RESTRICTED

# THE SEABEE ROLE OVERSEAS

NAVDOCKS P–55

BUREAU OF YARDS AND DOCKS
DEPARTMENT OF THE NAVY
WASHINGTON, D. C.
1951–1952

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# INTRODUCTION

The purpose of this book is to present to Civil Engineer Corps officers a comprehensive picture of their responsibilities in advanced base development.

With the state of turmoil existing in the world today, CEC officers might well be called upon to participate in advanced base work on extremely short notice and with little opportunity for additional training.

Because much of the work in various chapters has been standardized by Navy Regulations or directives, this book has been written in a modified handbook style for easy reference.

Since the CEC Reservé contains most of the commissioned ranks, the chapter subjects cover responsibilities of all echelons of command to provide study material of interest to the entire group. The early portions of the book deal with high-level planning to establish a background for discussion of details of work within battalions and other units.

The book has been divided into 12 chapters for study at 12 Reserve seminars. However, many of the chapters contain sufficient material for more than one session. Unit commanders are free to decide if the content of any chapter should be given lengthier study.

The development of advanced bases is such a broad subject that no single text can answer all questions. However, it is hoped that this book will stimulate discussions which will expand its usefulness.

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## *CHAPTER I*

# *CONCEPT OF OVERSEAS BASES*

THE AVERAGE AMERICAN is reluctant to embrace war. His temperament opposes it and his traditions back him up. But threaten his peace and security and no enemy encounters a more resourceful and formidable opponent. Thus, we have come to look upon ourselves as a nation of crusaders for peace in a world badly shaken by dire threats of war.

The upheavals spanning the last 34 years, which brought us World Wars I and II, now find us facing the real danger of a third violent global eruption. The state of the world during this period has crystalized the average American's thinking, literally forcing upon him a close acquaintance with war's basic theory, strategies, and tactics.

In light of the average citizen's fund of common knowledge of modern war we can treat the first basic concept—the importance of the overseas base. For example it is generally accepted that the only effective way to beat the enemy is to defeat him on his "home grounds". This primary strategy is as valid today as in the era of the spear and shield. Overcoming the stubborn resistance of both Japan and Germany vividly demonstrated this elementary fact in World

**Your advanced base may look like this.**

War II after we had learned it on a lesser scale in World War I. Therefore, the premise, that the nation to be defeated must be invaded, holds firmly.

For the United States, this basic requirement of conducting a modern war poses quite a problem. According to the theories of "geo-politics", "one-world" geography, or whatever you may choose to call it, the North and South American continents are only world islands lying on the fringe of the world's principal land mass.

If the United States is involved in global war we must first occupy and then deny the aggressor naval bases from which he could cross the oceans to attack us. If we would defeat him, we must take bases close to the enemy. From them, we can mount offensives against his homeland, a strategy forcefully demonstrated in naval offensive operations in World War II.

The "island-hopping" advance through the Pacific illustrated the strength and influence of a campaign to establish well-planned bases. Even though hundreds of thousands of Japanese troops remained in the by-passed area, they were nullified as an organized combatant force. This worked a great economy for our fighting forces. We retained the personnel who would have been casualties and saved supplies which would have been expended to overpower isolated enemy troops by a direct frontal attack. In addition, the war was shortened considerably.

The magnitude and importance of advanced bases in the Pacific Area, Africa, and Europe and the prominent Navy role in all these operations needs no recounting. The Navy, in general, and the Seabees in particular did a magnificent base development job.

### *ADVANCED BASES*

In wartime, the Seabee role overseas is going to be concerned almost entirely with advanced bases. However, to clarify this subject, we refer to the "Dictionary of United States Military Terms for Joint Usage", which defines an advanced base as—"A base located in or near forward areas outside the zone of the interior, the primary mission of which is to support wartime operations of the armed forces".

The *outlying base* is another type of *overseas base* where Seabees will be employed in the wartime expansion of naval activities. The outlying base is a permanent naval base (such as Pearl Harbor or Kodiak) located outside the continental limits, which is designed to serve as a strong point of support for the fleet and which can be maintained for limited periods during war. It differs from an advanced base, which is of a temporary wartime character.

Because the Seabees will be involved primarily in the development of advanced bases, this book deals mainly with material related to them.

### *TYPES OF ADVANCED BASES*

While the examples already cited reviewed the function of advanced bases, which directly supported offensive operations, there are other types in which the feature of direct support is not so apparent. These may be noted by study of the grouping of World War II bases. For example, the general types of advanced bases of the recent war have been placed in the following classifications:

(1) Those serving as bases for direct offensive operations, such as Guadalcanal and Tinian.

(2) Those mounting or supporting further offensives, such as Saipan and the amphibious bases in England.

(3) Those established as a part of or to protect a line of communications and supply, such as Iwo Jima, Samoa, and Brazil.

(4) Those established to hold threatened strategic areas such as Attu and Adak.

(5) Those which were a combination of these, such as Guam and Iceland, or which changed according to the situation.

(6) Those established because of an imagined threat. The motor torpedo boat bases on the west coast of Central and South America and the base at Prince Rupert, Canada, were in this category.

Advanced bases can also be classified by kind, such as destroyer, submarine, torpedo boat, land plane, and seaplane bases. However, these are usually secondary bases, and are simply named listings of bases which are already covered under the general types noted above. While a classification as to kind or name

**Assault wave on the way.**

is proper in dealing with the details of a particular area, or operation, it has small application to a general work of this nature.

### *ADVANCED BASES OF THE FUTURE*

While the future may introduce many new weapons and techniques, there is no immediate prospect of inventions or situations which will make it possible to wage and win a major war without advanced bases.

The kinds of advanced bases to be built in the future will be determined by many factors, such as:

(1) Date of the war.
(2) Capabilities of the enemy.
(3) Capabilities of allied nations.
(4) Strength and disposition of enemy forces.
(5) Location of allied nations.
(6) Characteristics of the theaters.
(7) Development of new weapons.
(8) General strategic plans.
(9) Tactical developments.
(10) Logistic plans.

The most complex type of advanced base is likely to be that in which ground, air, and naval forces must share the same limited area that has recently been the scene of intensive combined amphibious combat. While still subject to enemy attack, the combined forces must rapidly develop in that area major facilities for the support of further offensive operations. The Navy must be prepared to build such bases and the greater part of the work and responsibility for construction will fall upon the Seabees.

Advanced bases of the future will probably have similar functions to the bases of World War II, but their characteristics may be quite different. For while the reasons for establishing advanced bases do not change, the factors which govern their characteristics do change with the times.

### *COMBAT SUPPORT IS THE PRIME FUNCTION*

The effectiveness of any offensive is greatly increased by decreasing the distance from which it is launched. Therefore, it will always be to our advantage to operate from advanced bases as close as possible to the enemy. The ever-present demand for increased fire power and greater mobility in all our forces expands the need for mechanization, technical improvements, better maintenance, skilled personnel and larger facilities. This, in turn, increases the already high ratio of support forces to combat forces. Thus it is more important than ever that the support capacity of advanced bases be maintained with *maximum* efficiency. A degree of efficiency, much higher than that achieved in the past, is absolutely essential if advanced bases are to fulfill their future mission in the support role.

One of the unsolved and most difficult problems facing our military planners today, is that of keeping the ratio of support forces to operating forces to a reasonable minimum. Modern trends exert a constant pressure in the opposite direction; that is, technical improvements and increasing mechanization tend constantly to increase the size of the support forces.

In many ways, this is the most important influence in any war effort. Wartime production of ships, tanks, planes, and guns, can be multiplied many times over peacetime quotas, but the production of human resource, manpower, was fixed perhaps twenty years before. Nothing can be done to change this figure and the only way it can be increased is by added efficiency, better techniques, and better organization.

A human factor also adds pressure towards a further increase. Too often, particularly at a large advanced base, a disproportionate share of the base effort goes exclusively to its own support for creature comforts, or for "empire building". This results in a loss of effectiveness in support for the operating forces.

Emphasis must be placed on the providing of minimum needs, standardization of equipment, decreasing numbers of personnel required for support, and effort must be focused on cutting down logistic requirements to support bases. This will result in making a maximum number of personnel available for duty on combat craft and in combat units.

The foregoing may appear to be unusual emphasis on a minor administrative point. But is it? Suppose that in a future conflict we face a numerically superior foe. Will we have time to make up this disparity in numbers with superior weapons, superior equipment, and superior *techniques* and *organization?* We might! But just remember that the accelerated tempo of a future war is certain to permit few errors and little time for correction. So—it will be the duty of all base personnel, regardless of rank, to correct deficiencies as they find them —before they add up to disaster, small or large.

### *LOGISTIC SUPPORT*

To understand the "logistic" support furnished to operating forces by advanced bases, we must look at the definition of the term "logistics". Although all people do not agree on the definition, and many Armed Forces personnel are uncertain as to its place in military operations, for our purposes—"logistics" means the providing of *men, materials,* and *services* for the conduct of military operations. Even this simple definition requires clarification. For example, the word "providing" is used in a broad sense and includes determination of requirements, their procurement and distribution.

Here it should be explained that strategy and tactics change slowly with time, and that an alert military organization can easily modify them to fit the influences of new weapons or methods. Logistic support, on the other hand, always seems to be critical. From your own experience, you probably know the feeling that there is never enough of anything during a war. Under the stress of combat conditions, military forces are nearly always under a strain to meet even the minimum requirements.

**Enemy resistance ahead.**

### *ADVANCED BASE FUNCTIONAL COMPONENT SYSTEM*

The great need for a rapid, simplified, and workable means of logistic support for advanced bases has resulted in the Navy's *Functional Component System.*

Its development is very closely related to the history of advanced base development. The system grew out of the shortcomings and needs, both in planning and actual supply, of our first advanced bases in World War II.

After World War I, and until shortly before World War II, the bulk of construction and maintenance at the Navy's bases and other shore facilities was done by lump sum contract.

Just prior to World War II, the cost-plus-fixed-fee form of contract was introduced. It was a progressive step which permitted an extensive overseas construction program to proceed without the delays inherent in the lump sum contracts.

When we entered World War II, construction by private contractors at overseas bases came to a halt, except for such locations as Pearl Harbor, Panama and Cuba, where it could continue with comparative safety for civilian workmen.

The urgent need for construction at overseas bases, coupled with the fact that such construction could only be carried on satisfactorily by military personnel, led to the organization of Naval Construction Battalions—the Seabees.

### *ADVANCED BASE REQUIREMENTS*

To carry out their mission of building advanced bases, the Construction Battalions naturally required great quantities of construction materials and equipment. Much of it was of special type to fit the requirements of an advanced base, unlike the standard types of items used in ordinary construction. For example, there was a sharp increase in the requirements for temporary and semi-permanent housing, water distillation and purification units, portable generators, pontoons and other unique apparatus. In fact, so many of these new items went into the make-up of just *one* base, the job of listing, requisitioning, assembling, and shipping was almost beyond attainment.

In a way, much of this work was new to the Navy. In peacetime, for instance, the contractor handled most of the details involved in ordering and shipping and, there was no particular rush to place supplies at a base at some seemingly impossible delivery date. The Navy—Seabees—bridged the gap, learned to do the contractor's job and fight at the same time.

**Hitting the beach.**

### *ADVANCE PLANNING*

Before a base can be set up, especially when it must conform to an over-all strategic plan, it is necessary to have complete advance planning. Advance planning—in this sense—means that adequate personnel, material and equipment should be on hand, ready for shipment on schedule at appointed times.

Under the old system of requisition and supply for base construction by individual item, advance planning was almost non-existent. The base establishment operations early in World War II revealed some glaring defects—the time required for advance planning was much too great; essential items were omitted, left on the dock, or not shipped at the proper time; cargo which was to be unloaded first on arrival was loaded first, making it impossible to unload items in proper order; equipment for unloading was inadequate and caused ships to be tied-up for extended periods. Shortages and delays in base construction resulted from these deficiencies in planning.

With the step-up in base development operations, due to the war, detailed advance planning as a reality for base construction became even more remote. Tactical planners indicated that future bases would be set up in areas which were in enemy hands at the time. This meant that there was little or no information available while the plans were taking shape.

Because information was not available, it became necessary to make broad estimates of material and equipment requirements. These general estimates made it possible to plan for construction of any possible forward base installation, aided in rapid procurement of needed supplies, and led to progress in the right direction.

### *EARLY BASE PLANNING ARRANGEMENTS*

In line with this development and to provide better coordination and more efficient planning, the Chief of Naval Operations, early in 1942, directed the Supplying Bureaus to procure and assemble materials and equipment for a definite number of main and secondary fleet bases. Only broad requirements were indicated as a guide to the Bureaus executing this build-up plan. The main bases were designated "Lions" and were major, all-purpose naval bases to include facilities for ship repair. The secondary bases, designated "Cubs", were medium-sized fuel and supply bases, with no ship repair facilities.

In compliance with CNO directives, each supplying Bureau prepared its own material and equipment lists for those portions of the base which it furnished. The LION and CUB allowance lists established by the Bureaus formed the basis of procurement and overseas supply in the early days of the war.

In 1942, the "Acorn" unit was introduced and it provided for the establishment of an advanced Air Base. At the same time, some other units, and modifications of the three basic units (LION, CUB and ACORN), were standardized. The supplying bureaus followed through with corresponding allowance lists, procurement and assembly.

Soon after the issuance of the CNO directive establishing the LION and CUB base units, the area commanders requested that these base units be broken down into parts, to facilitate the ordering of smaller bases which contained only portions of the activities within a LION or CUB.

As the war progressed, and with the movement forward of the high-echelon planning headquarters, it became apparent that some system of standardization of units, as regards material, equipment and personnel, was highly desirable for use in efficiently planning a campaign.

Time was the primary motivation for this new system of base break-down. During war, time did not permit the preparation of individual base plans with the subsequent assembly of materials and equipment. Another consideration was the ease with which these "building blocks" for advanced base development, could be handled. In a way, it corresponds to the problems an individual would face in assembling a modern-day automobile. To list, procure, and assemble a car from separate parts would be an almost insurmountable job, particularly if there was a deadline date to meet. However, if the various assemblies, such as clutch, rear end, transmission, chassis, motor, etc., could be identified, ordered, and received on the basis of a brief list, even a comparatively untrained individual could possibly handle the job.

**Tough spots must be neutralized.**

Operational experience had proved that tremendous benefits could be gained if a catalog covering all units and phases involved in the establishment of *any* type of advanced base was available. Even though no two bases ever had identical characteristics, it was found that it would greatly expedite base development, if comprehensive and complete standards could be formulated, with deviations anticipated and permissible for specific cases. Basically, this theory is correct because revisions, corrections, additions, and deletions are so much easier than preparation of an original work.

A system of advanced base functional components offered a speedy means for logistic planning, and eliminated the repetition of calculations which were necessary when each base was designed separately.

At first glance, this method might seem wasteful of material, equipment and personnel, but this was not the case. The requirements for particular assemblies and subassemblies at many bases, regardless of type, are identical, and it is possible to design them for use anywhere. Fundamentally, under the functional component system, the problem is not to calculate all the needs of an advanced base, since the broad requirements have already been determined, but to find the *differences* and modify available units to fit the local situation. It should be remembered that an advanced base will probably *never* be composed of functional components, *exactly* as they are listed in the catalog.

In December 1942, the supplying bureaus were directed to make up lists of material and personnel of the component parts of the LION and CUB. The first step was to coordinate the work with all bureaus and CNO. After much inter-Bureau work the first *Catalog of Functional Components* was issued by CNO to all area commanders and naval activities on 15 July 1943 with the effective use date of 15 August 1943.

The *Catalog of Functional Components* went further than was originally contemplated since it listed many other functional components of various sizes in addition to all the components of the original LION and CUB bases. Since the first catalog was published, new editions have been issued periodically, embracing all new ideas, methods and improvements gained from experience in the combat theaters and on the industrial fronts.

At present, construction projects at naval establishments are accomplished by civilian contractors or by station forces. Material and equipment requirements are met without reference to the assembly or functional component system. However, the functional component system is still used in special instances, such as operational moves and training of Construction Battalions (Crossroads, Highjump, Amphibious Training Units), in connection with foreign aid requirements, and in full fledged operations like those in Korea.

In the event of a future conflict, the functional component system for advanced base development would be placed in force immediately. It is still the basic tool for Navy logistic planning, and, as such, is being used constantly.

Because the functional component system is such a valuable tool, the lists and publications of which it is comprised, are kept up-to-date for use in the study and preparation of War and Mobilization Plans. Although it may appear to

**Sometimes the going is rough.**

be an exceedingly complicated procedure, the functional component system actually furnishes a simplified and stream-lined method by which operational plans can, in a short time, be translated into the understandable terms of men and materials.

A working knowledge of the advanced base functional component system might easily pay dividends to the Civil Engineer Corps Officer. As a CEC Officer, you are subject to duty on staff commands, where the work includes direct application of the system, or is so closely related to logistics that knowledge of the system would be essential. "Logistically speaking", you may find yourself as a part of a functional component, receiving other components with which to set up your base. In that case, too, familiarity with the system will be exceedingly helpful.

So far, we have been concerned mainly with the history of functional components and the evolutionary steps which led to the development of the system. However, if we are to accomplish practical work with functional components, we should also know many of the details of the system and how it is organized.

### *FUNCTIONAL COMPONENTS*

A functional component is a balanced collection of personnel and material designed to perform one of the specific tasks at an advanced base. The size of a functional component depends entirely upon its *task*—it may consist of one enlisted man with 100 *pounds* of equipment, or of 1,000 officers and men with 10,000 *tons* of equipment, or it may contain only one ton of equipment and have *no* personnel.

Each functional component contains *all* the technical personnel and equipment necessary for the performance of its task. This includes workshop housing, vehicles, boats, construction equipment, office equipment, and other equipment. Also included is a 30- to 90-day initial supply of shop and office consumables.

Housing and messing facilities for personnel, defensive weapons, communication facilities and, in many cases, power plants and water supply are *not* provided with each functional component. These facilities are usually functional components in themselves and render their service to all other functional components.

### *FUNCTIONAL COMPONENT CLASSIFICATION*

These assemblies or components have been arranged into major groupings in the catalog of advanced base functional components and have been given letter designations. Generally, the components have been grouped by broad functions as follows:

The "A" grouping of components is designed to furnish the necessary personnel and equipment to command and administer an advance base. Included in this grouping are additional components which are designed to assist in this administration, such as base intelligence, shore patrol, military government, and a legal office.

The "B" grouping of components includes all those connected with port operations. The lower numbers in the series designate components connected with harbor defense, while the higher numbers stand for the port director group. Included are harbor entrance control post, harbor defenses, boat barge, and lighterage facilities, moorings, surface radar, and port director components.

The "C" series of components is designed to provide a base with adequate communication facilities, both visual and radio. Internal communications components directly related to communications are also provided such as, fleet post office facilities, teletypewriter systems, a registered publications issuing office, mobile communication facilities, and radio photo facilities. The over-all mission of the "C" components is to provide and maintain adequate and secure communication systems for the advanced base and for Navy units supported by the base.

The "D" series of components are those connected with supply or fiscal functions. Major components in this series are supply depots, tank farms, drum-filling facilities, disbursing offices, ship stores, and repair parts issuing activities. Mobile packaging units, air cargo terminal facilities and that group of components which provide stock and replenishment for supply depots are also included in the "D" series.

The "E" components provide the personnel and equipment to perform ship and boat repair. The large "E" components contain facilities for making voyage repairs to all types of naval vessels. Where ordnance shops are required to round out the repair section they are furnished by the "J" components. Other "E" components contain complete facilities for repairing all types of landing craft. Floating drydocks are not contained within functional components, but are usually provided to the base in the size required for the ships to be supported. Certain of the small ship and boat repair components are mobile, and by use of mountings can be set up and made ready for operation much faster than those requiring the erection of shops. Associated components to supplement ship repair are included in this series, such as oxygen, acetylene, and carbon-dioxide generating plants. Marine railways capable of hauling boats up to 50 tons are also included in the "E" series.

The "F" components, of which there are only two, are the cargo handling battalion for unloading ships either at dockside or in the stream, and a small component to provide cargo handling consumables such as dunnage, shoring, cable and slings.

The "G" components provide medical and dental facilities at an advanced base. Also included are such related components as malaria and epidemic control units, sanitation and rodent control units, and medical warehouses.

The "H" series of components are designed to provide for maintenance, support, and operation of aircraft in an advanced area. The major "H" components provide the air station or garage facilities and require the services of the FASRon for repair and maintenance of the planes. The "H" series also contains air navigational aids, airfield lighting, landing mats, gas storage, and photographic and aerological units.

The "J" series contains the ordnance components of the advance base and have the function of supplying ordnance equipment in support of the base mission. They also maintain, repair, and assemble ordnance equipment for the base repair section. Magazine storage of ammunition complete with handling equipment and personnel is also a feature of these components.

Get the stuff out fast.

The major components of the "N" series consist of basic camps of tents, tropical huts, or Arctic huts, in varying sizes to accommodate from 25 to 1000 men. Housing for personnel, galley, laundry or scrub decks, bakery, latrines, and showers, are provided according to the camp type and climatic location. Additional base services such as fleet canteen, recreation, educational services, band and chapel, are included in this series.

The "P" components have as their general function the construction and maintenance of advanced bases during the early phases of amphibious operations. They may also perform this same function for other components which make up the Navy's advanced bases. Included in this series are the Construction Battalion and the Construction Battalion Maintenance Unit. In addition, other "P" components provide special facilities and material used in construction and operation such as excavating, heavy hauling, quarrying, rock crushing, asphalt plant, camouflage, and decontamination equipment. Fire-fighting units are also included in this series.

The "Q" series contains one small component consisting of a few packaged tool kits necessary for unpacking when arriving at a new base,

Unloading takes time.

some basic office supplies, and special clothing if needed.

There is one other series of components, the "S" group. However there is no definite list of equipment in this series, and it is used simply as a designation for assemblies of miscellaneous gear not included in the standard components.

### *ADVANCED BASE UNITS*

An advanced base unit consists of a proper combination of all the functional components used in the establishment of an advanced base. It may be used to establish a shipyard, airfield, depot or supply base, repair base or for any type of naval shore installation at an overseas location. Certain frequently used advanced base units have been given special names for identification, such as LION, CUB, ACORN and GROPAC. Each has a definite list of components making up a standard unit and are described below as an aid in familiarization and understanding of the system.

### *LION*

A LION is an advanced base unit consisting of all the personnel and material necessary to establish, operate, and develop a medium-sized advanced naval base for other than air forces. It is composed of sufficient functional components to enable it to perform voyage repairs, to repair minor battle damage to a task force, to provide logistic support for a task force, and to operate a large and active port.

For its own support it contains adequate harbor defense, communications, supply, disbursing, boat repair, medical, ordnance, and base maintenance facilities. Two or more LIONS may be consolidated to form a large advanced naval base.

The installation of a LION unit requires the services of a number of Construction Battalions and cargo handling battalions for construction and unloading. The number of functional components needed for this purpose will depend on the local situation and the speed at which the base must be erected.

### *CUB*

A CUB is an advanced base unit consisting of all the personnel and material necessary to establish and operate a small advanced naval base for other than air forces. It is composed of sufficient functional components to enable the base to perform voyage repairs, to repair minor battle damage, to provide logistic support for a small task group of light forces, and to operate an active port. For its own support, it contains adequate harbor defense, communications, supply, disbursing, boat repair, medical, ordnance, and base maintenance facilities. A CUB is similar to a LION, but is only about one-half the size, and provides the same facilities but on a smaller scale.

As in the case of a LION, the number of CB's and cargo handling battalions needed for construction and unloading will depend upon the local situation and the speed at which the base must be erected.

### *ACORN*

An ACORN is a small advanced base unit consisting of all the personnel and material necessary to establish and operate an advanced naval air station. It is made up of a number of functional components which, when augmented by a FASRon (Fleet Aircraft Service Squadron), enables it to service, rearm, and perform minor repairs and routine upkeep for the planes of one carrier air group, or equivalent patrol plane squadrons. Without the FASRon, the ACORN can maintain the air station in operating condition and serve casual planes. For its own use, as well as for use of the flight group and the FASRon, it contains adequate communications, supply, disbursing, medical, ordnance, housing, and medical facilities. By appropriately grouping ACORN units, they may be used to form an advanced air base, including satellite fields as required.

The installation of an ACORN unit requires the services of CB's and Cargo Handling Battalions, and again the number needed depends on the local situation and the speed of erection desired.

### *GROPAC*

A GROPAC is a commissioned naval organization designed to install and operate harbor and water-front facilities and to furnish certain harbor patrols for an advanced base. Normally, its duties are to unload ships, repair small craft and harbor equipment, operate a harbor defense patrol, and provide a boat pool for use within the harbor. It furnishes its own administration, communications, medical, and housing requirements.

### *THE FUNCTIONAL COMPONENTS SYSTEM*

The functional components system gives to those preparing the base development plan a thoroughly tried and proven system of advanced base establishment. The proper selection of functional components, correctly echeloned and shipped, enables base planning to proceed with a high degree of accuracy. The system also enables the various departments at the advanced base to become operative in a much shorter time than would be necessary for bases erected by the piece-by-piece methods used in ordinary construction practice.

The units, such as LIONS, CUBS, and ACORNS, can be adapted to meet different missions assigned to specific bases. This is accomplished by tailoring the unit (adding or deleting certain components), to provide the services necessary to enable the base to carry out its special assigned mission.

**An LST holds plenty of cargo.**

Each component has a mission in itself. That mission is to provide the activity to which it is assigned, a service or facility for the proper support of outside units such as ship repair units supporting the fleet, or to provide services for the base.

### *FUNCTIONAL COMPONENT PUBLICATIONS*

The chief working tools of the functional component system are three publications. These are listed and described below.

#### *Catalog of Advanced Base Functional Components (Classified)*

This catalog is a one-volume confidential publication issued periodically by the Chief of Naval Operations. It is a general summary and reference, and gives a brief description of each functional component, its personnel complement, material requirements in broad terms, and approximate weight and cube. In addition to the component description, it lists several advanced base units (LION, CUB, and ACORN). These three standard base units are groupings of functional components so arranged as to establish a special type of advanced base, and form the backbone of overseas advanced bases. The catalogue is a ready reference for use by area commanders and their planning staffs. It is designed as a tool for high level planning and for that reason indicates, in broad terms only, the personnel and equipment in the components. However, this information is entirely adequate for planning at high levels.

### *Advanced Base Initial Outfitting Lists (Detailed)*

These lists are a reference which contains a completely itemized tabulation of the material in each functional component. The ABIOL (detailed) is designed for the use of those people who actually procure, handle, assemble, and ship the functional component materials to central centers or depots, and also at staging points in the forward area. They are entirely unsuited for planning staffs in view of their bulk and the detail they contain. However, their future use for planning is contemplated by taking lists from the machine cards, but at present no lists are being issued.

Detail listings for all Bureaus' contributions, except BuDocks, are maintained by BuSandA from data as presented by the dominant technical Bureaus. Printed copies of such listings are not available for general distribution. In general they are maintained through use of Electric Accounting Machine (EAM) cards with distribution being made to appropriate assembly depots. The detailed listing for BuDocks' contribution however is maintained, published and distributed by the Bureau of Yards and Docks as a general use publication.

Enemy snipers must be routed.

### *Advanced Base Initial Outfitting List (Abridged)*

Since it is impractical to do second and third echelon logistic planning with a quarter-ton of detailed initial outfitting lists, the lists have been abridged and are published in a single book. The ABIOL (abridged) is a comprehensive condensation of each functional component. It is intended to serve as an instrument for logistic planning when more detail is required than is contained in the CNO *Catalog of Advanced Base Functional Components*. It is issued by the Bureau of Supplies and Accounts and furnishes a list, in general terms, of the material items and personnel contributed by each bureau to make up the complete component. It provides logistic planners with a broad index of the material and personnel capabilities of each functional component as an aid in base development planning at field level, since it also includes the personnel contribution by the Bureau of Naval Personnel. The usual references in the ABIOL (abridged) are stock numbers, weight and cube, and quantities. However, it is not suitable for assembly or shipping purposes.

## *SUMMARY OF FUNCTIONAL COMPONENTS*

The number of functional components has gradually increased with time as more and more functions of advanced base development were included in the system. The first edition of the *Catalog of Advanced Base Functional Components* contained 77 components. In the 1944 edition the number had increased to 250 components, and the current edition now contains 279 components.

A summarized listing of the latest approved functional components has been included in Appendix "A" at the end of this book, together with a notation as to the dominant bureau.

For easy reference, the functional components have, in addition to their titles, unclassified code numbers consisting of a letter and a number (P1), or a letter and a number and a letter (P1A).

## *USE OF THE SYSTEM*

Knowledge of how the functional component system is used can be gained by running through the main steps of the planning involved.


Beach roads are essential.

A basic plan has come down from the top level planning staff which (after translation and elimination of unit designations) describes the base in the general terms as follows:

"An advanced base to provide support for one corps (3 divisions) of ground troops in the forward zone, plus tactical aircraft and medium bombers; and a naval base to support ASW operations, including naval reconnaissance aircraft, surface patrol craft, and escort vessels operating in the area."

The first step is to convert this broad description into the facilities required. A conference of the planning staff including type commanders, communications officers, supply officers, construction officers and others, develops the picture in further detail. They might decide that the following functional components are necessary to meet basic requirements of the Navy's portion of base development.

| | |
|---|---|
| B-1 | Harbor Entrance Control Post |
| B-9 | Fleet Moorings (to meet local conditions) |
| B-12 | Port Director (Medium) |
| C-2 | Radio Station (Medium) |
| D-2 | Storage and Supply (Medium) |
| D-4 | Tank Farm (Medium) |


Camouflage hides huge gas and bomb dumps.

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| | |
|---|---|
| E-3 | Ship Repair (Destroyers) |
| F-1 | Cargo Handling Battalions |
| G-2 | Hospital (600-bed) |
| H-9 | Aircraft Combat Operations |
| H-14B | Aviation Tank Farm (Medium) |
| H-15A | Airfield Construction Material |
| H-15B | Seaplane Ramp and Parking Area |
| H-17B | Photographic Laboratories (Medium) |
| H-22 | Air Transport Operations (Light Plant) |
| H-25 | High Intensity Airfield Lighting. |

In addition to the components, listed above, which cover the essential operating features of the base, a few minor components will probably be included to complete the installation such as:

| | |
|---|---|
| A-2 | Administration |
| D-24 | Ships Store Facilities |
| J-5D | Torpedo Depot |
| J-11C | Mine Detail |
| J-13B | Degaussing |
| N-6 | Bakery |
| N-18 | Base Recreation |

After deciding upon the functional components needed, the various staff sections thoroughly check and carefully revise the original estimate in order to arrive at a final figure which will cover the bare essentials of the requirement for that particular base and still be a feasible logistic plan. It is in this logistic planning stage that the value of the functional component system becomes so apparent. You can imagine the limited flexibility and the tremendous difficulty of planning if it were necessary to work with bulky, fixed lists of materials and equipment. The functional component method enormously reduces the actual mechanical work of handling such unwieldy lists and at the same time gives a minimum of interference with flexibility.

When the requirement list is finished, it is processed through channels and staff command in the theater of operations and then transmitted to CNO for final review and approval. Following CNO approval, directives are issued to the supplying bureaus of the Navy Department for implementation.

A single paragraph in a CNO directive covering the approximate requirements of the advanced base mentioned might read:

"1. In accordance with reference (a), Cub 77 (Modified) for movement DUMBO will consist of the following:

> A-2, B-1, B-9, B-12, C-2, D-2, D-4, E-3, F-1, G-2, H-9, H-14B, H-15A, H-15B, H-17B, H-22, H-25, J-3C, J-5D, J-11C, J-13B, two N-6, six N-7, N-18 and six P-1."

The other paragraphs of the directive are not included since it is desired to emphasize the extreme simplification of form under the functional component system, whereby a comparatively simple listing can direct the shipment of a complete naval base.

## *CHAPTER II*

# *ORGANIZATION FOR BASE DEVELOPMENT*

IN ITS BROADEST CONCEPT base development is the expansion and use of the resources of an area to support current and future operations. It begins with harbor and area clearance, and is followed by construction and operation of the base.

At the theater commander's level, detailed base development planning begins on about D-180 or sooner. Previously, base development was planned in very broad terms at the departmental and Joint Chiefs of Staff levels. Actual construction on the site begins when the first elements of the shore party "hit the beach" behind the assault waves. It continues until the base is built and in full operation, and the construction troops are relieved for restaging and outfitting for another operation. A brief history of theater organization in World War II may be helpful in obtaining a clear picture of this type of operation.

### *WORLD WAR II THEATER ORGANIZATIONS*

To us, the three most important theater organizations in World War II were the European Theater of Operations (ETO), the Pacific Ocean Areas (POA), and the Southwest Pacific Areas (SWPA). Other theaters were as important in winning the war, but it is in these three theatres that the greatest amount of base building was accomplished.

A characteristic common to all these theaters was that they were organized for joint operations and had joint staffs. Such a set-up is typical. All theaters of even moderate size will be organized on a joint basis in a future war.

Organizations within a theater are generally discussed under two broad classifications—command and administration. The military definitions for these two terms are given. "Chain of Command" or "Command Channel"

**The advanced base operation usually begins with an overseas movement.**

is the succession of commanding officers from a superior to a subordinate through which command is exercised. "Administration" comprises the management of all phases of military operations not directly involved in tactics and strategy. For additional clarity "logistics" is that portion of administration which deals with production, procurement, storage, transportation, distribution, maintenance and evacuation of supplies, equipment, personnel and services.

In 1943, the JCS published a "Basic Logistical Plan for Command Areas Involving Joint Army and Navy Operations". Adhering to the established policy of giving the theater commander all possible authority in organizing his command, the JCS defined only in broad policy the functions which the organization must perform. The plan prescribed that, "The Area Commander shall effect coordination of all existing agencies charged with planning, conduct and supervision of logistical services within the area. To this end he will organize suitable unified logistical-supply staffs consisting of both Army and Navy officers, or will provide for joint staff planning and operations on the part of the respective Army and Navy Staffs within his jurisdiction."

Charts 1, 2, and 3 show the organizations for the ETO, POA, and SWPA. It requires only a very superficial inspection of these charts to show that while no two organizations were similar, all three had "unified command". The variations noted may be attributed to factors which were special for each theater such as:

(1) Type of land mass, ocean area, or combinations of land and sea areas.
(2) Distances over which operations extended.
(3) Armed Forces and services whose missions were predominant.
(4) Nationality of the Allied Forces.
(5) Logistic problems.
(6) Personalities.

These factors greatly influenced the types of command and administrative organizations employed in an area. For example, in Europe once a beachhead was secured there was often (in comparison with other theaters) a fine network of highways, railroads, and airfields. In the POA and SWPA the distances between land masses were great and support was by water and sometimes by air.

### *European Theater of Operations (ETO)*

Chart Number 1 represents the organization of the ETO as of 12 February 1945, and shows the command relationships. Administrative support did not follow the lines of command in all cases.

The United States Strategic Air Force was supported administratively by the European Theater of Operations, United States Army (ETOUSA) except for the 15th Air Force (Strategic) which was supported by the Mediterranean Theater of Operations. ETOUSA handled the administrative details for the Army and Air and supported, logistically, all Navy forces ashore. Administrative support for the Navy afloat was through regular Navy channels.

### *Pacific Ocean Areas (POA)*

Chart Number 2 shows the organization of POA. Admiral Nimitz as Commander-in-Chief, Pacific, was served by a single joint staff and all orders issued through him were headed CinCPAC-CinCPOA. The command was divided into two major subordinate categories—type commanders and operational commanders. The type commanders were made up of the United States Army Forces, Pacific Ocean Area, commanded by General Richardson; the Pacific Fleet commanded by Admiral Nimitz; and the Army Air Forces, Pacific Ocean Area, commanded by General Eaker. Operational commands consisted of area commands and task force commands and were set up for specific operations and specific areas as the need arose. Area commands might and usually did have subarea and island commands subordinate to them.

The United States Strategic Air Forces in POA received administrative support from the Pacific Fleet, but were under the operational control of the JCS.

Administrative support was unilateral in that the United States Army Forces, Pacific Ocean Area, were responsible for the administrative support of all Army and Air Forces in the area, except that the Air Force dealt directly with the Zone of the Interior on air technical matters, and the type commanders of the Pacific Fleet were responsible for the administrative support of all Navy and Marine forces in the theater.

The area, subarea, and island commanders had both administrative and operational responsibilities within their areas but the support necessary to carry out their administrative responsibilities came from the type commanders.

While supply in POA was, in general, unilateral there were many supplies and services common to two or more services which were supplied by one service. For example, all petroleum was procured and transported by the Navy. The Navy also handled, with few exceptions, all intra-theater water transportation. There was a free exchange and transfer of equipment and supplies between the services with a minimum of paper work. Unified commands were set up in the lower echelons in POA to a greater extent than in any other theater.

### *Southwest Pacific Areas (SWPA)*

Chart Number 3 shows the administrative organization of the SWPA (1944). The top commander (General MacArthur) played a dual role in the SWPA. He was the Commander-in-Chief, Southwest Pacific Area and the Commanding General, United States Army Forces in the Far East (USAFFE). Much of the staff of SWPA functioned in dual capacity as the staff of USAFFE. The USAFFE had no tactical command but concerned itself primarily with relieving General Headquarters of personnel administrative matters and consequently required very few additional staff officers.

GHQ was not a joint but an Army Staff; however, naval and air officers advised when required. The GHQ was an Allied Headquarters but also functioned as a United States Theater Headquarters.

United States Army Services of Supply (USASOS) provided the logistic support for the U. S. Air and Ground Forces, except that the Air Services Command dealt directly with the Air Forces in the Zone of the Interior on all Air Force technical matters.

The Alamo Force, a task force consisting essentially of the Sixth Army, was set up by General MacArthur as the force primarily responsible for conducting combat operations in the theater.

United States elements of the Allied Naval Forces were under the Commander-in-Chief SWPA for operations but under the Navy Department for logistics and administration.

The Australian and other allied forces in the theater were administered through their own channels.

### *The Joint Staff*

The three staffs described here represented the World War II joint efforts. CinCPOA's Joint Staff was the only theater staff organized in World War II that was truly joint. Admiral Nimitz's dual capacity as CinCPAC-CinCPOA in his use of the single staff expedited administration. It was effective only because POA was predominantly on ocean theater containing no large land masses. It is doubtful whether a similar organization would work as satisfactorily in a theater with different geographical and force characteristics.

Based on the lessons learned in World War II, current opinion favors the typical joint staff shown in Chart Number 4. The following points must be considered in organizing for joint operations:

(1) When joint operations are involved, joint staffs, down to and including major task forces, should be formed.

(2) If administration is an unilateral responsibility, then coordination on the top level is imperative and should be established by a firm policy or by order.

(3) Liaison and cooperation between services and between staffs on different levels is essential.

(4) Unified control of services and facilities utilized by two or more services is desirable if such control is established at a sufficiently high level.

(5) Commanders and staffs should *not* have dual roles.

(6) Joint administrative control should *not* be exercised when the requirements for the services and facilities to be controlled are unilateral.

## *THE ADVANCED BASE IN THEATER ORGANIZATION*

The foregoing study has presented the command and administration organization on the theater and area level. The naval advanced base, when included in a joint endeavor, can be considered an element of the Task Fleets under the Theater Naval Commander. When the naval

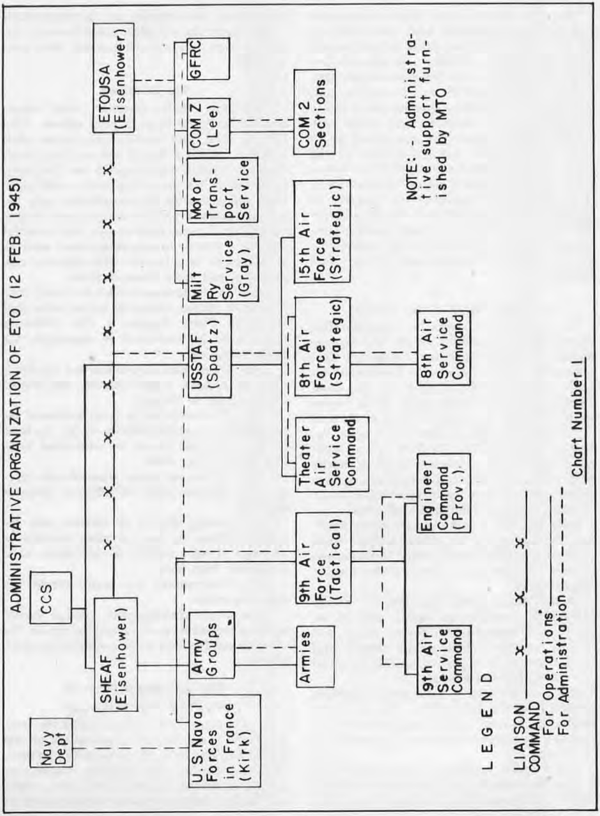



Chart Number I

ADMINISTRATIVE ORGANIZATION OF POA

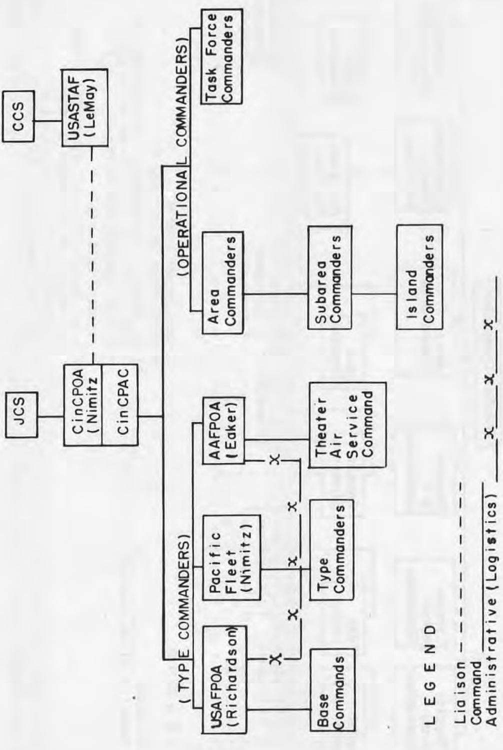
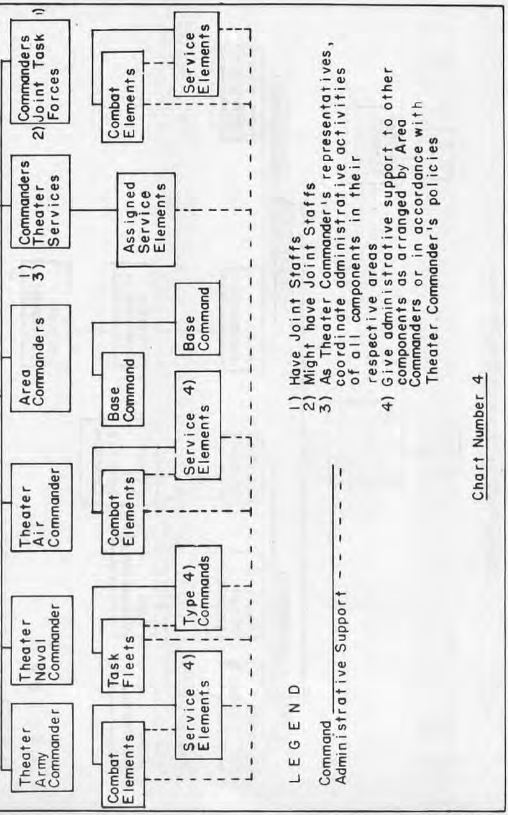
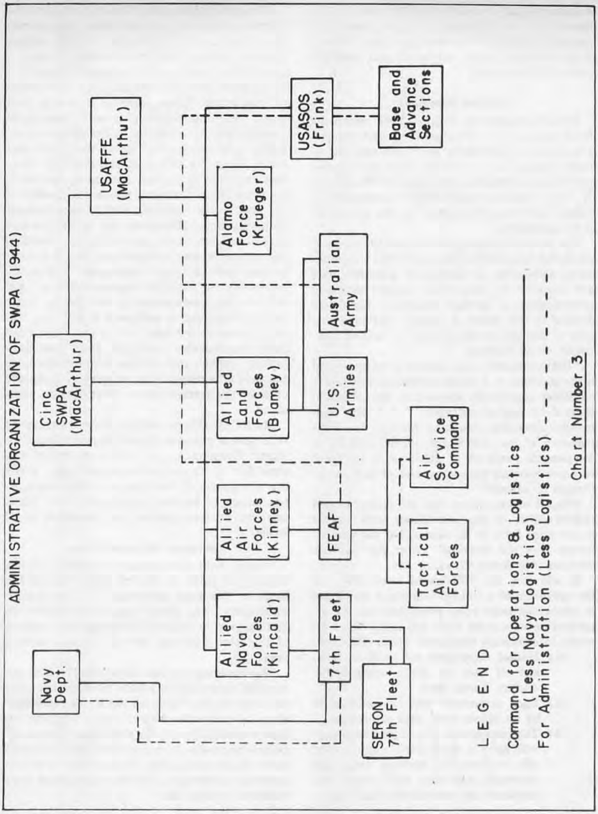



Chart Number 2


MODIFIED UNILATERAL ADMINISTRATIVE RESPONSIBILITY
Theater Commander 1)
Theater Army Commander
Theater Naval Commander
Theater Air Commander
Area Commanders 1) 3)
Commanders Theater Services
Commanders Joint Task Forces 1) 2)
Combat Elements
Service Elements 4)
Task Fleets
Type Commands 4)
Combat Elements
Service Elements 4)
Base Command
Base Command
Assigned Service Elements
Combat Elements
Service Elements
LEGEND
Command
Administrative Support
1) Have Joint Staffs
2) Might have Joint Staffs
3) As Theater Commander's representatives, coordinate administrative activities of all components in their respective areas
4) Give administrative support to other components as arranged by Area Commanders or in accordance with Theater Commander's policies
Chart Number 4




ADMINISTRATIVE ORGANIZATION OF SWPA (1944)

Chart Number 3

advanced base is under a purely naval command and in support of a purely naval endeavor it will follow the regular Navy Department channels in the command and administrative organization.

### *Unified Command*

Unified commands result rather naturally from the use of joint operations and the employment of joint staffs. They are not new or revolutionary, but evolved from the battle-tested knowledge and experience of World War II. They are the most efficient organizations which have been developed for the control of joint operations.

The Armed Forces of the United States operate under the Unified Command Plan and, since sharp delineation of duties and responsibilities are essential in preserving proper command relationships, a "unified command" should be defined at this point. A slightly abridged version of the official definition of a "unified command" is as follows:

"That command organization in which a joint force operates as a single command unit under an officer specifically assigned to the command thereof by higher authority. * * * The commander exercises command through the commanders of the Air Force, Army, and Navy components assigned or attached to his joint force, or through the commander of task forces formed by himself."

This, of course, means that the authority and responsibility of the commander with respect to his joint force is the same as if the various forces involved were all from one service, whether it be Army, Navy, or Air.

In addition, the JCS issued some rules for the operation of a Unified Command which are in effect, the same rules prescribed for the organization of a joint staff, but apply more directly to command functions. These rules are:

(1) Unified commands will normally consist of two or more components. (Army, Navy, Air)

(2) Each component will be commanded by an officer from that component.

(3) The commander of a unified command will have a joint staff composed of officers from the services under his command, and they will occupy key positions and responsible positions.

This simply means that the commander of a unified command has a force made up of units from two or more branches of the Armed Forces; that he has both the authority and responsibility necessary to command; and that he exercises command through the commanders of component forces forming the joint command. The commander of a unified command accomplishes the planning, assigns missions and tasks to the component forces and joint task forces under his command, and provides necessary support for planned operations. He leaves the actual field operations to the commanders of the task forces operating within his command. Applying these definitions and principles to a base command, where more than one branch of the Armed Forces occupies the site, it is quite evident that the base commander will be the commander of a unified command. Under him will be the commanders of the Army, Navy, and Air components stationed at his base. The joint forces at the base will be the Joint Port, Joint Construction Command, Joint Communications Center, and similar organizations. In the case of a major base, all service units will probably be formed into a Joint Service Command.

Most CEC Officers will be directly concerned with base commands, more commonly known as Island Commands, and will work within the structure of the unified command plan. While the advantages of this plan are tremendous, it has points of friction and frustrations which can only be overcome by real teamwork at all levels.

### *Command Responsibilities*

Usually base development is confined to the vicinity of ports or landing areas within the limits of the area established by the theater commander. The term "base commander," in this chapter, is used to indicate the commander of the joint command set up for this limited area.

The base commander is responsible for the accomplishment of the base development plan and must be familiar with the theater strategic plan. In accordance with the operation plan the base commander and his staff must constantly adjust themselves to the intricate shifts of command relationships and responsibilities as the operation progresses. The more important commanders involved are:

(1) The *Commander Attack Force* is in command of attack elements in the joint expeditionary force. These consist of the assault ships with their embarked troops and the supporting naval and tactical air units, operating to establish a landing force on shore.

(2) The *Commander of the Landing Force* is in command of the task organization assigned to carry out amphibious operations against a position, or group of positions.

(3) The *Commander of the Expeditionary Troops* commands the forces of all services assigned to the amphibious task forces for operations on shore, including any garrison or base development forces.

(4) The *Shore Party Commander.* Under the Landing Force Commander, he is in command of that organization of military and naval elements which is responsible for the execution of the unloading and evacuation plans of the landing force after seizure of sufficient working space ashore, and for the establishment, operation, and defense of the beach-support area.

(5) The *Commander Naval Beach Group* is in command of the naval elements of the shore party and any other naval elements which may be assigned or attached to the shore party for command of its naval elements, and any other naval detachments which may be assigned or attached to the shore party. Naval elements not permanently attached to the shore party (such as port director, harbor control, underwater demolition teams, pontoon detachments, construction units and garrison lighterage) should be temporarily placed under the Commander Naval Beach Group for administration and coordination when they are landed. They remain there until the operation has progressed to the point where they may revert to their appropriate permanent commanders. The Commander Naval Beach Group has direct access to all naval echelons ashore and afloat, and maintains the closest liaison and coordination with the Commander Administrative Group.

(6) The *Commander Administrative Group* is the naval officer who executes those supporting tasks of an administrative nature which are the responsibility of the commander of the attack force during the assault and subsequent periods prior to the operational completion of naval base installations. In general, the commander administrative group acts as the senior administrative officer present afloat and as such remains in the objective area for a considerable time. He may eventually become the commander of the naval base. In the early phases of an operation, he is responsible for the provision of logistic and administrative support to the vessels of the attack force and to naval forces ashore. Later, some or all of his units and functions are transferred to other naval commands as appropriate.

### *BASE DEVELOPMENT PERIODS*

Base development passes through four general periods or phases in a joint operation. These phases are presented in graphic form by Charts 5 through 8. The charts illustrating the various phases of base development have appeared previously but are repeated here in order to furnish a ready reference in a more detailed discussion of the subject.

Advanced bases differ according to their locality, however an effort has been made to conform to a pattern in their development. Hard experience has shown that there is a standard phasing which is both practical and successful.

The charts should be consulted for a description of the four phases of base development.

*Phase I.* This is the period required for the assault and consolidation of the landing forces ashore. The base area is composed of one or more beach support areas, each established and operated by a shore party under the control of a landing force commander. The Commander Expeditionary Troops has assumed full command ashore at some time during the period. Some elements of the base command have landed during the period, attached to the shore party or to tactical units. As soon as practicable after the initial landing, the base commander establishes advanced headquarters ashore. As the base command elements become operative, the base commander relieves the shore party commander of responsibility for the operation of the beach support area and such base development as he may have begun.

