph House	2	23 Mar 48	24 Mar 48	78
Telemetering Lab	1	25 Feb 48	22 Mar 48	78

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ITEM	NO. BUILT	STARTING DATE	COMPLETION DATE	MAN HOURS
Blast Building	1	16 Feb 48	17 Mar 48	984
Blast Footing A	9	9 Feb 48	27 Mar 48	1843
Blast Footing B	3	11 Feb 48	27 Mar 48	399
Clearing		5 Jan 48	7 May 48	980
Concrete slab under "O" tower	1	10 Mar 48	15 Mar 48	433
Ditching		5 Mar 48	7 May 48	800
Gamma Station A	1	2 Feb 48	26 Mar 48	989
Gamma Station B	1	2 Feb 48	26 Mar 48	1505
Gamma Station C	1	4 Feb 48	12 Mar 48	1081
Generator Shelters	3	1 Mar 48	29 Mar 48	433
Grading		10 Jan 48	7 May 48	1040
Guy Line Anchors		2 Feb 48	8 Feb 48	160
Range Poles	3	20 Mar 48	20 Mar 48	46
Seismograph Houses	2	22 Mar 48	27 Mar 48	347
Soil Stabilization		31 Mar 48	7 May 48	1800
Tank Revetment	1	16 Feb 48	12 Mar 48	458
Timing Station	1	2 Feb 48	17 Mar 48	3087
Winch Base	1	23 Jan 48	24 Jan 48	110
400' Station	1	5 Mar 48	1 Apr 48	24
1000' Station	1	5 Mar 48	1 Apr 48	24

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Maps, charts, and detail drawings. There follows an index to the drawings and plans for all installations other than for housing requirements. The drawings are attached as inclosures to this report. Certain drawings, which were superceded or which became obsolete, have been omitted from copies 2 and 3 of this report as they are of value for historical purposes only. Changes made subsequent to the final printing of the drawings have been noted on the appropriate drawings.

INDEX TO DRAWINGS AND PLANS

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2	Layout Aomon-Biijiri-Rojoa I's*
3	Layout Runit I*
4	Eniwetok Atoll
5	Causeway & curb details
6	Tank revetment
7	12'x12' 8' shelter inside whs 98 on Parry*
8	OCE test structures
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10	OCE test structure B
11	Gas & blast proof doors for test structures A & B
12	Structure A forms for concrete
12-A	Structure B " " "
13	Blast footing D
14	1000' Sta junc box
15-A thru T	BuY&D installations
16	Reinforcing steel Timing sta
17	Timing Sta
18	Timing Sta
19	Blast Building
20	Timing sta & Blast building misc details
21	Gamma Sta A
22	Gamma Sta B
23	Gamma Sta C
24	Blast Footings A & B
25	Forms for Gamma Sta A & C
25-A	Typical details of slot frames
26	Gamma sta & Blast ftgs misc details
27	Winch base
28	Roof support framing
29	Plan & section Q.A. doors with mounting frame, A.E.C.
30	Channel mounting frame A.E.C.
31	Winch assembly
32	Brick layout sch. III
33	A.E.C. Evaluation Lab layout
34	30" Dia manhole trunk
35	30" Dia manhole cover
36	Floodlighting system plan

[redacted]

* Drawings marked with an asterisk have been superceded as follows:

E- 1	superceded by		MJ 3201
2	"	"	MJ 3301
3	"	"	MJ 3401
7	"	"	E-51
38	"	"	J&M Sheet #17
43	"	"	NU E 174A
44	"	"	NU E 178A
45	"	"	NU E 179A
46	"	"	NU D 180A

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V. CONCLUSION

The solution credit for this particular problem belongs to no one individual nor to any single group of individuals. Controlled decentralization of authority working through the normal staff agencies of Army, Navy, and Air brought into play an array of talent and means which made child's play of our most urgent requirements. For example: Test construction included erection of three 200-foot steel towers. These towers had been purchased previously by AEC and were in storage at Sandia, New Mexico. They had been specially designed for the job and had no previous record of erection. Were they properly designed? Had all parts been delivered? What, if any, difficulties would be encountered during erection? A test erection seemed to be in order to that these and other questions could be answered. Time was pressing. Soldier labor did not guarantee the skills to do this job. Obviously the thing to do was to employ contract labor. The Chief of Engineers was consulted. A few minutes with Brig Gen Bragdon, Chief of Construction Division, OCE, developed these facts. Peter Kiewit & Sons, a highly reputable construction firm, were doing work at Sandia, New Mexico, for the Corps of Engineers. Peter Kiewit and Morrison Knudsen, as joint venture contractors, were performing work for the Corps of Engineers in the Pacific. These firms had the facilities and know how to accomplish this tower erection job in nothing flat if they would undertake to do it. A few phone calls, two trips to Albuquerque, and a conference with Peter Kiewit resulted in this accepting a contract through the Western Ocean Division of the Corps of Engineers to perform both test and site erection of towers. One apparently troublesome problem was thus quickly overcome. Similar examples could be given to show how Lt Col Kennedy, utilizing the organization and facilities of the U. S. Coast and Geodetic Survey and the Army Map Service, produced the means to meet the mapping and survey requirements of JTF 7; how the Army and Navy supply channels in Oahu made possible the mounting of the advance construction forces - on time and with enough; how the Public Works Officer of the 14th Naval District, with but few days advance notice, negotiated a contract with the Hawaiian Dredging Company, which successfully accomplished the construction of a 700-foot sheet pile causeway between Aomon and Biijiri Islands and of three foundation structures on coral heads in the middle of Eniwetok Lagoon; and how the purchasing and expediting organizations available to the Western Ocean Division were called upon time and again to meet, and they did meet, almost fantastic delivery deadlines.

No, the successful conclusion of the construction work at Eniwetok Atoll is due to the efforts of many and the team work of all. It illustrates the wisdom of taking full advantage of existing staffs and organizations.

REPORT OF THE CONSTRUCTION ENGINEER,
DEPUTY ISCOM, KWAJALEIN

I. PLANNING PHASE

1. Colonel Keith R. Barney, CE, was notified 24 October 1947 that he would handle construction work at Kwajalein for the Joint Task Force. On 25 October 1947 reconnaissance of the site was initiated by Colonel Barney and was completed by 31 October. The basis for the determination of what construction was required was the so-called "Roberts Letter", an undated report submitted to the CG, 8th Air Force, by Lt. Colonel Roberts, A-3 thereof, as a result of an inspection he had made of the area. This report, which had as a subject: "Inspection of Kwajalein and Eniwetok", was specific as to the requirements for various activities, and, in some cases, selected the actual structures desired.

2. Major General Kepner, Deputy Commander, Joint Task Force Seven, explained these requirements on the ground, and, in some cases, modified them. The principal change he made was with respect to housing. The Roberts Report had recommended that the Task Group (hereafter ATG) be housed in the open area south of the runway. General Kepner preferred to put them north of the runway, in the developed areas, where they would be nearer their activities. This last solution proved possible and was executed.

3. The principal requirements, established as outlined above, were:

a. ATG Headquarters Building

[redacted]

e. Housing

f. VIP Housing

These requirements were considerably increased later, as will be described below in this report.

4. There follows in this paragraph a short technical description of each of the items in paragraph 3 above:

a. ATG Headquarters Building

The Group desired to use as a headquarters Building No. 1259. This is a one-story, T-shaped, framed structure. It had originally been a mess hall, of about 1000-man capacity, and had been used during CROSSROADS as a photo laboratory. Since it had been slated for removal, it had been practically cleared of all wire, plumbing, and other installations. To be usable it required new asphalt roofing, wiring, screening, plumbing, painting, and partitioning as desired.

b. Mess Hall

Building 1156, which was desired, is the large building just east of the ATC Terminal. It had been used as a mess hall during CROSSROADS. It was rated as a 2000-man mess and would seat more than 800 at one sitting. It was arranged for four (4) serving lines. The building itself was in poor condition. Like the headquarters, it had been slated for removal, and had been completely cleared of wiring and plumbing fixtures. All mess equipment had also been removed and used elsewhere. To be usable, the building required complete plumbing, painting, wiring, screening, roofing, extensive carpenter repair, installation of mess equipment, and a new steam supply system. There was also a very troublesome drain problem, the former drains being plugged and the sewers leading from them inadequate in size and grade. One of the most unpleasant jobs fell to the men who crawled under the mess hall, where they had about 18" clear space. They cut clean-out holes in the drain pipes (the pipes had not been originally equipped with such), and then cleaned the pipes.

c. Motor Pool

[redacted] ing a dispatcher's tent.

d. Warehouses

The adopted warehouse solution involved getting some space from the ATC, and erection of four (4) quonsets. One of these quonsets was later converted into a briefing room.

e. Housing

Housing for 2000 personnel was required, 350 of whom would be officers. As stated above, General Kepner preferred that this housing be on the same side of the runway as other base installations. This proved practicable and was so done. Reconnaissance on the ground showed it would be possible to find space for this

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housing in a total of four (4) areas holding respectively about 240, 100, 50, and 50 pyramidal tents each. Prior to actual construction these figures were modified to fit strengths which had been more closely estimated - that is, 229, 50, 40 and 49 tents. The decision to use tents instead of quonsets was based on two factors: first, the overall amount of labor required at the site was less; and, second, it was desired to clear completely about 2/5th of the tent area after its period of use so that it might be employed for other purposes.

The tents were designed to be floored with concrete or wood (the latter in areas to be cleared), sided, screened, raftered, and lighted. The plate line was set at 6'6" above the floor which would give headroom out to the edge of the tent.

f. VIP Housing

It was some time, 9 January 1948, before it was possible to reach a decision as to the number of observers to be accommodated, 30; and the location of their housing, at the extreme Navy end of the island. This required the construction of four (4) 20x48 quonsets for housing, one 20x60 quonset for lounge and supply, a shower and head building, and some interior work on an existing mess hall. At the time of the original estimate it was thought that this camp would be larger, accommodating 80 VIP's, and material was requisitioned for it accordingly.

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[redacted]ages as they developed, and to keep those in Hawaii, who should be informed, advised of what we were doing. The duties actually evolved about as planned. The personnel of the office were Lt Colonel R. S. Morgan, CE, in general charge of the office; and Captain W. W. Killen, AC, 926th Engineers, Supply Officer. The office was located adjacent to that of the Engineer, Seventh Air Force (later Pacific Air Command), who furnished us clerical help as required. However, the office operated separately from that of the Engineer, reporting directly to A-5, Pacific Air Command, as far as staff supervision was concerned.

b. (1) Materials to be obtained in Hawaii were requisitioned. The original bill of materials had been compiled hastily, as previously described, and the original screening for availability in the islands had been done equally in haste. Hence, strenuous efforts were made both to refine the bill of materials and to discover additional quantities of supplies here.

(2) The quantities on the bill of material tended to increase steadily. The local availabilities also increased, in a broad general way, proportionately.

(3) All Air Force, Army, and Navy supply sources were utilized in obtaining the requirements for the project. Navy sources

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furnished the 20' quonsets, substantially all the mess gear, the boilers, and a considerable proportion of the paint.

(4) Requisitions were routed as follows: They were prepared in this office, directed on the depot concerned, usually the Hawaiian Engineer Depot. They were transmitted through A-4 and AG, PacAirCom to G-4, USARPAC, and were hand-carried by Captain Killen. G-4 then transmitted them to the appropriate depot. Requisitions on Navy, except for mess gear, were handled through the Hawaiian Engineer Depot, as described above. Mess gear was not formally requisitioned but the Navy worked from an informal list we supplied. Towards the end of the requisitioning period J-4 desired to see requisitions which thereafter were routed through him to G-4. As a general exception to the above, items found in the Air Force were requisitioned directly on the agency concerned through A-4 and bypassing USARPAC agencies.

(5) All supply agencies were responsible for their own boxing, crating, and marking, and delivery to the port.

(6) Inclosure No. 1 is a tabulation of the materials we needed as we viewed the situation and were requisitioning on 6 December 1947. It does not include small mess gear which Navy was assembling for us.

(7) It will be noted that there are many items which are neither Engineer equipment nor construction material; for example, beds and office safes. We requisitioned these and similar items by agreement with other agencies as to which would supply them.

(8) Materials were estimated and ordered for showers and heads but the Navy contractor built them. This was handled by advising Navy (Public Works, Pearl Harbor), by letters, 9 and 11 December 1947, what had been ordered for these projects and by turning the items over as they became available. Since the Navy elected to install water-borne sewage disposal and the estimate was for vault type, Navy had to obtain considerable additional material for that item themselves.

c. The PacAirCom Quartermaster, Colonel Brunson, accompanied by assistants, visited the site and gave complete recommendations on matters of Quartermaster interest, particularly the mess halls.

d. Shipping requirements were estimated; lift was requested and assigned to items of supply.

e. Decisions as to the numbers of troops to be employed in the work, and their deployment to the job, were made. Employment of the Byrnes Organization, Navy contractor at Kwajalein, was decided upon. These two inter-related decisions are discussed at length in the next paragraph.

7. Use of Troops and Contractor

a. When the problem "broke" on 24 October 1947 the only engineer troop element in the Pacific Air Command consisted of the 926th Engineer Aviation Group. This Group consisted of a highly skeletonized headquarters and 3 Engineer aviation companies (not battalions) also at reduced strength. The total strength of the Group was approximately 18 officers and 330 enlisted men. About 300 of the enlisted men, those in the 3 Engineer aviation companies, were colored. The Group was at Wheeler Field; except for 5 officers and about 130 enlisted men, comprising the 2308th Engineer

[redacted]

JTF 7, that the troops at Kwajalein be reinforced by moving down a second company, the 2307th Engineer Aviation Company, and the operating elements of the 926th Headquarters Company. It was further recommended and approved that the Navy contractor at Kwajalein, the Byrnes Organization, already mobilized, do certain portions of our work.

c. The necessity for employing the contractor arose from several considerations. First: There was no practicable way to obtain aggregate for concrete except by utilizing the contractor's quarry and crushing and batching plant. Second: The 926th Engineers could not begin to meet the requirements for certain skilled personnel, particularly carpenters and plumbers. Third: The 926th could not meet the overall man hours estimate.

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[redacted]

equipment from Hawaii was 2200 measurement tons. This figure was revised upwards several times and the final figure of shipments from Hawaii was about 3500 MT. About 800 MT came from the mainland direct, mostly through Colonel Tulley's list of balances which he took to the mainland (see paragraph 5 supra). The original shipment was first set to sail 28 November. It actually sailed on 17 December 1947 with 1650 MT aboard for the Kwajalein job.

c. Approximate shipments follow:

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From Hawaii

Long Splice	Sailed 17 December	1650 MT
Faribault	" 27 "	850
LST 553	" 1 January	350
Hastings	" 9 "	500
Petrarca	" 20 February	130

From West Coast

Uvalde	Sailed 18 December	470
Others	-	250
TOTAL	--------------------	About 4200 MT

d. The operating command post of the 926th Engineers moved to Kwajalein on 16 December 1947. Its administrative elements, as well as those of the 2307th and 2308th Engineer Companies, remained in Hawaii.

II. EXECUTION PHASE

1. Preliminary Work

By 31 October 1947 there was sufficient information and troops at the site to permit going ahead with work if it had not been for the unavailability of materials. Such work as was possible was done before the arrival of the first ship, the Long Splice, about 28 December 1947. This work consisted of the following:

a. Building tent camps for the Headquarters Company and the 2307th Engineer Aviation Company. ATC was not able to accommodate construction personnel in their housing areas, hence it was necessary to provide additional housing.

b. Clearing sites. There was extensive clearing of buildings done in the Able tent site, located across the road from ATC Terminal.

c. Clean up and removal of unwanted partitions in ATG Headquarters and mess. In the latter we gave the kitchen floor 3 separate lye baths in an effort to free it from grease.

d. Selection and preparation of motor pool.

2. <u>Arrival of First Material</u>

The first materials, together with equipment, arrived on the Long Splice about 28 December and were available for use about 1 January, which for all practical purposes was the date construction was initiated. The Long Splice carried the following major materials:

About 160 M Ft lumber

6000 sacks of cement

A large proportion of our plumbing and electrical supplies

About half of the mess equipment (which in general was all supplied by Navy)

The Long Splice carried the following vehicles and equipment for us:

8 - 1/4 ton trucks

2 - 1-1/2 ton trucks

6 - 2-1/2 ton dump trucks

8 - 4 ton dump trucks

1 - arc welder, trailer mtd

1 - compressor air, truck mtd

1 - shop truck

2 - road graders

[redacted]

Service Club, NCO Club, Beer Garden, and the Theater. This was approved on 9 January 1948. The materials for it, and substantially all other additional work, had to come out of the over-run on the original estimate. (See paragraph 5, Sect I.) Additional work, in general, was the most trying problem encountered. It came up suddenly, was difficult to fit into the work program, and was very trying on the morale of the men who were constantly finding their work goals extended.

5. <u>Supply at Kwajalein</u>

a. We had the same 4200 MT of supplies to handle at Kwajalein which we had shipped. Navy had charge of unloading and delivery of the 4200 MT of supplies from Hawaii, although both trucks and details of personnel were furnished by the construction group on various occasions.

b. For warehousing space 3 40x80 Butler Warehouses were obtained from ATC together with a number of bins to put in one of them. The warehouses were used as follows: one forplumbing and electrical supplies; a second for mattresses, pillows, chairs, tables, and other camp equipment; and the third for mess gear, pumps, plywood, and various heavy items likely to be damaged by weather. Pipe, cement, lumber, paint, roofing paper, tentage, and quonset parts were stored in the open.

c. Issues were made to the construction forces and to the contractor on requisition approved by the Operations Officer. It was felt that he was in a better position to judge who should get a specific item than was S-4, and the system was established accordingly.

d. During the first month of work materials presented no problem. Materials had been obtained and were available in accordance with original designs. However, as extra work developed, more and more improvising and substituting was necessary. Even theoretically, and more so actually, 20' quonsets were exhausted and supply for the last buildings was secured by borrowing from the dump. Lumber became more and more critical, and on 19 February the supply could not issue one inch material in any size because it had none, and could only get 2x4 by ripping 2x8.

[redacted]

was done in the Petrarca shipment where contractor's lumber is painted green and ours red.

b. Inadequate descriptions in shipping documents and in tally sheets of the contents of boxes provided a problem. This necessitated considerable opening of boxes to determine their contents. Terminology used was too general, for example, "mess gear" might be anything from a stove to a spoon.

c. The basic supply difficulty was the length of the pipe line. This cannot be avoided although its effects can be ameliorated by careful pre-planning. Navy and ATC were both helpful in providing anything they had which was needed.

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d. Considerable waste motion ensued when squad instead of pyramidal tents were received. When the substitution was discovered construction was too far along to permit replacing the pyramidal by squad even had it been desired to do so. The net result was that 375 squad tents complete with all their poles, pins, etc., were stored. On 22 February they were being loaded out for return to Hawaii.

e. It was estimated that 20% of the total effort at Kwajalein was spent in unloading, warehousing, inventorying, and loading of supplies for use by construction personnel.

7. <u>Work by Contractor</u>

a. It would be wrong and unjust if this report ignored the major contributions made by the Navy contractor, the Byrnes Organization. The operations of this contractor were essential to the successful completion of the task.

b. The contractor assisted our program in two major ways:

(1) He furnished concrete, built showers and heads, and supplied carpenters and plumbers. This he was required to do by extension to his contract. This extension was given by Navy at Task Force request. Navy obtained the necessary funds and handled contract supervision and administration.

(2) The contract already provided for a waterborne sewage system, improvements to the brackish water supply, and new electric transmission lines. The contractor scheduled this work so that it would first be done in

the proper areas. For instance, the first sewer outfall placed on the island was one leading out of the Able tent area.

c. In addition, informal cooperation from the contractor was forthcoming substantially whenever it was asked.

d. It is estimated that 25% of the total work on the entire overall project was done by the contractor, and that 50% of the work requiring skills was done by his personnel.