*Phase II.* This is the exploitation of the landing and is the most critical period from the standpoint of base development. It is important that theater and force commanders realize that lack of firm assignment and knowledge of command responsibilities here will re-

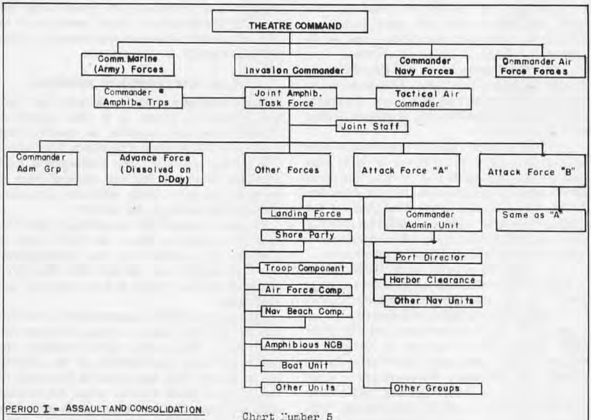



Chart Number 5

**PERIOD I — ASSAULT AND CONSOLIDATION**

**This chart depicts the Assault Phase during the landing of amphibious troops or prior to the assumption of command ashore by the Commander Amphibious Troops, or other ground forces command designated by the Invasion Commander, and prior to the setup of Base Command elements ashore.**

*** Base Command is afloat or in a rear echelon during this period, and will be landed upon call from Commander Amphibious Troops after Commander Amphibious Troops has established his command ashore and has determined that the tactical situation permits commencement of base development. The Base Commander then becomes part of the Amphibious Troops Command. (See Period II Chart.)**

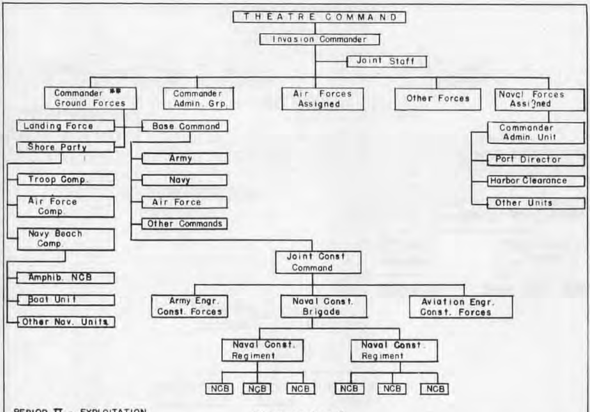



Chart Number 6

### PERIOD II — EXPLOITATION

**Commander Amphibious Troops and Base Commander have now assumed responsibility ashore and the Joint Amphibious Task Force is dissolved. The composition of Construction Force Command Headquarters organizations required to supervise appropriately the base development will be determined by the Base Commander. Therefore, no standard can be established for determining the requirements for Brigade and Regimental Commands.**

****Commander Ground Forces may be Commander Amphibious Troops (see Period I) or other Ground Forces Commander designated by the Invasion Commander.**

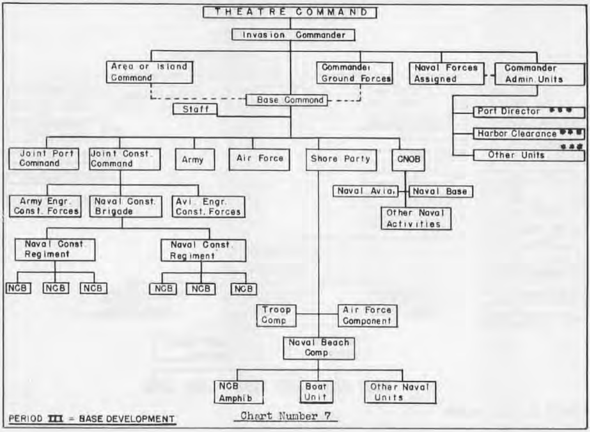



Chart Number 7

**PERIOD III — BASE DEVELOPMENT**

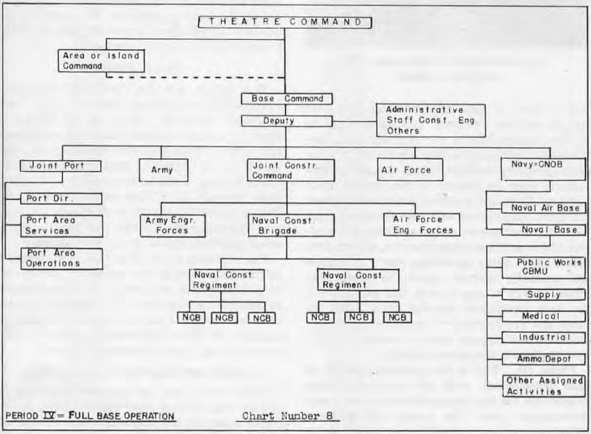
The Shore Party is now attached to the Base Command and is turning over its functions to other elements of the Base Command. The Commander Administrative Unit may still be functioning as SOPA (Senior Officer Present Afloat) supporting remaining elements of the Joint Amphibious Task Force and would be turning over these functions to CNOB (Commander Naval Operating Base) and Joint Port Command as rapidly as possible.

———————— Direct chain of command

........................ Alternate choice for chain of command

**Commander Ground Forces may be Commander Amphibious Troops (see Period I) or other Ground Forces Commander designated by the Island Commander.

***Transferred to Joint Port or CNOB as and when requested.




**PERIOD IV — FULL BASE OPERATION**

**The Shore Party has been withdrawn or absorbed into the Base Command. The Port Director is responsible to the Joint Port Command. The CNOB has assumed all the local duties of the Commander Administrative Group.**

**Piers are needed to bring men and equipment ashore.**

sult in loss of time and material and even serious military reverses. Any uncertainty as to the responsibilities for construction, handling of shipping, unloading cargo, and clearing cargo from the beachheads may damage logistic support from the interior to the forward combat lines. During this period, pre-invasion plans for base construction and use of base troops, modified after speedy reconnaissance and analysis of the on-the-ground situation, are put into effect. Shore party operations over the beaches will normally continue under the commander expeditionary troops during this period with the base commander bending every effort toward the development of improved unloading facilities and storage areas in order to finish over-the-beach operations quickly.

*Phase III.* This is the principal period of base development, with the base commander responsible for the accomplishment of the base development plan. The assault forces have withdrawn or are rehabilitating locally as in the case of an island being secured completely, or the assault and reinforcing elements have progressed to the point where the base area is secure from ground attack. In the latter case a rear boundary for the tactical forces is established, and the base commander has complete control of the area in the rear of this boundary. The shore party is attached to the base command and is turning over its functions to other elements of the base command, such as the joint port command Army and Navy, as appropriate, preparatory to absorption or withdrawal as directed by the operations plan. The Commander Administrative Group may still be functioning as administrative SOPA (Senior Officer Present Afloat) in support of the joint expeditionary forces present, turning over those functions to the commander of the naval base and the joint port command as rapidly as possible.

*Phase IV.* This is the period of all base operations. The functions of the shore party and the Commander Administrative Group have been assumed by other agencies operating under the base commander. Construction required to complete or expand the base facilities is continued during this period.

## *NAVAL BASES*

This chapter has dealt primarily with joint operations and a build-up of a base under joint command. However, many of the advanced bases in a purely naval theater of operations will have a command and administrative organization in which the relationship shown in Chart Number 4 will be followed from Theater, Area, through the CNOB (Navy), with all activities under the CNOB. Port Operations will then fall under the CNOB who will also have Army garrison troops under his command.

The problems of transition and the command relationships during the formative periods of base development are among the most complex in amphibious warfare. But teamwork, complete knowledge of the subject, and a sense of urgency are most important in assuring the success of any base development project.

## *BASE DEVELOPMENT PLANNING*

While most base development planning is done at the theater commander's level, it becomes a part of the planning at every level of command, beginning with the Joint Chiefs of Staff (JCS). Every phase of a campaign is affected by base development, for campaign planning is a function of the theater command and base development is always an important part of operation and logistic planning.

Theater organization is heavily stressed in planning base development. However, this emphasis is not due to preoccupation with high level matters. Because the two subjects are interrelated, it is extremely difficult to understand base development unless it is known how the theater staff accomplishes base planning.

### *The Theater Commander's Job*

The theater commander is responsible for all base development planning within his theater. This includes responsibility for *detailed* administrative and logistical planning. There are good reasons for this arrangement. They are:

1. Requirements for bases within the theater must fit the strategic aims of the theater commander.

2. The theater commander is the only one with the authority to resolve the many command and logistic problems of advanced bases.

3. The theater commander alone has control over all the forces within his theater of operations. Therefore, only the theater commander can assure unity of effort of all the forces under his command.

4. Only the theater commander has the authority to transact business with any or all of the other services and other governmental agencies.

5. The theater commander has the only permanent staff large and diversified enough to do a complete planning job. He is the only commander who receives all the information necessary to do the complete job.

6. The staff of the theater commander is the only staff in the theater that has sufficient "lead" time in which to do the planning.

In most cases the factor of "lead" time forces the theater commander into detailed planning. It is obvious that much long range planning is necessary before the first wave of an amphibious operation "hits the beach". Ordinarily, the commander of the joint task force for an operation is not named until D–100. After he is selected he must assemble his staff and set up his command. Normally, planning for the advanced base development has begun months before he was selected. As a result, the theater commander is the only individual in the field who has a staff available to do the necessary advanced planning. Also, he is the only individual in the field with sufficient authority to coordinate and supervise such an operation. Therefore, if he is to properly discharge his responsibilities, he must include detailed advance base development planning among his functions.

### *Planning Procedure*

A glance at the process of base development planning may make its intricacies more logical. To do this, only some general assumptions are necessary concerning the theater and the personality of its commander. The Armed Forces are operating under the Unified Command Plan issued by the JCS late in 1946. The plan has

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**Docking facilities may be non-existent at the advanced base site.**

designated certain geographic areas as Unified Commands and has named a commander for each. Trouble has arisen in the Western Pacific and United Nations troops have been sent in to control the situation. The course of action from here can follow one of two paths.

First, the JCS make their own estimate of the situation and issue a directive to the theater commander stating what they intend to accomplish in his theater. The directive will state the objectives the JCS hopes to attain. These objectives will always be strategic, but may be of a political nature and have actual physical goals. The theater commander will deduce his mission from this directive unless a definite mission has been stated. From the JCS directive and his mission, he will then prepare a campaign plan. Copies of the plan will be sent to the JCS for approval and to the commanders of the Army, Navy, and Air Force components within the theater for comment, recommendation, and advance planning.

The second course of action by which a campaign plan may be developed is where the theater commander has recognized the weakness of his theater due to post-war curtailment of forces and the mounting problems which confront him. Consequently, he will have made requests for additional forces and will have prepared a campaign plan, or several, all based on different situations and assumptions. These would have been submitted to the JCS in advance for approval, so that when a crisis arose the JCS could authorize him to execute one of

**Modern advanced bases require joint planning.**

the plans. This procedure was used to a great extent before World War II and is acceptable by JCS. This type of planning requires a high level of ability and can be used when there are no other commitments in other areas which must be considered at the same time. However, for our purposes in studying advanced base development, we can assume that *theater planning will generally start with a JCS directive.*

Assume the first course of action has been taken. The theater commander has submitted his campaign plan to the JCS for approval. The campaign plan will express the need for bases in broad and general terms, such as: aircraft facilities for fighter interception and area defense; port facilities necessary to support ground and naval operations as outlined in the schedule of phased operations; or similar descriptions. While the campaign is under consideration by the JCS, the theater staff is doing two things: It is preparing outline plans for each of the phased operations listed in the campaign plan and preparing a theater strategic study. One portion of the theater study is the base development study, which will be amplified later in a more detailed description.

When the campaign plan is returned approved, the theater commander immediately issues an outline plan for the first operation listed under the phased operations of the campaign plan. The outline plan is issued about D-160, while the directive was issued by the JCS on D-270, or sooner, and the theater commander gets out his campaign plan no later than D-180. The outline plan goes to the same commanders and agencies that receive the campaign plan. While the various commands are studying the outline plan for the first operation, the theater commander issues the base development planning directive on or about D-150. Upon receipt of the base development planning directive and using the outline plan as a basis, the cognizant commands begin firm planning. Their first act is to prepare estimates of facilities and service personnel which will be required for base development. The estimate of requirements usually arrives in the theater headquarters around D-105.

After receiving the estimates of requirements from all the component services, the theater commander calls an echelon conference. Balancing the shipping that he will have available against the estimates of requirements, the theater commander allots shipping space to each of the component services. The actual running of the echelon conference is usually a job of the logistics officer of the theater staff. Each component commander has carefully prepared a detailed estimate of requirements because it represents his best bid for the men, material, and ships which he believes necessary to support the tasks assigned in the forthcoming operation.

The echelon conference is really the key to any single operation, because it is at this conference that men and material must be fitted into the bottoms available. Never in the history of warfare has there been a time when there was enough shipping available for an operation. It is at the echelon conferences that the first and perhaps the controlling revisions are made in the base development plan. The construction schedule must also be tailored to parallel the revisions in the echeloning of troops and materials.

Shipping is not the only critical factor in echeloning for an operation. Port capacity and facilities, or beach capacity, in the objective area may dictate the manner in which troops and materials are echeloned. However, beach port capacity need only be a temporary bottleneck, since beach capacity can be improved by early construction and by having labor and cargo handling battalions scheduled on the target early.

Within the limits of the control factors, shipping dates and lift are adjusted during the echelon conference to assure the arrival of personnel, at the proper times, to construct and operate the base facilities in the objective area. The conference later acts as the referee and makes the decisions as to *what* and *how much*.

### *The Echelon Schedule*

The echelon conference is held as soon as possible after the arrival of the estimates of requirements, usually somewhere between D-105 and D-100. The work at the echelon conference results in an echelon schedule which is published a few days after the conference. After the publication of the echelon schedule, all services immediately take up the detailed planning assigned to them in the base development planning directive. The echelon schedule becomes a time-table upon which the component services base their detailed planning since each commander knows what units and materials he will receive, and the time of their arrival on the target.

### *Who Does The Work?*

The theater commander is following the rules of good business when he assigns portions of the theater base development plan to the component commanders for preparation, for he is having the people do the planning who will later do the work. In this way, the theater commander gets better answers and the theater staff is free to do other current and long-range planning which must go on constantly. A theater command never has just one operation in sight.

Each component or subordinate commander submits his portion of the theater base development plan and these are assembled and issued over the signature of the theater commander around D-80. The theater base development plan contains only enough detail to enable the theater commander to decide whether or not the plan is feasible. However, in preparing their portions of the theater base development plan, the subordinate commanders have gone into considerable detail in order to do a complete job. Thus, the subordinate commanders have already accomplished a large part of the work necessary to complete their own more detailed base development plans.

Immediately after the theater base development plan has been issued, the type, force, component, and other subordinate commanders begin assembling their own base development plans. The plans are issued around D-60. It is here that divisional and other subordinate units within each service begin their final base development plan. If the type, force, and component commanders are as effective as the theater commander, they too have had their subordinate commands working on their own particular portions of the base development plan. This method of preparation also results in the subordinate units having already done a large measure of the work necessary to complete their own base development plans, and have this finished by the time the theater plan is issued. What remains to be done in the subordinate plans after this work is completed is largely decisions on technical problems and detailed task assignments.

While the subordinate commands are preparing their plans, the theater planning is being reviewed, and all necessary changes are made at this time. There is very seldom any change in the theater plan which will materially affect the subordinate plans, and as a result, it is not unusual to find the theater, the service, and the force or type, base development plans issued within a few days of each other. Such was the case in the planning for Okinawa, when every plan from that of Admiral Spruance down to that of the various division commanders in the landing force were issued within a period of ten days. It is known in military parlance as "concurrent planning."

So far, this description has been concerned with the planning and action which directly affects the operation. For a complete picture, we must go back to about D-160, to the point where the outline plan has just been issued. The outline plan states gross requirements for the operation. The Army, Navy, and Air Force component commanders check these requirements against what they have on hand in the theater plus what they expect to have on hand by D-day. Matching these stocks against the requirements stated in the outline plan, they arrive at the procurement which must be accomplished by their continental support agencies. This procurement includes men, materials, and equipment.

Navy procurement in the United States begins when the Navy component commander sends his alerting letter to the Chief of Naval

Operations. The alerting letter lists Navy requirements for the proposed operation in terms of functional components. After the echelon conference is held at about D-105, the Navy component commander follows up with an order letter. The order letter contains a detailed list of all the functional components which will be needed for the operation. The detailing implies that the components have been tailored to fit the specific base and task.

As soon as the theater echelon schedule is published, the Navy component commander forwards the definition of echelons to CNO. This document lists the components by echelon, giving lift and scheduled arrival dates. The alerting letter is advance notice that certain components will be needed by a certain date. These are compared against CNO's schedule of availabilities, and any deficiencies are listed for procurement. The order letter states that certain components are definitely wanted and CNO earmarks them for the operation. Finally, the definition of echelons tells CNO what is wanted and when it is wanted. With these documents CNO can take the steps that are necessary to assemble the men, material, and equipment at the port of embarkation for mounting. The Army and the Air Force employ similar procedures.

### *The Planning Timetable*

Advanced base planning is an exceedingly complicated procedure and in order to keep the foregoing discussion from becoming too confusing, there has been little mention of the timing sequence, and practically no description of the individual documents involved. Taking the planning documents in order, first we have the JCS Directives being issued sometime between D-270 and D-180. After the JCS Directives have been sent out, the planning phases follow at the approximate times shown below:

1. The Campaign Plan ...... D-180
2. The Outline Plan ........ D-160
3. The Theater Strategic Study D-160
4. Base Development Planning Directive .............. D-150
5. Estimate of Requirement .. D-120
6. Echeloning Conference .... D-105
7. Type, Force, and Component portions of the Theater BD Plan .............. D-80
8. Theater Base Development Plan .................. D-60
9. Type, Force, and Component Plans ............ D-60 to D-30

While these plans are being developed, issued, and sent through command channels, the following documents are prepared concurrently by the Navy component commander and forwarded to the Navy Department:

1. The Alerting Letter ... D-160
2. The Order Letter ..... D-105
3. Definition of Echelons . As soon after the Order Letter as possible

In describing the place of the various documents in the advanced phase development plan-

There may be enemy opposition to advanced base establishment.

ning procedure, their relationship to command and staff work has been stressed. For full understanding, we need some description of the documents themselves.

The JCS Directive is self-explanatory. It tells the theater commander what the JCS wants to accomplish in his theater; it gives a tentative date for the accomplishment of the task; and it gives a tentative allocation of forces to do the job.

From the JCS Directive, the theater commander prepares his campaign plan. The campaign plan is actually a statement of intention and tells how the theater commander proposes to attain the objectives set forth in the directive. The campaign plan is stated in general and broad terms, but contains enough detail to enable both the JCS and the component commanders to comment on it and to make recommendations. The general situation is discussed in the campaign plan along with a concept of the plan, phased operations, troop requirements, command, maintenance, and logistics.

Listed in the campaign plan is a series of operations necessary to attain the JCS objectives. For each of these proposed operations, there must also be a plan. These are the outline plans, each of which deals with a specific operation. The subject matter covered in the outline plan is the same as was covered in the campaign plan, but is in more detail and in more specific terms. For example, instead of a concept of operations as was contained in the campaign plan, the outline plan will contain a scheme of maneuver or troop tactical plan. The outline plan furnishes the cognizant commands with enough information to begin firm planning and, in some instances, the outline plan can become the theater operation plan with only minor changes. However, like the campaign plan, the outline plan is only a statement of intention made months in advance of the scheduled D-day. This means that outline plans are subject to major changes or, if the tactical situation dictates, they may be scrapped altogether.

The theater strategic study is issued with the outline plan and represents the combined total of intelligence within the theater. The CEC officer is ordinarily interested only in the section devoted to base development; that is, the base development study. In this section, the topography and other physical features, such

**We may have allies at the advanced base.**

as port installations, beach conditions, road nets, and other items of a similar nature will have been described and evaluated. Also, several sites for bases will have been studied and their capabilities assessed both in current usability and new construction required. How each site or combination of sites fits into the theater strategy will have been studied and evaluated. Recommendations as to the desirability of developing these sites will also be contained in the study.

While the outline plan and the strategic study are being reviewed by the various interested commands, the base development planning directive is prepared and issued by the logistics division of the theater staff. It contains:

1. A preliminary plan showing the areas to be developed.
2. A general statement of facilities required by the component services.
3. Construction priorities.
4. Completion dates.
5. The command or staff responsible for coordinating and assembling the plan.
6. Dates for:
   a. Submitting estimates of requirements.
   b. The echeloning conference.
   c. Submitting the separate portions of the plan.

Taken in order, the next step is the preparation of the estimate of requirements, which might be said to depend upon the outline plan. It does depend upon the outline plan to a great extent in the sense that the scope of the estimate of requirements is determined by the outline plan. However, the same as with all the other planning documents, the preliminary work on estimates was used to develop the outline plan so that much of the labor on all these documents is done concurrently. The estimate of requirements has no standard form which must be used by all services, and in the past, each theater commander has developed a form that best suited the needs of the theater. Essentially, however, all of them contain the same basic information:

1. Advanced base unit or functional component description.
2. Number of personnel by unit or component.
3. Measurement tons of material to be lifted.
4. Data on heavy lifts.
5. Equipment requiring special handling.
6. Mounting points for units.
7. Successive shipping echelons for units and components.

The documents which have been described are basic ones and have been given a detailed description to insure complete understanding. The other documents listed in the planning timetable are either self-explanatory or have already been explained in the text. To summarize briefly, any base development plan is a guide rather than a definite program of performance at the regimental, brigade, and higher levels.

A few CEC Officers will be on high-level staffs, or have other related jobs on that plane, but the greater majority will be at a lower command level where the viewpoint is somewhat different. The problem will be the same at any level, and the principles and processes used to solve it will be the same, but the difference will be in the detail. Where a theater deals with total requirements, the average CEC officer will be working with definite sites, numbered components, measurable construction effort, and fixed starting and completion dates.

A chart of the planning timetable is included in this chapter and it may be used as an aid to illustrate steps in the planning process.

## *INTERNAL ORGANIZATION OF ADVANCED BASE UNITS*

Because the CEC officer will be so intimately associated with the details of advanced base development, the internal organization of the base will be of extreme importance to him. Conditions are so varied and sources of irritation so numerous, that it is essential that the commanding officer or the officer-in-charge of a functional component at an advanced base fully appreciate the position he occupies within the organization. Understanding of his relationship to his immediate superior, to his subordinates, and to other units at the base, plus a spirit of helpfulness, will assure smooth operation and the success of an advanced base mission. There are no regulations which can rigidly compel this course of action. Command relationships at an advanced base, previous to actual establishment, are not sharply delineated. This affords a measure of freedom to the base commander in choosing the best type of organization to be used and is the means by which flexibility is preserved.

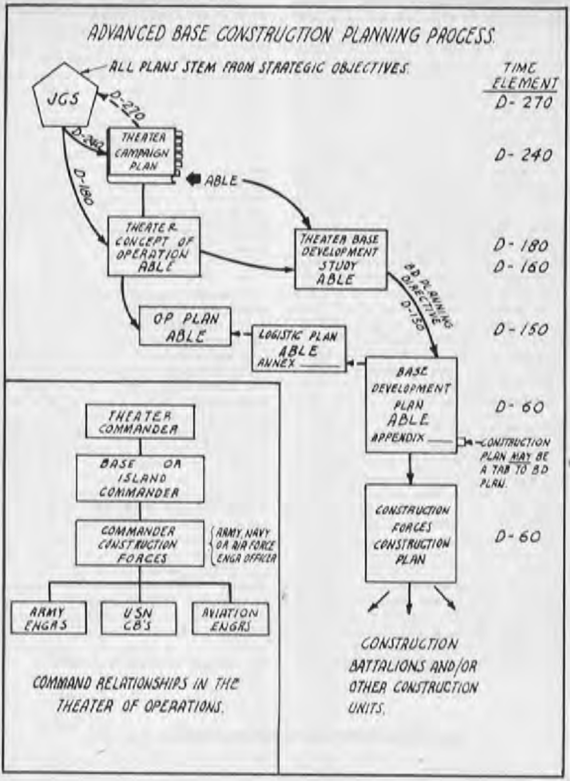
The A-1 through A-4 functional components furnish the command for administering an advanced base, but they do not contain all the personnel complements normally required, since it is intended that some positions will be filled by direct assignments and by officers from other components.

Therefore, the base commander must set up a clear-cut advanced base organization to fit local conditions at the site. There is no substitute for a clearly defined organization and functional chart to circumvent faulty command relationships, and each officer within the command must be thoroughly familiar with it.

Two types of advanced bases are described in the text that follows, to illustrate the main features of internal organization.

### *Organization of a LION*

The command and administrative lines within a LION are quite complex. This complexity is likely to be further increased in actual practice, since it is quite unlikely that a standard LION as outlined in the *Catalogue of Advanced Base Functional Components* would be shipped from the U. S., constructed, and put into operation without considerable alteration.


ADVANCED BASE CONSTRUCTION PLANNING PROCESS.
ALL PLANS STEM FROM STRATEGIC OBJECTIVES.
TIME ELEMENT
D-270
D-240
D-180
D-160
D-150
D-60
D-60
JCS
D-270
D-240
D-180
THEATER CAMPAIGN PLAN
ABLE
THEATER CONCEPT OF OPERATION ABLE
THEATER BASE DEVELOPMENT STUDY ABLE
BD PLANNING DIRECTIVE
D-150
OP PLAN ABLE
LOGISTIC PLAN ABLE ANNEX
BASE DEVELOPMENT PLAN ABLE APPENDIX
CONSTRUCTION PLAN MAY BE A TAB TO BD PLAN.
CONSTRUCTION FORCES CONSTRUCTION PLAN
CONSTRUCTION BATTALIONS AND/OR OTHER CONSTRUCTION UNITS.
THEATER COMMANDER
BASE OR ISLAND COMMANDER
COMMANDER CONSTRUCTION FORCES
ARMY, NAVY OR AIR FORCE ENGR OFFICER
ARMY ENGRS
USN CB'S
AVIATION ENGRS
COMMAND RELATIONSHIPS IN THE THEATER OF OPERATIONS.

A basic consideration in designing the functional component system was to provide flexibility. The base commander must endeavor to preserve this characteristic when drawing up the command and administrative plan for his base. The actual organization of an advanced base unit depends on so many variables that no single type of organization can be universally applied. The base commander of a LION receives his orders to report to certain higher command for duty as base commander of a specific LION. He is the senior officer of the A-1 component of the LION and has the rank of captain. The A-1 provides the necessary staff to carry out the administrative functions of the LION. However, the military and technical assistants required to complete the staff are the commanding officers or officers-in-charge of the various major components assigned to the base.

The major components of the LION will usually be headed by commanding officers. Some of these components are the Construction Battalion (P-1), Cargo Handling Battalion (F-1), Ship Repair Unit (E-1), Supply Depot (D-1), Hospital (G-2), and Ammunition Depot (J-3B). Smaller components are usually headed by an officer-in-charge. This type of component may be assigned in such a manner that the officer-in-charge may be ordered to report to the commanding officer of another commissioned component, as in the case of the E-13A being assigned to the E-1 as a component part of the Ship Repair Unit; or he may report directly to the base commander of the LION for duty. At large bases there may also be a number of components which are not commissioned, and which are either attached to a commissioned component or under the base C. O.

The base commander furnishes internal administration only for the components directly assigned or attached to his staff command. The commanding officers of commissioned components at the base are responsible for the internal administration of their components.

When a small component is attached to a larger commissioned component, the personnel of the smaller component are under the administrative control of the commanding officer of the larger component. For example at a large base where the E-1 component (Ship Repair, Large) includes as a part of the repair facilities a Base Ordnance Shop, J-1, the personnel in both the E-1 and J-1 components are under the command and administrative control of the commanding officer of the E-1 component. If, for some reason, the J-1 component acted directly under the operational (command) authority of the base commander, then the commanding officer of the E-1 component would exercise only administrative control over the J-1 component.

### *Organization of an ACORN*

In general, the organization of an ACORN follows that of other advanced base units, with certain exceptions as to FASRons and operating personnel. Both the FASRon and the Operating Squadron based on an ACORN are commissioned units. Consequently their respective commanding officers exercise both command (operational) and administrative control over personnel in these units. The commanding officer of the squadron may report to the base commander for duty, in which case the relationship is not unlike that of a commanding officer of a destroyer reporting to a division commander for duty. Or the air group or squadron may be assigned to a fleet command and be based on an ACORN for support only. In this case operational directives are received from the area commander or task force or group commander having operational control. In whatever relationship exists, close liaison must be maintained in order to establish a smooth-running command. The relationships existing between the ACORN, FASRon, and Operating Squadron will be covered in more detail in a later chapter dealing with an air base.

## CHAPTER III

# THE BASE CONSTRUCTION PLAN

THE SEABEES' ABILITY to erect any type of structure with magical speed immediately after "hitting the beach" has earned for them a reputation as construction supermen. The title is well-deserved, for the Naval Construction Battalions contain men whose technical skills can well be described with superlatives. However, the outstanding success of these construction projects is not based on technical skill alone.

Before the Seabees landed on D-day, there were long months of planning by the "brains" at headquarters. Somebody deduced the mission from the strategic plan for the theater; another coordinated the advanced base development with the tactical situation; some one calculated the intricate logistics problems for the movement; dates were set and schedules drawn up; a host of men, materials, and equipment were estimated, checked, revised, and worked over. These, and a myriad of attendant details had to be accounted for to insure success.

All this preparation was completed long before D-day to allow time for assembling, shipping, training, and other essential pre-invasion steps. The influence of this planning was felt all the way back to the factory production line and beyond.

### RECONNAISSANCE

One of the first steps in the long and tedious planning process for advanced base development was reconnaissance. Reconnaissance is a rather formidable term, but it boils down to a simple, understandable subject when the details are investigated. It is a thorough survey or close inspection of an area to gather information. The scope is not infinite. Reconnaissance is confined within definite limits by determining what information is wanted, the amount

**Pontoon pier construction is usually needed at an advanced base.**

**Existing roads at advanced bases are normally inadequate.**

of detail expected, and the relative importance of the information.

Before an advanced base construction plan, or any other major construction plan can be drawn up the planners must have sufficient intelligence data concerning the particular situation and locale to start with.

Ideally, the required information may have already been prepared and may be easily obtainable from sources within our country. Ordinarily, however, an advanced base is far from our continental shores and very little detailed valuable information is available. Thus, to accomplish essential planning the available information must be augmented with data obtained by an on-the-spot inspection.

Intelligence will normally be gathered from a number of sources, chief among which will be:

1. ONI reports
2. BuDocks Advanced Base Studies
3. Army Engineer Studies
4. Maps and charts
5. Aerial photographs and air reconaissance
6. Ground reconnaissance—beach or site.

General information may often be extracted from the sources listed in the first five items above. However, to obtain the detail necessary for final planning of construction at an advanced base, close inspection is required.

The CEC Officer is chiefly interested in engineer ground reconnaissance, which means searching for, accumulating, and reporting information on the terrain, resources, installations and activities which affect construction. Engineer reconnaissance may be classified under two broad types—*general* and *special*. *General reconnaissance* secures engineering information of a general nature in a particular area. *Special reconnaissance* supplements general reconnaissance by securing *detailed* information on a specific subject, structure, or construction task.

In World War II sites for advanced bases were in remote regions. At times they were even in enemy hands. In either case a ground reconnaissance was necessary. There were, in fact, a number of cases in World War II when territory which was still in Jap hands was reconnoitered.

Personnel selected to reconnoiter an area should be chosen carefully. They should have training in reconnaissance methods and technical knowledge of the construction mission. It is also very helpful if they are already familiar with the area.

Equipment for a reconnoitering party is chosen according to the mission. For example, equipment for an airfield or road reconnaissance would include a prismatic compass, tape, device for measuring vertical angles, field glasses, maps, tracing paper, aerial photos, notebooks, pencils, camera with film, individual equipment, medical supply kit, and weapons.

### *Plans and Orders*

Like any other operation, a reconnaissance must be planned. The plan should be simple and involve only two main steps. First, review your knowledge of the situation and all pertinent directives to determine the type, detail and importance of the items of information to be collected. Next, study maps and photographs, and consider the primary mission, time limitations, security measures, and the report to be prepared.

Reconnaissance orders, like any others, should be clear and complete. Whether verbal or written they must include a full listing of the information desired and the time limitations for the job.

### *Check Lists*

Outlining the requirements for check lists for reconnoitering parties may seem like unnecessary attention to detail. But they are a valuable aid to a reconnaissance party. They immediately indicate what and how much information is needed; they prevent omissions and confusion; and they eliminate the need for lengthy explanations and instructions.

You may be grateful for a check list in either of two situations. If you are heading a reconnaissance party, you will appreciate having a check list that prevents you from overlooking important features. If you are sending out a reconnaissance party, the check list assures you that you will be given the correct information.

Check lists vary in technical detail according to the type of reconnaissance. The following lists may be used as guides in the preparation of report forms and show the information normally desired. When a check list is too comprehensive and contains unneeded items, they may be ignored in the report. When greater detail is required, the items in the check list may be expanded. While there are many types of reconnaissance, the ones listed below are those of primary concern to Seabee units.

*Site reconnaissance for new construction:*

1. Location and description of site.
2. Proposed installation.
3. Type and availability of transportation facilities.
4. Character of terrain.
5. Construction materials—aggregate, timber, etc.
6. Drainage of area.
7. Water supply—availability, quality, quantity, source.
8. Sewage disposal—suitable outlets, drainage for pit latrines.
9. Electric power availability, capacity, and reliability.
10. Adequacy of area for immediate needs and for expansion.
11. Relationship to military objectives.
12. Availability, condition, and adaptability of existing structures.
13. Flood or tide data.
14. Delay probabilities due to enemy interference.
15. Regional factors—population; direction and distance to nearest towns; accommodations available as billets; character and use of surrounding region; attitude of inhabitants.

The leading bulldozers may need protection.

*Airfield reconnaissance:*

1. Location and description of site.
2. Meteorological data.
3. Hydrologic data.
4. Soil data.
5. Local resources.
6. Water supply.
7. Access and communications.
8. Utilities.
9. Obstructions and mental hazards.
10. Natural concealment.
11. Work estimates.
12. Elevation.
13. Drainage.
14. Accommodations for personnel.
15. Possible future expansion.

*New road reconnaissance:*

1. Existing facilities.
2. Future expansion.
3. Soil characteristics.
4. Drainage.
5. Curves.
6. Topography.
7. Availability of materials.
8. Miscellaneous factors (light, concealment, and water-table levels).
9. Unusual obstacles.

*Existing road reconnaissance:*

1. Show route followed, including route number, starting point, and destination. Make line sketch of route. Post observations, showing distances from towns along route. Use this form for road and railroad routes.
2. Type and condition of road.
3. Repairs needed (location; time, labor and material estimates; whether or not materials are near site).
4. Load capacities and condition of bridges (repair data).
5. Other critical points (location, nature, repair data).

*Bridge reconnaissance:*

1. Location.
2. Width and depth of stream, and profiles.
3. Velocity of current and character of flow.
4. Tide levels, high and low water levels, and flood data.
5. Nature of banks, shore approaches, and bottom.
6. Tributary streams.
7. Number and types of barges and other boats available.
8. Location of locks, dams, and fords in vicinity.
9. Access and approach roads.
10. Local materials.

(Reconnaissance for an existing bridge would include the above items plus the following)

11. Bridge data (type, design, repair estimates, etc.).
12. Demolition data (points vulnerable, time, labor, and explosive estimates).

*Water reconnaissance:*

1. Location of water source.
2. Source (well, spring, stream, lake).
3. Capacity of source.
4. Character of water.
5. Temperature of water.
6. Results of tests.
7. Possible sources of pollutions.
8. Possible chemical contamination.
9. Accessibility.
10. Proposed developments.
11. Data on underground sources gained from inhabitants and local records.

**Roadwork must begin on D-day.**

Other types of reconnaissance, such as those for quarries or pipelines, may be of importance to the Seabees. The two criteria for deciding what information should be gathered are—the *requirements for the project* and *total information relating to these requirements* as found at a site.

#### *Reports and Forms*

Reconnaissance reports are usually written. Maps, overlays, simple sketches, photographs, and prepared forms are used whenever suitable, for they can be prepared quickly and result in a better picture of actual conditions. Accuracy and completeness are essential, since the reconnaissance reports will be analyzed and evaluated to establish policy and solve vital problems.

However, some of these features are overshadowed by the time limitations imposed by war. The basic rule to follow in any reconaissance is—*It is better to get an incomplete report back in time, than a complete report too late.*

### *THE NAVAL CONSTRUCTION BATTALION*

Before the intricacies of an advanced base construction plan are explored, it is well to know with what tools you will work. The Navy has set up the "P" group of components with the general function of construction and maintenance during the early phases of amphibious operations. In the "P" group of components, the P-1 functional component (Naval Construction Battalion) is the unit with which you are most likely to work, and is the unit

**New roads should look like this by nightfall of D-day.**

in which you are probably most interested.

The construction battalion is an organization complete with personnel, administration, housing, subsistence and equipment. It is an independent, self-sustaining unit under all normal conditions, and is organically designed to operate alone. Its personnel are technically trained and equipped to perform the various shore and water-front construction tasks which may be required at advanced bases. Normally, it is not a specialized construction organization.

### *Organization for Operations*

The operating organization of a construction battalion is shown on the accompanying chart. At least 75% of the battalion complement should be available for project construction. Most of the balance is required for camp maintenance, administration, staff, supply and subsistence.

*COMMAND*

1. *Commanding Officer*—A naval construction battalion is a commissioned unit under a commanding officer. The responsibility of his command is absolute, except when and to the extent relieved by competent authority or otherwise as provided by *Navy Regulations*. He may delegate authority at his discretion when not contrary to regulations. However, such delegation does not relieve the commanding officer of his continued responsibility for the safety, well-being, and efficiency of his command.

2. *Battalion Executive Officer*—The executive officer is the alter ego of the commanding officer. He is primarily responsible for the organization, training, performance of duty, and good order and discipline of the entire command.

3. *Construction Operations Officer*—The construction operations officer directs and coordinates all of the engineering and construction work and acts for the executive officer in all such matters.

*STAFF*

1. *Special Service Section*—This section is directed by the battalion chaplain who reports directly to the battalion executive officer. It contains the chaplain's office and the recreation services for the battalion.

2. *Medical and Dental Sections*—These sections contain the battalion medical and dental services respectively. They are directed by the respective staff corps officers assigned to the battalion, who report directly to the battalion executive officer.

*ORGANIZATION OF COMPANIES*

1. *Headquarters and Service Company*—The headquarters and service company is composed of the engineering, headquarters, security, and supply service sections, which are all under the direction of the headquarters company commander. The company commander exercises administrative control and service support for all personnel of the medical, dental and special service sections. This company's executive officer has the direct responsibility for battalion personnel administration in addition to his other duties as company executive officer.

   a. Engineering Section—This section contains the drafting, surveying, photographic and planning functions. It is organizationally part of the headquarters company, but is responsible to the construction operations officer for operational direction.

   b. Headquarters Section—This section contains the communications, post office, clerical, personnel and administrative functions for the battalion.

   c. Security Section—This section contains the police, ordnance, firefighting and refuse disposal functions for the battalion.

   d. Supply Platoon—This section contains the supply functions for the battalion. It includes a technical material supply section directed by a warrant carpenter. His mission is to maintain supplies of construction material, equipment, and parts necessary for continuous operation of the four construction companies of the battalion. He maintains liaison with the construction operations officer to fully coordinate all supply and shop stores functions in support of construction.

2. *Company A. Equipment*—Platoons 1 and 2 are the mobile equipment platoons. Platoon 3 is the heavy equipment platoon. The barge and diving section of the heavy equipment platoon operates and maintains all barge equipment assigned to the battalion and performs special diving missions. These operating platoons are assigned to assist the other companies of the battalion as directed by the construction operations officer.

3. *Company B. Shop*—This company consists of three platoons: an equipment repair, a construction maintenance, and a metal shop platoon. It performs all shop work for the battalion construction effort and the maintenance of public utilities of the battalion camp and shop areas.

4. *Companies C and D. Construction*—These companies consist of three platoons each; a light construction, a heavy construction and a utilities platoon. Each company includes all of the construction trades necessary to perform the construction mission of the battalion. The operation of automotive and construction equipment is performed by company A in its support of companies C and D.

*PERSONNEL*

Tables No. 1 and No. 2, Appendix B, contain the personnel allowances and distribution for the battalion, by rank and designation for officers, and by ratings and rates for enlisted men. Personnel may be assigned within the battalion to meet certain job requirements. The rating and rate structure will dictate as far as possible the assignment of personnel to the battalion.

*EQUIPMENT—GENERAL*

List No. 1, Appendix B, contains the allowance of major items of equipment. These items will be furnished in the initial P-1 outfitting list when a battalion is organized for movement overseas. Additional items not included in the initial outfitting list, or deletions, will be a matter of special request of higher authority to meet special requirements.

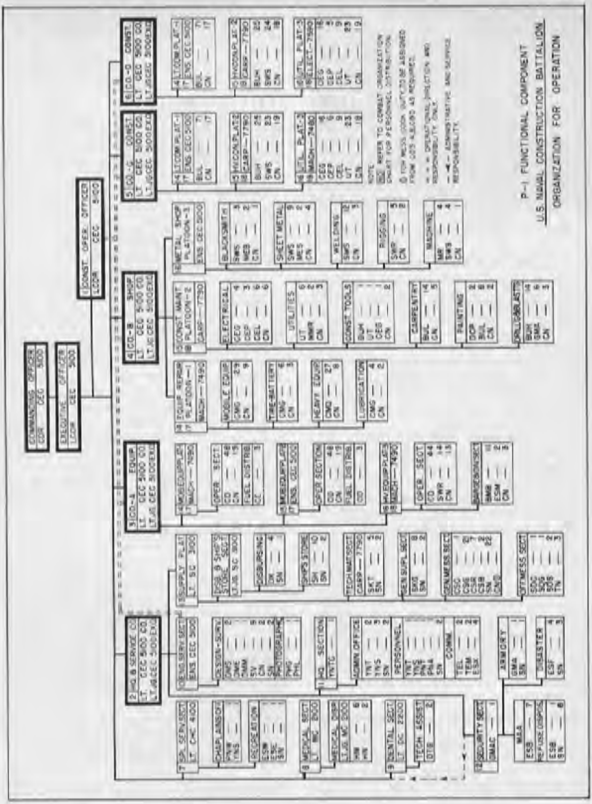
### *History of Seabee Organization*

Most CEC officers know that the first construction battalions were organized during World War I. It may not be known, however, that the organizations which existed at that time bore very little resemblance to the Seabee battalion of World War II.

The idea conceived in World War I was that each battalion should be comprised of separate trades; that is, one battalion would consist entirely of laborers, another of carpenters, and similarly for other trades. This concept was perfectly sound and feasible for a major construction operation. But it was not at all adaptable to the organization of forces for "island hopping" campaigns such as were carried on in the South and Southwest Pacific during World War II, where possibly only one or two battalions would be required at a given site.

This unsatisfactory condition for small scale operations was soon recognized and the organization was arranged so that each battalion consisted of four companies. Each company contained all construction skills and could therefore build anything.

The present organization of the Seabee battalion is much the same as that developed for World War II, consisting of five companies when the headquarters company is included. This is excellent for military and housekeeping purposes, but is sometimes awkward on a construction job employing an entire battalion. For such a task it is the responsibility of the battalion commander to reorganize the battalion, for work, on what might be called a "job basis" or "contract basis." That is, men of similar skills in all companies of the battalion are organized into a distinct unit to accomplish the work of their trade required on any individual job. And it is here that many differences of opinion appear, for there are probably as many ideas on battalion work organization as there are officers in the Corps. The decision as to what type of work organization to use will rest with the battalion commander and will depend on the local situation and the project assigned to the battalion.


P-1 FUNCTIONAL COMPONENT
U.S. NAVAL CONSTRUCTION BATTALION
ORGANIZATION FOR OPERATION

**Working conditions may be far from ideal.**

### *Other Commissioned Components*

The Amphibious Construction Battalion (ACB) and the Construction Battalion Maintenance Unit (CBMU) are other commissioned, self-contained mobile units which are required for construction and maintenance during the early phases of amphibious operations or which help to make up an advanced base.

The Amphibious Construction Battalion operates as a unit of the Naval Beach Group used in an amphibious landing.

The Construction Battalion Maintenance Unit maintains and operates the public utilities of advanced bases upon completion of the construction work of the base, and is also available for minor construction assignments at the base. It functions as a unit under the command of its officer-in-charge. At larger bases more than one of these units may be required, in which case they are combined and organized under the command of the senior officer-in-charge.

### *Additional Components*

Other P components furnish additional personnel and material to augment battalions and maintenance units for special requirements of construction, maintenance, fire protection, and operation and maintenance of transportation equipment.

## *ORGANIZATION OF CONSTRUCTION FORCES*

The number of construction battalions required for any specific base development program will be determined by the theater commander and selected from the naval construction forces assigned to him by the CNO. These battalions will normally be organized into a construction force, whose commander reports directly to the officer responsible for execution of the theater commander's base development plan. In a joint operation, this officer (who may be Army, Navy, or Air Force) may be designated the area commander, the island commander, or the base commander, depending on geographic and operational factors. The construction battalions in a joint operation will be a part of the joint construction force. In a purely naval operation, the senior naval officer ashore may be designated island commander, base commander or some similar title and all naval construction battalions will be organized under a Commander Construction Force who will report directly to him.

As stated previously, the primary function of the Seabees is the construction and maintenance of the facilities required at a particular activity and as decided by competent authority. However, this policy must be flexible enough to enable the construction and maintenance forces to be utilized on other work when required. Construction forces can be used on maintenance and maintenance forces on construction. Further, a local emergency may arise and compel the commanding officer to assist other units in various military tasks, operation of small boats, or other incidental work. It is important that all Seabee personnel be utilized for their particular skill and not diverted from the primary mission. Therefore, special assignments should be regarded as temporary.

**Organized work saves men and machines and time.**

### *LARGER SEABEE UNITS*

Though originally the basic Seabee unit was a battalion, as construction operations grew larger, it became evident that the work of individual battalions in the same general location must be coordinated. As a consequence first the regimental organization and later the brigade organization and construction troops organization came into being. Even with these larger Seabee organizations the basic concepts of skilled men in skilled jobs and units organized as battalions in such a manner that they could be split into four separate parts still continues.

The formation of construction forces into regiments and brigades will be determined by the area or theater commander and approved by the CNO. These higher echelon units will not be loosely formed on an arbitrary basis of multiples of battalions, but will be formed as a distinct outfit to meet the specific needs of a particular geographic area or situation. Such commands or staffs will be formed when the extent of construction effort in a particular area is large enough to justify their use as a part of an area or base commander's organization.

Seabee battalions, regiments, and brigades operated in all combat areas during World War II in the construction and maintenance of advanced airfields, communication facilities, fleet and other facilities. Because of their mechanical skill, they have even been called upon to perform emergency repairs to fleet units such as aircraft carriers and destroyers.

**Surveying work starts on D-day immediately after landing.**

**Marine construction and demolition is another requirement at an advanced base.**

#### *Construction Regimental Headquarters*

This is a command and administrative organization to direct and coordinate the work of construction battalions in the same operation or locality. Staff personnel and equipment are held to a minimum to insure flexibility, mobility, coordination, and continuity in the work of the units of the regiment to obtain maximum production.

#### *Construction Brigade Headquarters*

This is a command and administrative organization for the coordination and control of construction regiments, together with battalions and detachments in the general area, not within a regimental command.

### *ABOVE THE BRIGADE*

So far, the discussions has been concerned with the formation of battalions, regiments, special units, and brigades. Some situations require the organization of forces even larger than a brigade. Opinions as to exactly how these larger forces should be organized differ. Skilled trades units such as battalions of carpenters, machine operators, truck drivers, etc., can be utilized to excellent advantage on large construction projects. However, *one of the prime reasons for the success of the Seabees during the past war was the fact that they were all-purpose units.*

There has been great pressure at times toward formation of special Seabee units of every description, namely: truck driver battalions, waterfront battalions, air field construction

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battalions, electrical installation battalions, power plant battalions, and other special-purpose units. While there may be justification for the establishment of some special units, it would defeat the basic concept of an all-purpose unit.

However, for any very large construction task it may be necessary to use men from more than one brigade, or what might be called a "division". This "division" figure might be as many as 20,000 to 30,000 men. Even so, the principle of "job" or "contract" organization can still be applied. For example, if a large crew of heavy equipment operators is needed, the unit can be organized by taking men from each of the battalions forming the parent organization.

The formation of these special units can always be accomplished by the senior commander or brigade or troop commander in the field. By this method the present, flexible organization of the construction battalion is retained. The foregoing is not a brief against special units, but for general work the special unit is usually unwieldy. For overall efficiency, it is better to form special units for special cases and then disband them when finished.

However, circumstances sometimes demand the formation of permanent specialized units. The recent formation of the highly specialized amphibious construction battalions is an example of this.

### *CONSTRUCTION FORCES*

In the past, some confusion has arisen regarding the respective functions and responsibilities of construction battalions and maintenance units. Present doctrine calls for establishment of a construction force responsible directly to the area, island, or base commander for base construction in accordance with the base development plans of the theater commander. (See the charts in Chapter Two for command structure during periods of assault through base development.)

The area, island, or base commander is *solely* responsible to the theater commander for base development. For discharge of this responsibility the construction force is assigned as a unit of his command. His subordinate unit or activity commanders such as Commander Naval Operating Base (CNOB) are responsible for maintenance of their respective facilities. For this purpose, maintenance units may be utilized for base construction in the early phases, as part of the construction force, but when so attached, they will be used, as a matter of policy, for construction *only* of those facilities to which they will later be attached for maintenance.

Dynamiting big trees saves time.

### *THE CONSTRUCTION PLAN*

The best way to approach the problem of advanced base construction is by way of the viewpoint of the officers concerned. By reviewing their responsibilities and functions—and your relationships with them—you, as a battalion officer, will have a practical picture of a base construction plan.

Logs like this require power saws.

Advanced base construction uses lots of lumber.

### COMMANDER CONSTRUCTION FORCE

The Commander Construction Force, as field commander of all construction battalions and engineer troops assigned to the operation, is responsible to the base commander for construction of the various facilities of the base in accordance with the base development plan of the theater commander. Under unusual circumstances, and in minor operations, the Commander Construction Force may sometimes be assigned additional duty as base civil engineer officer. However, this is not usually desirable.

#### *Planning by the Commander Construction Force*

If the forces taking part in the operation are designated in advance of formulation of the plan, the Commander Construction Force, through the base commander, will be called upon to advise on engineering and construction features of the plan. The Base Development Plan when issued will cover all major elements of the base development program, including mission of the base, units assigned, area allocations, permanency of construction, priorities of construction, echeloning of units, and target dates.

Since it is intended as an overall guide for all tactical and logistic elements, it will not usually be in sufficient detail for the construction battalions involved, and it will be necessary for the Commander Construction Force to prepare a construction plan. The construction plan stems from the base development plan and may be a separate plan, or may be issued as a construction annex to the Island Commander's operation plan, if such is prepared. After approval by the base commander, the construction plan usually becomes the construction order.

The construction plan includes task assignments for subordinate units of the construction force, logistic and administrative information, a general schematic layout of the base, a construction schedule, and echeloning of construction forces and materials.

The construction plan should instruct but not restrict. It must assign tasks and limit areas of responsibility of subordinate units. But it must not attempt to solve problems of engineering and design of individual facilities and installations. These are within the capabilities and properly the function of the basic unit of

Operating sawmills is a Seabee job.

**Facilities must be properly housed.**

the construction force—the construction battalion.

The construction plan must prescribe the organization of the construction force. The general area allocations made in the base development plan will be extended in the construction plan to provide a layout of all facilities of the base, showing the most favorable locations indicated by the best available intelligence. In analysis of intelligence data, prime consideration must be given to the possibility of using existing facilities, so as to reduce the construction effort.