8. Water Supply

a. The question of water supply at Kwajalein is of such engineer interest as to justify a paragraph for itself.

b. At the start of construction, water was supplied to the ATC end of the island in two kinds, fresh and brackish. The fresh water is distilled by Navy and delivered by tank truck. There are no fresh water systems except for one or two cases where one storage tank serves several buildings. Construction, so far as fresh water was concerned, consisted of tanks placed at the various structures and fresh water lines leading from them to water coolers and taps. It presented no particular problem.

c. Brackish water was quite another matter. The ATC system consisted of three wells, one of which had been abandoned; a 4" main along the through road; an elevated tank near the NCO Club; and a 450,000 gallon tank at the extreme end of the line and end of the island. The line itself was in bad condition and the pumps at the two wells, which were in use, were both improvised setups of very unreliable performance. The whole resulted in frequent interruptions to service.

d. The Navy contract already entered into provided for Byrnes to lay a new 6" main, open new wells, and generally rehabilitate the brackish system. This he proceeded to do, laying his new line from the Signal Center down the highway and putting in new wells, one in the warehouse area, and one in the area behind the new mess hall. The first of these wells, the one in the warehouse area, after coming on the line about 1 February, served as the entire brackish water supply for the Army end of the island until the second line came on about 20 February. The ATC operated their pumps only intermittently after the first described well came into use.

e. During the period after arrival of construction groups and prior to the opening of the contractor's first well, the ATC was furnished both equipment and assistance in keeping their system going. Two pumps which had been ordered in anticipation of this trouble were installed, one in ATC No. 2 well and one at their elevated tank.

9. Laundry

a. The following actions were taken by this office with respect to laundry. The original reconnaissance disclosed that ATC and Navy each operated a laundry. The Navy one was a fixed type installed in buildings; the ATC one was a trailer mounted setup with various modifications which put much of it in buildings. Navy also had, en route, the machinery recently removed from a large laundry elsewhere.

b. In a conference on 8 November 1947 it was agreed by all concerned that the Navy laundry would be expanded and rehabilitated with the view of taking the entire load. This was confirmed in a large general conference held 29 November 1947. In the meanwhile Navy had proceeded with design for their expansion.

c. Based on information obtained by Major Starker, USARPAC laundry expert, on a trip to Kwajalein, ATC Hickam was furnished with a list of parts necessary to put all their units in operation and provide an operating reserve. ATC requisitioned these parts in early December. These parts were at the ATC Hickam Terminal en route to Kwajalein on 27 February 1948.

d. On the same date Navy had finished construction of their new building and were installing machinery.

e. Construction troops built a tank at the ATC laundry in order to provide storage for fresh (rain) water. The idea behind this was to use fresh water instead of brackish water for the first washing and thus considerably reduce the time it was necessary to leave clothes in the washer.

10. Telephone System

During the reconnaissance it developed that the ATC phone system was operating at capacity and could not be utilized by the ATG without expansion of the switchboard and other installations. Based on Colonel Barney's estimate of the number of phones required and an estimate by the Communications Officer, PacAirCom, of the materials required for these phones, requisition for material was made for this work. It was installed by a detachment from the 472nd Signal Construction Company. Phone locations were furnished by the ATG.

11. Roll Up

a. Roll-up was not a true one since most of the materials will be of use to either ATG or ATC. However, a roll-up plan was submitted and approved by Joint Task Force headquarters, which provides for the following:

(1) Engineer tools and equipment to be returned to Hawaii.

(2) General purpose vehicles to be turned over to ATC at Kwajalein.

(3) Construction materials to be turned over to ATG if they desire them, it not, to ATC.

b. Personnel were returned by air in small groups as their work was finished.

III. GENERAL COMMENTS

1. Difficulties

The following difficulties were encountered. It is appreciated that some of the problems raised were unavoidable and that others solved themselves as time went on. However, they did appear to be serious problems at the time.

a. Secrecy - The classification of the projects offered delays at first. Officers and offices with whom it was necessary to deal had either not heard of the project or were convinced that that office had nothing to do with it. Each resulted in delays while someone was briefed.

b. Delays in Communication - It appeared that there were delays in delivery of messages to those for whom they were intended. A reply to a routine question to Hawaii, requiring no elaborate staff consideration, could not be expected in much less than a week.

c. Additional Work - This is always a problem to the Engineer. It is difficult to schedule properly, presents supply problems, and in a case like Kwajalein where the troops concerned are bending every effort to get their work done and get out (the 926th Engineers took one day off - Christmas Day - between 15 December and 18 January) - presents a real morale problem. The construction engineer should not be left to the mercy of every visiting staff officer who happens to have a favorite idea.

d. Complete and Timely Supply Documentation - Should be accomplished in order to avoid confusion at the receiving end.

e. While it is understood that the staff appreciates this principle, it seems pertinent to stress the importance of getting the decision of the planner to the operator at the earliest possible moment. For instance, A-3, 8th AF, recommended in September that the existing large mess hall be used. As late as October 15 troops on the ground had authority to tear this same building down and had only been prevented from so doing by the pressure of more urgent work.

2. Acknowledgments

a. It is desired to call your attention to the following personnel who assisted in the execution of the project to a degree beyond the ordinary superior performance of duty:

(1) Commander Muller, Staff Supply Officer to ComNavAirBases, who was most cooperative and helpful particularly in the assembling of mess gear.

(2) Lt. Colonel Cranford, 926th Engineers, who worked hard, effectively, and long hours preparing the estimate, preparing the 926th Engineers to go down to Kwajalein, and as Executive Officer on the job.

(3) Captain J. E. Feorene, S-3, 926th Engineers, whose sound professional background, energy, and ability to get work done proved invaluable.

(4) Captain Anthony Pollaro, 2308th Engineer Aviation Company, who, having been at Kwajalein with his company for some time previously and thinking they would be back about 1 December; when faced with the ATG task, plunged into the work with greatest vigor and got performance out of his company which would have been considered creditable in organizations with far higher skills.

b. It is also desired to acknowledge the support received from the "rear echelon" - Lt. Colonel Ray S. Morgan, CE, and Captain Willie Killen, USAF; from Colonel Savage, A-5 PacAirCom, and Lt. Colonel Donald J. Miller, Engineer PacAirCom; and Lt. Colonel Keith of the Joint Task Force staff.

c. The Byrnes Organization superintendents on the site, Mr. Herbert Miller, and his successor, Mr. George Dedman; and the Navy supervisor of the contract, Mr. Mohr, were helpful and cooperative and on many occasions gave us valuable assistance.

d. Work at Kwajalein was greatly facilitated by the strong guidance and support received from Captain J. P. W. Vest, USN, IsCom Kwajalein; and from Colonel George Bond, USAF, General Nowland's special representative.

Operational Report
Transportation Section

Chapter 1

Period from Organization to completion of Report of the Joint Proof Test Committee to the Joint Chiefs of Staff

1. The Transportation Section of Joint Task Force Seven was established on 6 October 1947 when Lt. Col. Brown reported to Lt. General Hull for duty as Transportation Officer. This section was assigned office space next to J-4, and immediate steps were taken to work in close conjunction with the J-4 Division. In this manner, the Transportation Officer was closely apprised of supply problems and his advice could be readily obtained.

2. The immediate problem was of a broad planning nature. From all available information it was necessary to prepare estimates of requirements in shipping, troops, land transportation, air transportation and other means to properly support the projected operation from a transportation standpoint. These broad requirements then had to be incorporated into the report of the Joint Proof Test Committee which the staff was preparing as a matter of urgency and which when approved by the AEC and JCS would form the basis for operation "SANDSTONE." In addition, the physical requirements had to be converted to estimates of funds required, in order that total projected cost of the operation could be determined. In computing costs, it was first necessary to work out with each service (Army, Navy and Air Force) what services could be furnished without reimbursement from the AEC. The bulk of troops and supplies to be moved consisted of Engineers and Air Force, and therefore the estimates of cargo and troops to be moved prepared

by these two agencies were the primary consideration in computing transportation support required.

3. The major decisions and broad plans for meeting transportation requirements which were made at this time were as follows:

a. It was determined that one Navy APA and two AKA's would be required from about 1 December until the conclusion of the operation to make the major personnel and cargo water movements. This lift augmented by several LST's assigned for lift in the forward area, and lift which could be obtained on opportune regularly scheduled Army and Navy shipping would meet the requirements. If unanticipated large requirements arose, Army passenger and cargo transports could be used to fill in, with reimbursement for operating costs obtained from the AEC. It was realized that requirements at various times during the operation would require use of shipping other than that regularly assigned to the operation. It was planned to obtain such shipping as required, rather than to ask for regular assignment of shipping which would stand idle during long periods.

b. It was determined that an initial water echelon consisting of vessels obtained from COMSERVPAC and USARPAC would move Engineering and support troops from Oahu to Eniwetok during early November. It was known that several Navy LST's could be obtained and that the Army was in a position to furnish lift in at least one C1-MA-V1 and several FS boats. Since much of the equipment from Oahu would be heavy engineering equipment, LST's would be ideally suited for this mission.

c. The initial water echelon from the U. S. would be mounted

Force troops and equipment. Oakland was selected as the outloading port for this echelon since the major Air Force and Army depots from which supplies would come were closest to Oakland. In addition, the closeness of the Army port of embarkation would enable ready liaison with the Navy in following up Army and Air Force supplies.

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California during the latter part of February. This would consist of the headquarters ship and supporting vessels.

f. It was determined that the following Transportation troops should be placed in the Eniwetok troop basis:

(1) One complete port company.

(2) Twenty port troops to accompany initial echelon from Oahu.

(3) An amphibious truck detachment.

There was some question initially whether the port troops would be

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included. It was pointed out by the Transportation Officer that if they were not included, the Engineer troops would be required to discharge vessels at a critical period in the construction work. Also that much equipment would be broken due to use of inexperienced troops. Based on these arguments, a port company was included. A unit was immediately alerted by the Chief of Transportation, and a final training program begun.

g. It was decided that no specialized motor transport units would be required. The distances over which cargo and personnel would be moved on the islands of Eniwetok Atoll was limited. It was considered that organic vehicles and drivers, of units to be stationed in the atoll, could meet land transportation requirements.

h. It was determined that the Air Transport Command operated by the Air Forces would be the primary carrier of passengers and freight for the operation. If ATC could not meet requirements, Naval aircraft of the Naval Air Transport Service would be used.

i. It was evident from the first that there would be no established port facilities, shore or floating cranes, etc, at the test site. Therefore all cargo would have to be loaded so as to be discharged with the ship's gear, and adequate lighterage would have to be provided for discharge of ships. The Naval Task Group Commander was made responsible for operation of the small boat pool. This pool was to be augmented by 6 LCM's and 6 LCVP's to be provided by CG, 2nd ESB.

j. It was decided to follow a policy of moving supplies directly to Eniwetok except in emergencies in order to avoid transshipments at Oahu or Kwajalein with resultant delay, extra expense, and inevitable breakage and loss.

4. It will be noted that the main thought in planning during this period was to meet the transportation requirements in support of Eniwetok. It had not yet been determined what operating facilities would be required at Kwajalein. Also Kwajalein was an operating port and reinforcement was required rather than a buildup of an organization from the ground up as at Eniwetok.

5. During this period the main difficulty in planning was the high degree of secrecy of the project. Discussion of requirements and capabilities with operating echelons of the Army, Navy, and Air Force was necessarily held to the minimum. Even then conversations were limited to generalities and a complete outline of the problem at hand was impossible.

6. The completion and submission of the report of the Joint Proof Test Committee completed the broad planning phase. At all times during this phase the Chief transportation officers of the Army, Navy and Air Force were kept informed of developments in the planning in order that they would be in a position to concur with the final report without delay.

[redacted]

Annex 1

[redacted]		TOTAL CARGO
	T	L/T
		10
	86	550
	39	261
	66	479
	35	311
	781	209
	15	576
	52	10
	69	84
	321	444
	64	43
	62	61
	48	57
	551	2663
	962	251
	118	4817
	878	773
	774	335
	399	88
	967	2084
	234	105
	121	390
	000	400
	911	3908
	831	11083
	742	14991

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TOTAL CARGO	
M/T	L/T
143	25
85	61
2224	1015
100	50
198	526
772	161
215	2076
795	1552
217	123
171	67
105	48
460	149
591	71
375	981
882	196
102	43
398	112
400	100
082	5265
151	2091
233	7356

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on 1 December, 45 days hence. The magnitude of the problem faced may be imagined by comparison to supply conditions during wartime when it required, with all stops removed, 60 days to lay supplies down at a Z/I port for water shipment after receipt of request from a theater.

2. The first problem faced was organization of a transportation section and planning for placing personnel so as to meet all require-

ments. Captain K. E. Jackson, USA, (TC), was obtained from the Chief of Transportation and reported on 15 October. It was determined that liaison and assistance from Navy transportation could be obtained through Rear Admiral Wellings, J-4, and his assistant Captain C. H. Duerfeldt, without the specific assignment of a Naval Officer to the Transportation Section. A field officer (Major Gibson) was obtained from the Army Chief of Transportation to accompany the initial echelon from Oahu for the purpose of organizing and operating the port at Eniwetok. Rear Admiral Wellings decided that he would return to Oahu and coordinate outloading of the initial water echelon from Oahu. He would be assisted by officers of the Joint Task Force Seven (Forward) Staff which consisted of officers obtained for Temporary Duty from the local Oahu Army and Navy theater logistical staffs. It was planned to obtain another officer from the U. S. who would be briefed in Washington, and then move to Eniwetok with ships papers of the first water echelon from the U. S., and assist in discharge of these vessels. It was considered that no additional transportation officers would be required at Kwajalein since this was an established Navy port, although of course augmentation of troops would be necessary.

3. It was realized that this was not the ultimate in an organization to handle all transportation problems. However, it was impossible to obtain sufficient personnel to set up an integrated transportation staff with echelons at all critical points. It was necessary to use personnel from existing staffs in Oahu with limited staff supervision from Washington.

a. Preparation and publication of policy memoranda in the form of letters, Staff Memorandums, Annex to Field Order, etc.

b. Implementation of outloading of water shipments from Oahu and the U. S. including obtaining and routing vessels, assignment of troops and cargo to vessels, and coordination of loading plans with the ports. This necessitated three trips by the Transportation Officer to the West Coast during this period.

c. Arrangement for inland transportation and followup of special shipments from depots in the U. S. to West Coast water and aerial ports.

d. Exercise of staff supervision over air shipments both within the Zone of Interior and to the forward area.

e. Preparation of plans for discharge of vessels in the forward area.

Preparation of Policy Memoranda

5. Subject Letter, "Marking Directive - Operation Sandstone," published 16 October 1947. Preliminary discussions on the question of marking instructions brought out a considerable difference of opinion as between J-2 of the Task Force, and shipping agencies of the Army, Navy, and Air Force. The shipping agencies wished to use the normal

four letter shipping designator for water movements, and "in the clear" markings for movements by air; while J-2 desired a system where markings would obscure the destination. Security considerations won out and a system of using four digit shipping designators to represent individual islands in Eniwetok Atoll, and one for Kwajalein was devised. The numerical designations were obtained from a list of such designators maintained and assigned by the Department of the Army. This system is the standard one for marking used for classified Army and Air Force movements. The Air Transport Command made strong representations to use "in the clear" markings. This was over-ruled for security considerations. In addition, a dual system of markings would have made diversion from water to air or air to water impracticable without completely remarking containers. It was directed that a green "X" would be painted on each container. There was some objection by J-2 to this procedure. However, it was considered necessary to clearly designate all Sandstone supplies, which would be moving through large supply installations, in order that they would not be mis-shipped. This marking proved invaluable to the out-loading ports as later experience was to show.

6. Subject Letter, "Procedures for Obtaining Project Material and Equipment" published 16 October 1947. The transportation portion of this letter listed modifications to POM (Preparation for Overseas Movement) for troop units to move in this operation. Such requirements as it was impracticable to complete due to time limit for movement were deleted.

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ports, including a system for followup by loading ports. Since Navy ports were responsible for most of the loading, the Commanding General, San Francisco Port of Embarkation was designated to assist Navy West Coast ports in following up Army and Air Force shipments. In this manner, it was considered that the Army supply system could be tied into the Navy port. The system for disseminating Joint Task Force procedures to agencies subordinate to the Army, Navy and Air Force was to furnish copies to the appropriate service with a request that the agency be directed to comply. No difficulty in this regard was experienced.

9. Subject Letter, "Establishment of Channel 19X," published 12 November 1947 by the Air Transport Command. This memorandum was worked out in conjunction with J-2 and J-4 and the Air Transport Command Officer, Joint Task Force Seven. The system was designed to meet security

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12. Subject Letter, "Discharge Plans for AKA's 89, 93, APA 222 and Marshall Victory." This letter set forth broad plans and target dates for discharge of vessels at Eniwetok.

13. Appendix 4 (Transportation) to Annex E, "Logistics," Field Order #1. The purpose of Field Order #1 was to set forth the major responsibilities of each agency of the Joint Task Force in carrying out

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the Sandstone operation. It was also to contain other pertinent information concerning the operation which is common to a field order. The transportation annex summarized major policy memoranda previously published and set forth the responsibilities of Task Group Commanders for transportation functions. In this connection, the Army Task Group Commander at Eniwetok was made responsible for discharge and loading of all vessels in the Atoll. The Naval Task Group Commander was made responsible for operating the boat pool and furnishing lighterage as requested by the Army Task Group Commander. In practice, this system worked well.

14. Staff Memorandum #25, "Procedure for Distribution of Shipping Information," published 23 December 1947. This publication reduced the security classification on various portions of the distribution of shipping information, in line with the overall reduction in classification of the project.

15. Staff Memorandum #28, "Loading of AGC 7, AV 4, AV 5, and CVE 115," published 6 January 1947. This memorandum was necessary in order to limit the indiscriminate allocation of personnel and cargo to these vessels. These four vessels, being combatant ships, are extremely limited to space for carrying cargo. One individual was designated for each vessel, with authority to approve or disapprove allocation of cargo to that vessel. The policy for assigning cargo to them was that only items necessary for use on board or required enroute would be placed on them. Other cargo which merely required transportation to Eniwetok would be moved on other lift available to the Transportation Officer.

[redacted] from about 5,000 to 9,000 M/T. This increase was due to expansion of requirements and also because more of the required equipment was found in Oahu than it had been originally anticipated would be the case. Arrangements were made to obtain 2 additional LST's from the Navy and to utilize 2 Army FS boats which were afterward to be used as a shuttle in the forward area between Eniwetok and Kwajalein. On the 16th of

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Engineer and Communications, to obtain estimates of the personnel and tonnage which they wished to move. This lack of firm requirements was in some measure due to the fact that the test plan of the AEC had not yet been finalized. This situation continued up until the time loading was completed. There was a continual increase of material to be supplied and loaded. The shipping available consisted of 2 Navy AKA's and 1 APA. An AKA vessel is in some ways unsuited for loading and handling Engineer equipment. The AKA's furnished had trunked hatches which limit the size of equipment which can be placed in the hold. The heaviest gear is of 30 ton capacity. For general cargo movement, a Standard Victory type cargo vessel is much more satisfactory. However, AKA's were available and therefore used. It was planned that each AKA would be able to carry about 7500 M/T of cargo. The 2 AKA's furnished had a bale cubic capacity of 11,000 M/T. In actual loading, it was found that the 7500 M/T figured was just about what they would carry.

19. In each of the loadings from the U. S. a similar system of dealing with the loading port was followed. As soon as a list of cargo had been made up, it was furnished to the loading port together with broad instruction for loading. This included such items as port or ports for which vessel was to be loaded, date vessel would be on berth, sailing date desired, notation of any cargo requiring special handling, cargo requiring special stowage so as to be available for first out discharge and assignment of units to vessels. Following this general plan, the port prepared detailed plans and proceeded with loading. As long as the broad requirements were met the loading officer had complete latitude in loading the vessel. Sometime prior to each loading, the Transportation Officer made a trip to the loading port in order to resolve any unusual problems on the ground. Through this personal contact and almost daily telephone calls, problems which came up could be readily resolved. Due to almost daily changes or additions to the loading list, this communication by telephone was mandatory. There was no limitation placed on long distance telephone calls, and in an operation of this degree of urgency such use of the telephone is a blessing.