The schematic layout will be approved by CNOB and the base commander, prior to issue. It is not intended as a detailed site plan, and will not pretend to show the exact location of buildings, roads, and such projects; these will be developed in the field by the construction battalions charged with the work. It is essential that the Commander Construction Force coordinate these layouts and guide the OinCs of the battalions in site selection. Detailed criteria for selecting facility locations are given in BuDocks publications and will not be repeated here, but a brief listing of water-front and non-water-front facilities will serve to indicate those components usually in competition for similar sites within the areas allocated to the base.

*Facilities Normally Given Priority for Water Front and Harbor Locations:*

(1) Berthing Space—Cargo, Tanker, Ammunition, Carrier, and Submarine.
(2) Ship Repair Facilities and Floating Drydocks.
(3) Transit Sheds.
(4) Fleet Fuel Depots; Terminal Handling Facilities.
(5) Harbor Defense Installations.
(6) Port Director, and Aids to Navigation and Radar.
(7) Ship to Shore Communications.
(8) Fleet Supply Facilities.

*Facilities Best Located Away from the Water Front:*

(1) Administration.
(2) Quarters.
(3) Supply Depots, except Fleet.
(4) Construction Equipment Storage.
(5) Construction Equipment Shops.
(6) Hospitals.
(7) Motor Pools.

**Good sanitation facilities are essential.**

**P.T. Squadrons may need Seabee construction work.**

**Bridges are another Seabee job.**

(8) Motor Repair Shops.
(9) General Maintenance Shops.
(10) Tank Farms.
(11) Ammunition Depots.
(12) Radio Stations.
(13) Air-warning Stations.
(14) Water Supply and other Utilities.
(15) Waste Disposal—in some cases the water front, but never in the harbor.
(16) Recreation.

Location of airstrips is an important feature of the base layout. Some considerations used in evaluating reconnaissance reports and affecting the final selection are:

(1) Speed in leveling to desired grade or for repairing existing facilities.
(2) Condition of subgrade and approaches.
(3) Proximity to rock, higher elevation land, and materials.
(4) Possibility for enlargement.
(5) Protection and service possibilities.
(6) Conflicts of flight patterns.

The construction schedule included in the construction plan will show the approximate starting and completion dates for major projects to meet the requirements of the base development plan. It will not show the various phases or operations under each project—this is left to the battalion on the project.

The construction plan will also include information regarding support to and from other units, organization details, and instructions concerning supply and logistic problems. It will assign responsibility to subordinate units of the construction force for the early establishment of dumps to receive and issue all structural material such as huts, tents, pipe, wire, fixtures, and other building supplies during the construction of the base. After the construction phase has been completed, and when the base is in full operation, excess material of this type may be turned over to the supply department for issue when needed for maintenance, but during the construction period it will be under complete control of the Commander Construction Force.

### *Construction*

Accomplishment of construction for base development is the major function of the construction force. The Commander Construction Force is directly responsible to the base commander for execution of the theater commander's base development plan. He has prepared for this task by insuring the readiness of his construction troops, and by shaping his construction plan to fit anticipated conditions. However, in the final analysis, the success of the construction effort depends upon the state of training, efficiency, material readiness, and adaptability of the basic components—the construction battalions.

By his construction plan, the Commander Construction Force has delegated the accomplishment of the various construction tasks to his subordinate units. He has designated their objectives and defined the limits of their authority and responsibility. Within those limits, they are free to determine means and methods to gain their assigned objectives.

Once the actual engineering and construction work has begun, the Commander Construction Force will normally act only for purposes of coordination, to change basic precepts or task assignments to meet changes in mission directed by higher command or dictated by local conditions different from those expected. All detailed engineering will normally be delegated by the construction battalions charged with the work, except in those unusual cases where the work of two or more battalions is so interdependent that it must be coordinated in detail. In such cases, the necessary coordination will be effected at the regimental or brigade level, as determined by the special features of each case.

The regimental commander and his staff will likewise limit their functions to overall coordination of the battalions, insuring that manpower and equipment are deployed so that all projects may proceed in equitable conformance with assigned priorities and completion dates. Experience has proved that only by this delegation of responsibility for details will the full efficiency of the construction battalions be realized.

In addition to the construction battalions, which make up the major part of the naval element of the construction force, the Commander Construction Force may have available during the early part of the construction phase some or all of the CBMU's designated for base maintenance. These units will be utilized for construction of those facilities which they will later maintain. Detachments will be transferred to the base public works department as the need for maintenance and operating forces grows with the progressive completion of base facilities.

Another source of construction manpower is local labor, which must be utilized as much as possible for suitable projects, both to assist the local civilian economy and to release construction troops for other projects. When personnel of the base operating components arrive before completion of the facilities, working parties of both skilled and unskilled ratings may be made available to the Commander Construction Force to supplement his construction troops. In any circumstances, component personnel should erect their own tent camps and field sanitary facilities under the direction of the Commander Construction Force. All such work must be coordinated with the overall development plan by the Commander Construction Force.

**On a joint operation the Seabee may work with equipment from other services.**

Naturally, no two base development programs are alike. Construction priorities and target dates for completion of various projects are decided by the strategic and tactical situation, the mission of the base, climate, shipping, forces available, and many other factors. Unloading difficulties may cause a shortage of materials for a high-priority project, resulting in a revision of construction schedules. The one common factor is continuous hard work for all hands in the construction force to build the base in the shortest possible time.

An essential first step in development of any base is a thorough inspection of the site by battalion and staff officers and field engineers, in order to check intelligence data and obtain the necessary field information from which to prepare detailed project plans as needed. A few hours expended in careful survey may save considerable time during the construction period.

### *Priorities*

After sites have been selected and construction commenced, a typical base construction program at one location might be:

*First Priority*

*Step I*
Temporary Unloading Facilities (Ramps and Pontoon Docks)
Fighter Strips and Airfield Requirements
Bivouac Areas
Rehabilitation of Roads and Bridges
Harbor Clearance
Temporary Supply and POL Installations (Dump Areas)
*Step II*
Ship Repair Facilities and Shops
Sanitation and Pest Control
Water Supply
Galley and Refrigerators
Tank Farms
Saw Mills
Generators and Power
*Step III*
Piers
Hospitals
Airfield Operational Requirements
Naval Supply Depot
Storage of Perishables

*Second Priority*

*Step I*
Personnel Housing
Warehouses
Mess Halls
Strengthening and Widening Roads and Bridges
*Step II*
Base Roads
Drainage
Enlarging Temporary Facilities as Approved
*Step III*
Camouflage
Recreational Facilities

It is important to the success of any construction program that as few changes as possible be imposed upon it once it is under way. Some changes of course may be necessary and desirable because of changing conditions. Frequently recurring changes of priorities or locations will bog down the best planned schedule, and this must be avoided by the commander construction force and the base commander.

### *Supply*

One of the most important functions of the brigade and regimental staffs during the construction phase is to insure and regulate a constant flow of construction materials, equipment, and supplies to the battalions. Each battalion will normally establish an equipment and materials yard for its organic allowance. In addition, all construction materials and equipment from other components which are unloaded before they can be efficiently received at the construction site should be stockpiled at central locations in the custody of and under the control of the commander construction force or one of his subordinate echelons. This construction material stockpile (huts, lumber, cement, pipe, wire, fittings, and so on) should be pooled, rather than maintained in a rigid item-by-item consignment to individual components. The construction force can then use this material, as necessary, to meet the requirements of the base development plan.

The construction battalion allowance will normally include only a sixty to ninety days' supply of consumables. A consumable is that which is not reusable. The initial resupply of these items will be from the D components which arrive in later echelons, and subsequent resupply will be by normal requisition. A supply officer is included in the complement of each battalion to assist the battalion commander in this important function.

### *Maintenance*

The construction force ordinarily has no maintenance responsibilities other than maintenance of its own camp, shop, and dump areas, which is handled by each battalion for its own area. Maintenance of completed facilities is the responsibility of the CBMU which functions as the base public works department. The construction force will also be responsible for maintenance of its construction and transportation equipment, which will be accomplished by its own personnel, augmented if necessary by a P-11 (Automotive Maintenance) component which will later be attached to the base.

advise the commander construction force and the base commander as to the adequacy of his unit to perform the assigned and implied maintenance functions for the base.

### *Construction Responsibilities*

If the CBMU reaches the site during the early construction phase, as is normally desirable, it is attached to and is a part of the construction force and participates as directed by the Commander Construction Force in the construction of the naval base it is to maintain.

The commanding officer of the CBMU (the prospective public works officer) will maintain liaison between the base commander and the commander construction force and will advise them when it becomes desirable to detach the CBMU, entirely or in part, from the construction force, for maintenance of the base.

### *Maintenance*

The maintenance procedures and responsibilities of the CBMU follow the same general pattern as those of a public works department at a continental naval station.

Shops and their operating forces will be set up to maintain buildings, roads, bridges, and water-front structures, including inspection, painting, replacement of damaged or dangerous structures or structural elements, road paving and patching, ditching, and general cleanup. Minor construction work within the capabilities of the unit will be accomplished as necessary.

### *Outline for a Construction Plan*

Until now the construction plan has been presented from the viewpoint of the officers concerned; that is, how it affects them and how they handle it. No concrete example has been given.

It is obvious that an actual construction plan should not be included in a work of this type. For one thing, it would be too voluminous. For another, it would, of necessity, be narrowed in scope since it would be confined to one example. Lastly, it would contain many technical details unnecessary to an already qualified CEC Officer.

However, to furnish a guide for indicating the scope and arrangement of a construction plan, a "Form for a Construction Plan" has been included in Appendix "C" of this book.

The form given in Appendix "C" is an outline of a construction plan to be written by immediate higher authority for use by a U. S. Naval Construction Regiment, Battalion, Unit or Detachment. It need not be used in its entirety—any or all parts may be used as applicable in a particular situation. However, every construction plan, no matter how brief, should include the four main parts—information, task, logistic matters, and administrative matters.

A construction plan is often written for an entire construction operation involving several construction tasks. In such cases the construction plan must be supplemented by project orders which assign individual construction tasks to one or more specific subordinate units for accomplishment. Also, the project orders may include special instructions regarding those logistic and administrative matters which apply only to the subordinate unit or units to which the projected order is directed.

A construction plan should include *only* that information and those instructions necessary to accomplish the construction task and collateral duties. A construction plan is not a substitute for a base development plan but stems from and is written in support of such a plan. When placed into effect, the construction plan becomes the construction order.

### *How Much You Do*

In the hustle and bustle and seemingly confused activity at an advanced base, there is one question which you alone, regardless of rank, are going to be forced to answer. It is—How much work will I do for others? You'll get innumerable requests for aid or materials from units of your own and other services. How much should you do for them and how much should they do for themselves? What policy should you use as a guide?

The construction plan contains a general guide for such situations but, of course cannot cover all cases. A good rule to follow is—*Give all the help you can, so long as it does not interfere with your primary mission.* This is only common sense and good teamwork, for there is nothing so valuable as a spirit of cooperation and helpfulness to assure the success of an advanced base mission.

# CHAPTER IV
# AMPHIBIOUS OPERATIONS

Amphibious operations have long been established as a major element of modern warfare and their basic doctrines have been tested by experience. However, there is still room for improvement of techniques.

Amphibious operations are, of course, primarily a Navy job. The Navy must transport large numbers of troops, equipment and supplies over wide reaches of water and furnish protection during transit. At the objective the Navy still has full responsibility for landing everything necessary, and sometimes the additional duty of deploying men and material on the beach and establishing a base.

### History

An amphibious operation is extremely complicated. It involves the most delicate maneuvering and requires the absolute best in planning, attention to detail, and execution. The problem is even more difficult in a joint operation since it requires a greater degree of careful planning, teamwork, and execution.

The history of modern amphibious operations began in 1935, when the Army and Navy agreed that the Navy beachmaster would control the beach from the high-water mark to seaward. The shore-party commander would be an Army officer charged with organizing the beach, establishing dumps, medical installations, prisoner-of-war inclosures and message centers. The beachmaster and shore-party commander were expected to work closely together.

In 1938 a Navy manual stated that the shore party was a special task force organization which included the beachmaster group. In 1941 the Army published *Landing Operations On Hostile Shores*, which gave some jobs to the Navy which the Navy's 1938 manual had listed as Army missions. All of these publications said that the *men for shore operations would come from the Army and Navy units in the operation*. In the 1941 practice landings of the 1st Infantry Division and 1st Marine Division it became clear that such shore parties were altogether inadequate. Also, detaching men from

Seabee rhino ferries delivering vehicles at Normandy.

**Pontoon causeway section being secured to LST by side-carry method.**

combat divisions to serve in shore parties meant loss of men and units sorely needed during the critical operations which follow an over-water assault. The Marines solved the problem by organizing a pioneer battalion which became organic to a Marine division. At about the same time the Army formed what were to become engineer amphibian brigades.

Ideas and doctrines about shore parties were still hazy and inadequate. But the *development of permanent organizations for shore party work* was a good beginning. These organizations—Marine and Army—got their first tests at Guadalcanal and North Africa in late 1942.

### *Mediterranean Amphibious Operations*

The North Africa landing in World War II was our first really big amphibious operation. As a result, it was recommended to the War Department that all phases of amphibious operations, including joint Army, Navy and Air Force tasks, should be taught in all service schools. Also, that the separate Amphibious Force Command and General Staff course taught at Amphibious Force, Atlantic Fleet Headquarters, be expanded to include training, planning, and coordination between the different services. Most of these recommendations were approved.

The North Africa landings had shown that success or failure largely depends upon the ability of the attacking force to supply itself for more than just two or three days over open beaches. The shore party was the unit charged with supply over the beaches.

In planning the landings on Sicily the U. S. Seventh Army was assigned a portion of the coast where only a few ports of low capacity existed. This led to a decision to organize the beaches and shore parties so that they could sustain the army for thirty days.

The aggregate strength of each division shore party was approximately 4,000 men. Eventually the shore parties were to come under the control of the 1st Engineer Special Brigade, which was to control all of the beach operations for the army and operate the dumps.

This ambitious plan established the shore party as the principal logistical agency for the army in the Sicily campaign. The Navy brought 66,000 troops ashore in the first three days and ultimately more than 100,000 were landed. The average daily tonnage landed over the beaches in July was about 5,000 with the maximum of 6,600 tons landed on any one day. The port of Palermo on its maximum day handled 5,700 tons. The shore parties did a magnificent job in the execution of the supply plan. Now it was felt that Army, Navy and Air Force could perform together on a large-scale amphibious operation.

At Salerno and Anzio, some of that confidence was shaken. The Salerno assault lacked the overwhelming force in troops, fire power, logistical support and air power, which are all essential to amphibious operations. At Anzio the amphibious assault proceeded smoothly. However, the troops were enmeshed and encircled in a low flat plain with the Germans "looking down their throats" from the surrounding hills. Teamwork of a high order was evidenced by naval gunfire from destroyers which moved in close to shore to help stop the tank attack that was part of the German attempt to cut the beachhead in two. The situation at Anzio exemplified two important amphibious lessons—the necessity for exploiting initial success in a landing, and supply over the beaches in the event the beachhead is contained by the enemy. Anzio tonnages were so great that the beachhead was equivalent to the third largest port in the world. The ability to supply troops over open beaches for an extended period was proven here.

The amphibious assault on Southern France was one of the most successful large-scale beachhead operations in World War II. Its planning, preparation and execution were based not only on established doctrine but also on lessons learned in all previous amphibious landings in the Mediterranean. This operation has been used on many occasions as a model for teaching basic principles.

However, this operation was, in many respects, too easy. Everything went according to plan. There was no real test of the elaborate preparations and operational efficiency.

***Pacific Amphibious Operations***

More amphibious landings took place in the Pacific than in the Atlantic for obvious reasons. While many of these operations were smaller than the tremendous affairs staged in the Mediterranean and at Normandy, the knowledge gained was valuable in perfecting the techniques and planning for amphibious landings. None of the amphibious operations was perfect. But the errors made and the lessons learned were used to correct later operations.

Amphibious warfare in the Pacific also permitted comparison between the single-service system and the joint operation. The operations in the Southwest Pacific were mostly joint affairs, while a number of the landings in the Central Pacific were wholly Navy. From each and all of these landings something was gained.

On Attu we discovered the limitations of regular issue clothing and equipment. Field uniforms failed to keep men warm and would not shed water. Field boots came apart in the wet mud and tundra. Many essential items for ordinary living were missing. The planners failed to estimate properly the effects of terrain and weather. No real attempt was made to conduct amphibious scouting to confirm information obtained from aerial reconnaissance. Information about the enemy was lacking and this emphasized the fact that up-to-the-minute intelligence is always scarce in amphibious warfare.

At Guadalcanal in the Solomons surprise was achieved in the initial landings but from then on there was trouble.

Lack of sufficient personnel for shore parties, inadequate engineering and cargo-handling equipment on the beach, lack of motor transportation, lack of piers or docks, and obsolescent landing craft rendered the unloading and dispersal of supplies painfully slow. Tactically, the operation was a success. Logistically, it was almost a "flop".

Shipping was not only needed for food and ammunition. It was also needed for reinforcements, airfield material (particularly matting), fuel, and naval base facililties. Demand, in fact, heavily outweighed supply. Unloading at Guadalcanal was slow. Combat troops had to be pulled from the line to furnish labor. The boat pool was inadequate. Enemy air, surface, and subsurface activities were a constanct menace and did considerable damage to our shipping.

Our forces made many errors in this first offensive against the Japanese in the Southwest

**Pontoon causeway section just before launching.**

**Seabees chop lashings and launch pontoon causeway.**

Pacific Area. Among them might be listed the failure of commanders to obtain proper and detailed intelligence for planning and operational use, and failure to provide proper logistical support, proper sea reconnaissance, and communications. We also underest'mated the enemy air, naval, and ground reaction. The fact that both carriers were withdrawn simultaneously from the battle area for refueling shows a lack in planning the carrier support.

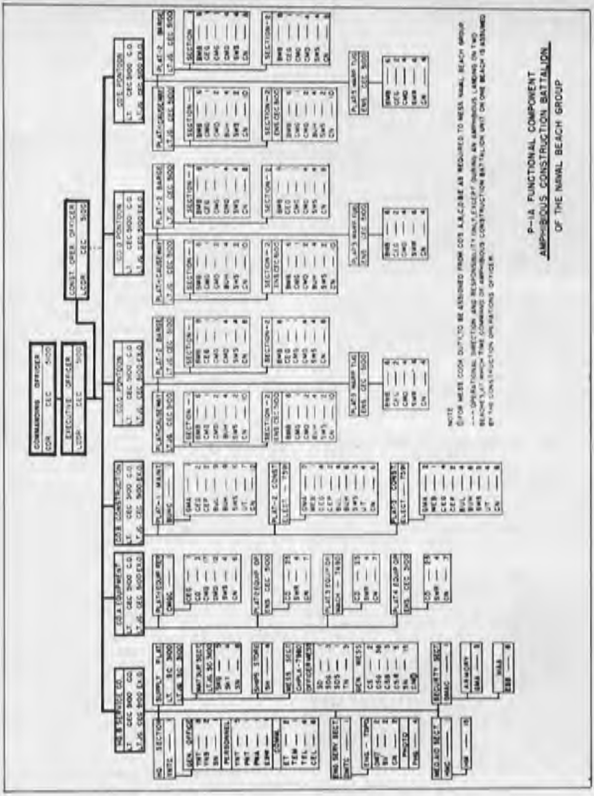
But from these failures, we learned "Know-how". We learned that time must be allowed for proper planning by lower echelons, that amphibious operations demand joint training to make a coordinated team, that detailed and correct intelligence of the theater of operations must be obtained at an early date and is the responsibility of the theater commander, and that the amount of supplies carried in the assault echelon must be limited to permit rapid unloading when vigorous enemy reaction is expected.

Properly equipped shore parties with adequate personnel are vital. Mechanical unloading aids for the beach are required to keep up with ship capacity. Also, engineering equipment and motor transportation are essential to keep beaches clear and to avoid congestion. The unloading must be geared to meet tactical requirements and flexible to follow tactical changes. Resupply must be arranged to arrive by echelons as required, to avoid congestion, yet support development and defense of captured areas. Communications must function so that information can be received and orders issued. Eternal vigilance is necessary, if unpleasant or disastrous surprise is to be avoided. Search and reconnaissance must be continuous and effective. A well equipped, administratively self-sufficient boat pool is necessary for tactical operations after the assault and for logistical use within the area. Naval gunfire and air support must be provided until land-based artillery and air support are available.

Guadalcanal was our first large-scale amphibious operation in which a boat pool was established. The pool consisted of 6 LCTs, 14 LCMs and 23 LCVs and their crews from the transports in the transport group. Since there were no orders or directives to this unit, it labored under great handicaps—insufficient boats, boats in bad condition, no repair facilities, very limited personnel, and no housekeeping facilities. Initially, it was a very inadequate setup, since the personnel could not even keep the boats in a serviceable condition. It was not until some time later that the value of the unit was realized. These boats were the only means of unloading ships, of maintaining communication between the various islands of the Guadalcanal group, and of conducting offensive operations, resupply of outlying units, evacuation of wounded, harbor patrol and control, and of rescuing survivors from our own and enemy ships and planes.

At Tarawa in the Gilberts the Marines suffered heavy losses in overcoming the Japanese. Here the deficiencies were almost entirely tactical and were corrected in the next operation. Technically, the CEC Officer and Seabee is not concerned with a listing of these deficiencies, since their interest and responsibility is with support.

At Kwajalein in the Marshalls tactical and logistical deficiencies of previous landings were brilliantly overcome. Amphibious operations proceeded concurrently in the Southwest Pacific. Step by step they pushed up the coast of



P–IA FUNCTIONAL COMPONENT
AMPHIBIOUS CONSTRUCTION BATTALION
OF THE NAVAL BEACH GROUP

**Seabees carrying anchors ashore to secure causeway to beach.**

New Guinea and Bougainville. All these operations were to culminate in the tremendous assaults on the Philippines and Okinawa.

These many amphibious operations were by no means perfect. Errors were made and corrected. Deficiencies appeared and were eliminated. But they all contributed toward today's highly efficient, well organized amphibious operation.

### *THE AMPHIBIOUS CONSTRUCTION BATTALION*

The CEC officer and Seabee are interested in the over-all operation because they want a complete picture and a general understanding of their billets. However, they are more concerned about such mundane particulars as the organization and specific tools they will work with. In an amphibious operation the CEC Officer is very apt to find himself part of or in charge of an amphibious construction battalion, and should know the development and present organization of such an outfit.

**Putting the ramps into position.**

#### *Development*

The present amphibious construction battalions were born in 1943, when amphibious warfare was still in the experimental stage. Like the Seabees themselves, the ACB's forerunners were born of necessity.

In 1943 the Allies, having just staged a successful assault on the shores of North Africa, were endeavoring to solve the landing problems posed by the shallow Sicilian beaches selected for the next operation. The question was—How to run heavy equipment such as tanks, bulldozers, and trucks through the shallow water to within wading distance of Sicilian beaches?

The Navy tried to solve this problem by the application and use of the already famous steel pontoon. The versatile cube had seen service in barges and lighters where it had proved capable of withstanding the terrific surge and strain of heavy seas, but could it be joined in sections to form a 500 foot causeway in a pounding surf? At Salerno, for instance, such a gap would have to be bridged under fire in a minimum of time.

The project seemed impractical until a method was developed for adjusting string assemblies of pontoons in slide-rule fashion. At the same time, however, Army engineers were experimenting with their celebrated steel treadways which could be laid across rubber "doughnuts". At a demonstration held before allied observers at the advance base depot, Narragansett Bay, the Seabees proved conclusively that their telescoping causeways launched by the momentum method were the best answer. Seabees were unloading heavy artillery from their LST before the Army engineers could set up their treadways. The pontoon causeway crews accomplished the mission in less than half an hour.

### *Seabees at Salerno*

Causeways for the invasion of Sicily, Salerno, and Anzio were perfected at Arzeu on the North African Coast, by the 1005th and 1006th Seabee Detachments, and this method of unloading troops and supplies has been given a large share of the credit for our amphibious successes in the Mediterranean. The 1006th CB Detachment, earliest forerunner of the present ACB, was largely responsible.

For the landing at Salerno, the 12-mile beach was divided into two parts—the north section to be invaded by the 46th British Division, landed from LST's with the aid of the 1006th Seabee Causeway Detachment; the south section to be invaded by the American forces, also to be landed on causeways manned by Seabee pontoon crews.

Before dawn on 9 September 1943, initial landings by assault Rangers and Commandos took place. The first LST (Number 386) headed into the north beach, carrying platoon C of the 1006th Detachment and a portion of the 46th British Division aboard. The convoy was under attack by German 88's during the landing, and LST 386 struck a mine, which wrecked the causeways. The ship, however, remained afloat, and all cargo was transferred to LCT's. Other causeways ordered to the north beach reached there as planned. Only one was used, however, for the beach was found to be of such nature that it was possible to beach LST's directly and to unload them after the Seabees had placed sandbags under the ship's ramps and spread mats.

LST prepares to marry with pontoon causeway.

On the south beach operation, units of the 36th American Division landed at the same t'me as the British landed on the north beach. The LSTs for the south beach landing grounded

Rhino ferry comes alongside pontoon causeway to unload vehicles at Normandy.

300 feet off shore but the causeways ran clear to dry land. Unloading operations were underway across the causeway ten minutes after the first LST grounded.

Before Naples harbor was opened, 190 LST's were unloaded by Seabees over causeways on the south beach. From actual records, it is estimated that about 11,500 vehicles went ashore over the 1006th Detachment's pontoon causeway during the invasion. In doing so, they suffered 23 percent casualties and earned the Navy Unit Commendation Ribbon.

### *Seabees at Anzio*

During the early part of January 1944, various officers and men of this group were temporarily assigned to the staff of Commander, Eighth Amphibious Force, and to numerous LST's within that force. On 22 January 1944, members of the 579th operated the causeways in the assault at Anzio-Nettuno.

Anzio is a small Italian coastal city, thirty miles south of Rome. Practically adjacent, but slightly east of it, is the town of Nettuno. The beach here contained a sand bar and shallows which extended several hundred feet from the shore. This underwater condition prevented the operation of the causeways in the usual manner, as the LST's grounded so far offshore that the pontoon strings could not reach the beach.

Seabee officers and men improvised a pontoon ferrying system and for two days succeeded in transporting much equipment ashore over the sand bar. To add to the difficulty, the men were subjected to almost constant bombing and strafing attacks; several were killed, many wounded, and much gear was damaged. Stormy weather began the day after the initial attack and by the next day all causeways were washed ashore by the surf. One platoon was returned to Bizerte; the others remained until March 1944, salvaging causeways and landing craft. They returned to Bizerte. Causeways were also operated at landings on Corsica and Sardinia.

### *Seabees at Normandy*

At Normandy, on D-Day plus 1, elements of the 25th Regiment manned pontoons, rhino ferries, and warping tugs at Omaha and Utah beaches. The 111th Battalion moved across the Channel on its own rhinos and delivered some 1,000 vehicles to Omaha beach in the face of heavy fire. The 81st Battalion did the same at Utah Beach. The 1006th also participated, installing and maintaining sunken pontoon causeways at both Omaha and Utah Beaches. At Omaha its steel highway extended 2,450 feet out to sea to enable landing craft to draw up to its "blisters" for unloading.

### *Seabees in the Pacific*

By 1944 the pontoon had become as familiar a part of the Pacific scenery as the traditional Seabee bulldozers. In January of 1944, the 121st Battalion were the first Seabees to send the causeways into action in the Pacific. In August of that year all pontoon detachments in the Pacific were formed into the 302nd Pontoon Battalion, the first of its kind.

At Okinawa pontoon barges operated by men

LST disgorges vehicles and equipment onto pontoon causeway.

LCM pulls into pontoon pier at Wolmi Do Island, Korea, to unload supplies.

of this battalion put ashore the bulk of our troops and equipment. It has been estimated that 110,000 deadweight tons of cargo and 64,000 American troops went over the causeways. The pontoon battalions also prepared pontoons to be used as seaplane repair barges, operated more than 100 small craft in the waters off the beachhead and organized crews of specialists to make on-the-spot repairs to damaged warships.

After the war a nucleus force of amphibious Seabees was retained as part of the regular Naval Establishment. The 105th Seabees activated in January 1947 and stationed at Little Creek, Va., were given the assignment of improving amphibious techniques. Now known as ACB2, the Battalion helped set the stage for the Operation Portrex maneuvers off the island of Puerto Rico during the spring of 1950.

Amphibious Construction Battalion #1 (formerly the 104th) has been assigned as part of our permanent naval amphibious force in the Pacific. A detachment from ACB#1 recently assisted in both the landing and the evacuation of United Nations troops in Korea.

### *FUNCTIONAL COMPONENT — P1A*

From all the work, experimentation, testing and experience which had gone before, was evolved the present Amphibious Construction Battalion. Under the Navy system for planning advanced base operations it is known as Functional Component—P1A.

#### *Mission*

The primary mission of the Amphibious Construction Battalion is to support the naval beach group during the initial assault and in the early phases of an amphibious landing operation. This is accomplished by installing and maintaining pontoon causeways, pontoon barge lighterage and pontoon barge transfer lines. It assists in the elimination of shoreline beach obstacles and boat salvage, constructs loading slots and improves beaching conditions. It establishes the naval beach group bivouac area and camp. It also assists the shore party in operations which do not interfere with its primary mission of supporting the naval beach group.

#### *Organization*

The organization of an amphibious construction battalion is shown here in chart form. The battalion is capable of carrying out operations in support of three regimental combat teams of an amphibious assault division. In a normal operation two regimental combat teams will land on two physically separated beaches simultaneously while the third is held in reserve. The battalion is organized so that it may be effectively divided into three organizations functioning independently of each other during the assault phase of an amphibious operation. Ordinarily the executive officer will be charged with the direction of the unit on one beach and the construction operations officer on the other. The officer-in-charge remains with the headquarters of the naval beach group and directs battalion operations from that headquarters.

#### *Command*

*Officer-in-Charge*—An amphibious construc-

Marines unload supplies from LCVP at pontoon pier at Wolmi Do Island Korea.

tion battalion is a commissioned unit under the command of an officer-in-charge. The responsibility of his command is absolute, except when and to the extent relieved by competent authority, or as provided otherwise by *Navy Regulations*. He may delegate authority to his subordinates at his discretion and when not contrary to law. However, such delegation will not relieve the officer-in-charge of his continued responsibility for the safety, well being, and efficiency of his entire command.

*Battalion Executive Officer*—The executive officer is the direct representative of the officer-in-charge. He is primarily responsible, under the officer-in-charge, for the organization, training, performance of duty, and good order and discipline of the entire command.

*Construction Operations Officer*—The construction operations officer has the responsibility of operational planning and direction of the battalion at all times except when an amphibious landing is executed on more than one beach. In such a landing he ceases to function as construction operations officer and assumes direction of battalion operations on one beach until the battalion elements revert to the battalion organization.

### *Organization of Companies*

*Headquarters and Service Company*—The headquarters and service company is composed of the engineering, headquarters, security, medical aid, and supply services under the direction of the headquarters company commander. The company executive officer has the direct responsibility for battalion personnel administration in addition to his other duties as company executive officer.

(1) Headquarters Section—This section contains the communications, post office, clerical, personnel and administrative functions for the battalion.

(2) Engineering Service Section—This section contains the drafting, surveying, photographic and planning functions for the battalion.

(3) Medical Aid Section—This section contains the first aid and minor injury treatment elements. The complement of the battalion does not include a medical officer. The naval beach group medical officer provides medical assistance to the battalion.

(4) Supply Platoon—This section contains the supply function for the battalion. It provides messing, material and equipment for berthing of the entire naval beach group and adequate supplies of construction material, equipment and parts for continuous operation of the battalion.

(5) Security Section—This section contains the police, ordnance, firefighting and refuse disposal functions for the battalion.

*Company A, Equipment*—It is the function of this company to operate automotive, construction and weight handling equipment in support of battalion operations and to provide

**Pontoon pier being set up by Seabees to unload supplies at Korea.**

organizational and field equipment maintenance for the battalion and naval beach group. It is designed for reorganization into three equipment operating units for amphibious landing operations.

(1) Platoon 1, Equipment Repair—This platoon provides all organizational and field equipment maintenance for the naval beach group.

(2) Platoons 2, 3 and 4, Equipment Operation—These platoons operate all automotive, construction and weight-handling equipment for the battalion.

*Company B, Construction*—This company consists of one maintenance platoon and two construction platoons. The construction platoons perform construction on their assigned beach areas. This company assists in unloading battalion equipment and material on the beach. It maintains the beach facilities of the beach group as well as assists in the repair and maintenance of pontoons, barges, tugs, etc.

*Companies C, D, and E*—These companies provide all the pontoon causeway, barge and warping tug requirements of the attack force during the assault phase of the operation. Normally two companies will be employed simultaneously in two separated beach areas, each supporting an assault regimental combat team. The third company may be assigned in support of the reserve assault force whose employment will depend on the tactical situation.

(1) Platoon 1, Causeway—This platoon consists of two (2) sections, each operating two complete causeways. Each causeway consisting of two sections.

(2) Platoon 2, Barge—This Platoon consists of two (2) sections, each operating four (4), 3 x 12 pontoon barges employed for general lighterage or for barge transfer.

(3) Platoon 3, Warping Tug—This platoon operates two warping tugs to assist in the placing of causeways and to perform salvage and routine utility work as required.

***Personnel***

The allowance and distribution of personnel for the battalion is specified by rank and designator for officers and by ratings and rates for enlisted personnel. Personnel may be reassigned within the battalion as found desirable to meet certain job requirements. However the rating and rate structure will dictate, in so far as practicable, the assignment of personnel to the battalion.

***Equipment—General***

The allowance of major items of equipment will be contained in the initial outfitting list when a battalion is organized. Additional items not included in the initial outfitting list will be a matter of special request of higher authority to meet special requirements.

***Ordnance Equipment***

Ordnance equipment is issued for defensive combat only. The allowance includes a hand

**Pontoon barges and causeway set up by Seabees to evacuate troops from Inchon.**

**Vehicles rolling ashore at low tide over pontoon causeways.**

weapon per man together with a standard allowance of individual infantry gear. However, the weapons allowance list may be modified at the discretion of the theater commander to best meet the requirements of the situation.

## *PONTOONS IN AMPHIBIOUS OPERATIONS*

The history of modern amphibious operations has been described briefly and the development of amphibious construction battalions has been traced. Of equal importance are the major tools of the amphibious construction battalions. These are the pontoon structures used in the landings. Two distinct types of structures have been developed for use in amphibious assault operations, the pontoon causeway, and the pontoon barge adapted for ferrying.

### *Causeway Construction*

Standard pontoon causeways are assembled from Standard Navy steel pontoons, angles, and fittings, and are made up by joining two causeway sections. A causeway section is commonly known as a 2 x 30 (2 pontoons wide and 30 pontoons long) and is 14 feet wide and about 177 feet long. These sections are used to form a floating bridge whose length varies from 177 feet to 325 feet. The causeway may be increased in length, as desired, if additional 177-foot sections are available, surf conditions are favorable, and the sections are properly anchored and secured to each other.

In some cases, the standard causeway section may be too long for bridging the gap between ship and shore, even after the section is placed at at an acute angle. However, it is possible to assemble and use shorter sections.

A ramp for unloading vehicles is built in the structure to be used as the inshore section. The offshore section has a special connection for securing the causeway to the ramp of the LST.

### *Causeway Operation*

For transportation to the objective, the causeway is loaded on an LST, side-carry method, and taken from the advanced base to the area where it is to be used. Towing is possible, but for long distances the side-carry method is preferred because of difficulties experienced in towing. Seabees are usually attached to the LST carrying the causeway, and they service it and launch it upon arrival at the beach.

The beaching method depends upon shore and surf conditions. One way, the "momentum" method, is to tow the causeway alongside the LST on the run to the beach and to release it while in motion. Or, it may be launched from the LST and towed by small boats. The second method is used when a long causeway is necessary, or when the causeway is to be employed as a floating wharf.

For the momentum method the causeway sections are launched, made up for the run to the beach, and secured by lines on the starboard side of the LST in such manner that they can be cast off instantly. A causeway platoon handles all the lines, and rides the causeway as the LST proceeds toward the beach with the causeway alongside.

When the LST grounds, all lines except the haulback line are immediately cast off and the causeway continues to travel forward under its own momentum until it grounds. Anchors are carried ashore to secure the causeway to the beach and the ramps on the inshore section are put into position for unloading. The offshore section is hauled back under the bow ramp of the ship by means of the haulback line and made fast. The sections are then securely fastened together and vehicles can immediately travel over the causeway from the LST to the beach. After the LST has been unloaded, the causeway may often be transferred to serve a neighboring ship.

### *Other Causeway Uses*

Causeways were first designed for use in unloading mobile equipment from LST's during the assault phase by bridging the gap from ship's ramp to the shore. Their usefulness, however, is not limited to unloading LST's. Other uses are: as finger piers to enable small craft carrying bulk cargo to be unloaded by cranes or vehicles; as floating wharves of many different combinations; as camels for the refueling of aircraft carriers; and as landing floats for the transferring of casualties from small boats to hospital ships.

The use of causeways as life rafts is a possibility. As a test at abandon-ship drills on one vessel, the pontoon detail, equipped with the necessary tools, launched the starboard causeway section in a total elapsed time of about four minutes.

### *Causeways as Ferries*

The ferrying method of unloading mobile equipment from LST's to shore can be used, under good surf conditions, when the LST grounds at a distance from the beach greater than the two-section causeway can bridge, and there are no additional sections immediately available.

For example, with these conditions assume that the causeway has struck the beach under the momentum method, and a connection has been made to the inshore end of the causeway from the winch line of a bulldozer. The haulback line from the ship to the offshore end of the causeway is used to pull the causeway back to the ship's ramp. A connection is made between the ramp and the causeway. Equipment is loaded within the safe capacity of the causeway, and the bulldozer pulls it to the shore. The ship's small boats help keep the ferry lined up with the bulldozer and the ship and assist in moving the ferry back and forth.

### *Use as Sunken Causeways*

The main purpose of sunken causeways is to unload small landing craft and boats in shallow water, on flat beaches, or on reefs where they might be left stranded by a rapidly receding tide. In such situations it may not be feasible to employ floating causeways, because of the probability of their breaking at the water line as the tide moves out, and to the possibility that the anchor lines necessary would foul landing craft in the shallow water. Experience gained in the Normandy landings indicates that smooth water is necessary for the successful operation of sunken causeways.

Sunken causeways must be marked with buoys, or flags on pipes connected to the causeways, to keep small craft from running into them when the decks are below the surface.

The causeway may be floated again at low tide, when the fill pipes are above the water level, by raising the fill pipes in a vertical position and forcing the water out of the pontoons.

### *Pontoons at Normandy*

To provide the assault landing needs of Omaha and Utah Beaches and have a suitable reserve, 36 Rhino ferries (6 × 30's) were assembled by Seabees at British bases. Each was 42 feet wide and 176 feet long, with deck space adequate for 30 to 40 vehicles. At the forward end, a 14-foot-wide ramp, 20 feet long, provided for the discharge of cargo. At the stern of the Rhino, two vertical timber knee-braces, designed to engage the sides of a lowered LST ramp, were installed. Two heavy-duty outboard propulsion units were provided for propelling the barges.

The installation of the outboard engines was one of the modifications made in the Rhino design as a consequence of operating tests made in English waters. The ramp described above was another, replacing a 60-ton capacity ramp called for in the original design. Other changes included the addition of plastic armor shields for coxswains, the elimination of a hinged fairlead, and the adoption of a closed cooling system for the outboard engines.

The Rhinos and causeways for the assault were assembled and launched at Falmouth, Plymouth, and Dartmouth, England, during late 1943 and through the spring of 1944. For the sunken causeways, 28 pontoon strings, each 2 pontoons wide and 30 long, were assembled, together with 16 causeway "blisters." These latter were sunken stages roughly equivalent to pierheads, 4 pontoons wide and 12 long, staggered on alternate sides of the causeways, and spaced 250 feet apart.

In addition, 36 Rhino tugs were built at the English bases, for the purpose of supplying auxiliary motive power for the Rhino ferries. Also provided were 12 causeway tugs for assist-

Ship-to-shore conveyor.

ing LCT's in berthing at the causeways; 12 warping tugs designed for pulling broached craft off the beaches; 2 Rhino repair barges, almost as large as the Rhino ferries, each fitted with two 5-ton cranes; and 2 floating drydocks of 475-ton capacity—enough to dock an LCT.

### *Pontoons at Okinawa*

Pontoon structures were used more extensively at Okinawa than in any other previous Pacific operation. One battalion of Seabees manned 96 barges of 3 x 12 pontoons, and another managed 28 sets of 2 x 30 pontoon causeways. The battalions were under the command of the Amphibious Forces, U. S. Pacific Fleet for this operation. Practice landings had been made at Leyte Gulf and in the Russell Islands. During a severe storm on the way to Okinawa, 8 causeways and 13 barges were either lost at sea or so badly damaged that they could not be launched for the invasion. Launchings started on D-Day (1 April) and by 8 April, all available causeways and barges had been launched and were in operation.

The causeways were used differently at Okinawa than in the Philippines, since the character of the beach was not the same. The attack took place over a wide coral reef. LST's could get to the outer edge of the reef and at low tide it was possible to drive many vehicles over the reef itself. Pontoon causeways and finger piers were constructed to permit men and vehicles to land dryshod at high tide.

The water-front construction program began on 5 May with preparations for placing an LST pontoon barge pier near the town of Kin on Chimu Wan. Additional pontoon piers, constructed at Katchin Nanto, Awase, and Kuba Saki, were also placed in operation during the month, although considerable work, such as clearing channels, dredging reefs, and improving access roads, was continued for some time. At Kuba, facilities were established for the storage and issue of pontoons and piling. Pontoon piers at Machinato and Yonabaru were rushed to completion for use in the support of combat troops. During the latter part of June, when the need for moving civilian refugees became great, a pontoon pier was constructed at Ora Wan.

Okinawa marked the first appearance in the Pacific of the warping tug. Eight of the craft arrived three days after the initial landing and began a career of usefulness. They worked barges around sharp coral reefs and got many a landing craft out of a tight spot.

### *Pontoon Airfields*

A pontoon development during the war, which did not reach combat use, was the floating airfield. The experiment was conducted at Davisville, Rhode Island, to develop a landing and take-off field for British use. The flight strip, 1,800 x 175 feet with two 50-foot parking strips, was assembled, towed to, and anchored in a cove of Narragansett Bay. For a short time planes used this field successfully but damage to minor parts in open water and the war's end resulted in abandonment of the experiment.

## *AMPHIBIOUS DEVELOPMENTS*

There are many research and development projects underway for improving equipment used in an amphibious assault. Most of them are not radical departures from present day items and their use is not spectacular in nature. They deal mostly with improving output, increasing mobility, lightening weight, and otherwise streamlining the articles used in landing on a foreign shore.

The development projects in BuDocks alone are too numerous to mention but a few outstanding examples are given to indicate the trend.

### *Ship-to-Shore Conveyor*

This project was undertaken primarily as the result of a request from the Marine Corps for a mechanical conveyor that would expedite the transfer of cargo, such as boxed rations, ammunition, water and drummed fuel from ship-to-shore after a beachhead had been established.

Additional requirements were that the conveyed cargo be ready for use, and that the conveyor function with a minimum of interference to major cargo unloading operations and normal beach activities. The unit has been developed and is now under construction.

Designed for mounting on pontoons or legs for over water operation or to rest directly on the ground, the basic unit is a 20-foot long, slotted-belt conveyor, weighing 530 pounds, completely self-coupled end to end into any desired system, and adaptable for use independently as a power or gravity loader. A switch section is included to permit diversion to all directions at the beach end. The coupling device permits a vertical deflection of 15 degrees and a lateral sway of 5 degrees which eliminates the necessity for straight line erection, allows floating sections to assume an arc line, and land section to fit the terrain. The conveyor is electrically driven from a central power plant, and systems are controlled from the central power unit or can be controlled from any 20-foot section. The capacity is approximately 40 tons per hour of assorted cargo. The conveyor is not designed for open seas, but can be used where there is some protection from the surf.

### *Ship-to-Shore Tramway*

The ship-to-shore tramway is a reef-spanning cableway, designed to augment the ship-to-shore conveyor. It also furnishes another contrivance for assuring the successful unloading of cargo to the beach.

Essentially the tramway consists of a shore tower, a ship tower, and a cable system spanning between the towers supporting a self-powered motor-driven hoist carrier. In addition to the deck tower, the deck rig includes a cable winch, a cable tensioning device, and guy ropes from the beach end of the system.

The cable tensioning device is hydraulically operated from the ship's tower and the carrier and hoist are driven by an integrally mounted engine controlled from the ship's deck.

The tramway has a load capacity of 2,000

A pontoon causeway pier in operation at Saipan.

pounds and the cable has a maximum free span of 500 feet. It is designed to properly tension the support cable for a maximum 6 feet rise and fall of the ship and to allow a tower displacement of 2 feet to either side of true vertical on a pitch cycle of 6 seconds. The carrier speed is 500 feet per minute with a load of 2,000 pounds, and the transfer capacity approaches 30 tons per hour.

### *Grader*

The success of the six wheel drive trucks that were developed by the Army Ordnance suggested that the same principle might be used in developing a new and smaller power grader which would have the same capacity as the larger and more cumbersome machine now in general use. Consequently, a six-wheel drive, front and rear wheel steer machine was developed which weighs approximately 5,000 pounds less than the conventional machine.

This is the first machine of its kind, and although powered by a 76 hp engine, tests have already proven that it will develop more pull at the blade than the conventional 100-hp machine. The six-wheel drive develops a very high tractive effort.

### *Air Compressor*

One of the newest items to be developed by the Bureau of Yards and Docks is an air compressor weighing 3,800 pounds, producing 325 c. f. m. of free air at 125 pounds working pressure, exceeding the output of a standard 315 c. f. m. compressor operating at only 100 p. s. i. and weighing 8,000 pounds. Thus the new machine has less than half the weight of the old, and has an even greater output. Dimensionwise, the new machine has the same width as the older model compressor but is 2½ feet less in height and 5 feet less in length. The smaller dimensions and lesser weight permits mounting the compressor on only two wheels as compared to four wheels required for the standard 315 c. f. m. compressors. This new unit falls in the same weight and size class as the present generator and 105 c. f. m. compressor and has the same diesel engine as our 60 KW.

### *Sea Water Distillation Units*

Fresh water, a basic need for troops in an amphibious operation, creates another handling

First Division Leathernecks prepare to board landing craft during Hungnam, Korea, withdrawal.

problem. It is bulky, heavy, and must be kept pure and palatable. Often, it is lacking in sufficient quantity when it is most needed.

To furnish drinkable water in quantity, BuDocks is developing three sizes of sea-water distillation units. These are the 85 gallon-per-hour, the 200 gph, and the 400 gph, yielding approximately 2,000, 5,000, and 10,000 gallons per day respectively.

All of these units are diesel engine-driven and embody the latest features including large weight reduction, cube reduction, scale prevention, low-salinity of product, and ease of maintenance.

The 85 gph unit shows particular promise. It consists essentially of a diesel engine, a compressor, an evaporator, a blowdown and distillate heat exchanger, a vent condenser, an engine water boiler built into the vapor head assembly of the evaporator, a raw-water pump, a blowdown pump, a 24-volt battery (four 6-volt batteries connected in series), and a sea-water electrolizing cell for scale prevention. The unit is mounted on an all-metal, 2-wheel trailer.

The assembled unit, mounted on tires and including the canopy and the towing hitch, is 12 feet 6 inches long, 6 feet wide, and 6 feet 6 inches high. Fully equipped, it weighs only 5,300 pounds.

### *Beach Stabilization*

Beach stabilization problems are considerably different from those of ordinary soil stabilization. In many instances the beach consists of a granular noncohesive material such as sand, and is constantly saturated with salt water between the low and high tide levels. It is in this very area that the assault landing forces may be working and where a stable surface is required.

The aim of this development project is to stabilize beach sands with a minimum quantity of inexpensive chemicals so that the surface will support the movement of trucks and other wheeled or tracked vehicles. To date, strips ten feet wide and up to 150 feet long have been prepared successfully. Some strips have carried light traffic within a few hours after completion and vehicles weighing up to 14 tons within 48 hours.

**Disabled tank being pushed aboard LSU at Inchon, Korea.**

Results have not yet reached the stage where it would be feasible to attempt the use of the process on a commercial basis. However, from a military point of view, the possibilities for rapid hardening and improvement in logistics justifies further research and development.

The foregoing examples are a few of the many key research and development projects which are being subjected to exhaustive investigation so that amphibious assault forces will be assured of having the latest and the best. In DuDock's air-borne equipment development work, special emphasis is being placed on multiple-purpose-utility in units, standardization of engines, availability of parts, and smoothness of operation. Both military and civilian equipment are being greatly improved as a result of this research.

# CHAPTER V
# BASE DEFENSE

MODERN ADVANCED BASE DEFENSE has become so complicated that it is now a job for specialists. It takes a skilled man to operate the scientific detecting devices which are needed to protect a forward area from a wily enemy using equally scientific methods of attack.

The ratio of support forces to combat forces must be kept as low as possible. The difficulty of defending an advanced base further aggravates this situation. It would be ideal if advanced base personnel could be augmented by harbor defense units. Although this is the goal of advanced base defense planning, it is not always fully realized.

Attacks may vary greatly in strength or type. Many can be beaten off or destroyed by station forces. Other attacks may be so strong that station forces alone cannot contain them and must call on combat units. However, the standard to strive for is an advanced base defense plan which is capable of defeating all anticipated attacks. This calls for assistance from combat units only in the event of a real emergency. Such a plan will place little or no drain upon the forward combat forces.

## BASE DEFENSE FACTORS

Before any plan can be made, the local situation must be surveyed to determine defense needs. First of all, we know that the primary function of the advanced base is to support the combat forces, and that defense of the base is a secondary function. This, of course, means that any defense plan devised will prescribe dual functions for base personnel, and that they will be fully exercised in combat roles. It also means that separate plans must be made for operation and defense.

### Types of Bases

One consideration in the defense plan is the type of base to be defended. Plans will vary widely because of the diversified character of advanced bases; the principal types are listed below as examples:

(1) *Naval Base.* A group shore command comprising those designated naval activities in a given locality which are capable of furnishing local logistic services directly to the operating forces.

(2) *Naval Operating Base.* A group shore command, comprising those designated activities in a given locality, usually beyond the continental limits, which furnishes limited operational and/or logistic services direct to operating forces.

(3) *Submarine Base.* A base which contains facilities for maintaining one or more squadrons of submarines.

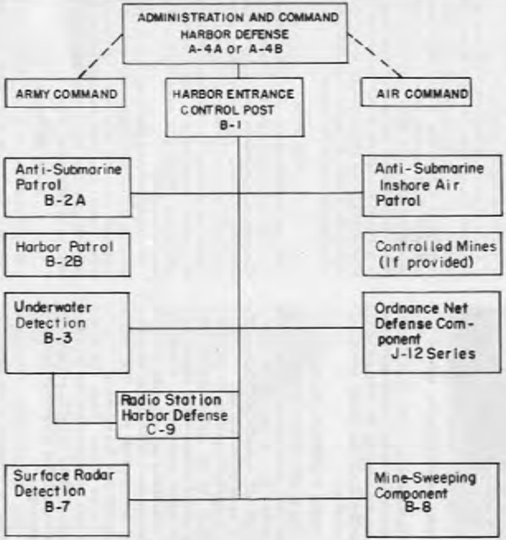
(4) *Motor Torpedo Boat Operating Base.* A base installation for repair and replacement of engines of as many as four squadrons of motor torpedo boats.

(5) *Supply Depot.* A major activity designed for the receipt, storage, and maintenance of material.