20. On 23 October, the Transportation Officer departed for the West Coast to make arrangements for the loading of the first group of vessels. A conference was held at San Francisco Port of Embarkation attended by sections concerned from both San Francisco Port of Embarkation

of the Troop Movements Division of San Francisco Port of Embarkation to be placed on duty at Port Hueneme, California on call of the Commanding Officer of the Advance Base Depot. In this manner, the San Francisco Port of Embarkation could call forward Army troops for loading at Port Hueneme through their representative at that point. Thus, the normal Army system could be used and routine reports rendered. Following this conference, a trip was made to Port Hueneme to discuss loading arrangements with the Commanding Officer at that point. This base was found to be ideally suited for the loading operation with adequate dock space for segregating and handling cargo. Detailed arrangements were made for liaison between Port Hueneme and the San Francisco Port of Embarkation. The next port visited was Seattle, Washington. As previously discussed in Washington, the Commanding General, 2nd Engineer Special Brigade, had planned to use his own troops to load the AKA. It was found that adequate equipment was not available and in addition most of the Engineer Special Brigade troops would be moving out for loading at Port Hueneme at about the same time as the outloading at Seattle was required. Arrangements were made therefore, for the Army Port of Embarkation at Seattle to accept all responsibility for loading Engineer Special Brigade equipment. A copy of arrangements agreed to at that time is attached as Annex 3.

21. During the month of November, there was a constand increase in requirements for movement of Engineer supplies and equipment to Eniwetok. It was soon evident that the 2 AKA's and 1 APA could not carry the total amount of cargo necessary. Arrangements were made to obtain a U. S. Army transport Victory cargo ship, which could be placed on berth at Port Hueneme after completion of loading of the 2 AKA's and

1 APA. This vessel would load regular Army cargo for the Far East at San Francisco, and sufficient space would be reserved to meet requirements of the Task Force. This arrangement permitted flexibility in planning and as additional items were received for loading, the amount of space earmarked on the "cleanup ship" was increased.

22. On 1 December, the AKA's and APA reported to Port Hueneme for loading. After bottom loading heavy cargo, the USS Yancey moved to Seattle for completion of loading. The Pickaway, Warrick and Marshall Victory completed their loading at Port Hueneme without incident. There was some difficulty at Port Hueneme in tracing cargo, due to a lack of proper shipping information reaching that port. It would have worked out better if each depot shipping material to Hueneme had been required to send a radio giving date shipped, bill of lading number, and other pertinent data. When the Yancey was about half loaded at Seattle, she received a message from Task Group 7.3 that the deck should be left free for the loading of boats at Pearl Harbor. Complying with this message would have meant leaving vital Engineer material behind. This matter was clarified by dispatch with Task Group 7.3. However, this was a problem in all loading -- the balancing of 7.3 requirements for carrying boats for use in the boat pool, with utilization of deck space for carrying heavy items of equipment.

23. During November and December, several shipments of Engineer supplies were made from Oakland, California to Kwajalein. Navy reefer vessels were regularly scheduled to Kwajalein with from 1 to 3 sailings per month. There was also an occasional AKA making a normal run to Kwajalein. These vessels were used by Joint Task Force Seven to move

any cargo necessary to Kwajalein. They were not used to move Eniwetok cargo since trans-shipment from Kwajalein to Eniwetok was considered undesirable.

24. The next major movement of troops and cargo from the U. S. was in January 1948. The major Air Force movement was set up for early February. The AEC had some critical material which they required at Eniwetok by the middle of February. An attempt was made to blend these two moves together in order that regularly assigned Task Force vessels could handle the requirement. However, it was impossible to arrange a satisfactory solution to this problem. However, it was found that a U. S. Army Transport cargo vessel could be obtained with a sailing date from San Francisco which would meet the AEC requirement. Therefore, it was arranged to move all available AEC cargo on this vessel. This arrangement proved to be very sound since it enabled the AEC equipment to be moved as a separate movement, and equipment requiring special handling was consolidated. The U. S. Army Transport Antolak (Victory cargo vessel) completed loading and sailed for Eniwetok on 23 January. Unloading of this vessel was completed at Eniwetok by 10 February, which was 8 days ahead of the deadline set by AEC. Most of the cargo for loading on this vessel arrived at San Francisco after 15 January. Through this movement, AEC was enabled to go somewhat ahead of their schedule for installation of scientific equipment.

25. In the movement of Air Force troops and equipment through the

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them until called for loading by the Naval Supply Center. The major difficulty encountered during this loading was lack of information at the loading port of information on incoming shipments. Numerous shipments came in by air without adequate advance notice and this was true to a great extent with rail shipments. Documents sent by the shipping depots by regular mail often arrived after the shipment came into the port. The net result was that the Army port had to pull packing lists from each box and cut new WD Documents on each shipment.

26. There was a large amount of equipment in this echelon which required mandatory deck loading. The Naval Supply Center had several vessels sailing during late January and early February to Kwajalein with regular Navy support shipments. These vessels were used to clear some of this deck load cargo. It was fortunate that these vessels were available since all cargo could not have been carried on the 1 AKA and 1 APA assigned for this movement. The Pickaway was assigned to load troops for Kwajalein and also housekeeping and other equipment designated by the Air Force to the cargo capacity of the vessel, (about 2,000 M/T).

The Yancey was assigned to load all troops destined for Eniwetok discharge with a mall amount of cargo for Eniwetok and the balance for Kwajalein discharge. Loading of troops and cargo proceeded according to plan and the vessels sailed on schedule. Items arriving later were moved on regularly scheduled Navy reefers to Kwajalein.

27. The loading of the AGC 7, AV 4, AV 5, and CVE 115 at Terminal Island Naval Shipyard during February was primarily a responsibility of the Naval Task Group Commander. During a trip to Terminal Island in January, the Transportation Officer made arrangements for assignment of office and warehouse space for the Task Group. In addition, a troop movement officer and a freight officer from the San Francisco Port of Embarkation were placed on duty at Terminal Island to assist in handling and following up Army and Air Force troops and cargo. The cargo to be loaded on these combat vessels was primarily scientific instruments and communication equipment for use on board or while enroute. The transportation problem was minor in nature and loading proceeded smoothly.

Movement of Supplies from U. S. Depots to Loading Ports

28. The major transportation difficulty in this operation was the documentation and movement of shipments from the Navy, Army and Air Force depots to be loading ports, and the issuance of necessary advance shipping information to the loading ports. In both the December loading at Port Hueneme and the February loading at Naval Supply Center, Oakland, shipments were late in arriving, shipments arrived without documents, and without advance information. This increased the burden on the loading

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thought unnecessary to do this inasmuch as the Navy, Air Force and Army depots were constantly making overseas shipments, and the regular method of paper work would suffice. However, experience proved that the more detail published, the better, when it comes to working with supply organizations. From contact with the ports, it was found that the difficulties encountered in handling of paper work for Sandstone cargo were in many cases common to other supply shipments moving through the port. An operation such as this where a relatively small amount of urgent supplies move through the depot system is a good criteria for bringing to light general deficiencies in the supply system. Therefore, a summary of troubles encountered was in each case passed to the service concerned for such corrective action as desired.

30. In making urgent shipments within the U. S., the following points were learned by experience:

a. Rail shipments should not be made by LCL or trap car since there is no method of tracing them.

b. Air shipment by either commercial or government aircraft should not be made unless on a designated aircraft for through shipment. It was found that regular air shipments were delayed enroute at trans-shipment points and were difficult to trace.

c. Rail express was the best means for making urgent shipments. Cross country, 5 days was invariably the maximum time required.

d. Commercial truck is a very efficient manner of making an LCL shipment. AEC used commercial truck considerably. This method especially lends itself to movement of classified equipment. A seal could be placed on a truck in Boston and broken by the consignee, only, on the West Coast.

e. A convoy of weather vehicles was driven overland from Tinker Field, Oklahoma to San Francisco. This proved to be a wasteful procedure since vehicles required 3rd and 4th echelon overhaul on arrival at West Coast. Normally vehicles should be shipped by rail if the distance to be moved is greater than 500 miles.

Planning and Staff Supervision of Air Shipments.

31. The Transportation Officer was responsible for planning and coordinating all transportation. With respect to air this involved planning the requirement for cargo and personnel to move by air, through determination of policy as between use of surface and air transportation. An officer on the staff of the Commander, Air Forces, handled detailed arrangements with Air Transport Command and processed priorities for air travel.

32. Surface shipments were scheduled from both the U. S. and Oahu to Eniwetok and Kwajalein at frequent enough intervals so that only the

following type of request required air shipment:

a. Change in material required due to a change in the scientific installation.

b. Spare parts required by breakdown of equipment.

c. Troops or equipment required at once due to a failure to anticipated need.

d. Certain AEC material which could not be made ready in the U. S. until a short time before it was needed at the site.

33. Numerous requests were received from the forward area specifying that the item should be air shipped. In some cases, material was diverted to water after consultation with the appropriate staff officer concerned. Sandstone shipments were being given priority handling by both ATC and NATS. Tonnage lifted for Sandstone caused a corresponding reduction in lift for Army and Navy Pacific Commands. Every effort was made to limit air lift to items for which time limits involved made air lift mandatory.

34. A daily status report was received from ATC at Fairfield port of aerial embarkation listing personnel and cargo lifted together with backlog. This system permitted a close check on what was moving and items delayed either in moving to Fairfield or after arrival could be expedited.

35. Naval air lift was used mainly for shipments of special AEC material requiring expedited handling and followup with the great volume of normal air shipments being made by ATC. Consolidation of NATS and ATC did not affect JTF-7 shipments inasmuch as the plan had not been implemented.

36. The normal system used was that all requests for movement of personnel and supplies came to either the Transportation Officer or to the Air Staff. Priority number was then assigned through the A-4 Division of the Air Force. A system was arranged whereby the Los Alamos echelon of AEC could move a limited amount of cargo by direct contact with Air Transport Command at Fairfield, California. This permitted urgent shipments to be made in case Washington could not be obtained by telephone in time to arrange the necessary priority designation.

37. Estimates were submitted to the Air Force from 30 to 60 days in advance for tonnage required for air lift during a given month by Air Transport Command. A portion of the allocation was re-assigned to Joint Task Force Seven (Forward) to cover shipments originating in Oahu. Through February 1948, tonnage moved by Air Transport Command had been held within the allocation requested.

38. Movements by air from U. S. by ATC were as follows:

	Personnel	Cargo (tons)
December	89	13
January	209	27
February	273	52

During the three month period, Naval Air Transport Service moved about 100 persons and 35 tons of cargo.

Section VI

Plans for Discharge of Vessels

39. Offloading of vessels in the forward area was recognized as

one of the major problems facing the task force. At Eniwetok no large piers were available and all cargo had to be discharged in the stream with the ship's gear into lighters. All concerned were cognizant of the difficulties experienced during the CROSSROADS operation in this regard. Therefore, considerable attention was given to planning for discharge. The first movement from Oahu consisted of LST's except for the "Coastal Crusader" which was a standard C1-MA-V1 cargo vessel with 30 ton heavy lift boom. Two hatch sections of the 854 Port Company, which had been set up for surface movement during December, were sent by air lift during November in order that they would be on hand to discharge to Coastal Crusader when it arrived. The gear of the Coastal Crusader was utilized to discharge the main deck loads of the LST's. It took about five days on the average to discharge an LST and the C1-MA-V1 was completed in about 2 weeks.

40. A total of about 20,000 M/T of cargo was scheduled to arrive at Eniwetok on four large vessels during the last week of December. In order to plan properly for discharge of these vessels, an officer trained in beach operation (Major R. L. Shipp, USA) was placed on Temporary Duty with the Joint Task Force during early November. He was thoroughly briefed in Washington on the problem involved and a detailed plan for discharge of the vessels was written. This plan indicated that priority should be given to discharge of the Yancey and Pickaway since these two vessels were required for the February movement. This officer , together with an Engineer Supply Officer was then sent to Port Hueneme to observe the loading of the Task Force vessels. He

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a platoon of an Army Port Company from the U. S. This unit was sent out by air prior to the time when large shipments arrived. In addition, the peak unloading period at Eniwetok had passed by the time Kwajalein was reaching its peak. All port troops were placed under operational control of TG 7.2 (Island Commander, Eniwetok) and he shuttled them back and forth to meet shifting requirements.

43. During maximum unloading periods, Eniwetok handled about 1500 Long Tons per week while Kwajalein unloaded about 100 Long Tons.

44. Damage to cargo during handling was very minor. Port operations at both Eniwetok and Kwajalein were handled in a highly commendable manner.

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the prospective rollup. In addition, arrangements were made for shipment of late arrivals from the Air Force Project on the USS Alstede departing Naval Supply Center, Oakland for Kwajalein on 15 March.

3. In Oahu, a board had been convened for the purpose of drafting a plan for the rollup of Sandstone personnel and cargo upon the completion of the tests. Based on a report from Eniwetok of personnel and cargo to be returned, a shipping schedule was prepared with tentative assignment of personnel and cargo to vessels. Equipment to be returned from Kwajalein was estimated from records on equipment which had been shipped

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which was the form used for publishing the rollup plan.

4. Considerable attention during this period was given to the preparation of procedures for documentation of rollup shipments. Air Force and Navy representatives agreed to the use of the standard War Department Shipping Document. In view of previous experience in the United States, the procedures prescribed for rollup included more detailed information concerning forms to be used, distribution of each form, and preparation of cargo for shipment. Comments of the Z/I ports concerning their desires for rollup procedure were also considered. Details are contained in Joint Task Force Seven Letter, dated 4 March 1948, Subject: "Disposition of Returned Property on Roll-up of Forward Areas at Termination of Operation 'Sandstone' and Preparation and Distribution of Shipping Information."

5. There was a considerable volume of air shipments from Oahu to Eniwetok at this time. During the week ending 12 March 1948, 65,392 pounds of cargo and 57 personnel were moved by Army and Navy (ATC and NATS) from Oahu to Eniwetok and Kwajalein. Water shipment from Oahu was also being made in some volume. Two full LST loads left for Eniwetok between 20 February and 5 March. This cargo consisted of lumber for use in rollup, as well as cement, submarine cable, and other items which were required due to changes or unforeseen additions to the Scientific Plan.

6. All possible impetus was placed behind an actual initiation

of the movement of cargo back from the forward area. The "Pickaway" was set up to make a run from Eniwetok to Oahu, and the "Yancey" to the United States. The Island Commander, Eniwetok and Island Commander, Kwajalein were reluctant to release equipment for loading even though its mission had been completed. They were concerned lest a change in requirements might later cause a requirement for the item. Therefore, continual pressure was necessary to keep the rollup program moving.

7. On 8 March, the Transportation Section embarked on the USS Mount McKinley for the trip to Eniwetok. A small section was left at Oahu to send forward supplies requisitioned by the forward Island Commanders.

8. A CPX was held enroute as a practice for action to be taken during the tests. The Transportation part in this exercise was minor since all vessels at Eniwetok during the tests were to be controlled by TG 7.3 as requested by J-3, Joint Task Force Seven.

9. The primary task of the Transportation Section from this point forward until the dissolution of Joint Task Force Seven is to plan and followup execution of the rollup.

Operational Report
Transportation Section

Chapter 4

Operations at the Site

1. In order to understand transportation operations at the site, it is first necessary to outline briefly the physical layout of the islands at Eniwetok Atoll with which the Joint Task Force was concerned. Joint Task Force Seven operations were conducted on islands on the Eastern fringe of the Atoll. Eniwetok Island, at the Southern end of the Atoll, is the largest island and the primary base for operations and supply. The zero islands on which the construction was placed, are located at the Northeastern edges of the Atoll. These islands consisted of Engebi, Aoman-Biijiri and Runit. The straight line distance between Eniwetok Island and Engebi Island is about 19 miles. LST's could beach at Eniwetok Island only. LCM's, LCT's and smaller landing craft could beach at any of the islands. There are no dock facilities at any of the islands where large vessels can berth. At Eniwetok and each of the zero islands, a small pontoon float was constructed where LCM's and smaller boats could tie up. The primary use of such floats was to embark and discharge passengers from small boats.

2. The primary means for moving personnel and cargo between islands of the Atoll was through use of small boats. Small boats available in the Boat Pool were as follows:

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between islands requiring fast transportation. They can make between 25 and 30 knots. Three LCI's were available and were used on a daily ferry run between Eniwetok and the northern islands. This was about a 3 to 4 hour trip. Two trips daily were made in each direction and this furnished a ready means of transportation for all personnel with other than urgent missions moving between the islands. The LCI's were also used for various other purposes such as towing steel barges around the Atoll. Each large ship ran its own boat schedule with available ships' boats. There was normally boat service on about a half-hour schedule from the ship to the nearest shore installation. All boats, other than those belonging to individual ships, were operated as a pool under supervision of an LSD (Comstock) to meet the needs of all users. Under this means of operation, the boats listed above were adequate to meet all requirements.

3. There were 13 L-5 aircraft available for carrying personnel between islands of the Atoll. There was a great demand for the service of these craft, and they represented a very valuable means for key personnel to move back and forth between Eniwetok and the other islands of the Atoll. The command and scientific ships were normally anchored off one of the zero islands, therefore, by use of the L-5 aircraft personnel could save about 3 or 4 hours in travelling between their ship and Eniwetok by use of the aircraft rather than boats. Two L-4's were also available but it was found that the prevailing wind was too strong for this type aircraft to give reliable service. Six helicopters operated from the Bairoko. These helicopters had the primary mission of carrying out special operations during the test days. Between test days they were used for trips of key personnel from ship to shore and between islands of the Atoll.

4. Transportation ashore was mostly by use of the jeep for personnel and the 2½ ton cargo truck for equipment. About 6 sedans were available on Eniwetok Island, and were used as a taxi fleet hauling personnel on call. In all there were about 150 jeeps on Eniwetok and the 3 zero islands. There was the usual complaint about a shortage of jeep transportation, however, this was due mostly to individuals not having a personal jeep assigned. There was no holdup of operational work due to lack of ground transportation. Some difficulty was encountered due to improper traffic control on Eniwetok Island. Additional M. P.'s to cut down speeding and other misuse of vehicles would have been helpful.

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these dumb barges was by use of LCM's or an LCI. Neither of these methods proved to be very satisfactory. Cranes available for use on the beach were inadequate. A Northwestern 35 ton crane was pulled off the scrap heap and rehabilitated. It was deteriorated so that only about 15 tons could be lifted. However, this crane was used for most of the work on the beach and the beach operation would have been severely handicapped without it. The only other cranes available were the Crawler type, 7 to 10 ton, and were too light for handling much of the equipment. In discharge and loading operations, pallets were used normally for handling general cargo. Cargo was loaded on flat bed trailers or 2½ ton trucks which were in turn placed in lighters and moved to the ship for working. The use of flat bed trailers facilitated cargo handling operations since the trailer could be pulled from the beach to the warehouse and left there for unloading when depot labor was available. It was found that placing landing mat on the beach where trucks, bulldozers, etc., were working was unsatisfactory. The mat breaks off and is pulled into the water where it may foul the propellers of landing craft. However, landing mat is useful for hard-stands in depot areas.

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6. Fourteen DUKW's operated by an Army Amphibious Vehicle Platoon were part of the Eniwetok equipment. They were used very little in cargo handling operations but had a variety of more important uses. They operated well as shuttle vehicles to run between islands of the Atoll and also for visitors inspections of the Atoll and for island security sweeps.

7. There were three LST's assigned as organic shipping for this operation. An average of two of these vessels was kept in a shuttle service between Eniwetok and Oahu. They could turn around in a little over a month, and cargo handling was more simple by use of these vessels than with a normal cargo ship. When in the forward area they were used for supervising the boat pool, pumping fuel ashore, and other related uses.

8. An Army port company was assigned to CTG 7.2 and performed most of the discharge and ship loading operations. This unit operated in a superior manner. The men were somewhat untrained at the beginning of the operation, but after a month or so of work, were able to perform any task given in a minimum amount of time. For example during Aprill, 900 long tons of general cargo was loaded on an LST in five days.