(6) *Air Base.* An air installation which provides operating, service, maintenance, and supply facilities for all types of air elements.

### Terrain Features

The topography of the area within and around the base must be considered in any defense plan. Favorable terrain features may be helpful in stopping hostile amphibious, airborne, or overland attacks. Natural obstacles can be utilized to strengthen the defensive position and to increase the effectiveness of field fortification. Land areas should always include any commanding ground adaptable for battle positions and a suitable system of communications. The defensive position which most closely




ORGANIZATION OF ADVANCED BASE HARBORDEFENSE

**Concrete anchors for harbor defense.**

approaches the ideal is one that is sited to permit sharp counterattacks. To fully exploit modern tactics and weapons, the area within the battle position should also contain ground suitable for airstrips.

#### *Forces Available for Defense*

The forces present at the base are naturally one of the chief considerations in formulating a base defense plan. In general, the type of forces which will normally participate in the defense of an advanced base are:

(1) *Regularly Organized Ground Troop Units.* These are the nucleus around which plans for ground defense will be framed. Such plans will include establishment of defensive sectors, organization and occupation of one or more alternate battle positions, and the organization of counterattack plans. The Seabees would normally be in this category..

(2) *Surface Forces.* These will usually comprise light surface elements for local naval defense patrol, mining and mine sweeping, and participation in limited offensive surface action or counterattacks.

(3) *Base Elements.* These will normally include units for operation of the harbor, the base facilities, and the communication forces. Construction forces (Seabees) might fall in this category at a large base supporting a joint operation.

(4) *Air Elements.* These will normally include air components whose primary duty is reconnaissance and contact with the enemy attacking the base, but may include combat planes at the base, or at nearby bases, should heavy attack warrant it.

(5) *Theater Forces, Air, Ground, Surface or Subsurface.* These forces may participate in the base defense only when higher authority believes their use justified.

(6) *Transient Forces Present on the Base.* These forces may be present only for maintenance, or repair, or for movement elsewhere. They will pass to the control of the base commander for employment in the defense when so directed by higher authority.

All the above forces should be integrated into an overall defense plan. The plan should contemplate either an attack where the enemy seeks physical possession of the base or neutralization. Where physical possession is sought the defense plan should deploy personnel to repulse a ground attack by airborne, amphibious, or overland forces; but where neutralization alone is sought the defense should be designed against an attack by surface bombardment, guided missiles, raids, or patrols.

#### *Vital Areas*

Another consideration in the defense plan is the vital area which must be defended. The vital area of an advanced base is that portion containing facilities and installations which must continue in operation if the base is to accomplish its mission. The airfield at Guadalcanal is a prime illustration of a vital area which continued to operate even when the base was under close attack.

At a small advanced base there may be only one vital area of key installations, while at a large base, there may be a number of them. In either event, these important areas must be defined in order that the advanced base defense plan can be built around them.

#### *Zoning the Defense*

The principal function of any defense plan is to preserve the base intact or at worst, to keep damage to a minimum so it will not interfere with the operational support mission of the base. The ideal defense is early detection of an impending attack and destruction of enemy forces at a maximum distance from the base. If this is not possible, enemy forces should be attacked and destroyed during their approach to the base area. If this is unsuccessful, enemy forces should be destroyed during their initial attacks. If an actual landing is made, enemy forces should be destroyed or contained in the landing area.

When the enemy has penetrated to the base, the final step is retention of control over the vital area and denial of its use to the enemy. Vital areas must be denied the enemy for the longest time possible. If it becomes obvious the enemy will occupy vital areas in spite of all defense efforts, then installations of value to him must be destroyed.

### *Timing the Defense*

Time is most important in the defense of an advanced base. The longer the enemy can be repulsed, the better the chances for a successful defense. The time gained permits a more complete counterattack to be prepared, base support missions can continue uninterrupted, and enemy strength will be dissipated and diluted by the continuing action when he cannot make a clear-cut decision.

Timing imposes an additional burden on the commander of the defense. He has the difficult decision of determining the moment when personnel should be diverted from their normal duties of operating the base to their combat roles or tasks directly related to base defense. Accurate intelligence is extremely important in this decision since it is the only means by which the base commander may weigh the enemy's potential for attack on the base. He must maintain a running estimate of the situation to insure that base forces are utilized to the utmost on operational duties before they are diverted to base defense.

### *Isolation*

Advanced bases are insular to a great extent, but even when located on extensive land masses the characteristic of isolation still holds. Advanced bases are self-sufficient communities located at great distances from the homeland and must depend entirely upon the resources present at the moment a crisis appears. In any case, the typical characteristic of isolation limits both the resources available for defense and the flexibility of the defense. Defense forces are closely restricted to the base locality in the event of an attack and the initiative rests with the attacker.

**Temporary radar for base defense is landed on D-day.**

### *Counterattack*

A base defense which proved strong enough to repel all enemy attacks might possibly wait until the attacker had frittered away his strength in futile attempts at penetrating the base and then retired from the area. However, this passive attitude would result in the defense forces being pinned down for a lengthy period with a consequent loss of effectiveness in base operation during that time.

A hard, driving counterattack, properly timed, right after the peak of the attack has passed, offers the defense its greatest chance for victory. At that moment the attacking troops are disorganized, tired, and in some cases bewildered; units have become separated; unit boundaries have been lost; leadership and communications may be non-existent; no time is available for the attackers to prepare defense positions at the objectives they have reached.

Under these circumstances a counterattack is very demoralizing to the attacker and records prove that it is then that the attacker suffers his largest casualties. At that time, an aggressive policy of counterattack becomes the most valuable combat technique which the defense can use.

## *BASE DEFENSE PLAN*

The base defense plan is the instrument with which the base commander formulates his defense of the base. It outlines and coordinates the defense missions of all major subordinate elements of the base command. A defense plan for an advanced base is prepared on the basis that defensive action will be taken to bring the enemy into a situation or position where a decisive counterattack can be mounted.

Applied to the ground forces such a plan will provide for the organization of battle positions, the organization of the ground for the defense against airborne and ground attack and the rehearsal of all applicable counterattack plans, using in each case the largest possible fraction of the available ground forces for participation in the effort.

For the air arm it will mean attack of the enemy at the greatest possible distance from the base along with continuous reconnaissance. For Navy surface forces, it will require that they make continuous security patrols along with such protective measures as mine laying and mine sweeping.

All of the forces on the base will participate, to some degree, in passive defensive measures such as field fortifications, large area smoke screens, dispersion, and camouflage.

Active counterattack defense and passive defense are supplementary to and in extension of the defensive plans of theater, area, and subarea forces. Such operations are coordinated to insure that all available defensive strength is utilized fully.

### *Base Operation Center*

The base defense plan can be made to operate most effectively through a base operation center where a coordinating officer maintains constant liaison with air, sea, and land components. The base commander has available at the base operation center a running picture of conditions to enable him to alter or change the defense at any time. With this arrangement, he can:

(1) Determine the forms of defense to be adopted.

(2) Organize and form components into task groups for defense of the base. This would include the allocation of forces and designation of commands.

(3) Assign planning tasks to subordinate commands.

(4) Prepare and distribute a planning schedule.

(5) Establish liaison between all commanders of the different services involved as an aid to the understanding of common problems.

(6) Request and disseminate intelligence in order to establish a priority on defensive and base operation tasks. Such priority is based on evaluation of means available, the assigned mission, enemy capabilities, and priorities assigned by higher authority.

(7) Initiate, develop, and publish plans for training and for the conduct of defense exercises.

(8) Request support from higher authority based on current estimates of the situation.

(9) Initiate, prepare, and develop logistic plans for base defense. Such plans will necessarily require close integration with logistical plans for base operation.

### *Command Responsibility*

The base command will have definite boundaries and these will be stated in terms of an individual island, a group of islands, an atoll, or a designated area on a land mass. Command follows regular channels. The base commander is responsible to the commander of the next higher echelon. The following components of the base command with their principal functions are responsible to the base commander for base defense:

(1) *Ground Defense Force.* This force is charged with the preparation of defensive installations, maintenance and coordination of ground security, and execution of defensive plans.

(2) *Base Air Command.* This command is responsible for maintenance of air security and consists of such of the following components as may be assigned:

(a) *Strike Command*, which employs light bombers to seek out and destroy hostile attacks en route to the base and to provide close air support for the ground defense force.

(b) *Bomber Command*, which employs long-range bombers to destroy hostile attacks en route to the base.

(c) *Photo Reconnaissance Command*, which executes photo reconnaissance missions, and processes and interprets all photographs obtained.

(d) *Search and Patrol Command*, which maintains continuous reconnaissance,

Standing gun watches after the alert.

antisubmarine patrols, and search and rescue.

(e) *Air Defense Command*, which maintains security of the base against enemy attack from the air by means of fighter aircraft to destroy hostile aircraft and enemy surface craft.

(3) *Naval Local Defense Force.* This force is assigned the general task of preventing enemy surface or subsurface forces from entering the harbors or the harbor-approach waters. Such a force includes forces afloat that patrol, mine, and sweep the waters; and forces ashore that operate detection units and nets and booms.

(4) *Base Antiaircraft Command Forces* assigned this command participate in protection of the vital base installations under the operational control of the air defense command.

(5) *Base Seacoast Artillery Command*, which provides long-range coast defense against the various forms of enemy surface and subsurface attack.

### *COMMAND RELATIONSHIPS*

Command relationships in advanced base defense are complicated by the diversity of the forces which participate in the defense. Following is a consideration of the relationship of the base commander with the defense forces under his command:

#### *Ground Defense Commander*

The base commander will normally assign to the ground defense commander the forces and other means required for the accomplishment of the Ground Defense Mission. The base commander is responsible for approving the plan of ground defense recommended by the ground defense force commander. The plan will include over-all ground security, a ground reconnaissance plan, and construction of defensive works. The base commander will assign other elements of the base command organizations to the ground defense force commander for combat missions when their primary support missions are no longer feasible. In addition, the plan as it affects the responsibility of the ground defense commander will include:

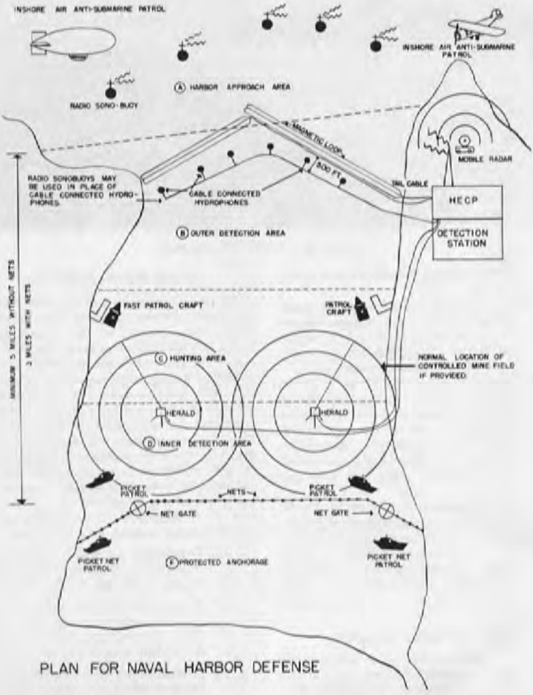
(1) Designation of specific areas to be defended in accordance with the commander's concept of the defense.

(2) Instructions relating to the composition and size of the ground defense force reserve, and conditions under which that reserve will be committed.

(3) General instructions relating to coordination of all ground security measures.

(4) Restrictions on opening of defensive fires.

(5) Coordination of ground antiaircraft




PLAN FOR NAVAL HARBOR DEFENSE

**Navy helicopters are useful for harbor patrol.**

fires and air warning service with the base air command.

(6) Instructions concerning minimum requirements in organization of the ground.

(7) Instructions relating to preparation and rehearsal of counterattack plans and coordination with other elements of the base command.

### *Naval Local Defense Force Commander*

The base commander will define under what circumstances the personnel of this force will come under the operational control of the ground defense force commander for ground defense missions. The plan for this force will include:

(1) Instructions for the conduct of search and rescue plans, including assignment of areas of responsibility.

(2) Coordination of antiaircraft control and air warning service between naval local defense forces afloat and the base air command.

(3) General instructions relating to defensive mining operations and harbor defense.

(4) General instruction relating to offensive operations to be conducted by the naval local defense forces afloat.

(5) General instructions relating to the operation and maintenance of naval defense installations.

### *Base Air Commander*

The operation of all air units actually attached to the base is under the control of the base air commander, subject to the over-all direction of the base commander, who will announce under what conditions certain personnel of the base air command will come under the ground defense force commander. The plan for this force will also include:

(1) Assignment of sectors of responsibility for the execution of local search plans, and minimum requirements for surveillance.

(2) Instructions covering coordination of the control of antiaircraft artillery smoke operations, air warning and fighter defense with the other major units of the defensive organization, and with transient forces.

(3) General instructions relating to conduct of close air support, particularly as relates to coordination with counterattack plans.

(4) Restrictions on the employment of aircraft.

(5) Instructions for operation and maintenance of air installations and facilities.

### *Base Antiaircraft Commander*

This is a major echelon of command next subordinate to the base command and as such the selection of position areas and the task organizations are subject to the approval of the base commander. The operational control of all antiaircraft within the base antiaircraft command should normally be placed under the air defense command for purposes of air defense. Therefore, it is the duty of the base commander to clearly define the exact nature and degree of control to be so exercised by the air defense command, together with such coordinating details as the employment of detection devices, searchlights, and smoke-generation devices. In addition the plan will indicate:

(1) The designation of primary and alternate position areas.

(2) The assignment of secondary missions for the employment of antiaircraft artillery against amphibious or ground attack.

(3) Instructions relating to the employ-

Harbor defense includes sea-rescue work. This pilot is ditching his parachute harness.

ment of antiaircraft artillery personnel in ground defense.

(4) Detailed instructions relating to the protection of vital base installations.

### *Service Elements*

The base defense plan will set forth general instructions relating to the over-all plan of logistical support. It will be supplemented by reference to the appropriate administrative plan, and will include instruction relative to the participation of personnel of service elements in ground defense under the control of the ground defense commander.

## *HARBOR DEFENSE*

While all the organizations and installations for advanced base defense are parts of the same thing, the CEC officer and the Seabees are particularly interested in the study of two special subordinate parts of this problem—harbor defense and ground defense.

"Harbor Defense" means defense of harbor or anchorage areas and their water approaches against attack by submarines or sneak surface craft and small craft transported to the vicinity by submarines.

Full protection against major surface or air attack is not the responsibility of the base commander. Defense against large-scale surface attack from the sea is a responsibility of the fleet commanders. The Air Force and Army are responsible for defense against major air or ground attacks.

### *Probable Forms of Attack*

The most probable forms of attack against advanced bases and their harbors are by:

(1) *Guided missiles* launched from ocean-going submarines. The only limit to their range is the distance through which they can be accurately controlled by their aiming mechanism.

(2) *Mines* placed in the harbor or harbor approaches. The conventional type of mines can be laid by submarines. Torpedo-mines can be fired into the harbor from outside by submarines, small, fast surface craft, or airplanes.

(3) *Sneak craft* penetrating the harbor defense. Some examples of this type of weapon are midget submarines, human torpedoes, and swimming saboteurs. These weapons would usually be transported to the vicinity of the harbor by ocean-going submarines.

### *Harbor Defense Functional Components*

Harbor defense units and installations are part of the functional component system and include all the personnel and material items which are necessary to defend a harbor. The functional components assigned to the duties of harbor defense are the lower numbers of the "B" series and they may be used separately when individual units are needed. The specific components designated for harbor defense are:

*B-1, Harbor Entrance Control Post.*—This is a joint command post for the coordination and joint operation of the Army and Navy elements of the harbor defense system. Its mission is to collect and disseminate information of activities in the defensive sea area, and to take prompt and decisive action to operate the elements of harbor defense in order to deny enemy action within the defensive coastal area. It calls for a Navy complement of 4 officers and 23 enlisted, and an Army complement of 5 officers and 50 men.

This component contains all necessary visual, radio, and office equipment, including a signal tower with signal searchlights and a signal mast, as well as housing and transportation facilities.

*B-2B, Harbor Patrol* (picket boats).—This component furnishes the material and personnel necessary for maintaining continuous patrol of a small harbor. Where large harbors are involved, multiples of this component will be furnished. Repair facilities for picket boats will normally be furnished by local small-boat repair services. This component will be under the direction of the harbor defense officer.

Personal complement is approximately 1 officer and 28 enlisted. Equipment furnished consists of 4 picket boats complete with machine guns and ammunition, depth charges, radios, under-water-sound receivers, navigation gear and infra-red system installed. If the situation of the harbor requires pontoon piers, they are provided on special request.

*B-3 (A to H) Detection Components* (sonobuoys, magnetic loops, heralds).—These components operate and maintain a complete underwater detection system and mobile radar for a harbor. As the amount and type of material and personnel must be separately planned for each specific harbor, the B-3 components are separately assembled and assigned by the CNO when required. A B-3 component may include any one or a combination of heralds, magnetic loops, sonoradio buoys, cable-connected hydrophones, radar, communications and servicing facilities. The specific requirements will depend upon the particular location. Equipment provided, other than specific installations to be made, consists of voice radio communication equipment, housing for equipment, power supply, transportation truck, and buoy boat.

*B-7, Surface Detection Radar* (equipment and operators).—This unit performs surface vessel, low-flying aircraft, and guided-missile detection at advanced bases. Information obtained on surface targets may be utilized in the fire-control system for shore batteries. Where more than one radar-station is required multiples of this component should be requested. When the component is to operate in an area isolated from camp facilities, one N-4B or N-5C must be ordered to accompany each B-7, and be so identified in ordering. This N-4B or N-4C will be marked for the B-7 which it

A sea-rescue team saved these men.

accompanies. These units are available for use with harbor defense components in isolated locations where facilities are not available.

The personnel requirement is 1 officer and 30 enlisted men. The unit includes navigational equipment; radar equipment for one fixed surface search set complete with tower and one mobile surface search set; radio equipment consisting of a TDD, TDX, or equivalent transmitter, RAD or equivalent receiver, and TCS (AC) or equivalent transmitter-receiver; electronic test equipment; electronic spare parts; engine generator set; air compressor, 20 CFM; first-aid kit; shop consumables; office equipment and supplies; operational housing (2 huts); automotive equipment (approximately 2 trucks); and construction supplies.

*B-8, Minesweeping* (boats and crews).—This component is capable of sweeping influence (magnetic, acoustic and pressure types) and moored mines. The equipment is designed for use in small boats. This component is available for use with harbor defense units when necessary. Personnel consists of 1 officer and 1 enlisted.

*J-12, Net Defense* (net installations).—There are three Net Defense Components, J-12A, J-12B, and J-12C. They differ from each other only in the amount of net they maintain and operate. These components contain only the essential materials to maintain and operate a specific net installation but they do not contain the actual net itself. Therefore, the required net along with the necessary number of gate-operating vessels must be requisitioned in the correct quantity for the advanced base. It is typical for these installations to vary considerably from the standard component.

The net components install net defenses by themselves as they do not have the necessary vessels for such work. The work must be done by AN's and AKN's with the small help that the net component can provide.

The relationship of the net defense component to the balance of the base assembly may vary widely depending upon local harbor conditions. Normally, the net defense component is dependent upon the base for general housekeeping services, but it may be located at such a distance from the base as to require independent camping and messing facilities. The best location for this unit is by a dock, but if this is not possible, it must be located by a beach which has a slight incline and no rocks.

### *Tactical Areas*

As a matter of tested and established practice, the harbor defense area is divided into five main tactical zones as follows, the:

(1) Harbor approach area
(2) Outer detection area
(3) Hunting area
(4) Inner detection area
(5) Anchorage area

### *Harbor Approach Area*

The harbor approach area is the outermost of the five tactical zones. At the entrance to this area from the open sea, the responsibility for the safety of inbound shipping passes from the fleet escorts to the advanced base commander. This area is patrolled continuously by surface craft on a 24 hour per day basis and by aircraft during the daylight hours. Detection equipment ordinarily consists of surface-search radar and shipboard sonar, and sonobuoys, occasionally when needed.

### *Outer Detection Area*

The outer detection system is intended to indicate the presence of large bodies, such as submarines, at the outer aproaches to the harbor, preferably far enough to seaward to allow time for counter-offensive patrols to find and destroy an intruder before he can pass through the hunting area. Detection equipment includes an outer loop of magnetic indicators, an inner line of cable-connected listening hydrophones, and surface detection radar. Magnetic equipment will not operate effectively in depths greater than 60 fathoms, consequently a steeply sloping bottom narrows the width of the outer detection area. In such cases, a line of sonobuoys is laid to the seaward of the magnetic detection loops to increase the protection.

### *Hunting Area*

The hunting area is located immediately inboard of the outer detection area, and is that stretch of water in which a hostile vessel is sought out and destroyed. In this area the movements of unfriendly craft are plotted by triangulation in the harbor entrance control post. Constant contact with an invader is maintained by use of heralds (Harbor Echo Ranging and Listening Device). This is a direction instrument which furnishes the data for tracking the movements of underwater craft.

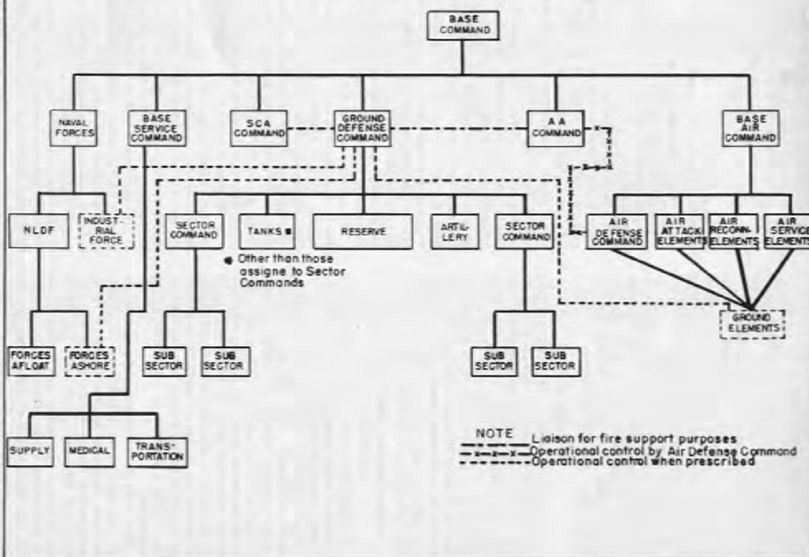
The term "underwater craft" is intentionally used instead of the more limited and common word, "submarine", which immediately evokes a mental picture of a certain type of submersible. Many unique and effective subsurface craft have been developed since the end of World War II and these will undoubtedly be employed in any future conflict.

Fast, heavily armed patrol craft are stationed in the hunting area to seek out and destroy enemy intruders. The location of patrol craft is also plotted, by use of radar, in the harbor entrance control post, and, by means of radio, these craft are directed to the target. From this description, it is evident that the harbor entrance control post performs a function comparable to that of a shipboard combat information center.

It is desirable to sink enemy craft in this zone, since they have not penetrated far enough to do any damage and they present less of a hazard to shipping than if they were sunk in the more constricted portions of the harbor.

Other defenses sometimes used in this area are uncontrolled mines, air patrols, and shore-based searchlights.

ORGANIZATION FOR BASE DEFENSE



### Inner Detection Area

The inner detection area is located between the hunting area and the net lines. The purpose of this zone is detection and destruction of sneak craft which have penetrated the outer defenses. Detection in this area is accomplished by magnetic loops and sonar small-object detectors. Picket boat patrols are used to destroy enemy targets found in this area.

At present, a short-pulse herald is the standard sonar device used for small-object detection. A target as small as a 32-inch mine case at a range of 600 yards can be detected by this herald under favorable conditions.

### Anchorage Area

The anchorage area is the inner, sensitive zone around which the other zones are designed. Fast picket boats continuously patrol this area and are especially armed to deal with small sneak craft or sneak swimmers. These picket boats also lay smoke screens when the anchorage area is under attack by sneak craft or from the air. A short-pulse herald guards the net gate against sneak craft attempting an entry under the stern of a friendly ship.

### Harbor Defense Against Sneak Attack and Guided Missiles

The pattern of harbor defense has undergone a series of radical changes as a result of developments during World Wars I and II.

Prior to World War I, harbor defense systems were traditionally organized for protection against surprise attacks by surface vessels. World War I introduced submarine warfare and broadened harbor defense to include protection against subsurface attack. In World War II, the effectiveness of radar and aircraft practically eliminated the danger of surface-ship attack, and narrowed harbor defense down to where it was chiefly a problem of protection against submarines.

Now, with the development of new weapons and the improvement in techniques for attack, the basic concept of harbor defense is again being revised. Guided missiles can be launched from great distances, conventional mines can be laid in harbor approaches, and torpedo-mines can be fired into harbors from outside. In addition, the effectiveness of sneak craft is only now beginning to be appreciated. The sneak craft of World War II did an outstanding, though unheralded, job of destruction to shipping. These craft will undoubtedly be developed and utilized to a maximum degree in the future. Their value is now well-recognized and we can expect them to be one of the main forms of attack against our harbor defenses.

### Future Harbor Defense Tactics

Defense against sneak attack will be the basic problem according to the current concept of harbor defense.

The greatest difficulties encountered in defense against sneak craft are detection and location. This same trouble is not experienced with submarines or surface ships, for an apparatus capable of detecting small objects will pick up these large craft with ease.

Sneak craft, however, offer uniformly small targets and sneak swimmers are even more difficult to detect. To further complicate matters for the defenders, some of the latest designs of sneak craft travel under water so that no single type of detection instrument is adequate. Magnetic indicator loops are not completely reliable because such small targets have an almost negligible magnetic field. Echo ranging devices give somewhat better results, but performance is far below the standard desired.

The principal reliance for underwater detection is being placed on sonar listening and echo-ranging devices. Shadowgraph and scanning type sonars are both subjects for extensive investigation. Frequency-modulated scanning sonar, in particular, gives greater promise of a completely reliable instrument than any of the other directional listening systems.

In all these investigations a human factor presents another obstacle. Most of the detection devices register on a screen, a dial, a graph, or a phone. Lengthy, intense concentration by the operator is required in order that signals will not be missed. This duty is extremely fatiguing and the burdensome task of watching or listening must be minimized in instrument design.

In the future, the sneak craft will also be supplied with a faster, more powerful "sting", so that defensive weapons used against them will have to be rapid-acting and stronger.

Guided missiles launched from great distances offshore will be a real threat to the base.

Plans for defense against these long range missiles is still in an early tentative stage. Undoubtedly, detection will be an added responsibility for the harbor defense inshore air patrol and the radar components. Installations, from which counter-measures can be taken against the launching platform and the missile itself, will probably be an added component at the base. Counterattacks against these missiles and their launching craft may also be a responsibility of the fleet commanders because of the great over-water distances involved.

### GROUND DEFENSE

The ground defense mission at the base has already been outlined in general terms. However, the CEC officer is more interested in the detailed part that his Seabee Battalion will play than in the comprehensive plan for the base.

The Construction Battalion has been trained for both building and fighting, but is almost never called upon to take part in an offensive. The Seabees may be called upon to organize a defense position, to act as one of the units in a perimeter defense, or to defend a position until relieved by a regular combat unit. Also, since aggressive counterattacks are part of an active defense, Seabees may be called upon to take part in minor offense actions. It is essential that CEC officers be familiar with the basic tactic principles of defense and be thoroughly familiar with the capabilities of the weapons with which the Seabees are equipped in order that they can properly organize a defense.

#### Defense Principles

The governing doctrine for defense assumes that a battle position will be organized and held regardless of cost, and that covering forces will be used to delay and disorganize the enemy attack and to deceive him as to the true location of the battle position.

The Seabees have the infantry mission in defense. This mission is, with the support of other arms, to stop the enemy by fire in front of the battle position, to repel his assault by close combat if he reaches it, and to eject him by counterattack if he enters it.

#### Seabee Combat Organization

The combat or military organization of the Seabee battalion is designed for defensive combat only. This feature is quite evident from an inspection of the accompanying chart on Seabee combat organization, and the type of weapons with which they are equipped.

The Seabee battalion combat organization is composed of a headquarters and service company and four rifle companies as follows:

(1) *Headquarters and Service Company*—The headquarters and service company consists of the intelligence, administrative, planning, technical and supply services for the battalion. The rifle section is equipped with ordnance equipment to defend the battalion headquarters area should the four infantry companies be engaged in combat operations removed from the headquarters.

(2) *Infantry Companies* — The infantry companies are organized from companies A, B, C, and D. Each consists of:

(a) *Company headquarters* — This company headquarters provides all service work behind the line of defense. This includes transportation, preparing and handling of ammunition, assisting in supply of food and water, removal of the wounded, messenger service, etc.

(b) *Weapons platoon*—This platoon is under direct command of the company executive officer and supports the three rifle platoons.

(c) *Three rifle platoons*—Each is organized into three rifle squads and one platoon headquarters. The latter performs functions similar to the company headquarters, on a smaller scale, in direct support of the three rifle platoons.

The companies in the combat organization are made up from personnel assigned from their counterpart in the operational organization. Naturally, the two types of company organization do not match exactly. In some instances, excess personnel from two operational platoons are combined to make up either the headquarters or weapons platoon of their respective company. In combat, as can be seen in the chart, the construction operations officer acts in a staff capacity only. He performs all logistic planning, operation planning, and the collection of intelligence with the assistance of the engineering service section of the headquarters company.

### *Seabee Weapons*

Each individual in the battalion is equipped with a personal weapon which is issued for defensive combat only. The allowance includes a carbine per man together with a standard issue of individual infantry gear. In addition to the carbine, .45 caliber pistols are issued the commanding officer, the executive officer, and each officer of the headquarters staff. Special weapons are issued to equip the weapons platoon and the rifle section of the headquarters company.

At present the small arms and special weapons allowance for the Seabee Battalion is as follows:

| | |
|---|---|
| CARBINE, .30 cal | 1118 |
| GUN, machine, .30 cal | 16 |
| GUN, machine, .50 cal | 8 |
| LAUNCHER, rocket, 3.5 in | 8 |
| LAUNCHER, grenade | 42 |
| PISTOL, .45 cal | 12 |
| PISTOL, Very, signal | 5 |
| RIFLE, automatic, .30 cal | 16 |

All of the above items are furnished complete with mounts, spare parts, accessories, and standard infantry gear. This weapons allowance list is subject to frequent changes with the advent of new or improved models and as new methods or special applications develop in their use. So while this weapons list is valuable as a guide, it may be modified by the theater commander to best meet the needs of the situation.

### *Employment of Weapons*

The .30 caliber machine gun is used to:

(1) Supplement rifle fire of the unit by placing short, concentrated bursts of fire upon grouped hostile personnel at medium or short ranges.

(2) Protect the flanks of the unit and adjacent units.

(3) Engage lightly armored vehicles, such as armored personnel carriers, armored cars, and scout cars.

(4) Lay down fire on a final protective line.

Firing positions occupied by the light machine gun to cover assigned sectors of fire are classified as primary, alternate, and supplementary. The first is the position offering the best conditions for the accomplishment of the mission of the weapon. The second is a position from which the same mission can be accomplished, but located at such a distance from the primary position that the weapon may be moved to it under cover and by hand in the event that heavy fire is directed at the original site. A supplementary position is one from which secondary fire missions can be accomplished which cannot be done from primary or alternate positions.

The orders to the light machine gun squads include the limits of assigned sectors of fire; the direction of the final protective line, if the squad is covering a part of the main line of resistance; instructions when to open and when to withhold fire, and other necessary instructions.

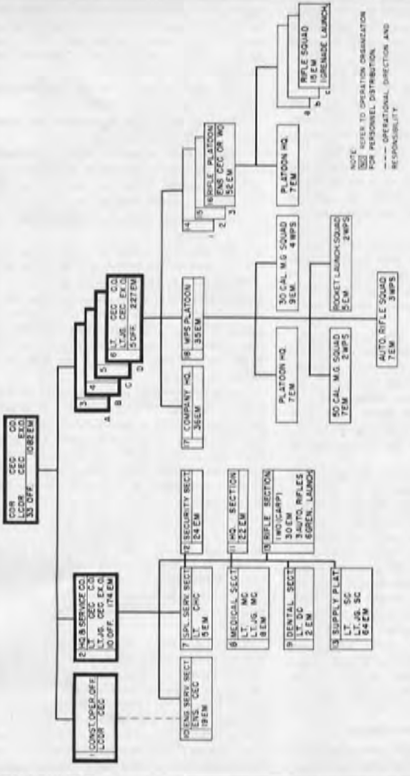
An enemy will search for locations of machine guns and endeavor to knock them out. Use of wet cloth, such as burlap, or dampening the ground beneath the muzzle will aid in reducing dust clouds caused by muzzle blast.

Cover positions are selected for men of the gun crews who are not actively engaged with the enemy. The positions should afford defilade and concealment; they should be located near the firing position and occupied after it is prepared. Sentinels are posted at the primary firing position to warn of hostile approach.

On the defensive, machine guns are usually placed in the combat groups, so as to cover the front and flanks of the position, and also the front, flanks, and rear of adjacent units if possible. Machine guns should be sited so as to deliver interlocking bands of fire along the front of obstacles and to enfilade the enemy when he is held up by the obstacles. Some machine guns should be echeloned in depth in the rear of the firing line where they can deliver flanking fire against hostile elements which penetrate the position and fire through intervals between combat groups.

Light machine guns are usually employed in pairs and both guns are sited to fire as nearly as possible on the same final protective line. The two guns should be placed 30 to 50 yards apart to prevent both guns from being knocked out by a single shell burst.

Fire of all guns on the main line of resistance is withheld until the enemy is within 500 yards. Individual scouts preceding the advance are not remunerative machine gun targets since such fire may reveal the location of the machine




P-1 FUNCTIONAL COMPONENT
U.S. NAVAL CONSTRUCTION BATTALION
ORGANIZATION FOR COMBAT

gun to the enemy. As the enemy closes with the position, guns are fired on their final protective line. Final protective fire may be released on prearranged signal. When final protective fire is called for from the front line, only those machine guns open fire whose final protective lines protect the unit calling for the fire.

In the event of a hostile penetration, machine guns fire on the enemy within their own sector of fire. Guns must not fire outside of these sectors for fear of striking friendly troops.

At night, and whenever they are not firing, the guns are laid on their final protective lines. In case of a raid or night attack, the gunners deliver final protective fire to break up the assault.

The *automatic rifle* provides the squad leader with an easily controlled and maneuverable weapon capable of a large volume of fire. It is used against ground targets in much the same way that the light machine gun is used and it also engages air targets.

The *.50-caliber machine gun* is a dual-purpose weapon designed primarily for use against low-flying aircraft. It is also very effective against ground troops and can stop practically all rolling equipment except tanks. Many instances are known where these guns even stopped light tanks by directing their fire against the side wheels or the thinly-armored rear end of the vehicle.

The *3.5-inch rocket launcher* is, of course, the latest type of bazooka. It is designed primarily for defense against enemy tanks but may on occasion be used as a sort of expedient field artillery. It is particularly valuable for knocking out enemy tanks which have penetrated the defense position. Whenever possible, the rocket launcher operator should endeavor to get a shot at the sides or rear of the tank.

The *grenade launcher* is a weapon of opportunity and can be used against enemy troops' machine gun emplacements, tanks, vehicles, or other worthwhile targets. It is a high-trajectory weapon with characteristics similar to the mortar, and for that reason can be used on targets screened from direct fire.

### *Organization of the Ground*

Organization of the ground is the strengthening of a defensive position by clearing fields of fire, constructing field fortifications, and camouflaging. The sequence in which this work to be executed is expressed in orders in the form of priorities. The assignment of priorities does not prevent simultaneous work on several tasks. After the location of combat sites has been fixed the normal priority is:

(1) Clear fields of fire and remove objects masking observation.

(2) Lay anti-tank mine fields and execute important demolitions.

(3) Provide adequate signal communication and observation systems.

(4) Prepare individual shelters and weapon emplacements.

(5) Prepare obstacles (other than mine fields).

(6) Prepare routes for movement of reserves and for supply and evacuation.

Obstacles are an important element of the defense when they are suitably located and are covered with protective fire. An excellent example of an obstacle is a barbed wire entanglement parallel to, and protected by bands of fire from machine guns located on the flanks of the defensive position.

The simplest form of barbed wire entanglement, requiring minimum time and effort to construct, consists of one or more strands (trip wire) placed 8 or 10 inches above the ground 50 to 100 yards in front of a defensive position. It is most efficient when concealed in tall grass or other vegetation. A 3- to 6-strand wire fence is even more effective.

The "concertina" is a useful form of obstacle on roads or other vehicle channels. They are large coils (about 3-foot diameter) of number 9, 10 or 11 baling wire, and when stretched out across a road they resemble a huge coil spring. If baling wire is not available they can be improvised by wrapping barbed wire around an oil drum.

Concertinas can be piled upon each other like logs to form a more effective barrier and have the advantage of being easily removed to allow our troops access to the blocked channel. They should have booby traps and flares attached as an added nighttime precaution. They bring trucks, light tanks, and other vehicles to a skidding stop by tightly binding wheels and tracks. In addition they cut the tires of wheeled vehicles to pieces.

Protective shelters are needed for tower personnel and other base operating crews.

Steel cable stretched across a road about 4 or 5 feet above ground is useful for cutting the tops off vehicles or the heads off personnel. A steel deflector cable stretched across a road at an angle of about 45° to the centerline is very useful for throwing tanks, trucks or other vehicles into the ditch or over an embankment or bridge abutment.

Obstacles should be outside hand grenade range (50 yards) so that the enemy may not approach close enough to throw grenades. The obstacles should be concealed and constructed at an angle to the position so as not to reveal its location or the location of the machine guns covering the front.

Foxholes constitute the first type of individual cover constructed. If time permits, they may be increased to squad trenches and later widened and deepened to field works. Before the construction of any type of trench or emplacement it must be determined, by taking the prone position, that the position affords an unobstructed field of fire to the front.

Foxholes also provide the best and quickest means of individual protection against bombing or shelling attacks. Men who are reluctant to dig foxholes before their first combat action, become kin to the ground mole thereafter, and dig foxholes with enthusiasm and without any urging.

When selecting and establishing a defense position consideration should be given to the following terrain features:

(1) Observation: the position should be on terrain affording good observation so as to assure ample warning of the enemy's approach or other movements.

(2) Fields of fire: it must be possible to fire on the enemy along the front and flanks at ranges great enough to stop him before he reaches the main line of resistance.

(3) Concealment: concealment from view, both aerial and ground, is important, and is attained by the skillful use of woods, ridges, irregular terrain, and camouflage. A too lavish or extensive use of cover will normally result in limiting the field of fire.

(4) Natural obstacles: unfordable streams and swamps or mountain barriers make movement difficult for the attacker and enable the defender to protect his flanks or to hold part of the front with relatively weak forces. In relying on natural obstacles, however, the Malayan campaign was a lesson which showed that barriers of this nature can often be bypassed by a determined enemy.

### *Perimeter Defense*

Infiltration by the enemy is prevented by all-around protection of every unit, large or small. During daylight, observers are posted within each unit area to keep the ground between these areas under constant surveillance. At night, listening posts are established to cover all trails or other avenues of approach into defense areas.

Dense jungle or woods limit observation and fields of fire to a few yards and necessitate special security measures against infiltration. A perimeter defense provides maximum security against infiltration and should be organized during a prolonged halt, by units in bivouse, by isolated units in a sustained defense and in special situations where normal security measures are inadequate.

This type of protection should be established for units of all sizes from a small group such as a patrol or a squad, up to, but seldom exceeding, a battalion. In daylight the perimeter defense dispositions should be supplemented by listening posts, observation posts, and patrols. Whenever a perimeter defense is to be established by a unit for the coming night, sufficient time for its organization should be allowed prior to darkness. During darkness, all personnel remain within the perimeter except for such prearranged patrols as may be necessary. Men must be cautioned against moving out of their foxholes at night when there is danger of enemy infiltration inside the perimeter. With the foregoing exception, all movement at night is regarded as hostile and is dealt with accordingly. Trip wires located outside the perimeter beyond hand grenade range are connected to booby traps and flares. Two or three-man foxholes provide battle comradeship and permit one man to be alert while the other rests.

As the name implies, the perimeter defense takes the form of a circle. In general, two-thirds of the unit form the perimeter defense while the remaining one-third is disposed toward the center to form a defense in depth. Foxholes on the perimeter are spaced about 5 yards apart. The diameter of a company perimeter is approximately 75 to 80 yards; a battalion perimeter would be proportionately larger. All automatic rifles and machine guns are generally placed on the perimeter; mortars are disposed on the center. The unit commander remains at the center where he may control all portions of the defense.

### *The Defense*

A unit assigned to the defense of an area on the main line of resistance is disposed to cover the assigned front with fire; coordinate its fire with, and mutually support the units on its flanks; afford close rifle protection to the supporting weapons emplaced within its area; and offer resistance in any direction for the protection of its flank and rear. Its subordinate elements are distributed in width and depth so as to be mutually supporting and capable of all-around defense.

The battalion commander assigns frontages to his forward line companies in accordance with the natural defensive strength of the position and relative importance of their defense areas. When a company occupies a vital area having poor observation and poor fields of fire, such as in heavily wooded, broken terrain, its frontage should not exceed 500 yards. Where the terrain is more open and affords longer fields of fire, a frontage of 800 to 1,000 yards may be assigned. The narrower width should be used where strength of force will permit. The defensive area assigned to a company is usually from 200 to 500 yards in depth.

The company defense area is defined by boundaries and by limiting points on the main line of resistance (an imaginary line joining the forward edge of the most advanced organized defense areas). The boundaries indicate the areas of responsibility for each company. All defensive elements and installations of the company are included within its boundaries. Limiting points are points where the several lines in a defensive position cross the unit boundaries. They are used to insure coordination between the adjacent units; are sometimes designated by markers on the ground, and are shown by an encircled "x" on the map, marked "LP."

The company is deployed in three lines:

(1) Local security (line of observation).

(2) Firing line (main line of resistance).

(3) Support line.

These lines should be regarded merely as a convenient way of indicating the forward limit and the depth of the position to be held and of coordinating the defensive arrangements of adjacent units. The lines are not physically occupied by troops along their entire length; the defense plan provides for holding areas or tactical localities whose forward parts lie generally along a given line. Such arrangement affords better protection from enemy fire, provides more concealment, and permits the employment of mutually supporting fires.

Normally, an area organized and held by a company is called a *strong point*. A strong point is always organized for all-around defense if the terrain permits. Obstacles should cover all approaches but should not disclose the position of the defensive works or interfere with maneuver for counterattacks.

The firing line is the forward limit of the battle position and its location is of utmost importance. Its trace is usually along the forward slope of high ground and conforms to the contours. It should be impossible for the attacker to reach this line without passing through the concentrated fire of all defensive weapons. Usually two platoons of a three-platoon company occupy the firing line and each defends a front of from 100 to 250 yards.

The support line is normally established by the remaining platoon of a three-platoon company. The location of support platoons determines the location of the support line. It is usually 150 to 300 yards in the rear of the firing line (main line of resistance). If closer than 150 yards, hostile fire directed at the firing line will strike the support line; if located too far in the rear, the support platoons will not be able to give effective fire support to the forward platoons nor render quick assistance when needed.

The reserve company of a battalion is assigned to defend all or a part of the battalion reserve line, usually located from 300 to 600 yards in the rear of the support line. The method of organizing the reserve line is similar to that described for front line companies. The reserve company is located and disposed so that it will be able to support its own and adjacent front line elements; eject by counterattack all hostile elements that penetrate the position, and coordinate its actions with those of adjacent reserve units. The combat groups of the reserve company are located and disposed along the battalion reserve line so that they will be able to cover intervals between the strong points of front line companies.

Discussion of "lines," such as firing lines or reserve lines, is apt to be misleading. Troops are not distributed thinly along certain lines on the ground. The "lines" are merely imaginary boundaries and outline areas of responsibility. Almost invariably the troops are actually organized within "strong points" which are centers or areas which command the surrounding terrain. This, of course, means that the areas between strong points are not physically occupied. The interlying areas are denied to the attacker, primarily, by fire from the strong points. Counterattacks, roving combat patrols, obstacles, mine fields, or combinations of all of these are other means which prevent the attacker from penetrating the unoccupied areas.

*Conduct of Defense*

During hostile attack preparation fire, personnel occupying front line defense points take cover in their foxholes or emplacements. The hostile attacking force is not engaged by riflemen or other weapons occupying positions in the vicinity of the forward rifle platoons until the enemy is within effective rifle range (500 yards). Observers in each forward defense area keep the foreground under continuous observation.

As hostile attacking forces come within range, they are fired upon by weapons suited for long range fire such as artillery, mortars, and machine guns. Light machine guns may temporarily occupy supplementary positions for such fire in accordance with the battalion defense plan. These supplementary positions must be at least 200 yards ahead or in the rear of the firing line strong points so that the location of forward defenses will not be disclosed prematurely. A covered route to the primary gun positions must be available. Guns occupying supplementary positions are moved to their primary or alternate emplacements prior to arrival of the attacking force within effective rifle range. Light mortars located in the vicinity of the company support area execute fire missions within their effective range. Mortars emplaced in the vicinity of the forward defense areas hold their fire until those areas open fire.

As the hostile attack comes within effective rifle range, all weapons of the forward defense areas open fire on appropriate targets to inflict maximum casualties and stop the hostile attack before it reaches their positions. Requests for supporting fires may be made to artillery or mortar observers or to the battalion commander.

If the attacking elements reach the area covered by planned close-in defensive fire, machine guns shift their fire to the final protective lines and mortars fire on their primary target areas, while riflemen and automatic riflemen increase their rate of fire against the most threatening targets. The enemy is met successively by fire, grenades, and hand-to-hand combat.

If the enemy succeeds in penetrating the position, his advance is resisted by the company support, either by fire from its prepared positions or by counterattack. The decision to counterattack rests with the company comander. To be succesful, a counterattack must be delivered quickly before the enemy has a chance to organize to meet it. In case the company becomes surrounded, the commander makes such redistribution of any supporting weapons in his area as he considers necessary for its continued all-around defense.

### *General*

Here, the endeavor has been to approach to the problem of base defense from the viewpoint of the battalion, and there are several practical features, not previously mentioned, which should be reviewed.

*Communications*—A good system of communications is an essential part of any organized defense position. Communications are the commanding officer's eyes, ears, and nerves, which supply him with information and give him a voice for issuing commands.

Actual battle scenes and conditions are quite different from the common conception. Personnel are close to the ground and out of sight, because individuals exposed to full view don't last long. From a short distance it is often difficult to distinguish between enemy fire and friendly fire. Movements are covered. Thus, the picture of what is transpiring can be very confused unless the commanding officer is receiving regular reports.

For these reasons an adequate system of communication is of the utmost importance in the organization of a battle position, and it must be maintained constantly throughout the action.

*Underground command posts* — Common sense dictates all possible protection for command posts. They are the central control points and the concentration of activities at these places makes them particularly susceptible to destruction. If they are disabled or wiped out the operation may lose all direction.

In almost all situations underground command posts should be provided. Not only does such an installation eliminate most of the danger of sudden destruction by a single bomb or shell-burst, but also does away with the distracting noise and confusion accompanying the battle. In the security of such a shelter it is possible to better evaluate incoming information and to make decisions more deliberately.

*Repair of battle damage*—Battle damage to roads, airfields, and equipment should be repaired as soon as possible after it occurs. Seabees are particularly well-qualified for this work by inclination and experience. The outstanding job they did under fire on the airfield at Guadalcanal exemplifies the type of action which can be taken. If it is not possible to make repairs during combat, then they should be undertaken immediately after the action ceases or even in the lulls between attacks.

Even though your unit may be engaged in a furious combat action, its primary mission is still support of the main operation. If it is possible, some of your forces should be diverted to repair work. If they are all so heavily involved in combat that repair work is not possible, then they should begin repair of battle damage at the first opportunity. Keeping airstrips usable for plane operation, and keeping roads open for the movement of troops, guns, and supplies is the best assurance that the battle will be decided in our favor.

# CHAPTER VI
# DISASTER DEFENSE

ASSESSMENT AND CONTROL of disaster damage is new to advanced base planning. Before the atomic bomb the possibility of disaster at an advanced base was almost ignored. Disaster, both natural and man-made, has occurred in the past in crowded and vitally important communities. For example, there were artificial disasters such as the bombing of London and the bombing and fire storm at Hamburg. Also, there were natural disasters such as the typhoon which hit Okinawa and the storm during the landings in Normandy.

But catastrophes of this nature occur at such infrequent intervals that it has not been economical to consider them in advance plans. To do so would be like taking elaborate precautions against the small chance of being struck by lightning. Nor was it advisable to complicate an already intricate problem with improbable factors. There has usually been an alerting period when the personnel involved could get set for the blow..

With the development of the atom bomb as a practical weapon all this has changed. Disaster is now a real possibility and must be considered. It can strike at any time with little or no warning.

Popular feeling concerning the atom bomb has had a tendency to swing from one extreme to the other. Reaction has ranged from a feeling of helpless horror to a conviction that defense against atomic destruction need be no more elaborate than that set up against any other artificial disaster. Common sense, however, dictates a more reasonable attitude.

It is useless to minimize the power of an atomic bomb by comparing it to an earthquake or any other natural catastrophe. Natural forces are spread over a wide area, while an atomic attack may be confined to a small base or industrial center. The important thing to remember is that intelligent planning can reduce raidological destruction. Nuclear scientists are agreed that an adequate defense against atomic attack is possible.

### Disaster Analysis

Disaster analysis must consider calamities other than atomic attacks. In general, they are less intense than radiological warfare and have been taken into consideration in base organization. So, for practical purposes, any defense taken against the greater devastation wrought by an atomic bomb aimed at the base, will also be suffificient to cope with the lesser damage resulting from other types of disaster.

Disaster control at an advanced base cannot be compared with a peacetime emergency in a civilized area, so far as ability to weather effects is concerned. In a civilized area in peacetime, evacuation may be possible before the event and, in some areas, heavy construction may afford some protection. When disaster strikes, the surrounding fire-fighting equipment rushes to the area, doctors and police go into action, government agencies establish control or send aid, and churches and charitable organizations offer assistance. The scene of disaster is the focal point of help from the entire nation.

The situation at an advanced base in wartime is quite different in that the installation must rely entirely upon its own resources. Relief is not apt to be at hand. The continued usefulness of the base will be paramount and depends entirely upon the adequacy of the disaster defense plan and the skill of the base personnel in carrying it out.

To begin with, the base may be located in unfriendly territory. It cannot be temporarily evacuated and its fragile construction makes it liable to complete destruction. Some of the problems are very difficult. For example, quick medical care and hospital facilities for the injured will not be waiting just across a county line. They must be provided in advance. Similarly,

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Atomic bomb disaster at Hiroshima.

such elementary needs as food, clothing and emergency housing must be planned and furnished *before* and not after the A-bomb strikes.

It is impossible to picture disaster in anything but a depressing light. However, there is a bright side and that is that most advanced bases are not normally worthwhile targets for an atom bomb. It has been variously estimated that communities of 25,000 to 100,000 are the minimum personnel concentrations upon which the atom bomb may be used economically. While it is quite conceivable that a large logistic support area might contain the required minimum of people, they would be fanned out from the beachhead for so many miles that they would not present an attractive target from the standpoint of human casualties alone. If materials and facilities are properly distributed the base will be that much less attractive as a target. For this reason the small, the isolated, or even the medium-sized base is not likely to be attacked with the atom bomb in its present scarce and expensive stage. There may be exceptions to this line of reasoning where an advanced base is of extremely high strategic or tactical value. But at most advanced bases there will be little danger of radiological attack and, where the danger does exist, proper dispersion can minimize it.

### *The Atomic Weapon*

Although any discussion of A-bomb attacks is necessarily conjecture, the effects of atomic detonation have definite limits and can be outlined.