9. Travel between Kwajalein Atoll and Eniwetok was performed in the main by use of shuttle aircraft. There was a C-54 or C-47 scheduled in each direction daily. Mail, passengers and freight were carried on these flights. Special flights were set-up where necessary. In case the amount of cargo at Kwajalein made it worth while, an LSM, or other cargo craft was scheduled between the two Atolls. The distance is

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Eniwetok.

11. The main deficiencies in equipment at Eniwetok were as follows:

a. A heavy crane was needed. Two 35 ton capacity Northwestern cranes would have been invaluable.

b. Several small mobile cranes (cherry pickers) would have been very useful.

c. Additional steel barges and at least one tug would have facilitated unloading.

d. The port company should have had a D-7 bulldozer as part of its equipment on the beach. Borrowing this equipment from Engineer troops proved unsatisfactory since the bulldozer was never available when required.

13. Attached as an annex is a list of service texts used in planning and carrying out the transportation phase of the Sandstone operation.

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Operational Report
Transportation Section

Chapter 5

Roll-Up

1. From the beginning of transportation planning for Operation Sandstone, which was initiated during October 1947, careful thought was given to the problem of the return of equipment from the forward area after its purpose had been accomplished. It was know that the roll-up of the CROSSROADS operation had left much to be desired, and all hands were anxious to prevent a recurrence in the Sandstone Operation. The basic policy for roll-up was contained in Appendix 4 (Transportation) to Annex E, Field Order 1, published 14 November 1947, Par 8a quoted as follows: "Personnel and equipment will be returned to destinations designated by the respective Services as soon as practicable after the mission of the personnel or equipment in the Forward area has been completed." This principle was followed closely, and by careful use of shipping and air lift no backlog of personnel or cargo was built up until after 1 May. Following that date cargo had to be held for movement in the final roll-up in order that all shipping space would be used.

2. Field Order 2, Joint Task Force Seven, published 8 March 1948, contained general assignment of personnel and cargo to air and surface lift, and scheduled shipping. This field order was painted with a broad brush, and schedules and assignments had to be amended as the actual roll-up progressed. This field order, however, was very valuable

in laying down a general plan, about which details could be built.

3. About 34,000 measurement tons of cargo had been landed at Eniwetok, of which about 24,000 measurement tons was equipment requiring return to the U. S. or Oahu. About 20,000 measurement tons had been landed at Kwajalein of which about 8,000 measurement tons required return to the U. S. or Oahu. The first major movement of roll-up cargo was 1500 measurement tons loaded on the USS Pickaway for Oahu, sailing 15 March. Between that date and 1 May, a total of about 9,000 measurement tons was loaded out of Eniwetok leaving about 15,000 measurement tons for loading in the final roll-up. Thus the roll-up job at Eniwetok was about 40% completed prior to 1 May. Annex A, summarizes cargo loaded out by vessel with sailing dates from Eniwetok, while Annex B sets forth similar information for Kwajalein.

4. The system for assigning surface lift for personnel and cargo was similar to the method used on outloading from the U. S. The Island Commander at Eniwetok and Island Commander at Kwajalein were assigned space in accordance with their requirements. Both passenger and cargo space was tight. The main vessels available for surface lift were the APA 222, (USS Pickaway), AKA 89, (Warrick), AKA 93, (Yancey), and the LST's 45, 611, and 219.

5. The problem of returning small boats to Oahu or the U. S. was a formidable one similar to the trouble encountered in moving them forward. The LSD (Comstock) carried 2 LCT's, 2 AVR's, and several additional LCM's. The remainder of the boats were handled by other cargo and

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publishing new orders to return the unit. Also a new shipment number was given each unit for return which required remarking of all boxes and unit equipment. Navy shore based personnel were few in number (80) and obtaining orders was no problem.

8. About 10 April a "phase-out of personnel" report was submitted by each Task Group Commander. These reports listed all personnel assigned to the Task Group, together with the method of transportation desired, and date available for transportation. If air was designated, a statement of reason desired was required. Based on these reports, a plan was prepared moving each individual of the Task Group to the desired place. It so worked out that air lift and surface lift capabilities were such that the requests of Task Group Commanders could be met as submitted. The air lift capability from Kwajalein to Oahu was 35 per day by the Air Transport Command from Z day to Z plus 15, and after that 175 per week. The Naval Air Transport Command provided 50 spaces per week. Following is a summary of the method of movement of personnel:

a. From Eniwetok:

By unit vessel	5263
By military air lift	355
By surface lift	1925
Total Personnel (Eniwetok)	7543

b. From Kwajalein:

By unit aircraft	602
By military air lift	357
By surface vessel	648
Total Personnel (Kwajalein)	1607

Total on Operation at Roll-Up: 9150

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3 - Miscellaneous type fork lifts

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Annex A

JTF - 7 SHIPMENTS FROM KWAJALEIN

VESSEL	PORT OF DISCHARGE	SAILING DATE	ARRIVAL DATE	TOTAL CARGO M/T	TOTAL CARGO L/T
Faribault	Oahu	5 March 1948	15 March 1948	200	9
Yancey	Oahu U.S.	3 April 1948	10 April 1948 20 April 1948	400	10
Faribault	Oahu	16 April 1948	24 April 1948	15	1
Faribault	Oahu	3 June 1948	15 June 1948	917	38
Pickaway	U.S.	10 June 1948	23 June 1948	500	21
Warrick	U.S.	12 June 1948	26 June 1948	5500	274
			TOTAL..................	7532	354

ANNEX B

JTF - 7 SHIPMENTS FROM ENIWETOK

VESSEL	PORT OF DISCHARGE	SAILING DATE	ARRIVAL DATE	TOTAL CARGO M/T	TOTAL CARGO L/T	REMARKS
Pickaway	Oahu	15 Mar 48	22 Mar 48	1533	667	
LST 611	Oahu	19 Mar 48	31 Mar 48	1953	489	
YCV 17	Oahu	20 Mar 48	10 Apr 48	300	200	
Yancey	Oahu/U.S.	29 Mar 48	17 Apr 48	*3264	*1124	*Kwajalein- 174 M/T - 93 L/T Oahu -1440 M/T - 571 L/T U.S. -1650 M/T - 460 L/T 3264 M/T -1124 L/T
LST 611	Oahu	26 Apr 48	8 May 48	2029	956	
LST 45	Oahu	25 May 48	6 June 48	1500	600	
LSM 378	Oahu	27 May 48	10 June 48	400	185	
LSM 250	Oahu	29 May 48	12 June 48	415	223	
LST 219	Oahu	10 June 48	22 June 48	2015	893	
Pickaway	U.S.	5 June 48	23 June 48	1500	612	
Yancey	U.S.	10 June 48	23 June 48	7300	2012	
FS 211	U.S.	10 June 48	1 July 48	300	155	
LST 611	Oahu	15 June 48	28 June 48	1515	715	
			TOTAL	24024	8781	

Annex 3

STATEMENT OF RESPONSIBILITIES FOR LOADING 2d ESB EQUIPMENT

29 October 1947

I. PROBLEM

An AKA type vessel, supplied by the Navy, will partially load at Port Hueneme, California, and top off with equipment of the 2d ESB at Fort Worden, Washington. Vessel will be placed on berth at the naval base at Port Hueneme on 1 December 1947. It is estimated that the vessel will complete loading at that point at such time that it will arrive at Port Townsend on 6 December 1947. Equipment of the 2d ESB will be loaded from 6 - 10 December with a sailing date of about 11 December 1947. These dates are tentative and subject to change when vessel availabilities are known.

II. THE COMMANDING GENERAL, TASK FORCE HEADQUARTERS WILL:

a. Advise the Commanding Officer, Port Hueneme, Commanding Officer of the Seattle Port of Embarkation, and the Commanding General, 2d ESB, at the earliest practicable date of the name of the vessel, and the vessel characteristics, which will be assigned to this mission.

b. Advise the Commanding Officer, Port Hueneme, of the amount of space which can be filled with cargo at that point.

c. Direct the Commanding Officer, Port Hueneme, to furnish the Commanding General, 2d ESB, and the Commanding Officer of the Seattle Port of Embarkation, a statement of loading done at that point.

III. THE COMMANDING OFFICER, SEATTLE PORT OF EMBARKATION, WILL:

a. Be responsible for loading the vessel in accordance with the desires of the Commanding General, 2d ESB. This responsibility will

[redacted]

b. Maintain liaison with the Commanding Officer, Seattle Port of Embarkation, in order that the latter may be fully informed of equipment to be loaded and any other information required.

V. GENERAL REMARKS.

a. Military personnel will be used to perform the loading except for such technical advice as may be required from civilian personnel.

b. It is contemplated that the winchmen will be supplied by Navy complement of the vessel.

c. Details of the loading arrangements and determination of whether or not all loading can be accomplished at Port Townsend will be worked out between the Commanding General, 2d ESB, and the Commanding Officer, Seattle Port of Embarkation.

d. Funds required to carry out these responsibilities will be allotted through fiscal channels.

e. Personnel having a knowledge of the arrangements for this loading

/s/ William H. Donaldson, Jr.

/t/ WILLIAM H. DONALDSON, JR.
Colonel, TC
Commanding
Seattle Port of Embarkation

/s/ D. A. D. Ogden

/t/ D. A. D. OGDEN
Brigadier General, USA
Commanding 2d ESB

PHOTOGRAPHIC REPORT

1. It has been evident during the Sandstone tests that few, if any, of the personnel concerned have been thinking in terms of the military requirements to use experiments of this nature to gather scientific data and operational facts upon which an Atomic striking force must be built. During the preparatory period and throughout the test, there have been no manifestations of the establishment of policies or techniques which will develop the tools needed to exploit combat utilization of nuclear fission weapons. These policies and techniques are just as much a part of the scientific requirement as the data which determines the efficiency of the weapon. They must be scientifically determined and scientifically applied. That they lie outside the province of the Atomic Energy Commission as presently constituted does not detract one whit from their necessity to the United States.

2. The reader is asked to keep this observation in mind as he reads through a detailed description of how photography was actually applied to obtaining a record of Operation Sandstone.

3. The problem confronting the photographer during Sandstone was to record during a period of darkness all the phenomena which varied in luminosity from the light of less that 1/100 sun to the intense and blinding brilliance of 600 suns or more. Never had photo materials been called upon to record over such a tremendous scale. However, there was always the possibility of a low order detonation,

which would present an entirely different light value. These factors, plus the necessity to be prepared for a slight variation in time of detonation, made the technical problem of the photographer exceedingly complex. This was not simplified by the absence of luminosity charts from previous detonations. Add to this the problem of training aerial cameramen who peered through nearly opaque (ND 4.5) goggles at a wee red light that danced beneath the always present clouds as their aircraft orbited about the zero point at a distance of 10 or 8 nautical miles, and some concept may be obtained of the necessity for a complex operating plan and a rigorous training schedule.

4. The Joint Chiefs of Staff assigned to the United States Air Force the responsibility for obtaining the photographic coverage required by Joint Task Force Seven in Operation Sandstone. It was planned that photography would be made the responsibility of one organization in order to avoid unnecessary duplication and to simplify the problem of security.

5. The Chief of Staff, United States Air Force, delegated to General George C. Kenney, Commanding General of the Strategic Air Command, responsibility for providing the Air Force troops and materiel required to support Operation Sandstone. General Kenney issued verbal orders making Brigadier General Cullen available to Joint Task Force Seven as the Staff Photographer, in addition to his other duties as Commanding General of the 311th Air Division, Reconnaissance. It was also agreed by the Strategic Air Command that photo-

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a. Technical photography used for measurement.

b. Photography used to illustrate technical reports.

c. Documentary photography required to portray the sequence of events and the manner in which they were accomplished.

d. Identification photography required by security. This latter was made the responsibility of J-2, Joint Task Force Seven,

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and the Staff Photographer had no connection whatever with this phase. The other three phases of photography were obtained both from the air and from the ground. Motion picture or still photography in both black and white and color were the mediums used whenever technically practicable.

9. A conference attended by the senior members of each of the services represented in Joint Task Force Seven, and the Atomic Energy Commission, developed a requirement for documentary and technical pictures which would portray the problems presented in operating the Atomic Proving Ground. Seventeen pictures were outlined varying in classification from Top Secret Restricted Data to unclassified. Many of these films would have certain common scenes, but the narration and the general theme of the picture would vary to meet the requirement of the service with the primary interest. Shooting scripts were prepared to secure the footage in line with the foregoing.

10. The Photographic Plan. The establishment of the basic photographic requirements indicated a need for four types of operating organizations in the test area; an aerial photographic unit, an organization to install cameras and allied timing equipment in the photographic towers, technical and documentary teams, and an emergency film processing laboratory.

a. The air photo organization was modeled after the Air Force Operation Crossroads unit, using the same aircraft as those used on Crossroads with a similar camera installation. Two C-54's

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jalein. A total of one hundred and eight cameras of all types were used on any one mission.

b. The Test Director ruled that photographic towers would not be manned, as they would located at an average distance of five miles from the blasts. Principal reliance for the technical record was placed upon Fastax cameras with additional coverage obtained by high-speed 35mm and 16mm motion picture cameras and aerial still cameras, all of which were operated automatically. Individual time relays were built and installed which actuated the cameras at a predetermined time sequence. Submarine control cables originating at the central timing station were laid into each of the photographic towers to give an electrical impulse to the time relays at H hour minus one minute and minus one second. Because there was always a question as to the efficiency of the detonation and further that the requirement for technical photography was as great in event of a low order detonation as it was in the event of a full efficiency detonation, cameras were deliberately selected to obtain photography covering a wide range of luminosity and a considerable variation of time.

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detail in the mockup, an action which brought to light and eradicated most all of the operating and mechanical 'bugs'. This action saved much valuable time in the theater and gave assurance against failure of the unit to accomplish its mission. In all, four photographic towers were constructed and used; one on a coral head in the lagoon and three on the islands. The coral head tower was utilized for the recording of the three blasts, in conjunction with one on Aomon for X-RAY, one on Runit for YOKE, and one on Aniyaanii for ZEBRA, and thus records of each detonation were obtained from different angles.

d. Seven documentary photographic teams were organized as units capable of accomplishing every type of photographic service on the ground. Each crew was equipped with a professional type 35mm motion picture camera, a 35mm handheld movie camera, a 16mm professional movie camera, a standard still camera of the press type and a large portable view camera. In general, black and white film was

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the logistics of supply in the forward area would be reduced to a minimum. To conform with this decision, the bulk of the laboratory processing was accomplished at installations in the Zone of Interior. Still photographs were processed at Bolling Air Force Base, Washington 25, D. C. by the 10th Photographic Technical Squadron, a unit of the

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311th Air Division, Reconnaissance. Contracts were let with the Consolidated Laboratories at Los Angeles to process all motion picture black and white film, and with Eastman Laboratories, also in Los Angeles, to process 16mm color.

12. a. The Air Force had the photographic management experience, but was limited in the number of technicians available because of other high priority commitments, also partly from the demobilization scarcity which affected all the services. The U. S. Army and U. S. Navy each made a limited number of technicians available. These were augmented by 24 civilian specialists selected by Mr. Louis Hagemeyer, USAF, from ex-service personnel who patriotically agreed to serve at less than union rates in order that complete photographic records could be made of these tests. It was assumed that time and red tape would be shortened by employing these technicians through the University of California. It is known now that this assumption was incorrect and time and manpower would have been saved by hiring them as temporary civilian employees of the USAF.

b. The 311th Air Division used about 457 personnel exclusively on Operation Sandstone in three establishments in the United States and in the forward area. This does not include management that was engaged in other operations as well. There were approximately 100 photographers in the forward area, divided between the Air Photo Unit, the Photo towers, and the documentary crews. All of the personnel settled into excellent teamwork as soon as the novelty of their mission had passed. Electricians, mechanics, clerks, and the reputedly

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the need arose. A close watch was maintained on the results achieved by the individual photographers through the Zone of the Interior establishments of the 311th Air Division, and corrective action was taken in the theater as needed. The early planning for the photographic phase of the operation proved to be sound indeed as no changes to the basic plan were made and a maximum accomplishment was obtained with a minimum of effort.

14. It was planned to portray the various facets of the operation in both black and white and color photography as separate documentary films. For the purpose of cataloging, compiling and editing the work prints, the section designated as First Motion Picture Unit Detachment was set up in the Los Angeles area. This unit consisted of both military and civilian personnel from the Air Force First Motion Picture Unit, an organization assigned to the 311th Air Division, Reconnaissance. Here, the various films discussed in paragraph six reached their final form.

15. Security of photographic products was a matter of concern from the inception of planning. It was early decided that the photographic organization would not be charged with special security responsibilities, but that these would be controlled by the Security Officer, J-2, Joint Task Force Seven. An elaborate, and at times, cumbersome, security program was laid out for the handling of all photographic products. This program was followed to the letter throughout the entire operation. One or two minor modifications, such as the processing of films by Udey and Sweeney aboard the USS Curtiss and the handling of the film of the Fitzwilliam Group were made, but these did not modify the spirit of the basic plan.

16. CONCLUSIONS: The basic requirements for photography as laid down by the various services were met, thus it may be concluded that the initial planning was sound. It should be noted that the original

plan was followed throughout the operation. The difficulties of obtaining security clearances for the photographic personnel prolonged the preliminary period and caused considerable hardship to some photographic personnel, however, the job was done, and well done, and the hardships will be forgotten in the satisfaction of a difficult job excellently executed. The original conception that all photography in the forward area should be under one control, was, and remains, the sound and defensible idea. The intrusion of various scientific groups into the forward area at the last minute, each with a certain amount of photographic impedimenta, which, through the lateness of its arrival, caused modifications of the basic plan, should in no way detract from the soundness of the original concept.

17. Real progress is thwarted by the tendency to assume that correct equipment and techniques have been used if the results are satisfactory. This, because the photographic towers served their purpose, it might be argued that they were satisfactory, but it is stated emphatically they were not. Poor things were made to work by clever individuals working very hard.

18. a. The following recommendations have been determined as result of experience gained on Operations Crossroads and Sandstone. There has been no attempt to expand these in the body of the report as it is felt that their merits are self-evident.

(1) It is recommended that planning be initiated <u>at once</u> for the next series of tests and that equipment be simpler

in design and that it be specifically designed to solve the photographic problems presented by the operation Atomic detonations.

(2) It is recommended that the principal record of an Atomic detonation be obtained from an aircraft vertically above the detonation, utilizing full variety of cameras to secure high-speed as well as large image coverage in both color and black and white, whether the aircraft be an FP-80 or some other high altitude high-speed aircraft is immaterial to this recommendation. It is believed that the vertical coverage should be supplemented by aircraft orbiting about the point of detonation at medium altitudes and moderate distance. There again, the coverage should be both high-speed and large image in color, and black and white.

(3) It is recommended that Drone aircraft be used from which to secure photography of atomic detonations.

(4) A high-speed camera should be developed that will give the quality of the Mitchell camera with a speed of approximately 10,000 frames per second, have a good photographic definition and at least 200 increase in running time over high-speed cameras now in use.

(5) A single timer should be developed and procured which will actuate all the cameras of a given installation (tower or aircraft) with a predetermined amount

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from batteries and generators being used for recharge purposes.

(7) A means of superimposing a positive millisecond time trace on all film should be developed for all types of cameras, including stills. The time trace, which will establish the synchronization between various observing stations, air or ground, will permit comparative graphic studies between vertical and horizontal observation posts with time of graphs accurately shown. All cameras should be operated fully automatic, except for initial sighting.

(8) It is recommended that if Atomic tests are to be conducted over a prolonged period of time, that a complete laboratory be installed in the forward area for the entire processing of the photography of the test. It should be remembered that this was not done during Project Sandstone in the interest of economy, both in initial outlay and in the supporting services required for large number of additional people.

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record of Atomic weapons. This report should include a list of all the types of cameras - their abilities, limitations and the probability of improvement of each.

(14) It is recommended that the equipment and technique required to obtain the necessary scientific information regarding the detonation of an Atomic weapon over enemy

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terrain be determined and that development be started immediately.

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