As a basis for calculating the effects of an atomic bomb, we must assume some definite size; that is, a known energy output. The standard currently used is an atom bomb approximately equal in energy to those dropped over Japan. It is assumed that this hypothetical bomb releases an amount of energy roughly equivalent to 20,000 tons (20 kilotons) of TNT, and it is called the "nominal" atomic bomb.

On the basis of this "nominal" atomic bomb the type and extent of damage effects have been predicted. Without going into the technical details of cause and effect, the practical phases and ranges of damage can be listed.

There may be some doubt or criticism of the wisdom of limiting damage calculations to the effects of a nominal atomic bomb. However, this practical approach deals with conditions which *now* exist in regard to atomic explosions and does not base our planning on some unknown condition which *may* exist in the future.

The hydrogen, or "H-bomb", has not been developed as yet and therefore will not be considered in our discussion. Again to quote a leader in this field of investigation—"the hydrogen bomb now lies somewhere between the bounds of possibility and probability."

There is one way in which the power of the atomic bomb may possibly be increased. That is by increasing the efficiency of the present atomic bomb, since it uses only a fraction of the fissionable material of which it is composed. However, if a greater efficiency should be attained (for example, a bomb with an energy equivalent to 100,000 tons of TNT), our present data and estimates will still be of value because they are set up in such a fashion as will permit scaling up or down to fit the conditions.

Also, in the following, we will be concerned chiefly with an air burst at an altitude of 1,500 to 2,000 feet, since this is the type of explosion which results in the greatest and most widespread damage. And the shock wave produced in the air burst of an atomic bomb is the agent that produces the greatest destruction. Other characteristics such as heat, visible radiations, neutrons, gamma rays, and fission products do not together, produce as much damage as blast effect.

There are special applications in the possible use of an atomic weapon, such as exploding it on the ground or water surface, or shallow subsurface, to produce radioactive contamination. Or an earthquake shock or water shock might be produced by a deep subsurface explosion. However, the atomic bomb is not likely to be used in this manner against an advanced base.

Most of the damage effects of the atomic bomb are exactly the same as those caused by high explosive bombs and differ only in magnitude. But there is an important difference between the effects of an atomic bomb blast and those of a conventional high explosive bomb. The tremendous power of the atomic bomb results in a destruction feature called "mass distortion of buildings". An ordinary explosion will usually damage only part of a large structure, but the atomic blast can engulf and flatten whole buildings. Also, because the shock wave of an atomic explosion is of relatively long duration—about one second as compared with a few thousandths of a second for a conventional bomb—most structural failures occur during a small part of the positive phase of blast pressure.

### *CASUALTIES*

Naturally, most people are concerned with the bodily harm that can result from an atomic attack. There are three major effects of an atom bomb—blast, heat and radioactivity. Of the three, radioactivity is the most feared but least dangerous. On the basis of the atom bomb blasts at Hiroshima and Nagasaki, and subsequent tests, it has been estimated that in an air burst, the blast wave is responsible for 50 to 60 percent of the deaths, the heat-flash for 20 to 30 percent, and radioactivity for 15 to 20 percent.

For the unfortunate individual who is right under the bomb or close to ground zero, there is practically no hope. In fact, within one-half mile of the center of the explosion the chance of escape is only about one out of ten. And this does not mean one out of ten fully-exposed individuals. The one-tenth who may escape in this area are people who, through accident or by means of the shelter provided by strong protective structures, were shielded from the blast.

From one-half mile to one mile away, you have a 50-50 chance of survival. This is perhaps the most important area since it is here that the individual's own actions may determine whether he lives or dies.

In the area stretching from one mile to 1½ miles out, the odds that the individual will be killed are only 15 in 100.

At points from 1½ to 2 miles away, only two or three people of each 100 will be killed.

Beyond two miles, practically no deaths at all will result from the explosion.

#### *Radioactive Injury*

Radiation is responsible for an appreciable amount of injury, but has been greatly overrated in this respect by the average person. Various types of radiation emission take place during and after an atomic explosion, the more important being alpha particles, beta particles, gamma rays, and neutrons. Of these the gamma rays, which are similar to X-rays, are by far the most damaging to human beings. They are the critical radiation which must be assessed in plotting radiation damage and in planning protection.

To place radiation upon a calculable basis it is measured in terms of a unit called the roentgen (R). It is usually accepted that a dose of 400 R of radiation over the whole body in the course of a few minutes represents the median lethal dose that would be fatal to about 50 percent of the people exposed. The median lethal range of the gamma radiation from a nominal atomic bomb is about 4,200 feet.

A large proportion of the individuals within 4,200 feet (3,700 feet from the ground zero) of an atomic explosion who are exposed to the initial gamma rays will die from radiation sickness. These rays are very penetrating. So much so that ordinary clothing offers no protection. However, if part of the body is protected by a suitable shield, even a larger dose than 400 R will not prove fatal.

At less than 2,100 feet (about ground zero) from the explosion, blast and heat destruction are so severe in unprotected regions that radiological injury does not need to be considered. At a distance of 2,100 feet from the explosion the dosage of gamma rays would be 10,000 R. To reduce this below the median lethal dose of 400 R would require 20 inches of concrete or 30 inches of soil, but this protection would probably not stand up under blast at that range.

At distances greater than 3,000 feet (about 2,250 from ground zero) from the explosion, 20 inches of packed soil or 12 inches of concrete will reduce the dosage below the median lethal value.

At distances greater than 9,000 feet (about 8,800 feet from ground zero) radiation dosage is too small to have any serious consequences unless it is repeated at short intervals.

The distance of 3,700 feet from ground zero has been given as the maximum range at which a person would receive a median lethal dose of 400 R, but this it not so absolute as it may appear. It is based on the supposition that the exposure lasts during the entire first minute of the period of initial radiation. At this distance, only about one-half of the gamma ray dosage is received during the first second. That is why the individual's immediate action may be so important in preserving his life. Even though he may be within 3,700 feet of ground zero, if he obtains shelter within a few seconds after the explosion he may prevent the accumulation of a fatal dose of radiation.

Alpha and beta particle radioactivity are short range and present no danger in the initial period of radiation. They can be dangerous in the lingering radioactivity which may result from some atomic explosions, since they are a form of secondary radioactivity which may be ingested or may be contacted in dust or mist.

Neutron emission is another form of initial radiation which presents no particular danger. Most of the neutrons do not reach the ground surface. Where they do the blast and heat are so intense that neutron emission would not be the critical factor in determining survival.

Other forms of radiation are emitted in an atomic explosion but are either in the class of interesting attendant phenomena or hazardous only in special circumstances. A more detailed study of this radiation may be made by referring to the appropriate chapters of "Postwar Development," NavDocks P-31.

### *MATERIAL DAMAGE*

Structural, facility, equipment and supply damage resulting from an atomic explosion are much more difficult to analyze than personnel damage. With personnel it is possible to figure effects on average individuals at definite ranges. Material items are so diverse and effects so varied that it is possible to give only general estimates.

To begin with, you are all probably familiar with the structure, facility, and equipment damage which occurred at Hiroshima and Nagasaki. However, these instances are not too good a guide since the temporary structures used at an advanced base are very flimsy according to the ordinary standards of civilian construction.

Again, a good picture of the destruction wrought by an atomic bomb may be derived by reference to "Postwar Developments," NavDocks P-31. Here, only some very broad generalizations will be made so that the requirements for protection to be incorporated in advanced base plans can be visualized.

Within about one-half mile of ground zero there will be total destruction much the same

Pearl Harbor — Enemy attack can also cause disaster.

as would be experienced by a civilian community in similar circumstances.

In the area beginning at a distance of about one-half mile from ground zero and extending outward to a distance of about 2 miles, the destruction at an advanced base will probably be much more pronounced than in a comparable civilian community. In this area, in a civilian center, there are many fire-resistant, permanent types of structures which will show progressively less damage as you move outward. At an advanced base practically all structures are relatively weak, temporary types with small resistance to blast and heat.

Therefore, you may expect to find all advanced base structures damaged beyond repair for a distance of one mile from ground zero, and possibly as far as 1½ miles out.

Damage from 1 to 1½ miles out will be, at the very least, extremely heavy. With some exceptions, most advanced base structures will suffer complete collapse in this area.

In the area extending from 1½ to 2 miles out structural damage will vary from heavy to serious, but there will be some usable structures remaining.

Beyond the 2-mile limit, damage will be slight unless some special circumstance, such as a terrain feature, reflects or concentrates the force of the explosion upon structures at a point farther out.

In this era of almost complete mechanization there is another type damage which should be singled out and evaluated—vehicle damage. Trucks, jeeps, carriers and other vehicles within a distance of about one mile from ground zero will be destroyed or damaged so that it will not be feasible to repair them. In the area from 1 to 1½ miles out many vehicles will be salvageable. Beyond a point 1½ miles out most vehicles may be made to operate immediately or can be made operable with only minor repairs.

The damage described here will be caused by the *combined* effects of an atomic explosion, but the chief agents of physical destruction will be blast and heat.

### *PROTECTION PLANNING*

The foregoing portion of this chapter has presented only a very brief and condensed picture of disaster conditions resulting from an atomic bomb attack upon an advanced base. Only those features which are of paramount importance in planning disaster defense have been described. For instance, a general summation of expected personnel injury has been given but no detail has been presented regarding the various types and the seriousness of burn injuries. Where particular details are of importance in planning advanced base disaster defense they will be elaborated upon in the following.

#### *Base Layout*

Advanced base layout is probably the most important factor in minimizing the effects of an atomic attack. But it is not simple. In planning base layout there are, presently, three principal means of defense—dispersion, duplication, and protective construction. It is conceivable that any of these three methods could be developed to the point where atomic attack would be nullified. However, none of these methods alone is the final answer. A balanced combination of all will probably give sufficient protection until a better and more radical means of defense is developed.

Dispersion would seem to be a good form of defense because it requires so little in the way of additional materials. However, it has some major disadvantages, and in some cases local conditions prevent its full use. If carried too far, it reduces the centralized control exercised by the command; spreads communications over a wide area; increases transportation distances and requirements; and distributes supplies to many small stockpiles when they might be handled more efficiently if concentrated.

Complete duplication would take too much time, labor, and materials. A policy of procuring, shipping, assembling, and constructing two entire bases where only one was needed would soon drain the country of its essential materials.

Protective construction also has its disadvantages. An enormous amount of heavy construction materials would be required to provide adequate defense shelters for most of the base installations. The time and labor required would also be far beyond reasonable limits. In fact, substantially complete defense by means of protective construction might easily require a total effort exceeding that expended in accomplishing the primary support mission of the base.

In planning a base layout it is evident that some calculated risks must be taken. Gambler's chances cannot be completely avoided. But disaster defense measures must be carefully balanced and the choice, whether it be dispersion, duplication, or protective construction for a specific installation, must divert a minimum of effort from the primary mission.

Disaster control planning should begin at theater level and should emphasize the special equipment requirements. The normal allowances of equipment on hand at the advanced base will certainly be inadequate in the event of a disaster. Appraisal of the base should be made in anticipation of atomic attack, and early requests for disaster relief equipment should be included with the requests for base components.

It may be that the strategic importance of the base will not justify the cost of relief equipment. Also, it may happen that the disaster is so intense as to physically obliterate the base, or damage and contaminate the area so heavily that, in the judgment of the theater command, the facilities are unrecoverable. These are additional reasons why disaster control planning should begin at theater level.

The location of an advanced base will have a considerable influence on its vulnerability. If located on flat terrain it will absorb the full effect of the atomic explosion. If located on rolling or hilly terrain the effectiveness of blast damage is reduced by the shielding afforded.

Local features may be of utmost importance in disaster defense. For example, if caves exist, or if cave shelters can be developed, they offer the ideal form of protection against any type of attack. Where ravines or other terrain peculiarities are nearby, advantage should be taken of the protection they afford.

The value of foxholes and slit trenches should not be forgotten. They offer the best type of easily accessible personnel protection yet devised, and they can be prepared in a very short time with a minimum of labor.

The shape of the base layout also affects its vulnerability. A circular area is most vulnerable to atomic attack and a long narrow area is most vulnerable to high explosive or incendiary.

Segregation of facilities is another important point in base layout. It is obvious that all facilities of one type should not be located together. But even when the tentative dispersion has been made on the ground it should still be tested by checking the effect of probable bombing patterns. This will lessen chances of a facility being totally destroyed during an attack.

Also, it should be remembered that the aim of the attacker will often be faulty and therefore ground zero may not be at the location you select. This condition will militate in favor of the base during an attack, but will affect your planning and necessitate the testing of several possible "hits" in addition to the original, most pessimistic selection.

Waterfront disaster damage at Nagasaki.

It is reasonable to assume that everything within a radius of about one-half mile (or 3,000 feet) from ground zero will be totally destroyed; that is, will be economically unrecoverable. It is beyond this 3,000-foot distance that general protective measures should be taken.

Fires result from an atom bombing, consequently, special attention must be given to firebreaks, segregation of explosives, inflammables, and stockpiles in laying out an advanced base.

### *FACILITIES*

Generalizations have been made but a better approach, perhaps, would be to review briefly the essential facilities and summarize the protective measures for them.

#### *Base Utilities*

Electric power and water are the two base utilities most vulnerable to any type of disaster. Both communication and medical facilities are dependent upon them, although both can operate without them in an emergency. The reestablishment of electric power can be more quickly accomplished than can the repair of a severe blow to a water system. However, sensitive electrical installations, such as generators and transformers should be dispersed as widely as possible. These items should be included among the additional gear requested to implement the disaster defense plan. Nothing much can be done to protect electric power lines, but there should be a sufficient supply of wire and fittings with the disaster gear to replace equipment.

A base water supply system is subject principally to physical destruction and contamination during attack. If the base is dependent on a central water supply either of these two types of damage can produce serious effects requiring extensive repair. Emergency supplies of water, with adequate stand-by transportation, should be planned for in the event of a disaster.

#### *Communications*

In an average advanced base layout, defensive communications such as radar and radio should be located in an isolated area to reduce their vulnerability in a disaster. Wherever possible, communication facilities should be widely separated so that emergency service can be continued even with a high percentage of general disaster damage. If all communications are disabled a first-priority must be given to reestablishment of defensive communications. All communication areas should be supplied with emergency stand-by power as base utilities may be seriously or totally disabled by a disaster.

#### *Medical*

Advanced base disaster planning must provide for numerous widely-separated medical centers. All base medical facilities must be designed so that they can readily be changed

At Okinawa a typhoon caused disaster.

to combat medical stations. These emergency medical facilities might have to operate for a protracted period since they would provide the only medical care available. Careful planning and stockpiling of emergency supplies are essential.

Casualties in an atomic bombing attack will be heavy. Contemplated fatalities have already been listed with their causes, on a percentage basis. Percentages for the various types of injuries resulting from an atomic explosion are quite different and are of great importance because it is on these figures that plans for personnel rescue and repair are based.

It is estimated that 50 to 60 percent of the surviving personnel within the base area might suffer from burns. This is not an unreasonable estimate since near the center of burst, flash burns from radiant heat are often fatal, while serious burns may occur more than a mile away. In addition, many people suffer from flame burns due to fires started by the explosion.

Wounds, fractures and crushing injuries would comprise about 15 percent of the casualties, most of them resulting from the physical destruction wrought by the blast wave.

About 15 percent of the casualties would be severe shock cases resulting from wounds, burns, or combined injuries.

Another 15 percent, approximately, would be suffering from radiation illness.

Included in the casualties listed above would be many suffering from two or more kinds of injury.

One bright spot in this dismal picture would be the low incidence of blindness as a result of the atomic explosion. Even those at Hiroshima and Nagasaki who looked directly at the explosion from some distance suffered only temporary loss of vision. Eventual recovery was complete.

Immediate medical aid is of extreme importance in an atomic disaster. Competent medical authorities estimate that first aid and emergency field hospitals are far more important during the critical first six hours after the injury than elaborate medical care later. A large percentage of casualties are burn and shock cases which require immediate treatment. For example, even a healthy young soldier suffering from severe shock from wounds cannot survive for more than about eighteen hours unless he receives transfusions and treatment. His best chance for recovery is during the first six hours. His chances diminish rapidly thereafter.

Because such a great percentage of casualties are burn and shock cases requiring transfusions, whole blood and blood plasma are key medical supplies. They must be considered in disaster planning and stockpiled in sufficient quantities at strategic locations from which they may be rapidly distributed. Medical supplies for treating burn injuries will still be extremely critical items, even though in a slightly less important category than blood products. They should be similarly stockpiled.

Non-medical personnel at the base must be trained in giving transfusions, treating burns and other first aid measures. Human lives will depend upon this training.

In connection with shock cases the U. S. Public Health Service has announced a valuable emergency treatment when blood plasma is not available. It is recommended that one teaspoonful of salt and one-half teaspoonful of baking soda be dissolved in a quart of water and the solution be given to the shock victim orally. Some patients may require up to ten quarts a day. While this treatment is not offered as a substitute for blood transfusions it could be of great benefit in a disaster.

### *Storage and Supply*

Disaster relief for this facility will be the only occasion in which supply for the base takes precedence over the primary support mission. Housing, clothing, and rations must be provided for base personnel in the stricken area, and widely separated caches of these items should be placed at strategic points *before* a disaster strikes.

Principal disaster relief measures for storage and supply facilities will probably be fire-fighting and decontamination. Structural damage can and should be handled on an emergency basis. The area is usually concentrated, centrally located, and adjacent to harbor facilities, so that disaster relief for this area will be concurrent with airfield and harbor rehabilitation. Storage and supply facilities will be especially vulnerable to fire and water damage, but must be considered in the low-priority group.

### *Airfield and Harbor*

The relief planning for airfield and harbor areas depends upon the physical layout and operational function of the advanced base. Both are susceptible to physical destruction, fire, and contamination, in that order. Emergency repairs of other facilities should be kept to a minimum until these areas are in normal operation. Both are basically essential in performance of the primary mission of the base and most of the construction work should be devoted to placing them in operation again. In other words, they have a high priority as regards relief construction.

### *Ordnance and Petroleum Storage*

Ordnance and petroleum storage facilities are usually separated from other base installations because of the fire and explosion hazards inherent in them. Segregation of these facilities reduces their vulnerability to disaster. Because of this segregation, fire-fighting equipment should be a part of the original installations. These supplies require specialized fire-fighting equipment which must always be available in a stand-by status. It also enables ordnance or petroleum fires to be fought independently of structural base fires.

Petroleum facilities are of such great bulk, and form such a large percentage of supply,

**Storm damage to "mulberry units" at Normandy.**

that it is neither feasible nor economical to disperse them too greatly. Neither is duplication practiced to any great extent. With the development of improved underground storage tanks petroleum may be protected by proper cover and some dispersion. Ordnance supplies may be safeguarded in much the same manner if the terrain permits, since they lend themselves better to dispersion. However, they may also be protected by proper separation.

### EQUIPMENT

Presumably an advanced base is well equipped for rehabilitation since it has been built with its equipment on the site. The decision as to whether the base should be reconstructed, abandoned, moved to a new location, or disposed of otherwise, rests with the theater commander. Our problem is concerned with the immediate needs of disaster defense and relief.

#### Detection and Warning Devices

Radar and sonar instruments and patrols, as we have said, will be the chief devices for detection of an impending attack. In the interval between the initial warning and the actual attack personnel can seek shelter and take measures to ready equipment and protect valuable gear. By detecting an impending raid with a device such as a radio signal system that interval can be lengthened. Also, warning devices such as wailing sirens can act as valuable accessories in alerting an advanced base.

#### Fire and Clearance

The first consideration after a disaster is to limit further destruction. After an atomic attack, additional damage will result mainly from the fires started directly by radiant heat or indirectly by other means. Therefore, fire-fighting equipment is mandatory. However, it must be mobile and permit use by individuals as well as groups. Tank farms and ordnance storage structures have their own fire-fighting equipment.

Fire fighters will be dependent on construction crews and clearance equipment to move debris, clear access roads, and create firebreaks. Therefore, the plan for fire control should contemplate the use of bulldozers, tractors, truck cranes, and trucks, as well as such small tools as axes, shovels, wrecking bars, and power saws. Demolition may be necessary for both fire control and clearance, and the tasks involved may require explosives, shaped charges, oxyacetylene equipment, compressors and air tools. Basic equipment has been listed, but the exact nature and amount will depend upon the physical characteristics of the base.

#### Monitoring Equipment

Monitoring of the surrounding regions, especially those downwind, from an atomic explosion should begin immediately after the detonation for the guidance of rescue and fire-fighter teams. This will, of course, require special radiation detection instruments and trained teams. The teams should also be equipped with walkie-talkie radios so that data on radiation intensities can be transmitted immediately.

Monitoring of radioactive areas should first be carried out by low-flying aircraft or helicopters. However, as soon as practicable, the detection ground teams should move toward the center of the blast area until they reach a point where the radiation becomes quite dangerous (perhaps 50R/hour) and mark the point with a warning sign. Then the team should move outward until it reaches a point where the radiation reduces to moderately dangerous (perhaps 30R/hour) and place a warning sign. By placing successive points as they progress around the blasted region, the radiation detection teams could delineate the entire area which is hazardous for individuals.

After this operation the radiation teams and equipment can be used for searching out and marking isolated "islands" of radioactivity.

The chief types of relief equipment and their methods of employment have been briefly reviewed. It must be emphasized however, that while there may be a sufficient quantity of clearance and construction equipment on hand, there will never be enough other equipment of the type needed by the fire fighters and the medical corps. These services must have their equipment augmented from standby stocks, which must be planned, and provided before the emergency.

### RELIEF ORGANIZATION

The success of the disaster relief plan for the base will depend upon the state of preparedness, which in turn depends upon special equipment,

Wreckage hurled ashore at Normandy.

training, and organization. Equipment needs have already been enumerated. Training and organization will be related to and influenced strongly by the characteristics of the base. Organization, because it supplies control and direction, will be of paramount importance in relief planning.

There are two primary steps in the development of a disaster relief organization: training and a survey of conditions at the site. The survey includes a study of the base layout; its vulnerability—both in part and in whole; its functions; utilities; personnel, their duties, responsibilities and abilities; and the relief equipment available.

On the basis of this survey a course of action must be outlined to establish priority requirements. Several factors will influence the scheduling of priorities. As an illustration, a disaster relief plan assigns high priority to the utilities. Also, the schedule must be sufficiently flexible to meet conditions. For example, the commanding officer must plan to use the station and the key personnel for assisting in disaster relief work. After the problem has been assessed and a course of action determined, the manpower and equipment requirements must be outlined.

The staff portion of the disaster relief organization is standard. Under the commanding officer there will be a disaster relief or operations officer. The commanding officer will have a staff composed of those in charge of the various base facilities — communications, medical, public works, supply, and operations. Only through planning at a staff level can proper consideration and coordination of the many facets of the problem be assured. Superficially, it might appear that this is solely a public works and medical problem, but a disaster affects the entire life of a base and requires extra effort from all of its members.

### *Control*

Disorganization, panic or hysteria can convert relatively light damage into a disaster of major proportions. So the most important measure in a disaster is control, and the first mission of the base disaster relief organization is to establish this control.

As soon as control has been established, utilities must be placed in operation. These include communications, power, light, water, sewage disposal, and emergency provision for personnel. While this appears as a sequence of operations it is more apt to happen concurrently, since communications, for example, may form part of control.

From the relief viewpoint, water, rations, clothing, housing and medical care are paramount. Stand-by supplies, equipment, and fuel to meet the minimum subsistence requirements of personnel furnishes the best relief service in an emergency.

Such supplies should be stored in a remote protected area. In lieu of this, multiplicity and dispersion of operating units throughout the area is best. In this phase of disaster relief planning, stress should be laid on the necessity for additional equipment.

Repair of utilities is slow and sometimes impossible after a real disaster. For a comprehensive picture of how the organization operates, a review of the responsibilities of the various key functions is necessary. While the listing which follows is in a somewhat chronological order, all relief operations are somewhat concurrent.

### *Providing Communications*

Providing communications is of vital importance because it is the first step in the establishment of control. All decisions depend upon the information received by the communications system.

Any survey of communication facilities should include an estimate of personnel requirements for maintaining contact with the affected area and the means of obtaining information. Communications will be required between the disaster relief command and the next echelon above us well as with subordinate units such as fire and emergency repair squads, rescue teams, security guard, and other mobile units.

This staff section within the organization must see that facilities are provided for the repair and maintenance of communications and that equipment is available for emergency installations.

### *Determining Extent of Damage*

Reconnaissance reports (in this case, damage reports) should include exact details as regards the extent of structural damage; whether fires are raging and their location; whether radiological contamination is present and where it exists; and any other information necessary to give the command a clear picture of the destructive elements that are causing damage. Damage reports to headquarters should include the specific locations for each type of destructive agent and the extent of the hazard at the time of report. Specialized teams will not be formed to do each type of reconnaissance since the responsibility for reporting will rest with individual disaster relief units.

### *Monitoring and Guarding*

Monitoring for lingering radioactivity has already been described. Monitors should be on the alert constantly to detect any changes in the limits established and to place warning signs to indicate its danger clearly.

After damage has been taken care of and danger zones have been determined, the exact limits of work areas must be established and marked. Access to, and egress from these areas must be controlled to facilitate the work of the disaster relief organization and prevent interference by unauthorized personnel.

In addition to monitor guards, there must be a police system to properly control disaster relief activities. The police system controls the routes by which traffic concerned with disaster relief gains access to the area affected, guards exposed classified material, and maintains order in the base area.

### *Access To Damaged Areas*

Personnel actually carrying on the work of damage control will usually be divided into the following groups:

1. Fire-fighting squads.
2. General demolition, rescue, and repair squads.
3. Support groups handling specialized equipment such as heavy construction equipment, transportation, and material.
4. Relief groups providing medical supply, and other personnel facilities.

The composition and organization of these groups will be outlined in the disaster defense plan and will depend upon personnel available and relief requirements.

### *Fire-Fighting*

The first type of fire-fighting unit is the fire squad, which is made up of personnel trained along the lines of the existing fire departments. They are assisted, as required, by the second type, the repair squad.

### *Rescue and Repair*

Rescue of trapped or injured personnel is carried out by teams equipped and trained for rescue, demolition, repair and salvage work. Where fire is involved, the repair squads will be assisted by the fire squads in rescue of personnel.

Storm damage at Normandy was a real disaster.

Emergency first aid (and decontamination) centers will be set up along the perimeters of the damaged and dangerous areas. These centers should be established in accessible spots.

The repair squad is the basic unit for rescue work, emergency repair, emergency operation of facilities, and decontamination. Personnel with a sufficient diversity of skills are assigned to each squad to permit it to operate under varied conditions. It is an all-purpose unit relatively small in size but equipped and staffed to be self-sufficient and flexible. Each squad has direct communication with the disaster control center. Where tasks are too big for one squad, additional squads will be ordered in support by the control center and will function under the over-all direction of a designated squad leader. Support in the form of heavy construction equipment, trucks, and other vehicles, and repair materials will be furnished by special "Support Groups" on orders from the control center and upon the request of the squad leader.

### *Support*

The supply of available heavy construction and transportation equipment is not unlimited. Therefore, it must be assigned on a priority basis. Normally, such equipment will not be assigned permanently to any squad, but will be retained in a pool and dispatched on the order of the control center to the squads requiring it most urgently. This procedure will permit the control center to evaluate the relative priority of requests from its knowledge of the over-all situation.

The primary function of the "Support Group" is to furnish active support to the operating units of the disaster relief organization. The operating units are equipped with basic and essential items only. Supply support groups will provide operating units with other standard equipment such as lumber, steel beams, and construction material, as they are needed. In order that this group may be ready for instant action in a sudden emergency, the needed additional equipment will be maintained under the custody of the supply officer but must be instantly available for delivery. This group will also furnish logistic support in the form of food, clothing, and other emergency issue.

### *Planning by Staff*

The advance planning accomplished by the staff group must be assembled finally as a disaster control plan which will include the mission, the scope of operations, the duties and responsibilities of key personnel and their groups, and integration of the problem with the area. Because of the urgency for immediate action during an emergency, success or failure depends on this plan.

On the basis of this plan, the station complement is assigned in groups to the various relief tasks, and these groups are balanced in accordance with emergency demands. Rescue and evacuation would be of paramount importance at a continental station where personnel concentration is high. An advanced base complement is small and composed of active workers, so that evacuation would be much less important, except in the case of total disaster. Fur-

The atomic bomb disaster is still the worst.

ther, with adequate preparedness the personnel injuries resulting from an atomic attack could be kept to a minimum at an advanced base.

A possible breakdown of duties would be the assignment of the headquarters company to all problems related to planning, development of precautionary measures, monitoring, policing, command-field communications, and such duties. Then the base could be sectionalized and the field companies assigned to various areas. The field companies could be broken down into demolition groups, heavy-equipment groups, and other specialized groups. Another possibility would be the establishment of 15 to 20 general-purpose groups to handle small subdivisions of the original partitioned area. How this is accomplished would vary with local conditions. As long as the personnel are trained and drilled in their duties and adequate equipment is available, the plan and organization will have the greatest chance of effecting a rapid and successful recovery of the base.

### *Plans for the Moment*

The important points of advance planning for protection against the effects of an atomic explosion at a forward base have been covered in general: Any planning or organization, in detail, must be fitted to local conditions.

In the event you are caught in an atomic attack it is hoped that some preparatory defense measures have been taken. But whether they have or not, you will be in a terrific hurry and will want to know what to do at the moment—your life may depend upon instant action.

First—Blast and heat are the two greatest dangers, the same as with the detonation of high explosives. The things that protect you from blast and heat will protect you from radioactivity. If there are a few seconds of warning or no warning, dive into, under, or behind some shelter. Buried or semi-buried shelters are best but foxholes or trenches are also excellent.

Any shelter may save your life, so dive behind a bank, into a ditch or interpose anything possible between yourself and the explosion. If there is absolutely no shelter available within a few seconds of time, drop flat on the ground and cover your eyes and bare skin areas. This will protect to some degree against flash burns, prevent you from being thrown about, and lessen the chances of being struck by flying fragments. These are exactly the same protective measures the individual takes against high explosives. Assuming that the atomic explosion is an air burst, stay in your sheltered position for at least 90 seconds after the burst.

Second—Don't get panicky and try to rush away after the explosion has passed. If you are within a mile of ground zero, move outward and away from the center of the explosion. Help any injured individuals—they can't become so radioactive as to injure you, and radioactivity is not contagious.

Report to a field medical center for radiological checkup and decontamination if you were in close to the burst, or if you have other injuries. After clearance, report to your assigned disaster control station for fire-fighting, rescue or other duty.

If you were a mile or more away from ground zero and are uninjured, report to your disaster control station immediately.

Third—Lingering radioactivity is a danger which can be avoided by proper care. If you have been in a heavily contaminated area you may have picked up a dangerous amount of it. However, clothing acts as a "trap" for it, so by changing your clothing and scrubbing your body, you can remove it. After a scrubbing, have your body metered by a radiological defense man. By repeated scrubbings of the body with soap and water (paying particular attention to hair, nails and body crevices) you can remove practically all of it and easily reduce it below the danger level.

***Summary***

The subject of disaster at an advanced base is so broad in scope that details of plans and organization can only be prepared for specific cases. Here broad outlines have been given.

The official government publication *The Effects of Atomic Weapons* is currently the best publication from which to obtain basic data that can be used in preparing plans, organization and other phases of defense. At present much investigation is being carried on, particularly to develop structures that are resistant to atomic blast.

The casualties at Hiroshima and Nagasaki would have been less if the inhabitants of those two cities had known and put into practice nothing more than the defense measures we know today. So the picture of atomic warfare is not without hope. We *can* build a defense.

## CHAPTER VII

# HARBORS & DRYDOCKS

THE HARBORS AND DRYDOCKS dealt with here will not be those regularly used by the Navy or civilians during peacetime. When the Navy moves into a foreign port during wartime it can be assumed that berthing and cargo-handling facilities will, in many cases, be damaged. The extent of cleanup and repair work will depend on the military situation at the moment and local site surveys.

There is no starting point for theoretically estimating requirements or damage and no typical situation to cover all cases. For example, it would be useless to explain the rebuilding and repair of gantry cranes since all ports do not have them.

As in World War II, the Navy depends upon the well-known ability and ingenuity of the CEC officer and Seabee to repair salvageable facilities in the shortest possible time. Those installations which are vital to the support of the operation will be rebuilt first, and other repair work will follow in the order of its importance to the primary mission. Some facilities are never put back into operation.

This chapter, therefore, will confine itself to those military harbor structures and techniques most likely to be encountered. CEC officers and Seabees however, will normally have little or no contact with them in civilian life.

### PONTOON GEAR

The Navy steel "cube" or pontoon was one of the "miracles" of World War II. It had such a myriad of uses that the complete story of its

A spud pierhead and British built Whale" bridges at Normandy

"Whale" bridges leading out to spud pierhead.

many applications will never be told. It contributed immeasurably to high-speed construction and will probably find further use in a future conflict.

Official terminology has designated these basic units "N.L." pontoons, since the assemblies which they form are "Navy-Lightered" (N.L.) structures. However, they are commonly referred to simply as "pontoons."

Pontoon units are essentially hollow steel boxes tested to withstand an internal pressure of 25 pounds per square inch and an external pressure equivalent to a depth of 28 feet of water. However, it is the ingenious fastenings employed and the special applications of various assemblies that make them so outstanding. The pontoons are of two types; the rectangular T6, with deck dimensions of five feet by seven feet and depth of five feet; and the curved-bottom T7, with deck dimensions of seven feet by seven feet and depth of five feet and with the bottom curved up to the deck at one end. The T7 is chiefly used for the bow units on pontoon barges, but both types meet identical structural requirements, and the deck will support the heaviest wheel loads for which civil highway bridges are normally designed.

Seabees assemble pontoon string in the Arctic.

### *Use of Pontoons*

Pontoons in parallel strings have been widely used as cargo barges, tugs, causeways, finger piers, wharves, seaplane land slips, floating drydocks, camels in ship-berthing projects, bridges, and other structures. Single units have also been used as tanks for water, fuel oil, lubricating oil, sprinklers, shower tanks, and a multitude of other purposes.

## *PONTOON FABRICATION & FITTINGS*

During fabrication, each corner of a pontoon is cut off at an angle and a corner strap is then welded into place. This strap is provided with the holes required for the attachment of the parts and fittings used in making connections. To the inside of each strap is welded a nut to take the assembly bolt and a triangular wedge guide for the insertion of the pontoon corner connections. The corner connection is the assembly of wedge, bolt, and hand wheel nut used to secure pontoons to assembly angles. A steel assembly bolt is used to attach the pontoons to the angles. One bolt is used at each corner of the pontoon and passes through the angle

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**Pontoon strings being stored at an advance base.**

and into the nut welded to each corner strap.

Assembly angles are structural steel angles used to connect pontoons into strings. These angles are cut into lengths suitable for securing a definite number of pontoons. They come already perforated by bolt holes, and link and pin holes, and have wedge bars welded to them. Some are provided with couplings at one or both ends for attaching long strings. The link is a specially designed fitting used in conjunction with a link pin to fasten together the adjacent angles of two strings of pontoons. The wedge bar is a device welded to the assembly angles at regular intervals and is fitted with a mandrel or lug over which the wedge bolt of the corner connection fits. It also serves the secondary purpose of maintaining proper pontoon spacing in the string.

Closure pieces consisting of planks or channels are designed to close the openings between pontoons in a string. The three general kinds are deck closures, bottom closures and side closures.

### *Pontoon Strength*

A pontoon string is constructed from a row of pontoons joined by means of four long assembly angles. These angles, up to 105 feet in length, are sufficiently strong to distribute the load to a number of pontoons, and to carry the stress developed by the submersion of a string due to a load applied at its center. On test, individual strings of 11 pontoons, acting as a bridge supported at the ends, carried between 50 and 60 tons at the center, plus 25 to 30 tons near the end. Two 12-pontoon strings secured side by side and supported at the ends are strong enough to carry a 10-ton vehicle.

The pontoon strings are stiff in torsion and structures assembled from them are highly rigid. On test, a string of pontoons supported at 3 corners and carrying 20 tons live load at the center dropped only slightly more than 2 inches at the unsupported corner.

A corner connection is designed to carry the full load eitner on the assembly bolt or on the wedge. A corner with a broken bolt or a missing wedge does not therefore reduce the working strength of the structure so long as one of them alone remains. In some assemblies bolts may be safely omitted if the wedges are all in place.

Pontoon causeway sections, approximately 177 feet long (2 x 30 string—2 pontoons wide and 30 pontoons long) are intentionally of the lightest construction that can reasonably be used for craft of such a length. Severe sea conditions may overstress them or even cause them to break in two. While this has happened in only a few cases, the limitations of the structure should be recognized and it should be reinforced when the stress is going to be unusually severe.

## *PONTOON ASSEMBLIES*

Pontoons are used for the many structures already mentioned and, because of their versatility, new structures are being developed. In making up a pontoon structure the first step is to assemble pontoons into "strings" and launch them. The strings are attached to each other in parallel rows while afloat to form the

**Two pontoon barges with loading ramps and outboard propulsion units.**

kind and size of assembly desired. The manner of assembly is much the same in all cases.

Barges and other structures are described by the number of strings and the number of pontoons in the strings composing the assembly. For example a 3 x 7 barge is three strings wide and seven pontoons long. The pontoon gear is shipped with the kits of tools needed and the number and assortment of parts to make the specified pontoon structure. All barges come equipped with curved (T7) pontoons at both ends of a string, while strings for other pontoon structures may be made up entirely of rectangular (T6) pontoons.

*Barges*

There are three standard sizes of barges, the 3 x 7, 4 x 12 and 6 x 18, with capacities of 50 tons, 100 tons, and 250 tons respectively. Barge assemblies of other proportions up to 7 x 30 may be made for special uses; however, the limiting width is generally seven pontoons. Barges are shipped without propulsion units unless self-propelled barges are requested.

The barges, up to 6 x 18 (250 tons) are designed to carry a load at the center point heavy enough to bring the deck awash. For larger structures, a longitudinal distribution of the maximum load that the barge can float is required over not less than the center 6 pontoons of a 24-long floating structure, of over at least the center 12 pontoons of a 30-long floating structure.

Fenders should be installed on all pontoon barges and pontoon tugs to prevent the puncturing of the pontoons. One or more propulsion units may be placed at either end of a barge and they will also accommodate inboard propulsion units.

The barge may be fitted with a 30-ton capacity ramp for the loading and landing of vehicles onto the beach, or special pontoons may be used to give it a built-in ramp. The special pontoons which provide a built-in ramp are about equal in length to a three-pontoon extension at the bow of the barge. While normal bow pontoons curve upward from the bottom of the barge, the special ramp pontoons slope downward from the deck for about a two-pontoon width. At the forward end, the special pontoon section is fitted with a pair of hinged ramps, each about equal in length to a one pontoon width. These can be thrown forward (similar to the action of a trap door) so that the free end rests on the beach and gives a continuous ramp from the deck to the beach. The ramp is cleated transversely to strengthen the pontoons, distribute the wheel loads, and give vehicles better traction. The built-in ramp construction has proved useful during amphibious operations since it eliminates the space necessary for ramp stowage during the cruise, saves the time necessary to install a ramp, and is ready for use immediately after launching.

**Outboard propulsion unit with screw cranked up at low tide.**

Barges are used chiefly for transporting material from cargo ships to the beach. Other uses are as crane barges at transfer points just off a reef or beyond the surf line, floating dumps for fuel or ammunition, floating casualty stations, and floating repair shops. Small barges are usually transported to the harbor on the sides of LST's, four on each ship.

An outstanding type of special-use barge is the 6 x 30—the famous "Rhino Barge" of the Normandy landings. It has a rated capacity of 500 tons (approximately 80 vehicles). Because of its large cargo-carrying capacity, the 6 x 30 is particularly well adapted for offshore unloading of cargo from all types of ships. The stern is fitted to accommodate the LST ramp for unloading vehicles onto the beach. Normally, this barge is self-propelled, by two outboard propulsion units. For practical field use it should be noted that a Rhino Barge and an LST cannot be successfully joined in swells greater than three or four feet in height.

Seabees put finishing touches on fuel barge.

*Crane or Transfer Barge*

The crane or transfer barge is a 4 x 12, ramped-end, pontoon assembly, equipped with a propulsion unit and mounting a 10-ton capacity crawler-type crane. The mission of this unit is to transfer loads from other pontoon barges or boats to DUKW's or LVT's, where the other barges or boats have been beached due to rough water, or where the depth of water over the reef is so shallow that it will not allow them to reach the beach.

The transfer barge is anchored off the beach beyond the surf line or at the outer edge of the reef. This arrangement expedites the delivery of the cargo to the storage dumps with a minimum amount of handling when trucks and cranes are at a premium since it eliminates long trips by DUKW's or LVT's to the ships being unloaded. It eliminates the necessity of beaching pontoon barges for the unloading operation with the attendant risk of their being breached or damaged.

*Tank Barges*

Fuel barges have proved very satisfactory in landing operations and after the assault phase. A 3 x 7 barge with an outboard propulsion unit is used for this type of work. It is usually manned by Seabee personnel and the deck is loaded with 50-gallon drums of fuel.

The use of this barge, located at a safe distance offshore and flanking the beaching slots, greatly reduces the confusion around ships being unloaded and establishes a convenient refueling point between ship and shore.

The 2,000-barrel tank barge is a 6 x 18 with three 1,000-barrel vertical cylinder oil tanks secured to the deck. However, to maintain stability, it is not safe to fill these tanks to more than two-thirds of their capacity. The tanks are located in a line with their centers on the longitudinal center line of the barge. They are spaced about 29 feet apart, center to center, the end ones being a little less than 25 feet from the bow or stern, so that the center of each tank lies over a slot between pontoons. This puts the center of a tank over the fourth, ninth, and fourteenth slots of the barge. Piping, valves, and two pumps are furnished to complete the assembly. Outboard propulsion units may be attached at either end if necessary.

*Gate Vessel*

The hull structure for the gate vessel is a standard 4 x 12 pontoon barge without propulsion units. The main superstructure of the vessel is a 20-foot x 24-foot steel arch rib hut which is mounted on a platform 2 feet above the deck. A double drum hoist and fairleads are mounted on deck for use in handling the net gates. A 24-inch searchlight is mounted on a searchlight tower which has a 6 feet by 6 feet square deck erected 12 feet above the main deck.

*Storage Barge*

The 9 x 12 storage barge is an exception to the general rule that pontoon assemblies should not be more than seven pontoons wide. This special-purpose barge is made up entirely of the rectangular (T6) pontoons, and consists of nine strings of twelve pontoons. It is held by assembly angles tied together at the deck with links and pins and at the bilge with heavy tie rods. This results in a sturdy pontoon structure with a deck area of 64 feet by 138 feet.

Three steel arch rib huts 40 feet by 48 feet are mounted on the deck with their axes perpendicular to the longitudinal axis of the barge. These huts are sections of the standard 40 feet by 100 feet arch rib utility building. The barge provides for a considerable amount of covered storage that can be conveniently sited in situations where other storage space is not available.

### *Ice Breaker or General Utility Barge*

This is a 2 x 7 pontoon assembly which permits the attachment of an outboard propulsion unit at either end.

The weight of the propulsion unit gives a trim down by the stern and the scow type bow allows the forward end of the barge to climb onto the ice. The weight of the barge, the propulsion thrust, and the cutting effect of the bilge angles combine to break the ice. In breaking ice twelve inches thick, it has been found effective at times to swing the propellor through an arc of 100 degrees, 50 degrees to starboard and 50 degrees to port. This produces a mobile side-to-side list which gives a rolling action. When the barge becomes icebound the propulsion unit may be turned 180 degrees from its normal position and by using the maximum propulsive force, the barge can be backed down. The jam may then be broken by reversing the propellor to its normal position and again running forward.

**Fully equipped gate vessel.**

### *Tugboats*

Until quite recently, tugboat assemblies of 5-7-5 and 7-12-7 were the common standard. However, there have been many changes (particularly in tugboat design) and a 2-5-2 assembly with two inboard propulsion units is the tugboat currently used. The 2-5-2 tugboat is made of one 1 x 5 string, consisting of three T6 pontoons with a T7 pontoon on each end, and flanked on both sides by one T7 pontoon and one inboard propulsion unit. The tug has side and bottom closures and side and bow fenders. Suitable bitts, cleats, and chocks are installed as required.

The 2-5-2 tugboat also is undergoing changes since the use of compartmented gasoline en-

**Warping tug in heavy surf.**

Cleated, built-in ramps being secured.

gines is now frowned upon in the Navy because of their inherent hazards. In the postwar period there has been at least one fatality and a number of bad burn cases due to gasoline fumes and leakage in the compartment of the inboard propulsion unit. The trend on all pontoon structures is toward the use of outboard propulsion units and these engines are being modified and improved.

### *Pontoon Warping Tug*

The 7-12-7 pontoon warping tug was developed for use in connection with the floating of stranded barges and other craft, and for tug service where a line pull greater than that which can be obtained by the use of propellers alone is required. This assembly has been replaced by a 3 x 12 pontoon warping tug fitted for LST side-carry with an outboard propulsion unit stern mounted 3 feet 7 inches off center during operations and shifted 3 feet 7 inches further outboard during LST side-carry. It is equipped with a double-drum Skagit winch amidships and with a 3,000-pound light weight type anchor at the bow. A wire tow cable from one of the winch drums is passed astern under a guide spool aft of the winch. The wire rope cable from the other drum winch is led through a fairlead at the bow and secured to the anchor. An A-frame is mounted at the bow for securing the anchor when not in use.

*Method of Operation.* The tug approaches the stranded craft until it is a distance from it no greater than the combined lengths of the two cables on the tug. The tug is then headed seaward, stopped and the bow anchor let go. The tug is then backed toward the stranded craft and the anchor chain paid out to the bitter end. A messenger line is passed to the stranded craft and with it the tow cable is hauled to the craft and made fast. The winch is then used to take a strain on either the anchor or the tow line. Since maximum pull is developed on an empty drum, the initial strain is taken on the drum having the least wire. Additional thrust may be obtained by using the propulsion unit of the tug.

### *Net Tending Barge*

The net tending barge is a 10-12-12-10 unit which consists of two 1 x 12 strings flanked by two 1 x 10 strings with two inboard propulsion units. The principal superstructure on this barge is a crawler crane with a 30-foot boom reinforced to handle 7 tons at a 15-foot radius. Other equipment mounted on the deck for net handling operations are a 24-inch sheave block, fairleads, auxiliary hoist and fittings such as bitts, pad eyes, cleats, and fenders.

As with other pontoon structures, the net tending barge is being redesigned for outboard propulsion units and the deck equipment and fittings are being modified and improved.

### *Pontoon Bridge Units*

The pontoon bridge can be used to span a stretch of water or swampy ground for the movement of troops or supplies, but is most frequently used at advanced bases for connecting pontoon wharf units with the shore. A pontoon bridge may be made to any desired length by fastening a number of bridge units or barge units end to end by means of cable suspenders. There are two standard bridge units, the 2 x 12 and the 2 x 6 assemblies.

The shore approach to the bridge may be made by sinking and filling with water a single pontoon string parallel to the beach, placing earth fill behind it, and attaching it to the bridge by a bridge-to-wharf connection. Or one end of the bridge unit may be beached and secured to the shore by cables attached to anchors, deadmen, or posts driven into the ground.

Liberty ship ties up to pontoon docks.

An earth fill approach made with a bulldozer may suffice. Timber cribbing and riprap will make a fill more permanent. The standard ramp, of course, may be used in many cases.

### *Causeway Section*

The so-called pontoon causeway consists of two 2 x 30 sections and is used to bridge the gap between LST's and the shore in landing operations. It was such an outstanding success when employed for landing operations that it has been treated more carefully in the chapter dealing with amphibious operations.

## *WHARVES*

The two most commonly used sizes of wharves are the 5 x 12 (36 feet x 70 feet) and 7 x 60 (50 feet x 350 feet).

The 7 x 60 wharf is generally moored in water deep enough to bring cargo vessels alongside, and it is connected to the shore by means of pontoon bridges. A number of different bridging arrangements are possible using the accessories supplied with each wharf unit. Each method makes use of standard 2 x 12 pontoon bridge assemblies attached to the wharf at one end and to a 1 x 3 pontoon string filled with water at the inshore end.

Bridges may be connected to the side of the wharf or to its end. End connections are made through the use of hinges or the bridge-to-bridge connection. Cable moorings are used to anchor the wharf and connecting bridges to the shore.

Cargo ships docking alongside the wharf do not moor directly to the wharf but to several inshore and offshore anchorages. At one end the mooring is located out from the offshore side of the wharf, on a line making a 45-degree angle with the offshore side. The offshore anchorage at the other end of the wharf must be provided by the ship's own two anchors, one of which is placed normal to the offshore side of the wharf and the second out from and on the longitudinal center line of the ship extended. Shore anchorages are improvised from materials found on the site.

## *FLOATING DRYDOCKS*

Floating pontoon drydocks consist principally of a main wharf-like deck and vertical side towers. They may be submerged by admitting a controlled amount of water to the deck pontoons and raised by expelling the water with compressed air. The tower pontoons act as stabilizers.

Operation is from the deck of a tender barge attached to the drydock by means of a ramp or walkway. On the tender are compressors, an air-manifold, and control valves. Hoses lead from it to pipe mains along the sides of the drydock and pipe or hose connections are made from the mains to each deck pontoon. Catwalks are provided between the tower pontoons to facilitate handling of lines during the docking of a ship while the drydock is submerged.

An adjustable boat cradle is attached to the deck of the smaller drydocks to accommodate

Seaplane enters pontoon slip.

various sizes and shapes of boat hulls. In some cases a special cradle may have to be made up to fit a hull which cannot be handled by the regular cradle.

On many occasions it has been necessary to drydock vessels by using pontoon drydocks whose lifting capacity was less than the weight of the ship. Such situations have been handled by lifting one end of the ship at a time. When a pontoon drydock is used in this fashion the opposite end of the ship trails in the water and the dock has a trim downward towards the loaded end.

Normally, pontoon drydock capacities range from 100 tons (4 x 15) to 800 tons (30 x 12).

### *Seaplane Drydock*

A seaplane drydock was developed during the latter part of World War II to provide drydock and repair facilities for naval aircraft at advanced bases. Its use was limited, but postwar improvements are continuing and have developed this pontoon structure to such a degree that it will provide a very efficient facility for handling present and future types of Navy seaplanes.

The problems of seaplane drydocking are unusual and the methods for solving them are unique. For example, sleeve pontoon towers were developed in order to provide clearance between the bottom of the plane wings and the top of the towers while the plane is docked. There are no catwalks between towers on a seaplane drydock.

An additional feature, not common to other types of drydocks, is the tow and outrigger used for controlling the plane when entering or when afloat in the seaplane drydock. This is a trolley beam running longitudinally along the center of the deck on which a trolley operates. The trolley is fastened to an endless cable powered by a windlass on the tender barge. By attaching the plane to the trolley it can be hauled aboard after the dock is submerged.

### *Floating Cranes*

Floating crane rigs can be erected either by lashing the crane to the deck of pontoon barges or by mounting it on a special frame fastened to the deck.

Five-, ten-, and twenty-ton cranes are the sizes and weight lifting capacities usually employed.

Normally the 5-ton crane is mounted on a 3 x 7 barge, the 10-ton on a 4 x 7 barge, and the 20-ton on a 5 x 12 barge.

### *75-Ton Fixed Boom Crane*

The 75-ton capacity fixed boom is normally the largest crane employed at advanced bases, and it is designed to be mounted on a 6 x 18 pontoon barge. The boom is shipped as loose structural shapes and boxed small parts and may be assembled and erected on the deck of its pontoon barge without the aid of large weight lifting equipment.

Detailed description of this crane at this point would be useless, since currently it is being modified radically. The present trend is towards a greater weight lifting capacity, per-

Pontoon seaplane berth tests water jets.

Seaplane being lowered to pontoon propulsion barge for repairs.

haps up to 100 tons, and increased mobility. However, these design changes will remain within the advanced base concept. That is, it will still be erected on a pontoon barge from materials and parts available at the advanced base.

### PROPULSION UNITS

The outboard type of propulsion unit is favored for pontoon assemblies. During the greater part of World War II the units were powered with gasoline engines. Since the war development of the units powered by Diesel engines has taken place and in the future Diesel engines will be used.

Floating pontoon drydock accommodating vessel.

For limited specific requirements such as the net-tending barge and tug the inboard propulsion unit has been used but will be replaced with outboard units. The gasoline-driven inboard units were particularly hazardous in view of the confinement of the engine within the pontoon cell. Diesel engines will replace gasoline in the future although only one Diesel inboard unit has been constructed so far for use as a test model.

While complete Diesel replacement of gasoline engines, both inboard and outboard, is contemplated a sudden emergency may compel the CEC officer to work with the older type of propulsion unit. Therefore, it is deemed worthwhile to outline the general methods for installing these units.

#### *Installation of the Outboard Unit*

Outboard propulsion units have been designed especially for use on pontoon barges but may be readily attached to a barge of any size. While many fabricators have furnished units which vary greatly in appearance, their method of attachment to a barge is standard. Although one unit is usually sufficient to give satisfactory

Empty floating drydock.

operation, two or more units may be used with larger assemblies. Should two outboard units be used on a barge they should be separated by at least two pontoons as they have a tendency to destroy each other's efficiency if placed closer.

### *Installation of the Inboard Unit*

The decision to install an inboard propulsion unit must be made before the barge is assembled. This is because the unit will take the place of one of the stern pontoons of the barge, which must be completely assembled without the stern pontoon. The string may be launched and attached in the usual way to the other strings to make the assembly.

When the barge is completely assembled, the propulsion unit is lowered into position. Pipe stays are dropped through the lugs on the face of the unit and lined up so as to drop into the holes provided for them in the angle. Then the deck brackets of the unit are brought to bear on the adjacent deck angles of the barge, the bolt holes are lined up, and the bolts screwed in tight.

## *STANDARD LANDING RAMPS*

Standard ramps have been developed for use with pontoon barges for landing heavy rolling equipment on beaches and are also useful in making shore-to-bridge connections for permanent or semipermanent bridge and wharf installations.

Two sizes were developed during World War II, the 30-ton ramp and the 60-ton ramp. The 60-ton ramp is no longer standard but the 30-ton ramp is still employed for regular use. Both types are joined to the bow of the barge (or bridge) with standard hinges. Lugs are provided on the free end of the 30-ton ramp so that it may be connected readily to other pontoon structures. The ramps may be raised or lowered by means of 3-part topping lines from the nose of the ramp to small hand winches mounted on small stiff-leg frames located on both forward corners of the barge.

### *Pontoon Buoy*

A pontoon buoy is manufactured, but its design is so simple that it can readily be constructed in the field. A hole is burned in the middle of the deck plate and the middle of the bottom plate and a 2½-inch steel rod inserted through the two holes. The rod is welded into place at these holes. A ⅝-inch plate 24 inches in diameter with a hole in the center is slipped over the deck end of the rod and welded to the bottom plate. A swivel for each end of the rod is made of a $1\frac{3}{4}$-inch plate 12 inches in diameter with a $2\frac{1}{2}$-inch U-shaped rod welded to it. The center rod is threaded at both ends and the swivels are attached with nuts. A simpler attachment is a 4-inch diameter, $1\frac{3}{4}$-inch washer welded to each end of the rod instead of the nuts. A fender, one foot down from the deck and supported on clip angles welded to the sides of the pontoon, and a pipe rail on deck complete the buoy.

***Repair***

Repair and servicing of pontoon barges and propulsion units should be provided during the assault phase of an operation. Plans must include a method of transporting spare parts, tools, welding machine, batteries and the like, together with facilities for maintenance and repair after the target area has been reached and the barges put into operation. Repair and servicing facilities can be furnished by assigning a particular repair ship for this duty, by designating a pontoon barge as a repair barge, or by landing a repair truck and other equipment capable of accomplishing the necessary repairs.

***Transportation of Barges***

Pontoon barges and pontoon structures are usually transported by LST's. The pontoon assemblies are fitted with a continuous hinge bar that rests in the continuous shelf on the side of the LST. They may be loaded either by crane or by the special pontoon lifting gear.

**Floating drydock on its side.**

The pontoon barge units assigned for an amphibious operation are usually self-propelled, each having an outboard propulsion unit mounted on the stern. It is necessary to offset the propulsion unit from the center of the barge because of the side-carry method of transportation. Pontoon barges with propulsion units attached may be loaded onto and launched from the deck of the LST. Five 2 x 7, five 3 x 7, or

**Floating drydock being towed through Panama Canal.**

A typical floating pontoon drydock.

three 4 x 7 barges may be carried at one time on the main deck. However, since the side-carry method has been developed, the deck loading and launching method is seldom used on an amphibious operation.

### *Pontoon Assembly Depots Overseas*

In the fall of 1942 the Bureau of Yards and Docks realized that large quantities of pontoons would be needed for barges, piers, floating drydocks, and wharf assemblies in the offensive then being planned. Many ships would be required just for pontoon gear and much shipping space could be saved for other supplies if the pontoons were shipped knocked-down. As a consequence it was decided to establish pontoon assembly plants in forward areas.

The equipment necessary to build a complete pontoon assembly plant was collected, a group of Seabees was selected and trained, and Pontoon Assembly Detachment No. 1 (PAD No. 1) was sent to Noumea. This plant was quickly erected and placed in operation and in a short time was equal in efficiency to the best stateside plants. Later, five other pontoon assembly depots were established, each of which produced approximately 1,800 pontoons per month and assembled large numbers of pontoon structures.

Gate vessel in pontoon drydock.

While fabrication of pontoons overseas was a highly successful operation the net gain in shipping space is not so great as might be expected. Experience with the advanced base assembly depots has demonstrated that most of the shipping space saved by sending the pontoon gear "knocked-down" is taken up by the assembly crews, forces to support such crews, and food, material, and equipment necessary for their maintenance at the depot. For instance, PAD No. 1 required a pontoon pier, four prefabricated steel buildings for warehouses, shops, and offices, structural-steel fabricated plants, and a personnel camp of 40 huts, with all the usual utilities. In the future, circumstances will probably govern in each case in deciding whether to ship pontoons fabricated or knocked-down. A pontoon assembly detachment consisted of 17 officers and 418 men, equipped to manufacture about 1,800 pontoons per month and to form them into any of the final assemblies. For the fabrication of both rectangular and curved pontoons the detachment was equipped with two assembly lines consisting of jigs and fixtures to hold the pre-cut plates and structural forms in place for welding.

## *DRYDOCKS AND HAULING-OUT EQUIPMENT*

There are two types of drydocks in use at advanced bases—one, the marine railway, is built into the land, while the other, a floating structure, possesses a high degree of mobility.

A sea-going drydock ready to handle a ship.

The floating drydock is the type most commonly employed at advanced bases because of its mobility. It may be a pontoon drydock for small craft, or a semirigid structure of steel, wood, or concrete for larger craft. The installation, maintenance and operation are usually handled by trained personnel from either aboard the drydocks themselves or from shore-based repair activities to which attached.

### *OPERATION*

Floating drydocks are of general classification as follows:

1. Simple floating drydocks.
2. Seagoing docks.
3. Pontoon, seaplane, and other special types.

A floating drydock at light draft has its pontoon or working deck about 18 inches or more out of water. For a drydocking operation, the blocks are set to the ship's hull pattern, and the dock is submerged, by opening the valves leading to the dock's ballast tanks. When the depth of water over the blocks is sufficient to accommodate the ship's draft and maintain sufficient freeboard for the dock's top deck to insure stability, the flooding valves are closed. The ship is then hauled into exact position over the previously set blocks. The dock's pumps are started and the water pumped out of the dock's ballast tanks. Because of this pumping the dock rises in the water, bringing the ship with it. The pumping continues until the ship is high and dry on the blocks and a satisfactory freeboard is obtained for the dock's working deck. The pumping required in floating-drydock operation can be less than that for a graving dock because in the case of the floating drydock it is only necessary to fill and pump for the draft of the ship at hand.

### *CONSTRUCTION*

Because of the importance of mobility in the Navy docking facilities program, the floating drydock has been used increasingly within the past few years. Floating drydocks are cheaper in first cost, can be constructed quicker, and used to meet a changing front of operations such as were experienced in World War II. With floating drydocks it was possible to provide necessary repair services in the actual theaters of fleet operations, and our available floating drydock facilities could be shifted from one continental yard to another for most economical and efficient support of ship-repair operation. Floating drydocks were shifted up and down both coasts and were even sent from the East to the West Coast through the Panama Canal, in some cases by careening them almost 90 degrees. From a strictly military point of view and for conditions of warfare such as we

LSU's coming into LSD during Exercise Portrex.

USS AFDL-23 (Auxiliary Floating Drydock, Little).

have recently experienced and may experience again (in which our fighting ships were given everything in the way of repairs, except for severe battery and propulsion damage, at the site of operation) floating drydocks are the best answer. This does not mean that floating drydocks do not have some disadvantages. They are unwieldy and dangerous to tow, vulnerable to attack, subject to ready and severe damage, and can damage ships if mishandled. They require much more of a crew than does a graving dock, and they deteriorate rapidly. Some types, however, do have a high degree of mobility and for sea warfare, this is a prime requisite.

### *Sectional Drydocks*

Floating drydocks are constructed to several designs—in truly sectional form with no strength connection between sections; in one piece with full longitudinal strength; and in various combinations between these two ranges, depending on the conditions of service. Truly sectional docks depend on the ship being docked so as to distribute any unbalanced loads between sections where this factor is involved. With the one-piece dock this is a lesser consideration, although it is a fact that the ship will be effective in distributing the load to some extent if it can make its way to the dock. Semirigid docks are proportioned to take some predetermined portion of the unbalanced load in bending.

For Navy purposes, floating drydocks are also divided on the basis of military utility; that is, whether or not they are designed and equipped for overseas use and are on a self-sustaining basis. Non-military dock have on them only the features and machinery involved in straight docking operations although they usually are designed for sea movements. Military docks, on the other hand, have their own pc er-generating units aboard, distilling and heating plants, air compressors, cranes, shops and crews' quarters and are outfitted in the same manner as ships. Military docks can be in one piece or in three or more pieces and are either the rigid or semirigid type. All of them are fully rigged for towing so that all a towing vessel has to do is run a line to them when they are ready. Also, they all carry full material and equipment as required for mooring under any reasonable conditions of service.

### *SPECIAL TYPES*

Studies have been made to develop knocked-down docks of both wood and steel but so far without much result. The prevailing thought is that it is better to build the docks properly at locations where there are facilities, materials, and men, and then to tow them to where they are to be used. This involves some danger of loss in towing and extra effort in handling, but when a dock arrives at the base it is ready for use. With the knocked-down type of floating dock structure in its present state of development, there is no reasonable assurance of success. The smaller drydocks fabricated from pontoons are, of course, an exception.

### *MAJOR DOCK TYPES AND SIZES*

| | |
|---|---|
| ARD | Auxiliary Repair Dock |
| AFDL | Auxiliary Floating Dock, Little |
| AFDM | Auxiliary Floating Dock, Medium |
| AFDB | Auxiliary Floating Dock, Big |

| Type | Nominal Lift | Personnel | |
|---|---|---|---|
| | | Officer* | Enlisted* |
| | *Ton* | | |
| ARD | 3,500 | 6 | 180 |
| AFDL | 1,000 | 2 | 45 |
| AFDL | 1,900 | 3 | 80 |
| AFDL | 2,800 | 5 | 150 |
| AFDL | 6,500 | 6 | 190 |
| AFDM | 15,000 | 8 | 350 |
| AFDM | 18,000 | 8 | 350 |
| AEDB | 55,000 | 27 | 900 |
| AFDB | 81,000 | 27 | 1,000 |
| AFDB | 90,000 | 27 | 1,000 |

* Estimated wartime complement. Actual complement may vary considerably. Men will not live on the docks but will be quartered in APLs.

### *ARD*

The ARD docks are highly developed military units. They are one-piece steel docks with a closed, ship-shaped bow and a stern gate. Part of the lifting capacity is provided by the dock basin formed when the gate is closed.

The docks are in three sizes, the smallest being about 393 feet long over all, 360 feet by 40 feet in the dock basin, 20 feet draft over the blocks, and can lift 2,200 tons.

The middle size has an over-all length of about 485 feet, a dock basin of 413 feet by 50 feet with 21 feet 9 inches draft over the blocks and a lifting capacity of 3,500 tons.

The third size has a basin width of 60 feet to better accommodate LST's and similar ships. For maximum submergence this dock requires 35 feet of water.

### *AFDL*

The AFDL is a one-piece through dock. One type is of steel with a length of 200 feet, a width between wing-walls of 45 feet, draft over blocks of 14 feet 6 inches at total submergence which is 27 feet, and it can lift 1,000 tons. The next larger size is also of steel, has a length of 288 feet, a width between wing-walls of 45 feet, a draft over blocks of 18 feet 3 inches at total submergence which is 31 feet and can lift 1,900 tons.

The third size is a concrete dock with a length of 389 feet, a width between wing-walls of 58 feet and can lift 2,800 tons. The largest AFDL dock is of steel with a length of 448 feet, width between wing-walls of 70 feet, draft over blocks of 26 feet at total submergence which is 42 feet, and can lift 6,500 tons. These docks are full military docks in practically all cases.

The 2,800-ton AFDL's correspond closely to the ARD docks as regards equipment and complement; the 6,500-ton AFDL is similarly well-equipped.

### *AFDM*

The AFDM are of the three-piece self-docking type, and are constructed of steel. The smaller ones have a length of 544 feet, width between

AFDB-1 (Auxiliary Floating Drydock, Big).

Battleship Idaho entering AFDB-1.

wing-walls of 90 feet, draft over blocks of 30 feet and can lift 15,000 tons. The larger size has a length of 552 feet, width between wing-walls of 96 feet, draft over blocks of 30 feet, at total submergence of 52 feet and can lift 18,000 tons.

None of the advanced base docks is self-propelled but all are equipped to work in outlying areas with a minimum of support from other Navy activities since they carry their own workshop barges with them. All docks are complete with moorings in various situations, and except for the AFDM and AFDB docks, one-point moorings are generally sufficient for operation.

A 40-ton surf crane.

### *AFDB*

The AFDB docks are sectional steel docks and come in two main sizes. The sections are towed to the operating site individually and assembled in groups of seven, nine, or ten sections. The seven-section dock has sections 240 feet long and 101 feet wide, and when assembled is 725 feet long, 122 feet between wing-walls, about 40 feet draft over the blocks at maximum submergence of 67 feet, and can lift 55,000 tons. The seven-section dock will dock all battleships (with some limitations) and smaller vessels.

The ten-section dock has sections 256 feet long and 80 feet wide and when assembled is 827 feet long, 140 feet between wing-walls, 46 feet draft over the blocks at maximum submer-

Cruiser in AFDL.

gence of 78 feet, and can lift 90,000 tons. The ten-section dock can dock any ship now afloat.

The 9-section dock is the same as the 10-section dock except that the length is 744 feet and it can lift 81,000 tons.

### DOCKING THE DOCKS

For dock-repair purposes the smaller docks are docked in the larger docks and the latter are so arranged that they are self-docking. For the sectional docks, self-docking can be carried on at the same time when large ships are in the dock.

The AFDM's have two small end sections and one large intermediate section, and in self-docking the big center section can be lifted by the end sections, or the end sections can be placed in the center section. The big sectional docks are self-docked by detaching pontoon sections from the side walls, withdrawing them individually and docking them in the main dock chamber.

All advanced base docks must be self-sustaining and completely outfitted similar to ships, since they are employed in undeveloped areas where there is practically nothing to work with. They have large crews aboard (as many as 500 officers and men on the AFDB docks) and these crews must have materials to work with and supplies to sustain them for extended periods.

#### *Towing*

Plans for the towing operation must be carefully developed and materials assembled on the docks so that the towing units can handle them properly. All advanced base docks must be fully prepared for towing. Recommendations for handling are issued before a tow begins and the Bureau of Yards and Docks keeps in touch with tows underway in order to suggest methods of handling in an emergency.

#### *Operating Manual and Damage Control*

Elaborate operating instruction manuals have been prepared for all docks and, since the docks in effect are combat units, damage control books have been prepared similar to those issued for combat ships. Damage control studies cover possible enemy damage for all periods of the dock's activities, such as, when being towed, when

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**Aerial view of battleship Idaho in AFDB.**

assembly is in progress, when empty, and when occupied by a ship or ships.

### *MARINE RAILWAYS*

When an advanced base is semipermanent in nature and there is a large demand for small craft repair work, marine railways are usually constructed to haul craft out of the water for painting and repairing.

The topographic requirement for a marine railway is a gently sloping water front that permits the ways, or rails to be laid with little excavation.

The cradle for receiving the boat is mounted on wheels and is drawn up and let down by a rope or chain over a windlass. The cradle is let down with keel-blocks in place and the boat is floated over them. As the cradle and the craft are drawn in, the blocking takes the craft as it would in a drydock. When the painting and repairs are finished, the boat is lowered down into the water and floated.

The standard marine railway for advanced bases is of 50-ton capacity and includes transfer tracks for the movement of vessels to storage or repair areas. With a maximum capacity of 50 tons the standard marine railway is limited principally to the handling of landing craft or their equivalent.

The two components, E-26 and E-26A, contain the 50-ton marine railway as the basic unit.

*The E-26 (Large)* consists of two 50-ton marine railways to be located at either boundary of a storage or repair yard. It contains transfer tracks, with extensions, to accommodate approximately 60 LCM (3)'s, LCM (6)'s, or their beam equivalent in the storage area.

*The E-26A (Small)* consists of one 50-ton marine railway with transfer tracks and extensions to accommodate approximately 18 LCM (3)'s, LCM (6)'s or their beam equivalent in the storage area. This capacity can be increased by use of additional transfer trackage.

### *FLOATING CRANES AND DERRICKS*

Cranes and derricks, whether established on quays or piers or mounted on pontoons, are used for placing heavy weights such as engines, boilers, masts, armor and armament, on board or for removing them from shipboard. The cranes used on piers and quays are usually mounted on rubber tires or crawler-type tracks, or railway tracks to make them mobile.

A floating crane which is used for moving weights from one part of a harbor to another


**Pontoon causeway section being secured to LST.**

will have its hull shaped like a barge to facilitate movement. It may be towed or be self-propelled and is a form of a lighter.

Mobile cranes for use on piers and quays are the standard type and sizes used for general weight lifting at advanced bases. Crawler-mounted cranes range in size from 5 tons to about 70 tons in lifting capacity. Truck-mounted cranes are limited to approximately 15-50 tons capacity, and are extremely valuable within their capacities because they can work rapidly over a large area.

Floating cranes for advanced bases have capacities varying from 25 tons to 100 tons. Present plans call for the standardization of the 25-, 50-, and 100-ton units with general characteristics as follows:

| *Size* | *Operating Radius* | *Lift above water* |
|---|---|---|
| 25 ton | 90 feet | 65 feet |
| 50 ton | 115 feet | 90 feet |
| 100 ton | 80 feet | 97 feet |

Boom extensions can be provided to furnish additional reach for installing radar and other gear at ship's topmast levels.

### *GILHOIST*

The Gilhoist is a mobile hoisting structure capable of lifting small landing craft out of the

**Seabees use a Gilhoist to lift a landing craft out of the water.**

**The four-wheeled unit being towed by the tractor is a Joheemy.**

water and placing them ashore for servicing and maintenance. It is highly maneuverable and can be used over rough ground and beaches with slopes up to 20 percent. The largest craft it can accommodate is the LCM (6), and it is capable of handling loads up to 40 tons. It is also capable of functioning as a marine railway for the repairing of small craft.

The Gilhoist consists basically of a horseshoe frame, fitted with longitudinal frames, transverse member, gooseneck, and necessary cable, blocks, safety hooks and tires as accessories. The large steel horseshoe frame mounted on four pneumatic tires is the main supporting member on which the block is mounted for raising the boat. An accompanying tractor is used to provide locomotion for the Gilhoist and to supply winch power to the blocks and cables for hoisting. Hoists are made using a single hook pick-up with standard slings on the boats.

A pier has been designed for use with the Gilhoist where special conditions warrant the installation. The U-shaped pier is specifically designed to take the load of the Gilhoist with maximum lift. For a semipermanent installation with favorable beach and tide conditions the Gilhoist with pier provides an efficient docking combination which can be readily installed and maintained.

## MISCELLANEOUS HAUL-OUT EQUIPMENT

During World War II additional types of equipment were used for the purpose of hauling out small craft for repairs. Some of this equipment is still in use and with modifications would be used again. Equipment in this category includes:

*Le Tourneau Crane (20 ton capacity)*. This item consists of double boom frame with hook, mounted on two wheels. It is pulled by tractor, and can be shipped knocked-down and readily assembled in the field.

*Jeheemy*. This unit is a large four-wheeled pneumatic-tired salvage rig fitted with falls. A heavy tractor is required for operation. It was not designed to be shipped knocked-down; consequently shipment presents stowage and handling problems.

### *New Developments*

Research and development has occupied much of the BuDocks effort since World War II and many innovations and improvements have resulted. Many of the new items and modifications relate to advanced base harbor work. As examples, there have been great improvements in equipment and techniques for beach stabilization, welding, power generation, corrosion resistance, wood preservation, pile driving and construction tools.

One of the most spectacular developments is the new lightweight Diesel pile driver. This pile driver has many advantages over the heavier types for use in the field, its most unusual feature being its light weight of only 11,000 pounds. It is a wide departure from other pile driving units in that it is self-contained, and it requires no outside power plant with auxiliary pipes and equipage other than a crane and leads.

The hammer delivers 16,000 ft.-lbs. of energy at a single blow and delivers 84 blows per minute. There are other advantages inherent in its manner of operation so that it will eventually replace older types of pile driving rigs.

While there have been many other improvements since World War II, the Seabee construction skill that was so successful then is still basic. Changes have not been so sweeping or drastic that the CEC officer and Seabee must discard previous concepts. In the event of a future emergency it will only require them to learn the use of some new tools and work at an increased tempo.

# CHAPTER VIII
# AIR BASE

When the average Seabee is given a construction assignment all he usually wants to know is where the job is to be done. He can be trusted to supply the "know how." Outlining the construction of an air base to a CEC officer is unnecessary for the same reason. Consequently all this chapter will attempt to do is to list the basic considerations and requirements related to air base construction. The well-known ingenuity of the CEC officer can be counted on to solve specific problems as they arise.

With this in mind the construction effort necessary to establish an air base can be visualized without reference to voluminous basic data. A few workable construction guides and a description of the component installations of a typical airbase should give the reader a general understanding of his task.

### *Basic Considerations*

Air base construction in a forward area is rapid, temporary, and limited to bare necessities. *Speed* of construction is paramount. If carrier-based fighter planes are scheduled to come in at 1600 on D+7 for refueling the airstrip *must* be ready to receive them. There can be no deviation from the time-table. And nothing but a properly prepared airstrip is going to land the first plane when it arrives in the air over the field, on time and with fuel tanks practically empty.

*Economy of labor, materials and equipment* is an extremely important secondary consideration. For this reason quality, safety, convenience, appearance, and cost—all important in civilian structures—are subordinated. Consequently, military airfields are designed with lower standards than comparable civilian installations, and every effort is taken to improvise and substitute whenever possible. Full use of local materials and native labor mean great savings, if such resources are available and can be employed to advantage.

### *Equipment Maintenance*

Maintenance is vital to an entire project. In many areas of the world, the earth-moving capacity of a large bulldozer (such as a D-8) has been estimated as roughly equal to the output of 1,000 native laborers. This means that loss of one day's time by the machine is equal to a loss of 1,000 man-days of work, and makes the bulldozer operator equivalent to a supervisor of 1,000 native laborers.

The importance of proper handling and maintenance of equipment cannot be overemphasized. Careful training of operators and proper use must be stressed. Regular and thorough lubrication, inspection, maintenance, and adequate spare part stocks must be provided.

### *Local Resources*

*Existing facilities* such as buildings, wells, roads, sewage systems, power and communication nets, and captured enemy airstrips, are used wherever possible and to minimize the amount of new construction needed.

*Local materials* and methods used by the natives often prove valuable aids to airfield construction. Inspection of local road construction may reveal important data on drainage or subgrade conditions helpful in locating and designing an airfield in the vicinity. Road surfacings used in the area may indicate that local materials, even though unusual, are suitable for the base course of runways. Examples are coral, iron ore, lime rock, and shale or shell deposits. The native style of building construction may often be adopted in order to utilize native labor and local materials, and for camouflage.

*Local labor* may often permit release of trained troops for more complicated technical tasks. However, use of native labor may increase pilferage and the risk of sabotage and disclosure of information. But the additional progress possible with the proper use of native labor outweighs these risks. Its use is also a

Engine trouble must be remedied on the spot.

stabilizing influence on the local economy. As has been mentioned in "Tropical Engineering", NavDocks P-39, it is generally better to employ native labor in accordance with local customs rather than to impose American practices.

*Local equipment*, such as rock crushers, rollers, trucks, farm machinery, and animal-drawn carts are valuable for many airfield construction operations, and can be used to advantage when available. The use of native hand tools should not be neglected either. While these hand tools may be quite unusual and not up to American standards, the natives are very adept and capable of great production with them.

### *Construction Stages*

Building an advanced air base is a major project. However, the job is not done all at once. By proper planning and by limiting construction to bare necessities, an airfield may be built to support air operations very early after construction starts. In general, there are three broad stages in the development of an air base and it is essential that the master plan assures that work completed in each stage will be utilized in subsequent improvements and extensions. These stages may vary widely because of such factors as theater requirements, transportation, supply, proximity to the enemy, weather, soil, and drainage conditions. But the general scope, purpose and priority of each stage is usually the same in any situation.

First stage in clearing a jungle for fighter strip.

*First Stage.* This is the emergency period and its purpose is to provide essential facilities for air operations at the earliest possible date. In some cases a smooth, drained, compacted-earth landing strip may be sufficient. In other cases, considerable clearing, draining, grading, and surfacing with local natural materials or steel landing mat may be needed. Living conditions for personnel and housekeeping facilities may be very primitive. Personnel may be sheltered in tents or foxholes and field messes may be simply located under trees. This first stage is completed when a serviceable landing strip with some taxiways and hard standings have been provided even though the facilities are temporary.

*Second Stage.* This is the stabilizing or build-up stage and its purpose is to increase the capacity, safety and efficiency of air operations by improving, adding, and extending operational and technical facilities. Concurrently, security is being improved by dispersion, protective construction, and camouflage. Construction during this stage also proceeds by planned steps or substages, making full use of all initial work. For example, a smooth, compacted, and drained subgrade may serve aircraft temporarily. Meanwhile, base course and surfacing material is being prepared and stockpiled, or construction may proceed on other parts of the airfield. Similarly, an airfield may be required for use when the base course has been laid, but before the surfacing is completed. In other cases, an airfield originally designed for the use of lightweight or mediumweight planes may have to be strengthened to carry heavier planes, or a steel runway used initially may have to be replaced with some other type of surface.

*Third Stage.* This is the completion or final stage of development. Its purpose is to provide facilities for administration and comfort of personnel, such as buildings, utilities, galleys, and recreation equipment.

### AIR BASE CONSTRUCTION

Strategic and tactical considerations, advanced base studies, theater planning, reconnaissance and design are necessary and important preliminaries to the establishment of an air base. However, our immediate and primary interest is in air base construction, so it is assumed here that all the above steps have been completed. The subject starts at the point where the actual building has begun.

#### Priorities

The order in which construction progresses is important and must be arranged during the planning and scheduling. Priorities setting up the order of construction tasks are usually contained in the directive for establishment of the air base. This order may be modified later as dictated by local conditions, the tactical situation, or other governing factors. However, phased construction at any advanced air base conforms closely to the typical order as follows:

1. Runways, aprons, taxiways, and hard standings.
2. Control tower and administration center.
3. Maintenance and repair facilities.
4. Fuel and lubricant storage.
5. Ammunition storage.
6. Material storage (general supply).
7. Defense installations.
8. Hospitals.
9. Housing.
10. Seaplane facilities.
11. Fleet servicing facilities.
12. Other repair and storage, and depots.

#### Airfield Construction Operations

In most situations the steps in construction of the airfield and other facilities that compose the air base always follow the same order. The extreme conditions encountered in the Arctic or the desert are exceptions, but even there the order is much the same, with some steps eliminated, or other steps added. Generally, the operations required are those as described in the text which follows.

**Fighter strip clearing nearing completion.**

#### Clearing and Grubbing

Clearing and grubbing consists of removing trees, stumps, brush, logs, other vegetation, and boulders from areas to be occupied by landing strips, aprons, taxiways, hard standings, roads, buildings and other facilities. Trees and other vegetation which do not interfere with construction and are not hazardous to plane operation should be protected and left in their natural state. Clearing is held to a minimum to avoid unnecessary work and take advantage of the natural cover for camouflage.

Light vegetation can be burned, cut by a mower, or removed by dragging a heavy steel

**Seabees ready to begin final surfacing.**

It takes a big shovel to handle rock like this.

rail or I-beam crosswise behind a tractor or truck. Brush and similar vegetation may be cleared by a motor grader or dozer. Small trees may be cleared with hand saws or axes or by power saws, but are more efficiently removed with bulldozers. Small trees, lightly rooted trees, and low bushes may be removed by dragging a wire cable stretched between two tractors.

Large trees may be felled with saws or by explosives. The roots should be removed to about one foot below subgrade elevation. In areas to be covered by fill the stumps need not be grubbed out if their tops are at least one foot below subgrade.

Stumps can be grubbed by winches, explosives, or a combination of both. Trees may be pulled out by the roots with the stump puller attachment (rooter) depending on the size, soil and root growth. Care must be taken not to overstress a tractor or bulldozer when pushing out or pulling out trees and stumps.

In difficult cases large stumps or entire trees may be removed by a dozer without blasting or cutting. In these cases the earth is excavated on three sides of the tree and is ramped up against the tree on the unexcavated side. This enables the dozer to gain leverage by pushing higher on the trunk.

Boulders may be cleared by rolling or pushing them with a dozer if the ground permits. Deeply embedded or very large boulders may be broken up by blasting so they can be easily removed.

Disposal of cleared material is relatively simple, the only restriction being that the method conforms to the camouflage plan.

### *Stripping*

Stripping is the removing and disposing of top soil and sod which is not suitable for foundation material under a fill, or as a subgrade material when incorporated in a fill. Material of this type is excavated and disposed of during the clearing and grubbing operation. Top soil and sod may also be stripped when a subgrade material can be uncovered that has sufficient strength, when compacted, to provide a suitable base course.

### *Draining*

Regardless of the type of surface to be placed on the runway, well-drained profile grades and cross-sections are essential. Unless the completed earth grade affords a stable foundation free from standing water its supporting power will be lowered, construction difficulties will be increased, there will be danger of damage through frost action, and rapid surface disintegration in use will occur.

Surface water should be drained away from the site *ahead* of grading operations. The grading should be conducted and drainage arranged to allow surface water to quickly drain out of all cuts and off all fills.

The work on drainage installations can be divided into two phases. First, is the work necessary at the site to eliminate water that would interfere with construction operations. It includes excavation of diversion ditches to concentrate water in proper channels, and building of outfall ditches to drain low or marshy spots. This work may proceed concurrently with clearing and grubbing. Second, is the work of installing drainage facilities necessary for air operations at the base.

Many of the drainage problems must be decided at the moment, and on the site. It should be kept in mind that the drainage system must be designed to:

1. Remove all surface water quickly from operating areas such as landing strips, taxiways, and hard standings.

2. Intercept and divert surface water originating on land adjacent to the airfield.

3. Remove, intercept or divert detrimental ground water.

### *Grading and Compacting*

The best progress in grading operations results from job organization that permits quick loading and unloading, keeps idle equipment to a minimum, and provides a capacity load each trip. Length of haul is also an important factor and may be reduced considerably in many cases by careful arrangement of equipment circulation routes and by placing economical limits on the grading sub-stages within the operation. Each job must be analyzed to determine the correct equipment assignments and the necessary aids such as pushers, rooting, or blasting to keep major units working continuously and efficiently. Surface drainage should be provided at all stages of earthwork to avoid accumulation of water which will slow or bog down equipment. A thorough knowledge of the characteristics and methods of handling of the soils encountered will speed up the work.

### *Excavation*

General excavation is accomplished by scraper, dozer, or shovel and truck, whichever is most effective.

Scrapers are used for earthwork extending over a considerable area involving both cut and fill in successive sections. The motorized scraper is better adapted to long hauls than the tractor-drawn scraper because of higher traveling speeds, but requires a pusher tractor in loading. Maximum production is obtained when scrapers can haul a load coming or going, thus eliminating time lost in extra turns. In hard ground a

**Sometimes dynamiting saves wear and tear on equipment.**

pusher tractor or loosening by rooter is necessary for quick loading and high output.

The dozer is used where earth is to be drifted short distances and where turn-around space is limited. It is particularly well adapted to stripping, end-casting in fills, side-casting in the initial stages of side-hill cuts, and in the initial stages of through cuts. The best progress is made when material can be drifted downhill. The dozer may also be used in excavating basements or underground storage facilities and for constructing protective embankments around petroleum storage tanks, buildings and hard standings. It can be employed for loading trucks when used in conjunction with a strong, skid mounted timber incline up which the dozer pushes the excavated earth.

Power shovels are used in situations where large yardage can be reached with infrequent shovel moves. Disposal is ordinarily done by

**Carryalls smooth out the rough spots.**

Coral pits often furnish pavement for roads.

trucks but casting over the side may be used in side-cut work. Stripping and clearing for shovel excavation is commonly done with the dozer.

The clamshell and dragline are used for underwater excavation and for dry excavation below grade. At times the dragline may be used advantageously for backfilling ditches and other excavations where use of a dozer or backhoe would be awkward. Holes for posts or poles may be dug by a powered earth auger. Excavations for narrow footings, trenches, and heads are usually dug most efficiently with the ditcher.

*Fills*

Prior to fill (embankment) construction complete drainage must be provided and all stump holes, trenches, bomb craters and other excavations must be filled and compacted in layers to the original ground level before placing the main fill. Fill foundations should be reasonably free of organic material such as humus, leaves, or brush, especially on sloping ground, to avoid seepage slip-planes which may result in slides. Consequently, stripping may be necessary. A few light cuts with a rooter or plow along the contours of a hillside will improve the bond between foundation and embankment.

Fills of plastic or cohesive soil must be built up in compacted layers not thicker than 9 inches. Scrapers spread the soil in layers while unloading and a grader or dozer may assist in spreading and smoothing. Each layer should be uniformly compacted at controlled moisture content. Tests must be performed with the standard soil kits supplied to each Seabee battalion. A good practical test can be made for optimum moisture—the soil should feel slightly damp and is firm when squeezed in the hand. Periodic moisture and density tests are required to control compaction and assure that it does not fall below the desired minimum degree, which is 90 percent of the maximum density.

Earth fills are compacted with sheepsfoot rollers. Supplemental compaction may be obtained by distributing the travel of construction equipment over the embankment area. The sheepsfoot roller compacts a layer of loose soil from the bottom up. With each pass the roller penetrates less. This action is called "walking out" or "rolling out." The tamping effect of the sheepsfoot may be increased by loading the roller drums with water, oil, or sand. Continuation of rolling after the required compaction has been obtained is a waste of time and effort. The penetrating and cutting action of the roller leave a mulch of 1 to 2 inches of loose material on top of each layer compacted, and this assists in bonding successive layers. On the top layer, rubber-tired or flat-wheel rollers must compact this loose material to a smooth dense surface.

Rubber-tired and flat-wheel rollers may be used for compacting thin layers of soil, but are less effective than the sheepsfoot roller since they compact from the top down. This disadvantage is somewhat offset by the kneading action of the rubber-tired roller.

Soil that does not have a sufficient moisture content, and is to be used for embankments, must be dampened. It may be moistened in the excavation area or a layer at a time on the fill. When water is added on the fill the sheepsfoot roller is passed over the layer just before sprinkling. This allows the water to collect in pockets and to filter uniformly through the soil with minimum evaporation loss. Soil that is too wet, as after a rain, must be allowed to dry before compaction. Manipulation of the too-wet layer with plows, harrows, scarifiers, or graders will aid evaporation.

Granular materials such as clean sand or clean gravel can be compacted best when saturated. Because vibrating action usually is necessary for compaction, the track type tractor gives good results. Sometimes saturation alone will compact sand sufficiently for ordinary purposes, and may be accomplished by ponding the surface of the fill, or by jetting if water is available under pressure. Jetting introduces water into the fill through perforated pipes pushed into the material. However, never saturate plastic or cohesive soil.

The poorest soil materials are put in the lower layers of fills, and the select excavated material, as determined from the soil survey, should be placed on top of the fill to improve the subgrade. A minimum depth of nine inches of good material is desirable. If site excavation does not produce suitable select material, it should be obtained from borrow pits in adjacent areas.

Rock is ordinarily placed in the bottom of fills. If an entire fill is built of rock, it is finished off a few inches below subgrade elevation to allow for the placing of a cushion layer of suitable material. It is preferable to place rock fills in layers not thicker than the largest rock fragments, but in many cases end-dumping for the full height of the fill is necessary.

Embankments built around structures as a means of protection should be compacted in equal layers about 3 inches thick. Spots which are inaccessible to regular compaction equipment should be tamped with compressed air hammers or hand tools.

The subgrade must be consolidated evenly and densely. If the soil in either excavation or fill varies in type or quality, grading operations should be arranged so that the upper layers (12 to 18 inches or more in thickness) of the subgrade are composed of good, uniform types of soil. This should be done even though it may be necessary to overhaul or borrow in order to place selected soil; or even when it requires excavation below grade to remove peat, humus, tundra, gumbo, sticky clay, rotten shale or other unsatisfactory material that must be replaced with select hauled-in material. Particularly at those points where there is a transition from cuts to fills, poor soils must be removed and replaced with good, selected soil.

### *SUBGRADE PREPARATION*

The subgrade is the fill or natural soil foundation which supports any load placed on the surface of a runway, taxiway, hardstanding, or road. The subbase, base course, surface course, or steel plank is laid on its upper surface. The strength of the subgrade determines the thickness required in the pavement and base. The existing or prepared subgrade must be approximately true to grade, reasonably smooth, and the top 1-foot of depth should be free of stumps, roots and boulders.

Subgrade soils are evaluated in advance by the soil survey, but confirmatory tests are desirable during construction to verify the survey and plan and, if necessary, to alter operations to get the best results. Some good practical tests include observation of the behavior of the subgrade under loaded trucks, or tests on trial sections of subgrade covered with the proposed base.

After the grading has been completed the subgrade is brought into close conformance with the intended lines and grades. For plastic soils, except in cuts where the soil is clay, the entire area of the subgrade is scarified to a depth of six to nine inches and then sprinkled with water to obtain proper moisture content. It is then compacted with sheepsfoot rollers,

**Building an airstrip is a 24 hour-a-day job.**

**Surfacing material arrives at strip.**

preferably to about 95 percent of maximum density. Finally the subgrade is sprinkled lightly and rolled with rubber-tired rollers or loaded trucks and flat-wheel rollers.

Nonplastic soils, such as sand and gravel, are compacted best by vibration. Clean gravels are readily compacted to a dense state, but when compacting sands special attention must be given to the detrimental affect of slight moisture content which may prevent dense packing. Satisfactory compaction can be accomplished by either complete drying or complete saturation. Since drying is impractical saturation should be used whenever possible.

When the subgrade is a plastic and cohesive soil and the base course consists of course rock or gravel, a 1- to 2-inch layer of sand or screenings should be spread over the top layer of the subgrade and rolled. Sprinkling during rolling is desirable. Such a blanket course helps prevent the plastic soil from working up into the course base material under traffic during wet weather. This blanket course is not necessary if the base material is dense-graded.

In cold climates frost heaving may be prevented by placing a sufficient thickness of granular insulating material over or in place of the existing silt or clay types of soil that are subject to frost heave.

### *Subgrade Stabilization*

Subgrade stabilization includes any process for developing or preserving the stability of the subgrade, such as admixing sand with a clay subgrade or making other suitable soil mixtures.

*Mechanical Stabilization* — This process is the mixing and blending of natural materials and compacting them at optimum moisture content. A common example is adding sand or other granular material to a subgrade soil with a high percentage of clay. In this process enough materials are blended, mixed and compacted to form a stabilized subgrade 6 to 9 inches thick. To justify mechanical stabilization the time and effort expended on it must be less than that needed to construct a base of imported material thick enough to provide the same wheel-load capacity.

*Bituminous Stabilization*—In a bituminous-stabilized soil the bitumen bonds the soil particles together and makes the mixture resistant to water. Accurate control of bitumen content is required since either insufficient or excessive amounts will reduce the strength of the mixture. The ideal condition for the use of bituminous stabilization occurs when the natural subgrade soil is granular and has approximately the proper gradation for bituminous surface courses. In such cases the stabilization of the subgrade soil is accomplished by mixed-in-place methods and will give a pavement suitable for use without additional work. Bituminous-stabilized surfaces are widely used for airfields and may be employed even when the above-described conditions do not exist. In other cases, the basic conditions governing bituminous stabilization are as follows:

1. It should be used only when mechanical stabilization is impractical and base course material is not available or economical.

2. It should be used only when the resulting compacted mixture has a strength which satisfies minimum requirements.

3. Best results are obtained with granular and readily pulverized soils. Soils with high silt or clay content are not suitable for treatment.

**Rock excavation can hold up surfacing.**

4. Adequate technical control is necessary for good results.

5. It can be used most favorably on soils having inherent stability.

6. Continuous periods of dry weather are required for mixed-in-place processing.

7. Excessive moisture in the soil prevents successful mixing and compaction.

8. Cold or wet weather immediately after mixing will normally require that the mixture be dried before compaction.

9. It should not be attempted when weather conditions will retard progress or reduce the quality of the work.

*Cement Stabilization*—Certain types of soil may be stabilized by using an admixture of portland cement. By addition of cement to the soil and compaction of the mixture at proper moisture content, a strong surface is produced which has a high resistance to water and weathering action. However, soil-cement stabilization should not be attempted unless conditions are definitely favorable for it. The conditions which govern its use are as follows:

1. It should be used only as a stabilized course directly under a bituminous wearing surface in lieu of base material.

2. Granular and easily pulverized soils are necessary, and it should never be used with soils having a high silt or clay content.

3. There must be reasonable assurance that weather conditions will permit full compliance with requirements regarding moisture control and temperature.

4. There must be adequate technical control.

*Chemical Stabilization*—At present there is so much work in progress to develop new processes for chemical stabilization that it would be useless to list them, since none have been standardized. In the past, calcium chloride admixtures have been used but are not recommended for subgrade stabilization unless justified by unusual circumstances.

*Resinous-Materials Stabilization*—Resinous compounds have been developed that aid acid soils in retaining and developing stability when compacted at optimum moisture content. Here again the processes are mostly in a stage of development and no standardized methods can be given.

### *BASE COURSES*

A base course is required when the subgrade does not provide sufficient support for the load to be carried. Therefore, the quality and strength of a base course must be higher than those of the subgrade. Where it is economical to use two or more base materials differing in quality, but each better than the subgrade, they are always placed in ascending order of quality from the subgrade upward. A base is designed to spread or distribute a wheel load over the subgrade so the unit pressure transmitted to the subgrade is less than its unit bearing capacity. In all cases the subgrade ultimately carries the load.

Selection of the type of base-course construction depends principally upon the materials available at the site, but equipment available and prevailing weather conditions during construction are important factors also. A complete investigation should be made to determine the location and characteristics of all natural materials suitable for base-course construction. Base courses may consist of the following materials, singly or in combination:

*Natural*—This base course is composed of specially selected natural soils, gravel, or other

Fighter planes can land anytime.

materials such as coral, lime, rock, shells, or caliche, singly or blended.

*Processed*—Processed materials, such as crushed stone, crushed or graded gravel, and crushed limerock (materials usually having high bearing ratios) are ideal for the portion of the base courses directly beneath the top surface. Such materials in the lower portion of thick base courses do not have definite structural advantages over materials of lower strength.

Base courses of selected natural and processed materials are less affected by adverse weather than any others, require less technical control, and the materials are usually available locally. They are relatively easy and fast to build and are recommended in preference to bituminous- or cement-stabilized types except where the latter materials are definitely more suitable and more readily available. If not readily available, the transportation of bituminous material or cement for base-course construction is a major supply problem at advanced bases. For example, to construct a cement-stabilized base, six inches thick, on a runway, 150 by 6,000 feet, requires about 45,000 bags or 2,100 tons of Portland cement. Similarly, on the same size runway, to stabilize 6 inches of sand with a bituminous material requires from 1,500 to 2,000 tons of asphalt or tar products.

The quality and thickness of the base course required for a runway depends upon the strength of the subgrade and the size of the using airplane, as expressed by the wheel load. The objective is to build the most practicable subgrade, protect it by proper drainage, then provided above it only enough thickness of base, or base and pavement, to distribute the wheel load. The design should provide the necessary wheel-load capacity with the least total expenditure of time, material, and labor. For example, to justify extra effort necessary to stabilize a subgrade there must be a greater saving of effort by reason of the reduced base thickness. In many cases it is more economical to provide extra base thickness than to gain a little improvement in support by subgrade stabilization processes.

### *RUNWAY SURFACES*

The type of hard surfacing or pavement to be used on the runways, taxiways, and hard standings depends upon local soil and climatic conditions, weight and type of aircraft, time allowed for completion, available materials and equipment, and the extent of use.

The hard pavement surface is not designed to support the load alone. Ordinarily, it adds thickness and reinforcement to the base course, so that the load is distributed over a greater area. As a consequence, load is transmitted to a wider area of the subgrade, which must ultimately support any load on the surface.

Often the hard surfacing serves the additional purpose of preventing water from penetrating downward to the subgrade or of reducing the amount of surface material blown away by propeller, exhaust, or jet blasts. In many cases, these secondary functions may become the primary duty of the hard surfacing.

#### *Turf*

In exceptionally favorite climates, where soil and weather conditions encourage the growth of a dense, deep-rooted sod (turf) throughout the year, sites for airfields may be found where the natural soil with existing turf growth has sufficient supporting power to serve the lighter types of planes. In such climates a stable soil-

Fighter planes putting runway to the test.

aggregate subgrade with sufficient plant food present, or added in the form of fertilizer, may be prepared, and a satisfactory turf-surfaced field developed. Such turf is encountered in our Pacific Northwest, the British Isles and New Zealand, and it is on this type of surface that light steel landing mats have their best application.

*Steel Landing Mat*

Prefabricated steel landing mats provide a transportable hard-surfacing which can be placed readily with hand tools. Frequently it is necessary to provide a usable runway in less time than is required to place any conventional type of surfacing on the existing soil or prepared subgrade. In these cases it is often best to lay steel plank or mat on the natural soil, prepared subgrade, or base course to provide a usable runway for the short period required or until a more serviceable and durable surface can be constructed.

Steel landing mats are of two types—heavy and light. Because any military airfield may be required to handle heavy planes, the light mat is seldom used and is reserved almost entirely for special installations.

The most favorable conditions for the use of steel landing mats are,

1. Existing smooth, turf-covered or other areas that will ordinarily support light planes with little or no subgrade construction.

2. Very sandy or gravelly, noncohesive subgrades which have high supporting strength and whose only weakness is a surface characteristic.

3. Soil-aggregate surfaces that become objectionably muddy or dusty.

The more stable the underlying natural or prepared subgrade, the safer, more serviceable and more easily maintained will be the steel landing surface. When laid on soils that are soft, mucky, or boggy when wet, continuous maintenance will be required and operations may become difficult, hazardous or even impossible at critical times. When the supporting grade is deformed or displaced the steel mat bends out of shape and the airfield becomes rough and may be unusable in some sections. Mud, frost, or wet grass may cause hazardous slipperiness on steel plank surfaces and can only be prevented by constant maintenance.

*Bituminous and Portland Cement Pavements*

Bituminous materials and Portland cements are commonly required in such large quantities and demand such a large amount of transportation that they are seldom available for the construction of wearing surfaces on military airfield runways or roads at advanced bases. However, there are exceptions. Sometimes either bituminous materials or Portland cement are found at a specific site. In this case they should be exploited fully.

Bituminous materials ordinarily have a wider application than Portland cement in the construction of military airfields. For that reason they are used more. Surface treatments, compacted mixtures with aggregate, and penetration methods are the normal means for preparing flexible pavements with bituminous materials. They also can be used advantageously for patching and repair. Technical details relating to the application of bituminous materials are so numerous that an experienced CEC officer should be placed in charge of the operation when their use is contemplated. Such a man should not be hard to find since that type of construction is so common in our country.

Planes can use parking area before completion.

In lieu of experience the CEC officer can pick up a comprehensive knowledge on the use of bituminous construction by reference to the great number of books and magazines covering this subject.

Portland-cement concrete is the common rigid-type pavement for airfield runways. Almost every construction man is familiar with it so that it is useless to review techniques or structures. In the few instances where concrete pavements would be used on military airfield construction, it would not be necessary to seek a skilled man since several would be available immediately within the outfit responsible for the project.

### *Soil-Aggregate Pavements*

Soil-aggregate surfaces are simply courses of natural or prepared mixtures composed of well-graded material from coarse to fine; with high strength; without objectionable shrinkage, expansion or flexibility; and which will remain stable under load in either wet or dry weather.

Suitable material for soil-aggregate surfaces will usually be found within short hauling distances since this is a prime consideration in selecting the site.

Soil-aggregate pavements (and subbases and subgrades) are the type most widely used in the construction of military airfields. Outstanding examples are the numerous runways, roads, building foundations and other installations built with coral in the Pacific. Therefore, the responsible construction outfit must quickly locate deposits, select proper materials, and proportion soil mixtures in order to construct the stable soil-aggregate surfaces needed to complete the project.

The depth of surface and base courses of soil-aggregate depends largely upon local conditions, such as climate, stability of the subgrade, and wheel loads to be supported. Determination of the required depth must be made entirely in accordance with past practice, local experience, experiment, and judgment. For this reason, stage or lift construction can be used to advantage, since if the initial base or surface course proves deficient, it can be reinforced by adding another layer of material to increase the thickness. In any case, a thickness of not less than 6 inches total depth of compacted material should be used for the combined base and surface courses. If heavy wheel loads are expected not less than 8 inches of the best porous, granular foundation material should be used. Where subgrade supporting power is deficient the combined base and surface courses may have to be twelve inches or more thick.

Uniformity in base and surface courses is another essential and is controlled by spreading the required amounts of the separate materials for the course over the runway and then thoroughly mixing them to obtain a homogeneous mass. Thorough mixing is absolutely necessary. Unless the mixture is uniform, failures will occur in those spots where there is a deficiency of either aggregate or binder.

Even though the natural soil-aggregate is of excellent quality, it will almost never be found in the correct proportions, nor will it be possible to handle it in such a manner as will dispense with the mixing process. To secure a more uniform material of better quality and to facilitate mixing, the loading equipment in the deposit should be manipulated so that only the better material is taken, or that materials from different strata are properly proportioned when loading into the hauling vehicle.

## *AIR BASE FACILITIES*

The supporting facilities at an advanced air base are many and varied. A glance at the priorities previously listed in this chapter gives some concept of requirements. To list all the details of construction for the numerous structures involved would be far outside the scope of this book. Besides, many of the construction methods used are common knowledge among construction men. Therefore, it is deemed best to describe the required facilities in accordance with Navy terminology, that is, as shown in the Functional Components System. The CEC officer and Seabee can then determine the means for installing these facilities in various situations from his familiarity with the components, his background and his construction knowledge.

### *THE ACORN*

Under the present system of functional components, the ACORN is the standard type of air base unit which the CEC officer and Seabee will usually be called upon to install at advanced bases. An ACORN is a small advanced base unit consisting of all the personnel and material necessary for establishing an advanced naval air station. It is made up of a number of functional components which, when augmented by a FASRon (Fleet Aircraft Service Squadron), can service, rearm and perform minor repairs and routine upkeep for the planes of one carrier air group of approximately 100 aircraft or two patrol squadrons of approximately 12 aircraft each. Without the FASRon the ACORN can maintain the air station facilities in operational condition and service casual aircraft. The ACORN contains adequate communication, supply, disbursing, medical, ordnance, housing, and messing facilities for the flight crews and the FASRon as well as for its own use. By appropriate grouping, several ACORN units may be combined to form an advanced air base including satellite fields and required facilities.

### *THE FASRON*

A FASRon is a trained shore-based Fleet Aircraft Service Unit. It is a commissioned unit, and remains in commission throughout its period of service as a functioning Naval activity. The Chief of Naval Operations authorizes the commissioning of FASRons and the formation of augmenting units necessary to fill fleet requirements, and assigns their home ports. Deployment of FASRons and the attachment of augmenting units is as directed by the commander-in-chief of the fleet to which these squadrons and units are assigned by the Chief of Naval Operations, in the same manner in which ships or other units of the operating forces are deployed.

#### *Types and Complements*

FASRons are of two main types—CV and VP—corresponding to the general type of fleet air tactical units for whose support they are designed. FASRon augmenting units are also of the same two types, and may further correspond to the specific type fleet air tactical units for which they are deployed.

**Putting finishing touches on a taxi-way.**

Each FASRon is composed of a basic nucleus of personnel which may be augmented by the attachment of additional units of personnel in accordance with an established sliding scale to meet the demands of fleet deployment and changing work loads. The size of this basic nucleus (FASRon) as well as that of the corresponding FASRon augmenting units is directly proportional to the size of the fleet air tactical units or the equivalent fleet operating pool aircraft to be supported. The CV type FASRon is designed to support one fleet carrier air group of approximately 100 aircraft while the VP type FASRon will support two patrol squadrons of 12 aircraft each. The personnel operate the shop and service and maintain the aircraft, utilizing the physical facilities of the ACORN H components. FASRons vary in complement from 300 to 600 officers and men depending on the number and types of aircraft to be maintained.

A FASRon, based on a parent shore facility such as an advanced air station, normally performs all specialized shop work, including shop tests, and provides engine quickchange assemblies. It accomplishes minor and emergency repairs, routine maintenance, and service changes which are within FASRon capacity.

The FASRon operates a "ready issue store" for support of itself and assigned fleet aircraft units, drawing material required from the parent shore facility and issuing to the supported units.

A completed taxi-way.

## *THE H COMPONENTS*

H Components, in general, are designed to provide for maintenance, support and operation of aircraft in an advanced area under combat conditions, and may be combined with other functional components to form several types of air stations. Components H-9, H-12 and either H-10 or H-11, when combined, will form the technical aviation operations and maintenance facilities usually found in a standard ACORN unit.

The combination of components selected is determined by the type of operation to be supported and the degree of aircraft maintenance to be provided. A complete Acorn air station should include all the components listed for a standard Acorn in the Catalogue of Advanced Base Functional Components modified only as the climatic conditions and terrain of the local situation dictate.

### *Aircraft Operation Components*

*H-9, Aircraft Combat Operations (Basic)*—This is a standardized component, but it is important to realize that in addition to a functional standardization of all H-9 components there is a second standardization based upon the type of aircraft to be supported. Thus two H-9 components designed for the support of the same type of ASW aircraft should be identical but differ in many details from a third H-9 designed for the support of jet fighters.

It has a complement of 2 officers and 24 enlisted men, sufficient only for maintaining base aviation facilities and for servicing itinerant aircraft. The equipment and material furnished is suitable for accomplishing routine upkeep and servicing (comparable to class "D" maintenance).

The major items of equipment in the H-9 consist of:

(1) Housing for aircraft maintenance shops.
(2) Motorized machine and welding shops.
(3) Ordnance and re-arming equipment.
(4) Automotive transportation.
(5) Spare parts and consumables for 90 days.

To provide full support, operationally, the H-9 must be accompanied by either an H-10 or an H-11.

*H-10, Additional Operating Equipment (Landplanes)*—The H-10 component is a necessary supplement to the H-9 when land planes are operated. This component contains the airfield control tower, field and flood lighting sets, and the aircraft rescue boat. The complement of 5 officers and 28 enlisted men provides for the operation of the rescue boat, the tower, and field lighting.

*H-11, Additional Operating Equipment (Seaplanes)*—This is also a necessary adjunct to the H-9, but only when seaplanes are operated. In addition to a set of floodlights and seadrome lighting equipment the H-11 has anchors and moorings for seaplanes and boats for rescue, re-arming, refueling, and personnel. The complement is 1 officer and 23 enlisted men.

All communication equipment, such as radio transmitters and receivers, which are required by control tower personnel for the control of aircraft in the vicinity of the landing area will be furnished by the appropriate component. This equipment will normally be installed in the control tower. In case of interference between control tower transmitters and receivers in the basic radio communication center the control tower transmitters may be installed in the main transmitter building and operated from the control tower by remote control.

*H-12, Supplemental Aircraft Maintenance Equipment*—This component augments the H-9 component to provide facilities for more extensive repair work than is feasible with the H-9 alone. The combination of H-9 and H-12 components permits the FASRon to perform a degree of servicing, maintenance, and repair comparable to Class "C" maintenance. (Class "C" maintenance is defined as "routine upkeep and servicing and minor repairs," which includes, in addition to Class "D", replacement of maintenance parts, minor repairs to equipment and airplanes, and the effecting of authorized modifications, the accomplishment of which would cause only incidental interference to operating requirements.)

The H-12 component can be furnished as a separate unit but this is not standard procedure. When the mission and task of an ACORN indicates that an H-12 component will be required, the H-9 and H-12 are consolidated and shipped out as a single unit.

### *H-14. Aviation Fuel Storage*

The H-14 component is designed to provide storage facilities for airfields whose major storage depots are not close by. The necessary fittings, piping, pumps, and fueling equipment for piers are included. H-14D components can be added as required and connected to the main tank farm. There is no personnel complement for any of the H-14 components.

The H-14 components are as follows:

- H-14A Aviation Tank Farm (Large)—50,000 barrels, 4000 ready storage.
- H-14B Aviation Tank Farm (Medium)—20,000 barrels, 2,000 ready storage.
- H-14C Aviation Tank Farm (Small)—12,000 barrels, 2,000 ready storage.
- H-14D Ready Aviation Gasoline Storage—2,000 barrels.

Tanks, valves, piping, pumps, fueling hose, tanker moorings, and tanker connections required to construct the tank farms are included. Where two or more tank farm components are requested for one location, the number of mooring berths should be specified.

The H-14 components are being remodeled to provide for more efficient fueling of jet aircraft. Added capacity can be obtained simply by adding components. The changes being made will speed the delivery of fuel to the jet aircraft. The piping, pumping, and other equipment at the delivery end of the line will be the items chiefly affected.

### *H-15 Construction Components*

*H-15A, Airfield Construction Material*—This component contains 1,500,000 square feet of pierced-plank mat, which is sufficient to lay out a landing strip 150' x 8,000', plus a total of

**Carryalls and trucks rush a bomber strip to completion.**

10,000 linear feet of 30' taxi strip. The pierced-plank mat is so designed that adjacent sections interlock to form a continuous perforated steel runway surface. It is used as a strong surface cover when soil will not permit a good subgrade to be constructed or when an airstrip must be built in the shortest possible time. In the latter case the mat may later be replaced by a runway of orthodox construction, as previously described. This component has no personnel complement.

*H-15B, Seaplane and Parking Area*—Like the H-15A, the H-15B component has no personnel complement. It contains 12,000 square feet of pierced-plank mat for constructing a seaplane ramp 40 by 300 feet, and 150,000 square feet of 2-inch mesh for a parking area.

### *H-16 Aerological Components*

*H-16A, Aerological Unit (Large)*—The H-16A component consists of 4 officers, 10 enlisted men, and a complete package of all items of equipment needed to set up and operate a major aerological station. It is capable of making complete forecasts and keeping complete records.

The station may be a member of an extensive weather communication net, consisting of other ground stations, ships at sea, and aircraft when the aircraft location at time of observation can be accurately determined. In this case the C component (Communications) must be able to operate within a weather net to supply the aerological unit with the information required and to disseminate observations to other net stations.

*H-16D, Aerological Unit (Arctic)*—The H-16D component is designed to furnish major

This rock will make good sub-grade.

aerological facilities for making complete forecasts and keeping complete records, with sufficient technical and incidental equipment and supplies to operate for one year at an isolated arctic site. When the aerological unit (Arctic) is to be self-sustaining, appropriate camp, communication, and medical equipment, personal arms and equipment, and supplies, modified for arctic employment, should be added. The personnel complement consists of 4 officers and 10 enlisted men.

### *H–17 Photographic Lab Components*

In addition to developing, printing, enlarging, and storage services H–17 components are responsible for aerial and ground cameras, projectors, and projection equipment. The facilities of the H–17 components are available to the air organization based at the ACORN, and take care of processing all film exposed during photo reconnaissance flights. The unit stocks are photographic consumables, including aerial camera film.

*H–17A, Photographic Laboratory (Large)*—This component is designed to furnish photographic facilities for taking still and aerial pictures and for processing still, aerial, and motion-picture films in quantity. The personnel complement consists of a minimum of 1 officer and 6 enlisted men.

*H–17B, Photographic Laboratory (Medium)*—Consists of 1 officer, 4 enlisted men, and all materials required to set up and operate a portable photographic laboratory of medium size.

*H–17F, Photographic Laboratory (Squadron)*—This component provides housing for a photographic laboratory for use by a self-supporting photographic patrol squadron at an advanced base. When photolithographic reproduction is anticipated the H–21C should accompany this component. Photographic equipment and supplies are furnished as squadron property and accompany it to the advanced base. The housing consists of one photo lab (36′ x 168′) and three huts (20′ x 48′). Transportation furnished is four weapons carriers with spare parts. This component has no personnel.

*H–18A, Photographic Interpretation Unit (Large)*—This component is designed to serve an area command in contact with the enemy. It requires the availability of one photographic squadron for producing aerial photographs in volume for interpretation. Personnel complement consists of 56 officers and 33 enlisted men. All technical equipment, housing equipment, and transportation are included.

### *H–19 Air Intelligence Components*

*H–19B, Advanced Air Combat Intelligence Center*—This component is designed for inclusion in a naval intelligence center established at a key advanced position for the purpose of supplying air combat intelligence service to an area. The personnel complement consists of 6 officers and 6 enlisted men, with appropriate material, including office equipment and housing.

*H–19C, Air Combat Intelligence (Air Base)*—This component includes personnel and equipment suitable for local air combat intelligence service at a large advanced air base. It has a personnel complement of 2 officers and 2 enlisted men.

Surfacing shoulders along side runway.

### *H–21 Litho Printing Plant Components*

*H–21B, Printing Plant—Litho Reproduction (14" x 20")*—This component is designed to reproduce in quantity, by photolithography, simple charts, diagrams, text, and illustrated matter in sizes up to 14" x 20", with sufficient personnel to handle the workload of a small advanced base. The personnel consists of 6 enlisted men. Equipment includes all necessary supplies and housing. In ordering litho reproduction printing plant components, the climatic conditions should be specified, as different conditions necessitate substitution and addition to the material lists in some instances.

*H–21C, Printing Plant—Litho Reproduction (22" x 34")*—This component is designed to reproduce in quantity, by photolithography, aerial views, maps, charts, texts, and illustrated matter as large as 22" x 34", with sufficient personnel to handle the workload of a major advanced base or photographic intelligence squadron. The personnel complement consists of 1 officer and 24 enlisted men. As in the case of the H-21B, in ordering, climatic conditions should be specified.

### *Transport Operations & Lighting*

*H–22, Air Transport Operations (Landplane)*—This component provides ground equipment for the initial operation of transport aircraft (three R4D's or three R5D's) and the handling of passengers and cargo in an advanced area. Minimum line maintenance only is contemplated. It is expected that this component will be installed at an airfield at which some of the existing facilities for combat aircraft can be utilized. Personnel consists of 3 officers and 25 enlisted men.

*H–23, Air Transport Operations (Seaplane)*—This component provides seadrome and beach-front equipment for the initial operation of transport seaplanes (one JRM) and the handling of passengers and cargo in an advanced area. Minimum line maintenance only is contemplated. Seaplane ramp is not provided. Personnel consists of 3 officers and 52 enlisted men.

A parking area can be crowded.

Operations are often underway before strip is finished.

*H–25, High Intensity Airfield Lighting*—This component provides an airfield with high-intensity light equipment for low-visibility landplane operations. It will provide high-intensity lights, cable, and associated power equipment for one 7,000-foot runway and one 2,400-foot approach. Personnel consists of 3 enlisted men.

### *Navigational Aid Components*

*H–26, Air Navigational Aid Component (Large)*—This component provides complete facilities to assist in the navigation and control of air traffic in the vicinity of a major naval air station under instrument weather conditions. Personnel consists of 6 officers and 40 enlisted men. Equipment includes radar and radio beacons, both stationary and mobile, with primary power test equipment, and spare parts as necessary, HF/DF equipment, ground-controlled approach radar and communications, localizer, installation and maintenance tools and supplies, trucks, transportation facilities and housing as required.

*H–27, Air Navigational Aid Component (Medium)*—This component consists of 6 officers, 35 enlisted men, radio and radar equipment, housing, and office facilities required to install and operate all electronic aids to air navigation, approach, and landing. Among the most important items included are:

(1) Radar beacons (X band).

(2) Radio homing beacon.

(3) Ground-controlled approach (GCA)

(4) Long-range search radar.

(5) Height-finder radar.

If and when required a radio range station may be added to this component.

The facilities listed under H-27 in the *Catalog of Advanced Base Functional Components* are now undergoing changes made necessary by the rapid advances being made in the increased stringency of tactical requirements for precise navigation and control. As new devices are developed, tested, and approved they will be included in this component, at which time older equipment will be removed.

*H-28, Air Navigational Aid Component (Small)*—The H-28 is provided as an airlift navigational aid for use in Arctic or Antarctic regions where an accurate glide path indication is not required for the landing of aircraft. It consists of 3 officers and 20 enlisted men, with appropriate equipment.

### *COMPONENT COMBINATIONS*

Flexible combinations of different-sized FASRons and various types of H components can be used for servicing landplanes or seaplanes, as follows:

(1) *FASRon plus H-9 plus H-10 component* can service and perform routine upkeep on 100 single-engine land planes (equivalent of one carrier group), or 24 multi-engine land planes.

(2) *FASRon plus H-9 plus H-11 component* can service and perform routine upkeep on 18 to 24 multi-engine seaplanes.

The above working combinations are known as Class D Maintenance. When Class C Maintenance is required, an H-12 component is added, which provides additional facilities for minor repairs to engines, airframes and accessories, and for incorporating BuAer aircraft and engine changes. Class C and Class D are the only maintenance services intended to be performed at advanced bases. More extensive repairs such as the major overhaul and rebuilding of airframes, engines, and accessories are performed at major Naval Air Stations (having Class A and B maintenance facilities) in the continental United States.

### *Fire Protection at Advanced Air Bases*

Fire hazards, beyond the ordinary, exist at air stations due to the large amount of lubricants, high volatility fuel, and ammunition present and the number of times this material is handled and the amount of dispersal between tank farms, dumps and aircraft. Although equipment and personnel for fire fighting do not come under the H components, fire protection facilities are a definite requirement at advanced bases.

Fire Protection Components normally supplied to air stations, including ACORNS, are: P-12A, P-12B, and P-12G. The P-12D and P-12F are furnished on request. This equipment consists of fire trucks, pumps, ladders, hose and hose reels, fire extinguishers, special equipment for combatting oil and gasoline fires, and all needed supplies. A nucleus of specially trained personnel is also furnished.

# CHAPTER IX
# REPAIR BASE

In official Navy terminology there is no such thing as a "repair base." A "repair base" merely refers to an advanced base where repair facilities have been established as the primary function. There are so many attendant, supplementary and supporting activities at any repair base that the repair components (E components) are never placed in a separate group and shipped alone.

Repair units and facilities are always grouped as *part* of an advanced base unit (such as a LION, CUB, or one of the ship repair units listed in the *Catalog of Advanced Base Functional Components*) even though they may comprise the major portion of the advanced base.

### *Seabees and Repair*

CEC officers and Seabees have a vital interest in repair bases since they are called upon to construct such bases. They should also have a direct interest in the operation of repair bases. In World War II, they were often called upon to participate in ship repair work.

The simplest way to obtain a comprehensive picture of the work necessary in building a repair base is to know what is to be installed and for what outfits you will build. Knowledge of those components and units which you install are, of course, essential, but you also need a familiarity with other base organizations in the interests of a cooperative relationship.

The most practical way to attain this end is to know the units, personnel, and equipment of other components at the base. Also, there should be some familiarity with their organization, duties, and responsibilities.

## *SHIP REPAIR UNITS*

Ship repair units are assemblies of personnel, material and equipment that have been combined into efficient working outfits for the purpose of repairing ships, boats, and other floating craft at advanced bases. A ship repair unit is made up from a group of selected functional components carefully designed to provide a balanced team of trained personnel, technical equipment, and material necessary for a specific type of advanced base repair.

A functional component for ship repair is composed of the technical personnel and equipment necessary to perform a specific task. The functional component equipment includes workshops, housing, boats, vehicles, office equipment, and a 90-day initial supply of shop and office consumables. To give a more detailed picture of ship repair unit, a brief description of each component is outlined below:

*E–1, Ship Repair (Large).* Makes voyage repairs and repairs minor battle damage to all types of vessels in the fleet.

*E–1A, Ship Repair Augmentation.* Provides special and large capacity tools and equipment for use in augmenting ship repair components as necessary.

*E–3, Ship Repair (Medium).* Makes voyage repairs and repairs minor battle damage to most ships, particularly destroyers or smaller vessels.

*E–5, Ship Servicing.* A docking and working party intended to perform ship's force work such as running out fuel and power lines, assisting in docking, and the like.

*E–6, Landing Craft Repair.* Repairs both hulls and engines of all types of landing craft.

*E–6A, Landing Craft Spare Parts.* Provides for six months' supply of hull, machinery and internal-combustion engine spare parts for landing craft to be repaired by the E–6.

*E–8, Small Boat Repair.* Repairs both hulls and engines of small craft up to and including 56-foot landing craft.

*E–9, Small Amphibious Craft Repair.* Truck-mounted equipment designed to make hull and engine repairs to small boats and amphibious craft at any point beyond the range of

The reason for advanced base ship repair units.

stationary repair. All equipment mounted on three trucks.

*E 8A, Mobile LVT Repair.* Tray-mounted facilities transported by LVT's for repairing and salvaging amphibious tractors.

*E 10, Standard Landing Craft Repair.* Repairs both the hulls and engines of LCM's and LCV(P)'s.

*E 10A, Standard Landing Craft Spare Parts.* Provides for six months' supply of hull, machinery and Diesel engine spare parts to be added to an E 10.

*E 11, PT Operating Base Repair.* Provides facilities for major hull repair, minor engine repair and replacement of engines for one operating squadron of PT Boats.

*E 12, PT Major Engine Overhaul.* Provides facilities for major engine overhaul of four operating squadrons of PT Boats.

*E 13 (A through F) Minesweeping Equipment Repair, Augmentation, and Spare Parts.* Makes repairs to and issues replacements and spare parts for minesweeping equipment (such as magnetic cable, acoustic hammers and sweep wire) for all classes and types of minesweepers.

*E 16, E 16A, Oxygen-Generating Plant.* Oxygen-generating and cylinder-charging plants for the production of oxygen suitable for both breathing and industrial uses.

*E 17, Acetylene-Generating Plant.* A mobile acetylene-generating and cylinder-charging plant, mounted in a van type semitrailer, for the production of acetylene gas for industrial purposes.

*E 19, Typewriter Repair Component, (BuSandA Dominant).* Provides facilities for minor repair of typewriters and other types of office machines.

*E 20, Base LVT Repair.* Provides facilities for major repair and overhaul of LVT's.

*E 21, PT Squadron Portable Base Equipment.* Provides a PT Squadron with portable lightweight repair equipment for making front-line emergency repairs of minor nature.

*E 22, Mobile Landing and Patrol Craft Repair.* Tray-mounted, self-powered tools to handle routine maintenance and minor repairs to LCM's and LCV(P)'s.

*E 24, Carbon Dioxide-Generating Plant.* A mobile carbon dioxide-generating and cylinder-charging plant, mounted in a van-type semi-trailer, for the production of carbon dioxide for use in fire-fighting equipment aboard ship and at shore installations.

*E 25, Material Reclamation and Reconditioning.* Facilities for reclaiming of worn-out, broken, or damaged machinery and engine spare parts for reissue.

*E 26, Fifty-Ton Marine Railway and Storage Yard (Large).* Provides two 50-ton marine railways for hauling craft out of the water for painting and repairing. In addition, it provides transfer tracks to accommodate approximately 60 LCM (6)'s or their beam equivalent in the storage area.

**Ship repair requires heavy cranes.**

**Mobile machine shops are needed at advanced bases.**

**One type of machine tool used by advanced base ship repair units.**

*E-28A, Fifty-Ton Marine Railway and Storage Yard (Small).* Provides one 50-ton marine railway for hauling craft out of the water for painting and repairing. In addition, it provides transfer tracks to accomodate approximately 18 LCM (6)'s or their beam equivalent in the storage area.

### REPAIR BASE LOCATION

The choice of geographical location for advanced base repair facilities, and the type and size required, is a function of theater planners. Also, it is of major interest to the staff CEC officer. The choice is governed by the logistics required to support the tactical combat operations employed in carrying out the over-all strategy. Natural physical characteristics such as topography of the land, shore-line features, protected ship anchorages, prevailing winds, tide action, and ocean currents are weighed when making the final selection of the harbor site.

Once the geographical location of the advanced base is determined, the layout of the facilities at the site becomes the duty of the particular bureaus involved. This is where the CEC Officer and Seabee are most apt to become directly involved. Physical features of the location, such as topography of the land, soil conditions, water supply, drainage, type of beach, depth of water offshore, and natural harbor and anchorage protection (together with the types of ship repair work to be accomplished) have a direct bearing upon the arrangement of the ship repair facilities.

For instance, in connection with the E-8 or E-10 components for the repair of small boats, the nature of the shore line and beach would govern the decision as to whether a Gilhoist, a Gilhoist pier, or a marine railway should be used for hauling boats out of the water. In turn, this would determine the location of the repair shops. If a Gilhoist or Gilhoist pier is used, the repair shops could be located almost any place inshore from the water front. On the other hand, if it were necessary to use a marine railway, the repair shops must be located on the water front. Also, in planning the layout, consideration must be given to dispersion and use of terrain features for concealment. The degree to which these considerations affect component locations will be determined by the tactical situation at the moment.

### ORGANIZATION OF A LARGE SHIP REPAIR UNIT

To eliminate friction in dealing with other outfits at the advanced base it is well to have some familiarity with their organization and the position they occupy within larger units. A large ship repair unit at an advanced base usually consists of ten divisions, according to the following suggested arrangement:

*FIRST DIVISION* (Engineering and Administrative)—Repair Officer, Head of Department, Assistant Repair Officer, Technical and Administrative Assistant. Outside inspection and repair.

| | |
|---|---|
| Engineering | Safety Engineer |
| Planning | Education and Welfare |
| Production | Transportation |
| Personnel | Security |

*SECOND DIVISION* (Hull)—Hull Officer, Construction Assistant. Hull repairs, sail loft, riggers, paint and boat work.

| | |
|---|---|
| Shipfitters Shop | Sheet Metal Shop |
| Welding Shop | Carpenter Shop |
| Riggers Loft | |

*THIRD DIVISION* (Ordnance)—Ordnance Officer, Ordnance Assistant. Torpedo, ordnance, fire control (less electrical), optical and navigational instrument inspection and repairs, watch and typewriter repairs.

| | |
|---|---|
| Base Ordnance Shop | Optical Shop |
| Range Finder Shop | Typewriter Shop |
| Instrument Shop | Periscope Repair Shop |
| Watch Repair Shop | Canvas and Gas Mask Shop |
| Fire Control Shop | |

*FOURTH DIVISION* (Machinery)—Machinery Officer, Engineering Assistant. Engineering repairs (except electrical), boiler-cleaning details and central tool room, refrigeration, engines, blacksmith and piping.

| | |
|---|---|
| Light Machine Shop | Refrigeration Shop |
| Heavy Machine Shop | Boiler Shop |
| Blacksmith Shop | Boat Engine Shop |
| Foundry | Pipe Shop |
| Copper Shop | Sub Repair Shop |
| Pattern Shop | |

*FIFTH DIVISION* (Electrical)—Electrical Officer, Electrical Assistant. Electrical repairs and inspections, including gyro and batteries.

| | |
|---|---|
| Electrical Shop | Gyro Compass Shop |
| Outside Electrical | Sound and Motion Pictures |
| Instrument Shop | Battery Shop |

*SIXTH DIVISION* (Electronics)—Electronics Officer, Assistant Electronics Officer. Electronics installation and repair including radio, radar, sonar, test, infra-red, radiac, and special purpose electronics equipment.

| | |
|---|---|
| Electronic Shop | Electronic Equipment |
| GRF Repair Shop | Storage |
| Teletype Repair Shop | |

*SEVENTH DIVISION* (Supply)—Supply Officer, Supply Assistant. Central tool room, job order material requests, procurement and issue of materials.

| | |
|---|---|
| Supply Crew | Bulk Storage |
| Supply Office | Plates |
| Central Tool Room | Angle Iron |
| Issue | Paints and Oils |
| Store Rooms | Bar Metals |
| Inventory Crew | Salvage Stores |
| Shop Stores | |

*EIGHTH DIVISION* (Standard Landing Craft)—Landing Craft Officer. Maintains and repairs hulls and engines of 36′ and 50′ crafts with the aid of the operating personnel of the craft.

| | |
|---|---|
| Shop Buildings | Oil and Gasoline Storage |
| Trucks, Tractors | Crawler Crane |
| Spare Parts Storehouse | Drydock (Pontoon) |
| Pierced Plank and Mesh | Pontoon Pier |

*NINTH DIVISION* (PT Major Overhaul)—PT Officer. Overhaul of PT Boat engines, capable of servicing for four operating squadrons of PT Boats.

| | |
|---|---|
| Boat Engine Repair Shop | Machine Shop Tools (Special) |
| Geared Chain Hoist | Carpenter Shop Tools (Special) |
| Housing for Overhaul Equipment | Welding Shop Tools (Special) |

**Cleaning and painting ship hulls is a ship repair job.**

*TENTH DIVISION* (Minesweeping Equipment Repair)—Minesweeping Equipment Officer. Repair of minesweeping equipment, replacement and spare parts such as magnetic cable, auxiliary controllers for seven minesweepers.

| | |
|---|---|
| Repair Shop 40′ x 100′ | Spare Sweep Gear |
| Utility Storage | Tools and Repair |
| Building 20′ x 48′ | Equipment |

The tentative organization as outlined above applies to a large ship repair unit and has been subdivided in the fashion shown to attain greater efficiency. For a smaller or more specialized repair base such as would service PT boats, there would be no need for so elaborate an arrangement. In the case of the smaller ship repair installations, some divisions may be combined, eliminated, or organized on an entirely different basis in accordance with the existing situation.

### *REPAIR PROCEDURE*

Another matter of interest to the CEC Officer who is building for, or working with, a large ship repair unit is the manner in which such an outfit operates.

When a ship arrives for overhaul, the repair officer arranges, as soon as possible, for an "arrival conference" which is conducted by him with representatives of the planning and production divisions, and of the ship concerned. The officer from the ship to be repaired is usually known as the ship representative. This officer, in most cases, will be either the chief engineer or the first lieutenant of the ship, and is the contact officer on the ship concerned.

The repair officer plans and arranges for necessary repairs, and establishes availability

P.T. boat being overhauled.

and priority dates. He then turns the work over to the planning officer for the preparation and authorization of all job orders and requisitions for material required for them. After completion of repairs to the ship, the ship must receive permission for departure from the base commanding officer at least twenty-four hours in advance so that all publications, tools, and other equipment loaned to the ship's force may be turned in.

## DUTIES OF OFFICERS

The CEC Officer will deal constantly with the personnel of the repair base, being in contact with those officers in charge of divisions or components. It is with those people that the CEC Officer must cooperate when building facilities for them or when participating in actual repair operations. Working relations should be smooth and efficient, a condition which is difficult to attain in the turmoil of activity at an advanced base.

### *Repair Officer*

The repair officer is head of the repair department at the advanced base and is responsible to the commanding officer for the organization and administration of all ship repair activities. The work for which he is responsible is to:

(1) Support the policies, execute the orders of, and assist the commanding officer in the execution of his duties.

(2) Coordinate the activities placed directly in his charge.

(3) Pass upon requests for work from ships in accordance with general instructions from the commanding officer.

The repair officer is assisted by his staff officers who are listed below with the principal activities they control:

(1) Assistant Repair Officer. (Administrative duties, personnel and other related tasks assigned by the repair officer.)

(2) Planning Officer. (Planning Division.)

(3) Production Officer. (Production Division.)

(4) Transportation Officer. (All water and land transportation in connection with the Repair Department.)

(5) Safety Engineer. (Safety of personnel in the yard and shops.)

(6) Security Officer. (Security of the Ship Repair Unit.)

### *Assistant Repair Officer*

The assistant repair officer is directly responsible to the repair officer for accomplishing authorized repair work and preparing the Repair Department War Diary. He is assisted in this work by the officers in charge of the production divisions and other officers and enlisted men prescribed by the repair officer. His specific duties are to:

(1) Become familiar with all the details of the Department and to relieve the repair officer in his absence.

(2) Generally supervise the organization and administration of the ship repair unit, and maintain a file of repair force personnel.

Marine railway.

(3) Prepare letters and reports required for repair activity, and maintain a filing system in accordance with the instructions contained in the U. S. *Navy Filing Manual*.

(4) Prepare data for arrival and departure conferences.

(5) Establish such job order, planning, and follow-up systems as are necessary to handle all work in an efficient and economical manner.

(6) Attend the commanding officer's arrival conferences, with necessary assistants. This conference will be held as soon as possible after ship's arrival (in an emergency the ship will be boarded while enroute to the base), in order that job orders for emergency repairs may be given to the shops and work started immediately upon arrival of the ship at the base. The purpose of these arrival conferences is to provide immediate first-hand information as to what work must be done. He attends the commanding officer's completion conference (held approximately forty-eight hours prior to the departure of the ship) where the exact status of each job is discussed as regards satisfactory or unsatisfactory completion of work.

*Personnel Officer*—The Personnel Officer, Safety Engineer, and Security Officer are often the same individual, functioning under the administrative control of the assistant repair officer.

The personnel officer keeps suitable efficiency records and performs other general personnel duties, such as routine handling of receipts, transfers, discharges, reenlistments, extensions,

**Ship being hauled out on a marine railway.**

**Ship docked and ready for repair on marine railway.**

advancement in rating, courts, masts, watch, and liberty lists. He makes up the security watch and duty list, and the liberty list, and prepares and submits all reports required by the Bureau of Navy Personnel. He may also be the education officer, in which case he would arrange for systematic study and examinations for members of the ship repair unit.

The ship's clerk in the personnel office is the repair officer's writer. His duties are chiefly the handling of all incoming and outgoing mail and supervising, under the personnel officer, the preparation of all reports required.

*Security Officer*—The security officer is directly responsible to the repair officer for administering all details relating to the security of the repair department. His duties are to:

(1) Provide adequate security for the repair department area in order to safeguard government property, prevent and suppress disorderly conduct, and control vehicular traffic through the repair unit area.

(2) Check shops and yards frequently to see that existing security orders are being properly carried out, with particular care being taken in regard to the electronics division.

(3) Insure prompt compliance with all instructions issued by the base police or other sentries and patrols.

(4) Prepare instructions for the performance of duties relating to security, where permanent posts are established and maintained.

(5) Revise local repair department security orders as may be desirable from time to time.

**Marine railways are efficient for servicing small boats.**

(6) Prepare and maintain security watch and patrol lists in collaboration with the repair department officers and the leading chief petty officers.

*Education Officer*—An education officer may be detailed by the repair officer to assist the personnel officer in promoting athletics, social interests, and education.

The education officer is responsible for the proper supervision of training courses and other instruction of naval personnel for advancement within the repair department. It is his responsibility to see that a weekly report of all news items concerning the repair unit is submitted to the officer or man detailed to write the periodic news letter for publication in the ship's paper. He also publishes all base motion-picture schedules, organizes and trains station athletic teams, and sponsors athletic contests.

His additional duties are: (1) physical education officer and (2) athletic and gymnasium officer for the repair unit. He cooperates with the public works officer in conducting athletic meets. He represents the division in all athletic matters. In addition, the education officer performs such other related tasks as may be assigned by the repair officer.

The personnel officer, security officer, and education officer are subordinate to, or in a lower echelon than, most of the positions shown here. However, they are staff officers with whom you may sometimes deal and thus are included.

### *Planning Officer*

The planning officer is directly responsible to the repair officer for the preparation and authorization of all job orders for execution by the repair unit's supply officer (except those under the cognizance of the public works or captain of the yard); for preparing specifications, estimates, and reestimates for such job orders, and the procurement of funds therefore; preparing, procuring and issuing all drawings; preparing requisitions for material required in connection with job orders; keeping up to date all plans, specifications, and advance sheets.

### *Production Officer*

The production officer is directly responsible to the repair officer for the satisfactory performance of all work done under specific job orders received from the planning department. It is his responsibility to see that estimates are

**Cruiser with the damaged bow section removed.**

not exceeded and that necessary reports to the planning officer are made when revisions of estimates appear necessary; that dates of completion are met; that all shop buildings and other areas occupied by the repair department (including the drydocks and building ways) are kept clean. In maintaining the cleanliness of the water front the production officer must require ships to keep clean the space adjacent to their berths.

The production officer is assisted by all divisions of the ship repair department. The divisions correspond closely to industrial divisions of a civilian plant, that is, the *productive* work is actually done there. Each division officer has direct supervision of all work performed in his division shops, and all divisions are under the staff supervision of the production officer. The officer heading each production division also has general supervision of the division shop personnel, processes, development and plant maintenance.

The production officer will be notified, if possible, at least 24 hours in advance when a ship is docked, to provide the ship with detailed instructions having the force of yard regulations.

When major repairs are made to the main engines or main turbines of a ship during any overhaul period the engineering officer, the production officer, and the commanding officer of the ship arrange at the completion of repairs to hold such dock trials as are necessary to determine whether the condition of machinery is satisfactory. These trials are conducted by the ship's force and are witnessed by either the production officer or the repair officer's assistants, together with such personnel as are necessary for observing the operation of the machinery. No dock trial is held until authorized by the captain of the yard, who designates the time when the ship is to be moved alongside the quaywall, and arranges for the number and size of mooring lines.

### *Hull Division Officer*

The hull officer is in general charge of all hull work which has not been specifically assigned to shops of other repair divisions. The hull officer, also known as the "construction" officer, is responsible for all personnel assigned to the hull division.

**Cruiser bow section is a typical ship repair job.**

He initiates work to be performed on job orders assigned to his division, maintains a progress report of the work, and is responsible for the inspection of all work classed as construction and repair which has been assigned to the repair department.

He delegates one of the hull division officers as the outside superintendent and one as shop superintendent. Each of these officers is responsible for proper supervision and execution of the work done by their section, for the care and maintenance of machinery in their charge, and for the cleanliness of the shops.

The officer in charge of the hull division is responsible for the hull inspection in connection with the docking of each ship to be repaired, procures the necessary data and prepares the portion of the docking report relating to the hull. He is also responsible for making all air tests for leakage in watertight compartments.

The shops under the general supervision of the hull officer are:

| | |
|---|---|
| Shipfitter Shop | Sheet Metal Shop |
| Welding Shop | Carpenter Shop |
| Riggers Loft | Paint Locker |

He directs the priority and production of work in these shops, and sees that instructions covering safe methods of operating the various machines are posted and complied with.

He has charge of construction and repair on ships undergoing overhaul and in the drydocks; maintains a progress chart showing the percentage of completion of all job orders issued to his section, together with a record of the

Assessing damage and estimating necessary repairs.

man hours of labor performed on each job order to date; and performs other related duties assigned him by the repair officer. He is directly responsible for keeping a running schedule of all personnel assigned to the various shops under the general supervision of the hull division.

### *Docking Officer*

The docking officer is responsible to the hull division officer, through the repair officer, for docking operations, as defined by *Navy Regulations*, and is governed in this work by the instructions contained in pertinent operating manuals issued by the Bureau of Ships.

In addition to the docking officer's responsibility for the actual docking and undocking of ships, it is customary in Navy yard organizations to give him responsibility for upkeep and maintenance of drydocks and drydock equipment. In connection with this phase of the docking officer's work, it is usual for him to make a weekly inspection of the buoyancy tanks, blocking, staging and other drydock equipment and accessories, and to report their condition to the hull superintendent.

Repair dock for mobile ship repair unit.

### *Ordnance Officer*

The senior officer of the ordnance components (J Components) assigned to the ship repair unit is the officer in charge of the ordnance division, and is known as the ordnance officer. He is under the repair officer, and is in charge of all ordnance, optical, and typewriter repairs. He is responsible within the repair department for the maintenance of assigned equipment, including major items of repair that may be performed in the ordnance shops with the equipment on hand.

Shops under the supervision of the ordnance officer are:

| | |
|---|---|
| Ordnance Shops | Optical Shop |
| Range Finder Shops | Typewriter Repair Shop |
| Instrument Shop | Periscope Shop |
| Watch Repair Shop | Canvas and Gas Mask Shop |
| Fire Control Shop | |

He directs the priority and production of work in these shops, sees that safety methods of operating shop equipment are being adhered to, and that all safety regulations, department and base memoranda and orders are posted and complied with.

An officer from one of the J Components assigned to the ship repair unit will be designated by the ordnance officer as shop superintendent. He will have charge of all shops, inside and outside, coming under the ordnance division.

The ship's gunnery officer will be requested, during the arrival conferences, to inform the repair officer in writing what armament and repairs are desired or necessary.

### *Machinery Officer*

The machinery division officer is in charge of all machinery and engineering work which has not been specifically assigned to shops in other repair divisions. He is responsible to the repair officer for the engineering inspection in connection with the docking of ships assigned to the unit for repairs. During berthing of ships arriving for overhaul, he coordinates the work of the pipe and electric shop relative to making and breaking necessary steam, water, and electrical connections. He procures the necessary data and prepares the engineering portion of the docking report for his activity, and is responsible to the repair officer for all outside machine-shop repairs and installations that may be assigned to him.

He also acts as the engineering officer, and initiates work with job order, maintains a progress report of work, and is responsible for the inspection of all work assigned to engineering except electrical and electronics.

The shops coming under the supervision of the machinery (Engineering) officer are:

| | |
|---|---|
| Machine Shop Light | Refrigeration Shop |
| Machine Shop Heavy | Boat Engine Shop |
| Boilermaker Shop | Sub Repair Shop |
| Blacksmith Shop | Foundry Shop |
| Copper Shop | Pattern Shop |
| Pipe Shop | |

He directs the priority and production of the work in these shops, detailing such of his duties to his assistants as is necessary.

### *Electrical Officer*

The electrical division officer is responsible to the repair officer for all work relating to the repair, overhaul, installation, test, engineering, custody, and shipment of electrical equipment and accessories, as regards the ships to be serviced by the repair department.

He is also responsible for the operation and maintenance of all power-generating plants, wiring and power distribution systems, and the maintenance of all electrical motors, generators, switches, transformers, rheostats, and other electrical devices in the shops of the ship repair unit. He is responsible for the training of all men in the electrical division. To assist him with his duties he delegates one of his officers to act as shop superintendent and outside shop superintendent.

The shops under the direct supervision of the electrical officer are:

| | |
|---|---|
| Electrical Shop | Outside Electrical |
| Gyro and Compass Shop | Sound Motion Pictures |
| Battery Shop | Instrument Shop |

The electrical officer supervises the priority and production of work in these shops, maintains a progress chart showing the percentage of completion of each job issued to his division,

Typical shop buildings for ship repair at an advanced base.

together with a record of man hours performed on each job to date, and is responsible to the repair officer to see that required tests and inspections are made to the electrical equipment assigned to vessels.

### *Electronics Officer*

The electronics division officer is responsible to the repair officer for repair, overhaul, installation, test, engineering, custody, and shipment of electronics equipment and accessories of ships to be serviced by the repair department and major overhaul, major repair, installation, and engineering of all shore-based electronics equipment within the base area. He is responsible for the maintenance and upkeep of all intrabase communications equipment, all electronics equipment in base components which do not have electronics maintenance personnel attached, as well as all emergency communications equipment in the repair unit itself. He has technical supervision of all installation,

Seaplane in slipway for repair.

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**The 75-ton crane can lift a P.T. boat out of the water.**

maintenance, repair, test, and engineering of electronics equipment including radio, radar, cryptographic machine, teletype, infra-red, radiac, sonar, radio-radar-sonar countermeasures, and other special purpose electronics equipment installed or in storage at the base.

He is responsible for the training of all men in the electronics division. He conducts and supervises all necessary electronics tests; makes and forwards necessary failure, installation, field change and other reports; maintains and transfers the custody of all electronic equipment aboard ships; installs new electronics equipment aboard ships; and acts as technical advisor on electronics engineering problems to the repair officer, base communication officer, harbor defense officer, base commander, and other adjacent commands.

To assist him with his duties he delegates one of his officers to act as shop superintendent, outside shop superintendent, and shore electronics superintendent.

The shops under the supervision of the electronics office are:

| | |
|---|---|
| Electronics Shop | Teletype Repair Shop |
| CRF Shop | Electronics Equipment Warehouses |

The electronics officer directs the priority and production of work in these shops, maintains a progress chart showing the percentage of completion of each job assigned to his division, together with a record of man hours performed on each job to date, and is responsible to the repair officer to see that required tests and inspections are made to the electronics equipment assigned to vessels.

### *Supply Officer*

The supply officer functions under the assistant repair officer for the administrative control of the repair supply division. He is directly under the officer in charge of the base supply corps, detailed for this duty by the commanding officer.

The repair supply division is composed of one central issue storeroom and yard supplies covering the following groups:

| | |
|---|---|
| *Service Group* | *Incoming Stores Group* |
| Survey and Sales | Stock Control |
| Bookkeeping | Purchase |
| Inventory | Receiving |
| *Storage Group* | *Outgoing Stores Group* |
| Stores | Issue |
| Shop Stores | Delivery |
| Fuel | Shipping |

### *Landing Craft Repair Officer*

The landing craft division officer is in charge of the standard landing craft unit, and is directly responsible to the repair officer for all repair, overhaul, and maintenance of both hulls and engines in one standard landing craft unit. This work also includes maintenance of equipment, records, and progress reports. He has four principal assistants for handling administration and assignment of personnel.

### *PT Major Engine Overhaul Officer*

The PT division officer is in general charge of and responsible to the head of the ship repair department (E-Department) for the proper administration of a boat engine repair shop providing facilities for major engine overhaul and test for four operating squadrons of PT boats.

Shops coming under the cognizance of the PT division officer are:

| | |
|---|---|
| Boat Engine Repair Shop | Machine Shop |
| Packard Engine Test Unit | Welding Shop |
| Marine Engine Test Unit | Carpenter Shop |

The PT division officer is assisted by a crew of enlisted personnel, specially trained to perform with the unit.

The PT division officer maintains a ready reference file of all work assigned to his division, is responsible for the maintenance of all assigned repair equipment (including major items) that may be performed in the PT shops and attends to the security of the division, including dispersal of critical equipment and material in case of air attack.

### *Minesweeping Equipment Repair Officer*

The minesweeping equipment division officer is responsible for making repairs, and furnishing replacements and spare parts for minesweeping equipment such as magnetic cable, auxiliary controllers, acoustic hammers, sweep wire, and the like, for seven to twelve minesweepers. The shops supervised by the minesweeping division officer are housed in one utility building 40' by 48' for storage.

The minesweeping officer is responsible for keeping the Bureau of Ships allowance lists for his division filled, and the equipment in good working condition. He sees that there is sufficient training equipment available for his personnel, conducts periodical classes of instruction, and is responsible for their welfare within the division.

## *ORDNANCE COMPONENTS*

Ordnance components (J components) are a necessary part of any repair base and supply the ordnance equipment in support of the base mission. They also maintain, repair, and assemble ordnance equipment and furnish technical and operational information.

While ordnance components perform essential work at the repair base, they are in a separate series, since many of them are distinct units, either geographically or by operational function.

In general, the J components are not self-supporting units and must be integrated into the over-all base structure in order to obtain supporting services such as messing facilities, quarters, medical care, and the like. There are several J components which may require separate facilities, since they provide storage for explosives and must be in an isolated location.

### *Grouping*

Ordnance components naturally fall within three distinct categories and are grouped as follows:

Group I—Components directly related to the industrial functions of the repair base.

Group II—Components requiring isolation because they handle explosive materials.

Group III—Components with tasks that make them essentially independent within the repair base.

Ordnance components are listed below with their group category indicated to give the CEC officer some familiarity with them.

| | *Component* | *Group* |
|---|---|---|
| J-1 | Base Ordnance Shop | I |
| J-2 | Base Armory and Small Caliber Gun Repair and Maintenance | III |
| | J-2A Base Armory Component. | |
| | J-2B PT Base or SLCU Ordnance Shop. | |
| J-3 | Ammunition Depots and Magazines | II |
| | J-3A Advanced Base Naval Ammunition Depot (20,000 tons). | |
| | J-3B Advanced Base Naval Magazine (10,000 tons). | |
| | J-3C Advanced Base Naval Magazine (5,000 tons). | |
| J-4 | Explosive Ordnance Disposal and Base Demolition | III |
| | J-4A Bomb Disposal Component. | |
| | J-4B Mine Disposal Component. | |
| | J-4C Base Demolition Component. | |
| J-5 | Torpedo Depots and Advanced Undersea Weapon Maintenance | II |
| | J-5A Torpedo Depot Component (Large). | |
| | J-5B Torpedo Depot Component (Medium). | |
| | J-5D Advanced Undersea Weapon Component (Aircraft Launched). | |
| | J-5E Advanced Undersea Weapon Component (Submarine Launched). | |

| *Component* | *Group* |
|---|---|
| J-6 Mobile Aircraft Torpedo Units | II |
| J-6B Mobile Aircraft Torpedo Unit. | |
| J-6C Aircraft Torpedo Unit (Airborne). | |
| J-7 Air Base Magazine; Aviation Gunnery Ground Training Facilities | II |
| J-7B Air Base Magazine. | |
| J-7N Aviation Gunnery Ground Training Component. | |
| J-10 Optical and Fire Control Repair and Maintenance Facilities | I |
| J-10C Ordnance Optical and Fire Control Shop (Large). | |
| J-10D Ordnance Optical and Fire Control Shop (Small). | |
| J-11 Mine Assembly and Overhaul Facilities | II |
| J-11A Mine Assembly Depot Component (Large). | |
| J-11B Mine Detail Component (Small). | |
| J-11C Mine Detail Component (Large). | |
| J-11D Mine Assembly Depot Component (Small). | |
| J-12 Net Defense Facilities | III |
| J-12A Net Defense Component (Large) (2½ to 5 miles of net installation). | |
| J-12B Net Defense Component (Medium) (½ to 2½ miles of net installation). | |
| J-12C Net Defense Component (Small) (less than ½ mile of net installation). | |
| J-13 Degaussing and Deperming Facilities | III |
| J-13A Degaussing Component (Large). | |
| J-13B Degaussing Component (Medium). | |
| J-13C Degaussing Component (Small). | |
| J-13D Degaussing Component (Submarine Base). | |
| J-13F Degaussing Check Range Component. | |
| J-15 Personal arms and infantry equipment | III |

### *Tailoring J Components to the Base*

The complete individuality of J components exists only up to the point of actual landing. From then on local expediency may dictate many changes to individual components. For example, the torpedo depot (J-5) or the mine depot (J-11) may be combined with the ammunition depot (J-3); the base ordnance shop (J-1) and the ordnance optical and fire control shops (J-10) will probably be made integral parts of a ship repair activity; all automotive equipment may be assembled into a base motor pool; personnel, particularly nonrated enlisted personnel, may be reassigned to other duties that are more important. Collateral duties may bear little relation to assigned duties.

**The ship repair unit may also service outboard propulsion units for pontoon structures.**

Personnel of the J components are for the most part specialists trained for specific tasks. Their greatest value to the service is in their continued assignment to the particular technical specialty in which they are trained. Operating conditions at advanced bases make it impossible to maintain such precise assignments at all times, but the officer in charge of ordnance components should attempt to keep technical personnel assigned to technical duties.

The standard J components (like the E components which they ordinarily accompany) are provided with a 90-day supply of consumable materials. Normal supply channels are ordinarily established and operating well before the end of that period, so that replenishment supplies should be requisitioned through them. Ordnance supply is normally received through three channels as follows:

(1) Ordnance material furnished by the supply depots of the Bureau of Supplies and Accounts. Usually a special section of a supply center known as the "Ordnance Supply Depot" is responsible for small arms, gun mounts, torpedo tubes, fire-control equipment, spare parts for these items, and some degaussing spares.

(2) Ordnance material supplied through special aviation supply depots, such as aircraft guns, spare parts, etc.

(3) Other items of ordnance material which, due to their explosive nature, specialized

**The Gilhoist is useful for hauling small boats out of the water.**

usage, or limited availability, are handled by various logistic agencies within the area command.

*Ordnance Component Work*

Description of the work accomplished by the various ordnance components can be handled logically and better continuity maintained if they are grouped according to the functions they perform.

*Group I*

*Base Ordnance Shop*

The mission of the J-1 component is to maintain small arms and guns of various calibers up to 6 inches, both for the base and for fleet units serviced by the base. The actual work of the component consists mainly in making adjustments and replacing parts or subassemblies using spare parts sets provided with the component. The ordnance shop is dependent on the machine shops, sheet metal and other shops of the ship repair unit for fabricating work that exceeds the capacity of the small equipment provided in the machine-shop trailer issued with the component. Extensive damage received by guns and other equipment usually necessitates complete replacement of the unit or return of the vessel to continental yards. The organizational relationship of the base ordnance shop can vary widely between bases; at one base it may report directly to the base ordnance officer while at another it may be a subordinate command of the ship repair unit. In all probability the J-1 component will lose its identity as a separate component once it is an operating facility.

*Ordnance Optical and Fire Control Shop*

The J-10 (ordnance optical and fire control shop) components are similar to the J-1 in their relationship to the ship repair unit and the repair base organization. J-10 components, as combined optical and fire control shops, differ considerably from the J-10 components of World War II. At that time two separate components existed: the J-10A as an optical repair shop, and the J-10B as a fire control repair shop. Experience has demonstrated that these two functions should be combined into a single component; therefore, the large (J-10C) and small (J-10D) combined ordnance optical and fire control shops were developed. A dehumidified working space is required for optics work.

*Group II*

Sixteen of the J components require isolation because of the explosive materials they handle. Within this group are four subgroups, each differing somewhat in its relation to the repair base.

*Ammunition Depot and Magazine Facilities*

The individual components within this subgroup are J-3A, J-3B, J-3C, and J-7B, and they provide facilities for the storage and issue of all types of ammunition.

The J-3 series provides fleet support facilities, whereas the J-7B provides ammunition support for an individual air strip. Individual components may be combined or magazine capacities varied to suit the anticipated needs of a base, since the standard components are generally used as planning entities. At a large base the torpedo and mine facilities (J-5, J-6, and J-11 components) may be made part of the ammunition depots. Although certain of the standard torpedo and mine components are provided with magazines, such magazines are not issued if the components are to be used at a base that has adequate explosive storage space.

One of the most important considerations in planning or establishing an ammunition depot or magazine component is the actual physical location of the facility. The magazines must be isolated from the base proper, yet the location must be favorable for speedy issue of ammunition to fleet units. In selecting sites, full advantage should be taken of the local terrain in order to reduce haulage to a minimum, but dispersal must also be considered in guarding against enemy attack, providing drainage, and weighing other factors.

When the plans call for a large number of magazines considerable construction is necessary. Good roads to the harbor are needed and refrigerated space for batteries and VT fuzes may have to be provided. The J-7B requires an explosive storage area near the airfield and a few magazines for storage of fuzes, detonators, and pyrotechnics.

The automotive equipment supplied with ammunition depots is sufficient for normal requirements, but additional trucking must be furnished by the base whenever ammunition ships are to be unloaded or when ships are taking on ammunition.

### *Torpedo and Mine Assembly, Overhaul, and Issue Facilities*

There are six components within this subgroup (J-5A, J-5B, J-5D, J-5E, J-11A, and J-11D), and they provide facilities for the assembly, overhaul, and readying of various types of torpedoes and mines. Much of the adjusting and assembling of torpedoes and of some mines is not dangerous, but the balance of the component's work (such as the installation of warheads and the handling of completely assembled mines and torpedoes) requires an isolated location. Therefore, these components usually are separated from the rest of the base and associated with a J-3 or J-7B when the latter components are included in the base organization.

When J-5 and J-11 components are not employed in ammunition depots or magazines, they will be provided with magazines; conversely, magazines will not be included with J-5 and J-11 components if they are to be employed with the J-3 or J-7B components. Concrete bases for large air compressors will be required.

The location of the J-11 components depends on whether surface mines and aircraft mines are to be handled. An explosive storage area near the airfield is required for aircraft mines. A nonmagnetic building and dehumidified working area are essential.

### *Torpedo and Mine Readying and Issuing Facilities*

There are four mine and torpedo components in this subgroup (J-6B, J-6C, J-11B, and J-11C) and they make the final adjustments on aircraft torpedoes and aerial mines. All these components are mobile with the exception of a single small building contained in the J-11C, and in most cases they are employed for specific short-term missions. For example, the J-6C component is an emergency-use unit that can be transported in the torpedo station of any torpedo-carrying aircraft, and in this case is included as part of the J-6B component. As a rule, components of this type will move forward as the combat area shifts, leaving their work at the repair base to be picked up by a larger, more permanent component of the subgroup shown above.

### *Ground Gunnery Training Facilities*

There is only one component in this subgroup, the J-7N (aviation gunnery ground training) component, and it is designed to provide an advanced air base with facilities for general gunnery training. In essence it is a skeet range and must be located in a relatively isolated spot. Necessary shotgun ammunition is usually stored by the J-7B (air base magazine) component and the shotguns themselves maintained by the J-2A (base armory) component assigned to the advanced air base.

### *Group III*

There are sixteen components in Group III that are independent to some degree from other units at the base. The actual relationship of any one of these components to the balance of the base depends almost entirely on circumstances and will vary with the individual component and local conditions.

### *Armory Components*

There are two armory components (J-2A and J-2B), both of which provide spare parts and tools for weapons and launchers of various types, from personal arms in the J-2A to 20-mm. guns, rocket launchers, depth-charge release tracks, and the like in the J-2B. The

The Jeheemy is also useful to ship repair units at advanced bases.

J-2A is normally assigned to smaller bases such as Acorns, while larger bases such as Cubs and Lions normally obtain armory services from the J-1 component which contains all the spare parts and tools of the J-2A.

As a service unit, the J-2A is located as conditions dictate. It may be attached to a magazine or ammunition depot, but it should be readily accessible to all base personnel. The J-2B performs the additional service of repairing landing craft weapons. This work makes the component's function somewhat the same as a ship repair facility, so it should be located near the waterfront and be accessible to other ship-repair services.

### *Bomb and Mine Disposal and Base Demolition*

There are three ordnance disposal and demolition components (J-4A, J-4B and J-4C), which must be independent units with maximum mobility and readiness because of the nature of their trade and craftsmanship. Their field operations cannot be confined to the immediate base, since they dispose of explosives in the base area and surrounding territory. These components also require an area where they can dispose of explosives. Their relationship to the base organization is usually limited to the normal housekeeping services which the base provides for them.

These components perform an intelligence function by providing information on enemy ordnance, and in reporting the results of our own ordnance malfunctions. Personnel in these components are usually qualified as divers expert in underwater demolitions.

### *Net Defense*

There are three net defense components (J-12A, J-12B, and J-12C) and they differ from each other only in the amount of net they maintain and operate. Their mission, organization, and operations have already been described in the chapter on harbor defense.

### *Degaussing*

There are five separate degaussing components (J-13A, J-13B, J-13C, J-13D, and J-13F). The relationship between the degaussing components and the base or port facility can vary all the way from close integration into a major ship-repair activity to a completely independent, isolated function under the port director at an established port.

Normally, the "industrial" phases of degaussing work are done by the shipyard or ship-repair facility. However, *at an advanced base,* this type of work is usually minor in comparison with the actual degaussing, deperming, and flashing operations. Therefore, degaussing components are generally independent units requiring only the normal housekeeping services from the base. Material for small repairs to ship's degaussing equipment is included in these components, and additional spares are obtained through the supply depot.

The factors governing site selection are: shallow ranges requiring a 35-foot water depth; deep ranges a 60-foot maximum depth and a length of not over 500 feet. A North-South heading and slow currents are desirable in the degaussing site. Easy slopes on the bottom-mooring area are required for deperming.

### *Personal Arms and Infantry Equipment*

Three components provide the personal arms and infantry equipment for officer and enlisted personnel at advanced bases (J-15A, J-15B, and J-15C). Generally, this equipment is issued by one of two methods—either directly to components such as Construction Battalions (P-1), or to the base itself which then takes care of distribution to individuals. The actual point at which arms and equipment are issued to individuals depends on the base command. In combat areas arms would probably be issued to individuals before they go ashore. At major supporting bases arms are usually held in a pool and issued to officers and men when needed. Normally, repair and maintenance of personal arms is carried out by the J-1 or J-2 component assigned to the base. Therefore, no spare parts are issued with individual weapons.

# *CHAPTER X*
# *SUPPLY BASE*

THE TERM "SUPPLY BASE" is descriptive and does *not* refer to an established advanced base organization. Many advanced bases are responsible for supply support as their primary mission, but must themselves be supported by defense, housekeeping, medical, recreational, and other facilities. For this reason an advanced base, even though its principal function is supply, will never begin as a "supply base."

Under the tested system of Navy functional components a supply base is shipped as part of a LION, CUB, ACORN, GROPAC, or other advanced base unit. It may develop later that the advanced base is completely dominated by its supply duties. Also, it is possible for the base to become huge enough to be officially named a supply base. However, the latter is exceptional. It happens only in a stabilized situation, and is of only minor interest to the average CEC officer or Seabee, who is most likely to find himself assigned in or near the combat zone.

While official terminology does not recognize the term "supply base", this chapter will present a picture of an advanced base at which supply support is the primary function.

If the CEC officer and Seabee have some knowledge of the size, operations, and internal workings of the supply base, they can visualize the construction, repair, maintenance and other work their unit will accomplish in establishing such a base.

## *THE NAVY SUPPLY SYSTEM*

In order to understand fully the place that a supply base occupies in the Navy, it would be well to have some knowledge of the Navy supply system. Familiarity with the background and evolution of the present Navy supply system may be helpful.

Supply is a branch of logistics. Too often the term "logistics" is confused with "supply" and the two are used interchangeably. As mentioned previously, logistics is the broad field of endeavor which provides the physical means for war; that is, *men*, *material* and *services*. Supply is simply the *material* in this trio. Of course the policy and mechanism used in furnishing supplies is not simple for an organization as large as the Navy. Supplies must be requisitioned, procured, and distributed, and these functions require organization, planning, supervision, and proper execution so combat units can win battles.

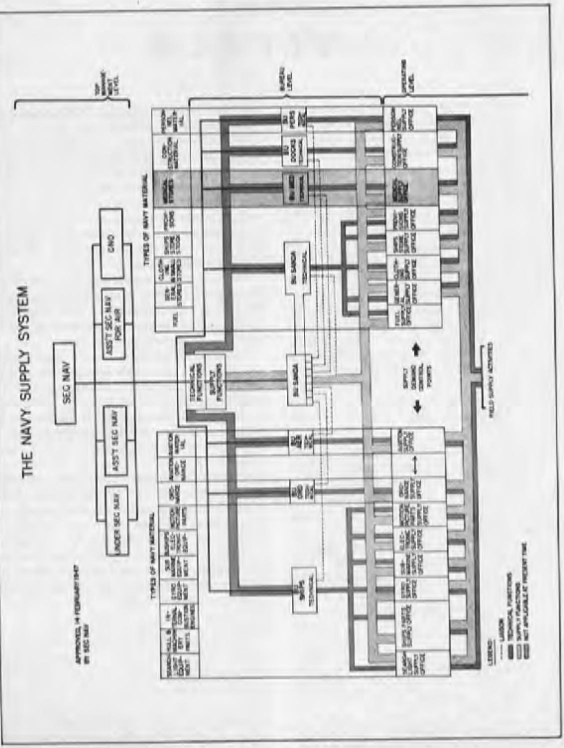
The aim of any military supply system is, in the words of a Civil War general, "to get thar the fustest with the mostest". This objective has been stated in innumerable slogans by the supply services of each armed force.

There is, of course, an Army supply system and an Air Force supply system, both of which have the same aims and objectives as the Navy supply system. Over all three of these supply systems is the Department of Defense supply system, which is not a real supply system, but merely a policy set-up for interservice coordination.

With the increasing emphasis on unification, it is essential that all of these supply systems be coordinated. Actually, the Navy supply system consists of some thirty-odd systems all administered and coordinated by a central authority, the Bureau of Supplies and Accounts. Between them these supply agencies handle the entire supply operation for all replenishable items used by the Navy.

### *Supply Items*

Replenishable items are those which are expended currently and for which there is a fairly regular, recurring demand. Replenishable supplies are neither ships, planes, tanks, major caliber guns nor any representative part of the actual physical plant of the Navy. They are consumable supplies such as provisions, spare parts, fuels and lubricants, and items of equipage.




**Organizational chart of Navy Supply System.**

There are an estimated three million replenishable items in the Navy supply system. But until the cataloging program is completed in about 10 years the number of such items cannot be stated definitely.

### *The Supply Pipe Line*

In general the Navy supply system consists of two separate but closely related parts. First, there is the physical plant—the depot system. Second, there is the control system—the organization which operates the depots and other physical facilities.

The physical plant and channels for supply may be compared to a huge hydraulic system. The supplies are the fluid being pumped through the pipe line layout. The materials flow from all kinds of production centers, where they are made, to the operating fleet or other forces, where they are used. Like any large hydraulic system, the equivalents of valves, pumps and surge tanks are needed to keep the flow at a steady rate through the pipe lines.

Thousands of feeder-lines draw materials from various places in the industrial watershed, and each of the pipe lines has its own system of valves and pumps. Material of every kind and description is pumped into the Navy supply system from private industry. Some of these pipe lines are full, some partly full, and others empty. The flow is extremely irregular and is not suitable for a supply system, where a steady flow that will not run dry is absolutely necessary.

To take out the heavy pulse beat because of irregular delivery from industry, and to insure that the supply system will not run out of material, a surge tank is placed in the system. That surge tank is a bulk storage depot. There are four of these—two large ones (Clearfield, Utah, and Mechanicsburg, Pa.) and two medium ones (Spokane and Scotia) backing up each coast. In addition to these big general depots, some feeder lines from industry are shunted over to small depots which are designated as bulk distribution points for certain types of material. An example is the depot at Bayonne, N. J., the East Coast distribution point for electronics and ordnance materials. These small depots perform the same function for the supply system as the large depots, but for only one particular class of material.

**Beachmaster supervises unloading of barges.**

Once the system has been set up to take industry's heavy pulse beats from the line there is yet another problem. The demands of the consumers (the operating forces) create another pulse beat which strains the pipe line running out of the general depot. To keep supply flow within reasonable limits more surge tanks, of sizes which vary according to their jobs, are installed close to the consumer. A number of local depots have been installed within reasonable distance of every major naval installation in the country. These local depots serve the needs of installations in the immediate area, such as shipyards and air stations, and render limited support to visiting fleet units.

The supply lines to and from the depots are railroads, waterways or truck routes and have a limited capacity. An overload, in fact, will clog them badly enough to cause an almost complete stoppage. These same pipe lines are, in many cases, used by more than one service and therefore their entire capacity is not always available. In military operations however, it is not possible to entirely remove a pulse beat. But by careful scheduling and strategic location of surge tanks (depots), the pulse beat *can* be kept within limits so the pipe line system is not strained to the breaking point.

Supporting the fleet and outlying bases is simply a matter of installing an extra large surge tank at a convenient port on each coast. One of these big surge tanks has the job of supporting all the ships and bases in a particular geographic area. These points are called *supply centers* and are similar to a depot of supplies. At present there are two active sup-

Pontoon barge tied up to stern of tanker will be used as lighter.

ply centers, one at Oakland supporting the naval forces in the Pacific and one at Norfolk maintaining the naval units and bases in the Atlantic. There are two more, one at Pearl Harbor and another at Guam, but these are being closed out.

With the vastly increased need for supplies that derives from wartime operations, the system can be carried two steps further on the distribution or outlet end of the pipe line system. Depots can be established at advanced bases and the system extended to the mobile logistic support groups. The Navy supply system is flexible and can be spread out as far as necessary to furnish support. The governing principle, however, remains the same. That is, actual physical supply support is furnished by properly placed depots and stock points.

Tractor crane and caterpillars awaiting shipment.

### *Supply Organization*

Navy material, because of the large number and variety of items, has been divided into groups, each of which is assigned to one bureau. The major types of Navy material by controlling bureaus are:

#### *BuShips*

(1) Hull and machinery equipment and spares.
(2) Internal combustion engine equipment and spares (ship and boat types).
(3) Navigational equipment and spares.
(4) Submarine equipment and spares.
(5) Gyro compass and dead reckoning equipment and spares.
(6) Motion picture machine equipment and spares.
(7) Searchlight equipment and spares.
(8) Minesweeping equipment and spares.
(9) Electronic components and spares (except certain aviation electronics items).

#### *BuOrd*

(1) Ordnance and ordnance stores.
(2) Aviation ordnance and ordnance stores.
(3) Automotive equipment and spares (ordnance types).
(4) Ammunition.

#### *BuAer*

(1) Standard aeronautical supplies.
(2) Automotive equipment and spares (aviation types).

(3) Public works collateral equipment.
(4) Catapult and arresting gear components and spares.
(5) Aviation electronic components and spares.

*BuSandA*

(1) General stores.
(2) Provisions (dry, frozen, and fresh).
(3) Clothing and small stores.
(4) Special clothing.
(5) Ships store items.
(6) Fuel.
(7) Material handling equipment and spares.
(8) Welfare and recreation equipment and supplies.

*BuPers*

(1) Library equipment and books.
(2) Training equipment.

*BuMed*

(1) Medical, surgical and dental equipment and supplies.

*BuDocks*

(1) Construction equipment and spares.
(2) Construction supplies.
(3) Automotive equipment and spares (except aviation and ordnance types).

*ONR*

(1) Special devices and spares.

*Control Offices*

The jobs within the bureaus that are concerned with providing supplies to the Navy automatically break down into two main categories. First, the technical or engineering jobs, such as research and development, design, cataloging and construction. Second, the supply jobs, like inventory control, procurement, storage, issue, transportation, financing, and accounting. The jobs in both categories are so closely related that their functions cannot be handled independently of each other.

Since it is practically impossible to find engineering and supply experience combined within individuals, Navy supply offices are staffed with both engineers and supply people. The agency which results from this fusion of supply and engineering functions and of supply and engineering people at a single point for each major category of material is called a *supply-demand control point*. It directs all the work of determination of requirements, procurement, and distribution for the class of material it is set up to control. There are nine of these control points at present, each organized in the same fashion and doing the same job for its own special class of material, such as ordnance, aeronautical supplies, construction equipment, and other items. Between them the *supply-demand control points* cover all the material in the Navy supply system.

The foregoing is a very much abridged version of the Navy supply system and outlines briefly the foundation of principles and prac-

**Pontoon sections are stored at advanced base assembly depot.**

**Outboard propulsion units in storage.**

ties upon which it is based. Without going into the infinite number of details attending the operation of so vast a system, it should give a general picture of the logistic cycle for Navy supply.

## SUPPLY COMPONENTS

The advanced base, regardless of its unit name at inception, is going to be made up from a balanced set of functional components. Since this is a supply base in which we are interested, the main components will come from the D series, for which the Bureau of Supplies and Accounts is the dominant bureau. The D-3, D-4 and D-11 components are exceptions in this series since they are dominated by the Bureau of Yards and Docks.

Knowledge of the content and mission of the D components is helpful in obtaining a picture of a supply base, and a brief description of them is listed below.

*D-1. Storage and Supply Facilities (Large).*

A large naval supply depot capable of storing, handling and issuing supplies for a large advanced base and for major fleet units.

*D-2. Storage and Supply Facilities (Medium).*

A medium naval supply depot capable of storing, handling and issuing supplies for a medium advanced base and for medium fleet units.

*D-3. Tank Farm (Large).*

Storage for sufficient fuel and Diesel oil to supply a large advanced base and major fleet units.

*D-4. Tank Farm (Medium).*

Storage for sufficient fuel and Diesel oil to supply a medium advanced base and minor fleet units.

*D-5. Stores Components.*

These components furnish fleet and advanced base material. The various categories of material are identified by letters which make up the component number, such as D-5A, D-5B, D-5C, etc.

*A—AKS Fleet Issue Material Load List* (Afloat use only). Includes C&SS and Ships Store Stock to support 40,000 men for 30 days and quantities of general stores items to support 40,000 men for 90 days. This category of material is intended primarily for issue by stores replenishment ships but may be ordered by advanced base supply departments furnishing direct supply support to the fleet.

*B—Advanced Base General Stores List* (Advanced Base Requirements). Quantities are sufficient to support 5,000 men for 90 days. This category of material is for primary use at advanced bases and does not include materials for issue to fleet units. Bases supporting fleet units must be augmented by an appropriate number of D-5As.

*C, D, E, F—Special clothing* for Arctic, cold, temperate, and tropical climates, respectively, for 1,000 men for 30 days.

*G—Provisions (Dry).* For 1,000 men for 30 days.

*H—Ship's Store Stock.* Provides cobbler, barber, tailor, fountain, and laundry stocks for the D-24A, D-24B, D-24C, and D-24D components for 1,000 men for 90 days.

*J—Ship's Store Stock.* Provides cobbler, barber, and tailor stocks for the D-24E and D-24F components for 100 men for 90 days.

*K, L, M—Clothing and Small Stores* for cold, temperate and tropical climates, respectively, for 1,000 men for 90 days.

*D-9. Petroleum Products.* Petroleum products for an initial 90-day supply to operate all equipment included in the functional components constituting a movement.

**Ammunition must be handled with care.**

*D-10, Storage and Supply Facilities (Small).* Provides the supply department of a small advanced base.

*D-11, Drum Filling Plant.* Provides for the operation of filling drums with gasoline, oil, and lubricants.

*D-12, Supply Component (Small).* Provides a specific component with a supply department.

*D-19, Material Recovery (Large).* Provides a salvage yard to handle all salvage and reclamation functions at a large advanced base.

*D-20, Disbursing Office (Large).* Provides complete disbursing facilities for the handling of 5,000 to 10,000 accounts.

*D-21, Disbursing Office (Medium).* Provides complete disbursing facilities for the handling of 2,000 to 5,000 accounts.

*D-22, Disbursing Office (Small).* Provides complete disbursing facilities for the handling of approximately 2,000 accounts.

*D-24, Ship's Store Facilities.* Provides an integrated ship's store with trained personnel, building facilities, equipment and stock. The replenishment stocks for these components are obtained from the D-5H and J components.

D-24A—To support 6,000 men
D-24B—To support 4,000 men
D-24C—To support 2,000 men
D-24D—To support 1,000 men
D-24E—To support 250 men
D-24F—To support 100 men

*D-26, Mobile Packaging Component.* Prevents loss of equipment from deterioration; preserves and packages equipment for reshipment and storage.

*D-27, Freight Terminal.* Provides an advanced base in the garrison stage with an organization for combining the unloading, dockside handling, and delivery of material.

*D-28, Advanced Material Handling Unit.* Provides facilities designed to handle the early supply dump, unloading, storing and initial supply functions at a new advanced base.

*D-29, Overseas Air Cargo Terminal (Large).* Regulates and maintains the flow of inbound and outbound cargo intended for air transportation at a large air terminal. The most urgent cargo is forwarded by air within the limits of air transport capacity and the remainder is diverted to surface transportation. The purpose is to expedite delivery to the maximum extent.

*D-29A, Overseas Air Cargo Terminal (Small).* Performs functions similar to those of a D-29 but at a small air terminal.

*D-30A, Automotive, Construction, Weight, and Material Handling Utility Equipment Repair Parts (Large).* A large spare parts depot capable of storing, handling and issuing spare parts for a large advanced base. Stocks of repair parts will be "tailor made", based on equipment included in the movement.

The *D-30B* and *D-30C* components are spare parts depots medium, and small, respectively. They have the same functions as the D-30A, but on a smaller scale.

## SUPPLY PROCEDURES

The internal workings of a supply base might seem like a far cry from the normal work of the CEC officer and Seabee. However, there are good reasons why this is not true, and the CEC officer and Seabee may find familiarity with supply processes very valuable in their work. For one thing, knowledge of how the supply base is organized, manned, equipped, and operated will assist in determining the scope of your construction work and other support work.

### Initial Supplies and Replenishment

Initial issues of consumables are not intended to cover an extensive period. They do, however, permit a unit to function until replenishment supplies can be provided. Ninety days is the period normally covered by initial issues.

The Bureau of Supplies and Accounts' material contributions, included in the *Advanced Base Initial Outfitting Lists*, are being broken down between equipment and supplies for use. Then in case material support could not be furnished by area supply activities, or if time is too short to allow replenishment through normal channels, the supplies in the various advanced base functional components could be assembled and shipped as an interim measure until normal supply lines are established.

### Requisitions

Requisitions are unnecessary for the initial issue of equipment and material to the advance base unit since these supplies are included in the original setup. For supplies needed thereafter or in excess of set levels the regular supply channels and procedures are used.

Requisitions from advanced base units which

Trucks unload fresh vegetables from transport.

have not left the United States normally will not be approved because the units are presumed to possess all equipment and material necessary for performing their missions. If special circumstances warrant "in excess" requisitions, they will be forwarded to the CNO through the commander of the area to which the unit is assigned and the dominant bureau. The request must accurately describe the circumstances and clearly indicate special conditions applying to the particular unit.

In determining when an item requested for an advanced base unit is in excess, little consideration is given as to whether it is equipment or a consumable. "In-excess" requisitions are those for items which do not appear on the initial outfitting list of the components making up the base, which have not been previously approved by the CNO, or for which the quantity ordered plus the quantity on hand exceeds established totals.

### *Authorization For Requisitions*

After a unit has reached the advanced base, requisitions for major items of equipment or material to be used in establishing permanent or semipermanent installations are referred to the area commander. The approval of the area commander is sufficient authority for issue except that any group of requisitions approximating a functional component must be approved by the CNO. The area commander considers the probable future status of the base or activity for which the material is required, and forwards a copy of each approved requisition to the CNO and the dominant material bureau. Requisitions for general stores material are forwarded to the theater supply activity for screening.

Requisitions from advanced bases should contain sufficient information to expedite handling. In order to receive prompt service, it is important to include all pertinent data available, especially for technical material, i.e.,

(1) Name plate data, part number, exact dimensions, type vessel or purpose for which intended, and any other information for description of items.
(2) Latest date delivery required and the percentage of the total requested quantity needed by that date.
(3) If air shipment is requested, precise reason for urgency.

### *Advance Estimates*

Many times an advanced base can advise supply agencies of requirements by submitting estimates far ahead of formal requisitions and consequently enable the procurement of the material for anticipated needs. Among the factors to be considered in determining replenishment requirements are:

(1) Ratio of use indicated by allowance lists, stock cards, or stock records.
(2) Operation plans.
(3) Seasonal variations in the use of an item.
(4) Stowage capacity.

(5) Length of delivery time and procurement lead time.
(6) Availability of substitutes.
(7) Availability of the item from another activity in case of emergency.
(8) Desirability of requesting an additional amount of important essential items to act as a margin for error.

### *SETTING UP SUPPLY*

The early steps in setting up an advanced base supply establishment demands the utmost from the supply personnel and is typical of the effort which must be put forth by everybody during the first phases. Usually under the worst of conditions, the men must be fed, clothed and furnished with the bare necessities of life. Activities must be supplied with equipment and material. If the supply system fails, the entire operation will break down.

The supply officer's first concern upon landing at an advanced base is the establishment of an office for directing the efforts of the supply department. Arrangements should be made with the administrative component of the LION, CUB, or ACORN to which he is attached, for prompt routing of correspondence pertaining to supply matters and eventual routing of all incoming mail. The communications officer is contacted and arrangements made for the prompt transmission of outgoing messages.

#### *Storage*

The supply officer should plot tentative storage areas on a chart and explain to each officer in charge of a component or head of department that he is responsible for the receipt and proper storage of his material so that supplies for each component may be properly placed and easily located. If covered storage space is available it should be utilized, if not, dump layout plans should be prepared. The tentative storage plans should be distributed to the commanding officer of the LION, CUB, or ACORN, his executive officer, beachmaster, unloading officer, commanding officers of the cargo handling battalions, all supply officers, and all officers in charge of components. Whenever possible, material should be stored near to its final disposition place.

Highly combustible items should be isolated from other supplies as a safeguard against fire and bombing. While dispersal of some items is absolutely necessary, complete segregation of all materials is undesirable and usually impossible as a practical measure. In arranging for dispersal, priority should naturally be given to establishing a storage area for drummed lube oil and fuel.

When arranging bin spaces use prefabricated bins which can be built quickly. Otherwise, it may take months to construct bins from rough

**Trucks unloading drums from landing craft at jungle's edge.**

**Cherry picker unloading cement clumps.**

Typical storage area on Pacific island.

lumber. For an average size base approximately 5,000 bins will be sufficient.

During the first phases of advanced base development, it may be necessary to store practically everything outside. Protection for everything but the most durable material is obtained by stacking on dunnage and covering it with tarpaulins.

Special handling and security measures must be given to alcohol, alcoholic beverages, narcotics, and the like, since they are the items most often pilfered. Storage of empty beer or soft-drink containers takes extra care as they may become breeding places for mosquitos.

*Stock Control*

While fiscal accounting is kept at a minimum in wartime, material accounting is of extreme importance. The supply officer must know what materials and equipment are at the base and where they are located.

Local accountability should be established at the earliest possible date. Stock tally cards should be posted as soon as possible after actual transactions and will become the basis for stock records and stock control. Custody record cards should be used to account for items of equipment of a pilferable nature. After the advanced base is established, custody record cards should be obtained on all items of equipment. This procedure establishes local accountability, establishes records of equipment, and relieves the supply officer of inventory responsibility.

Requisitions should be examined for unreasonable or unusual demands. Stock records should be checked regularly to determine whether material is available, or if a shortage exists and requires a reduction in issues.

General stores must be assembled at any supply base as replenishment for all components. Where it is necessary to store equipment for establishing a component, or the initial stocks of general stores to operate the component after it has been established, controls must be set up to insure that this material is issued to the proper activity.

Special stock control procedures should be established for material furnished to advanced bases for specific purposes to insure that these items are issued to the proper activity. Some of the types of material are as follows:

*Material required for battle damage repair of ships.*

1. Special submersion pumps.
2. Metal plates, shapes and structurals.
3. Welding rod and other supplies.

*Material required for upkeep and repair of ships.*

1. Anchors and anchor chains.
2. Radio, radar equipment and parts.
3. Navigational and plotting instruments.
4. Wiping cloths.
5. Special shipboard pipe, pipe fittings, tubes and tubing.
6. Paints specified for use only on ships, such as fire retardant and antifouling.

*Material required to support various major installations or construction within the base area.*

1. Radio equipment and parts.
2. Radar equipment and parts.
3. Construction equipment and parts.
4. Supplies needed to complete major construction such as cement and lumber.

### *Ship's Store, Clothing and Small Stores*

The larger D-24 ship's store component provides for branch stores to be set up at convenient locations about a base. The operation of a retail ship's store and a clothing and small-stores store is a duty of the individual unit supply officer.

The stock in a retail store should be stored in an orderly manner, and kept in the original boxes prior to its breakout for shelving and sale. Where small stocks are maintained, one storekeeper can usually handle all of the stock. Where bulk stocks for retail sales are handled the storeroom and sales room accountability should be divided. Security precautions must be taken to protect stock including locks on all doors and windows, a guard detail during hours when the store is closed, weathertight construction when possible, and material stored off the deck since seepage can ruin valuable stock.

Diagrams and special instructions concerning housing layouts for the establishment of ship's stores at advanced bases will be available for each component in the D-24 series.

Clothing and small stores may be carried for sale in the ship's store. At small activities this results in a considerable saving of construction and personnel. However, an individual issue room is essential where a large number of men must be served.

### *Supply Issue at the Base*

During the first few months at the advanced base the supply department will be expected to issue supplies to base units at almost any time. They will probably be issued directly from the dump. As the base becomes established and crises arise less frequently, routine issue can be established. Units may be required to adhere to this routine except in emergencies. This holds particularly for provisions, clothing, ship's store stock, cleaning gear, and other standard maintenance items for which the demand is constant and for which issue rates are fairly regular.

**Supplies being hoisted aboard a ship at Hungnam, Korea.**

By setting up a routine supply procedure the supply organization is left comparatively free to make emergency issues and to concentrate on the more important mission of serving the fleet. Usually supply officers of ships have a limited time in which to transact their business ashore. The base supply department can help them by providing efficient supply support and enabling them to speed their ship departure.

### *Supplies for Ships*

Large advanced bases handle large volumes of cargo consigned to ships. An alphabetical file with name and number of each ship should be maintained for all ships that come into the base. The card index file is excellent for this type of record, and makes it easy to find the address of a particular ship and ascertain if any stores are being held for it. The information on the face of the index card should include the number of pieces of cargo being held and their location.

Ship's gear which has been held for a long period of time can often be turned into stock. Before doing this the base should send an inventory of such supplies being held to the ship for which they are intended, and request permission to use the stock for general issue. Frequently a ship to which cargo has been consigned and is being held changes location and wants its cargo forwarded immediately. However, such cargo cannot be transhipped without proper letter authority from the ship or a directive from the area commander.

1st Marine Division waiting to load supplies during Hungnam evacuation in Korea.

*Processing Supply Shipments*

Assembling and packing material for shipment is a very important job in any supply department, so it is necessary to plan this process with care. Used boxes should be collected and saved for reissue because lumber is usually a scarce item. Box weights should normally be kept under 250 pounds since two small boxes are far less cumbersome than one large box. Because of the scarcity of lumber it is both wise and economical to make box sizes conform to the lumber on hand.

It is standard practice to use outside measurements when computing the cubic measurement (cube or volume) of cargo items. The bottoms and ends of containers are included when determining over-all dimensions. When packing irregularly shaped articles the greatest projection should be measured. Rounded objects such as barrels and drums are considered rectangular solids, the diameter being used as the length or the width.

Articles shipped in bales, bundles, or packages too small to permit the use of a stencil, should be marked with a weatherproof shipping tag. When tags are used for marking rods, bar stock, springs, or articles of a similar nature, they should be securely attached to the article with wire.

Requests for air shipment should always include detailed reasons. Sizes and weights of the articles should be carefully considered because of the space and load limitations of transport planes. Urgent need is the chief reason for air shipments. Consequently, all hands must be impressed with the necessity for speed in handling air cargo. There must be no delays, due to routine handling methods, which would result in loss of the time advantage gained through air transport. There should be thorough familiarity with transport planes schedules and related details. In packing air cargo, all excess weight must be eliminated and markings must be both clear and legible to expedite rapid handling.

### *FUEL SUPPLY*

At the advanced base supply depot fuel facilities are established both afloat and ashore. The floating facilities provide for fleet fuel requirements and the shore installations provide the needs of base components. The officer in charge is designated as the fuel coordinator. It is his duty to arrange for all harbor fueling and for the issue of fuels ashore. He works in close contact with the port director and harbor communications, and acts as the boarding officer for merchant tankers and Navy fleet oilers.

*Afloat*

Facilities for receipt, storage, and issue of the bulk fuel oil are established in the harbor area as soon as the enemy action abates sufficiently to permit fuel installations. Auxiliary tankers are usually provided for use as station tankers. The fuel coordinator arranges for an adequate supply of fuel and appropriate lube oils aboard each station tanker, and berths them in anchorages that can be approached with safety.

### *Ashore*

Facilities for receipt, storage, and issue of bulk petroleum products are set up at various locations on shore to meet the requirements of the base, and the officer in charge is responsible for all operations in that connection. He also enforces security regulations, maintains records, submits reports, and maintains the dump, fuel plant or tank farm.

Speedy refueling during and immediately following a landing in a new area is vital to the success of a military operation. Inevitably this refueling must be done without the aid of any of the customary devices. Most of the work involved is the hard physical labor necessary in handling great quantities of drum stock. Segregation of drums by type ("mogas", "avgas", Diesel) is highly desirable in spite of the tedious extra work involved.

Bulk fuel handling must be organized to receive or issue on a 24-hour-day basis. A complete crew is seldom necessary at night unless an operation begun during daylight hours must be continued.

Supply of other petroleum products requires an organization which will serve the local needs of the other base activities and operations.

Petroleum products are accounted for by reports covering initial inventory, receipts, and issues for specified periods, and are used for logistic purposes rather than for establishing financial accountability. The supply and shipment of fuels and lubricants is a staff responsibility. Preparation of requisitions, collection and forwarding of the necessary returns, and handling of incoming fuel is done according to local directives. The fuel officer's first responsibility is to insure that the supply of fuel does not fail even though financial accountability does not exist.

### *Salvage*

Conservation of materials and equipment at an advanced base supply depot is exceedingly important. A local salvage and reclamation activity should be placed into operation immediately when the supply organization is set up, for the purpose of recovering and reissuing usable materials and equipment. In many instances in World War II, advanced base units maintained operations with salvaged materials when replenishment supplies were delayed or not available.

**Trucks hoisted aboard during Hungnam evacuation.**

Critical materials or valuable scrap should also be salvaged. While such items may not be suitable for reissue locally, they can be sent back to rear areas or to the United States where they are badly needed. The empty hulls of turnaround vessels can be utilized for shipment, thus effecting a further economy.

### *Pilferage*

Although not generally recognized as such, pilferage is one of the most serious problems in the proper operation of the advanced base supply depot. It can happen anywhere in the supply line and can cause major upsets in the smooth flow of supplies. At advanced bases, almost everything is in short supply and critical to some extent, so that any pilferage even though small in amount, may strain the supply system to the breaking point.

Pilferage varies in character from an unauthorized diversion of government property all the way down to outright theft. Stealing ship's service articles for personal use is the most obvious and probably the most prevalent form of thievery, but many other materials are stolen by both service personnel and local civilians. The methods used are innumerable and are surprisingly ingenious, and the items stolen will vary with the locality. For example, in World War II in France the chief items stolen were gasoline, vehicles and cigarettes; in the Middle East it was lumber, nails and wire; and in other theaters it was clothing and foodstuffs.

The only real protection against pilferage is constant vigilance. Materials should always be guarded, since no other system can cope with the many stratagems used to commit theft.

### *Cargo Handling and Transportation*

Supply bases may be located at any of a number of places—in rear areas or on undeveloped sections of newly occupied shores. They may be large or small and have good roads or no roads at all. Storage areas may be all mud and woods until hardstands and roads can be built. Regardless of its condition however, the supply base will have the same mission—to furnish supply support to operating naval units. In doing this it will, of course, need the help of trucks and power equipment assigned for cargo handling.

Cargo handling, and the power equipment used for shifting supplies are bound to cause the supply officer a few headaches, especially where the supply base has no prepared storage space and the roads are either nonexistent or in poor condition.

In the initial phase of an advanced base operation the CEC officer will have some very definite supply functions and responsibilities in regard to the handling of construction supplies and equipment. In this early phase, the supply officer may not yet be on the site or may be so preoccupied with setting up supply that he cannot properly furnish the construction requirements. Therefore, construction supplies and equipment will be handled in construction dumps under CEC officer control until supply departments are set up and capable of taking over.

It is typical for the advanced base supply depot to be big and sprawling, for materials must be dispersed as a safeguard against enemy attack. Also, since smaller advanced bases, where turnover of stock is slight, will not have cranes or fork lift trucks available, nor will the large advanced base have such equipment in early phases, materials will be stacked by hand labor and result in lower piles over larger areas.

This means that initially a great deal of transportation over muddy trails may be necessary in receiving and issuing supplies. Trucks will be used for shifting material within the supply depot and for hauling stores to various activities. Unless the equipment is kept operating the materials will not move and the supply system breaks down. Maintaining supply transportation is a real job and at times may become the prime function in support of the base.

### *Supply Depot Transportation*

The advanced base supply depot has an automotive component assigned, consisting of drivers and mechanics with a CEC officer in charge. The Automotive, Construction and Weight-Handling Equipment Overhaul (Depot Maintenance) Component (P-11) is composed of approximately 20 officers and 630 enlisted men and performs the truck hauling, unloading operations, and maintenance of the depot automotive and weight-handling equipment. It is equipped to perform depot maintenance on approximately 500 pieces of automotive and construction equipment per month.

The basic allowance of automotive equipment for a supply depot functional component at a large advanced base is shown in the following list. It may be increased in a particular theater of operations if conditions warrant and it will be decreased for medium or small supply bases.

1—25-ton machinery trailer.
10—13-ton semitrailers.
6—Trailers (full refrigerators).
35—Jeeps.
6—¾-ton weapons carriers.
50—2½-ton 6 x 6 cargo trucks
6—2½-ton 6 x 6 dump trucks.
1—2½-ton 6 x 6 750 gal. tank truck.
2—2½-ton 6 x 6 oil field trucks.
10—2½-ton truck-tractors.
2—4-ton cargo trucks.
2—1-ton grease trucks (field service).
2—300 gallon water trailers.
1—Machine shop on chassis.

An Automotive, Construction, and Weight-Handling Component (P-5A) consisting of one CEC officer and 40 skilled mechanics equipped with tools, is the unit normally assigned to supply depots for automotive maintenance work. It can provide field maintenance for approximately 250 pieces of automotive, construction, or weight-handling equipment contained in a movement. Such a unit can be expanded or reduced as needed, and it can be integrated into other automotive components if necessary.

Weight-handling equipment such as cranes, hoists, or special trucks is assigned on the basis of local requirements, and is operated and repaired by the automotive component attached to the supply depot.

*Cargo Handling*

During World War II stevedoring work was carried on by Construction Battalions (Special) designated as F-1 Components. Late in the war, a Logistics Support Company, Component (D-23), was developed to provide services in warehousing, stowage, repair, protection of cargo, and repairing handling gear.

After World War II it was decided to transfer the responsibility for cargo-handling units from the Bureau of Yards and Docks to the Bureau of Supplies and Accounts, since their work was almost entirely movement of supplies. The new cargo-handling battalion, Functional Component (F-1) performs most of the work formerly accomplished by the D-23 and old F-1 components, which were abolished at the time of the transfer between bureaus.

A Cargo-Handling Battalion is composed of approximately 20 officers and 504 enlisted men. It includes personnel and equipment for loading and unloading ships at dockside, for trucking cargo to an activity or dump, for preparing of stowage plans, hatch lists, and manifests, and for controlling all cargo scheduled for loading.

The principal elements of the cargo-handling battalion are the stevedoring company and the trucking company. The trucking company, of primary interest to the CEC officer, is composed of CEC officers and Group VIII personnel. It is divided into a shop platoon and two trucking platoons. Its complement consists of four officers and 156 enlisted men. Its mission is to provide the trucking service and repair for the battalion under the direction of the C.O. of the cargo-handling battalion.

When ships do not unload at dockside, the cargo-handling battalion must be augmented by a Lighterage Component (B-5C) for barge operations. When cargo operations are conducted over a beach, a *cargo-handling beach party platoon*, composed of two officers and 82 men, is employed. When cargo movement is not over a beach, the beach party platoon should be omitted from the F-1 Component.

**Seabees unloading oil via floating pipeline.**

One Cargo-Handling Battalion, operating at dockside, can handle 2,400 measurement tons per day and work five hatch gangs simultaneously for two 10-hour shifts. When working a ship lying in the stream, the battalion, augmented by a lighterage component, can move 1,600 measurement tons per day. The F-1 Component includes cargo-handling equipment, such as slings, snatch blocks, gravity-roller conveyors, hand trucks, warehouse tractors, crane trucks, fork-lift trucks, chain hoists, tractors, semitrailers, heavy-duty trailers, jeeps, weapon carriers, commercial trucks, wreckers, automotive cranes, and crawler cranes.

*CEC Supply Responsibility*

CEC officers will have no direct responsibility for supply. Even on those few occasions when the CEC officer has a supply berth he will have practically no financial responsibility. However, he has the moral obligation of seeing that the jobs dependent upon him are well done. He is an important figure in the logistic structure of which supply is a part. The success of supply support for the fighting forces depends upon his work. Until he builds the roads, buildings, docks and other structures, the supplies will not move. So, while he may not be a supply man by function, he is a supply man in fact.

# CHAPTER XI
# AIRBORNE OPERATIONS

MOST CEC OFFICERS have at least a working knowledge of airborne operations. And our World War II Seabees are no stranger to air operations either. However, actual application of airborne operations to Seabee activities is new, and basic standards have not as yet been set up.

The CEC officer and Seabee may well wonder how airborne operations will affect their duties in the future. The answer is that transport by air is daily becoming the standard method of transportation, not only of personnel, but also of heavy gear. The improvement in aircraft, and the increased weight-carrying ability of planes and gliders available for air movement has opened a new field.

CEC officers thus have a professional stake in what the airplane can do to make our Seabees more mobile and more effective. It is a foregone conclusion that more air transportation will be used in a future war. Although only a small number may serve in airborne units making assault landings from the air, many may be in air-transported units operating as a routine method of transportation.

CEC officers will be especially concerned with air transportability, since they have all the responsibilities of ground officers and are

Parachute supply drop (Paradrop).

The R 4 Q (C-119) can transport a 16,000-pound truck.

responsible for the construction, repair, and rehabilitation of air strips and air bases. The success of an airborne operation may easily depend upon the speed with which arrival airfields are made available and their serviceability for succeeding echelons of the airborne operation.

CEC officers will deal with the practical side of airborne operations. This means they must be familiar with the principles and practices of *air transportability*. However, understanding the purposes, advantages, and limitations of airborne *operations* gives us the reasons for the methods used in air transportability. Therefore, knowledge of the background and development of airborne operations is essential.

### *Yesterday's Airborne Operations*

The history of large scale military movements by air dates back to the beginning of World War II. Although the first airborne operation involving a division of parachutists was planned as far back as 1919 it was not until cargo-type aircraft had been developed that attempts were made to use planes in moving fighting ground troops. Before World War II, airborne operations had been limited to supply drops to French units in World War I, to U. S. Marines in Nicaragua, and to experimental military air movements.

In 1935 the Russians moved two divisions by air from Vladivostok to Moscow, a distance of 3,500 miles. By 1936 the U. S., the British, Germans, and Russians were using small parachute forces in field maneuvers. In 1938 a complete German infantry regiment was moved into Silesia in transport planes, and the same year the French organized one battalion of air-infantry but disbanded it in 1939.

### *The Russians*

Despite their early interest, the Russians made little use of airborne operations in World War II. Occasionally they used small paratroop forces in rather frantic attempts to block enemy armor which had penetrated far to their rear. Frequently they dropped saboteurs and guerrilla organizers in areas behind the Germans. But at no time did they employ airborne forces on a scale used by the Germans, Americans, or British. However, this may not have been through choice, but because of a lack of transport plane production, since the Russians were forced to concentrate upon production of arms for their chief combat forces—infantry, artillery and tanks. The extent of Russian airborne operations in the future cannot be estimated from the extent of their participation in such activities in the past.

**Present-day airborne operations can transport thousands of troops.**

### *The Germans*

The Germans were intensely interested in airborne techniques long before World War II for a good reason. Germany was strong in tanks and planes, but weak in warships. In armored "blitzkrieg" warfare, paratroopers can secure bridges and roadnets that tanks must use after penetrating to the rear of the enemy. Since most of the world's sea lanes were denied to them, the Germans realized that amphibious operations would be difficult. Airborne operations seemed to be the answer.

This reasoning was justified soon after the war began. When German panzer divisions swept across Holland in May 1940, paratroopers frequently seized key bridges before they could be destroyed. In Belgium, glider troops and paratroopers easily captured the powerful fortress, Eben Emael. When the Germans attempted an amphibious invasion of Norway, the British fleet filled the North Sea with German dead, but the Germans poured men and supplies into Norway by air at several lightly defended points and Norway fell.

The German seizure of Crete in May 1941 is probably the only major battle in history in which airborne units *alone* decided the issue. The initial assault and *supply support* were entirely by air during the early phases of the operation. The Germans actually planned to attack Crete from both the sea and the air, but British warships sank 40 percent of the seaborne convoys en route, and drove the rest back to port. There were really two amphibious expeditions, both of which failed.

In the air, it was a different story. Before D-day, the Luftwaffe bombed and strafed the island thoroughly. British planes on Crete finally had to leave to avoid annihilation. Once the air was cleared, the Germans landed gliders and paratroopers at four widely separated points. British and Greek defenders destroyed or bottled up the enemy at all but one of these airheads, but that was all the Germans needed. They flew in an air-transported mountain division and after seven days of bitter fighting, took the western end of Crete. By the time their regrouped amphibious forces reached the island, Allied resistance was broken.

The importance of this operation was that it first forcibly brought to the attention of the military world the actuality of transporting large fighting forces by air. It was no longer an academic subject, since 35,000 troops fully equipped for battle were flown into Crete utilizing an estimated 1,200 transport aircraft. This operation proved that even when a defender has well-trained and well-led troops in prepared positions, if the attacker is able to use air support and airborne supply he may overcome the defender.

*American Airborne Development*

When German airborne soldiers helped "grease the ways" for panzer units driving through Belgium, Holland, and France, we took immediate notice. Since at that time it was primarily an Army responsibility, the Chief of Staff, on 20 August 1940, directed that studies be made of "the organization, equipment, and tactical employment of parachute and air-transported infantry." Unlike the Germans, we decided that airborne units should belong to the ground forces, not to the air forces. Although they rode to battle in planes, we believed that airborne soldiers were essentially ground troops since they fought as such after landing.

By September 1940 we had activated a parachute battalion. And by the summer of 1941 we had a provisional parachute group. In March 1942, the newly formed Army Ground Forces organized an airborne command as one of the first steps in the creation of an airborne army. We had activated in 1944 five airborne divisions and six airborne regiments. We used our airborne troops in a primary airborne role on fourteen different occasions in World War II.

Obviously, when airborne forces of such great size are employed, they will need supporting forces, among which will be the ever-

A paratrooper carries a heavy load.

Bailing out.

important engineers. Our Marines, incidentally, are experimenting with airborne techniques and training regularly in airborne tactics. Also, there is every reason to believe that many Seabees will be air-transported in support of Navy forces in any future war. To gain a comprehensive view of just what an airborne operation entails it may be worthwhile to review some of these World War II operations.

*Sicily*

Sicily was the first big combat test for our airborne forces. Previously, U. S. paratroopers had jumped in North Africa, and had performed relatively minor missions on a battalion or smaller scale. But in Sicily (Operation Husky) they were used in strength at the crucial point of a major operation, their mission being to block a veteran enemy tank division moving to counterattack our beachhead in the Gela area.

Two things made this drop more difficult than usual. The jump was at night with only the light provided by the moon; and a 35-mile wind was blowing. Training jumps are usually called off when the wind velocity exceeds 15 miles an hour. Because of the high wind and our general inexperience, carrier planes scattered airborne troops in clusters over a wide area. Only one-eighth of the airborne force landed in the areas intended.

Despite this, small groups of paratroopers disrupted the enemy's counterattack everywhere. They took and held key strong points.

**The ground must be organized after landing.**

They seized portions of the main road from Gela inland, ambushing Germans and Italians who rushed to destroy our amphibious forces on the beaches. Fighting in front and alongside of ground troops, they helped delay a powerful enemy armored thrust long enough for amphibious troops to gain a toe hold.

There were plenty of mistakes in this airborne operation, and the strong wind was unexpected bad luck; but the airborne force accomplished its basic mission of softening the enemy counterattack against troops landing by water.

*Europe*

It took only a few hours to fly parachute battalions from distant African assembly areas for the Sicilian invasion. Later in World War II the Allies moved a corps through the air to fight behind enemy lines on three separate occasions. At one time an operation was planned that involved six airborne and four air-transported divisions. In this fashion, airborne operations came of age and provided a solution to the problem of concentrating men, firepower and equipment at distant battlefields at a modern, fast tempo. After Sicily, major airborne operations in Europe took place at Salerno, in Normandy and Holland, and during the Rhine crossing.

On the morning of 9 September 1943, an amphibious U. S. corps and an amphibious British corps hit the beaches of Salerno. Two days later, the Germans smashed between them and threatened to drive through to the sea. In this critical situation, two regimental combat teams of paratroopers were committed and jumped into the beachhead at night.

The regimental teams helped stem the enemy assault, and the boost they gave to the seaborne forces breaking out of the beachhead was probably a decisive influence on the outcome.

*Normandy*

Since airborne regiments had been so successful, it was reasoned that airborne divisions, which were greatly needed to assist amphibious forces scheduled to land at Utah Beach in Normandy, could be developed. Utah Beach, at the southeast corner of the Cotentin peninsula, was the only suitable landing area for seaborne forces near the vitally important port of Cherbourg. A short distance inland from the beach was a lagoon crossed by a few narrow causeways leading to the mainland. If the Germans held or destroyed these causeways, the strip of land between the lagoon and the ocean could easily become a death trap for seaborne invaders; so it was absolutely necessary to secure these exits from the beach.

It was decided that three divisions from the newly formed 1st Allied Airborne Army would be used for seizing these "sensitive" objectives. Two U. S. airborne divisions were to land in the Cotentin peninsula and a British airborne division was to drop near Caen some 35 miles east of Utah Beach. It was a delicate situation, for the Cotentin peninsula was covered with enemy units well-trained to handle airborne invaders. Obstacles in the form of hedgerows and German antiairborne barriers dotted the countryside. Antiaircraft batteries fringed the coastline of France over which troop carrier planes would pass.

The U. S. airborne division, which landed behind Utah Beach had more than a thousand troops on or near its division objective by H-hour. They seized the causeways over the lagoon and made contact with seaborne troops on D-day. Then they turned south to overrun a German parachute regiment and made possible the junction of two U. S. corps.

The other U. S. airborne division, which landed deep in the Cotentin peninsula, was similarly successful. Most of its paratroopers landed in an area about five by seven miles with the drop

Curtiss R 5 C (C-46)

roughly centered on the objective. Adequately supplied from the air, the division expanded its airhead. It fought for 33 consecutive days, along with amphibious troops, in the westward drive that cut off the Cotentin peninsula and helped secure the port of Cherbourg.

Near Caen, the British airborne division grabbed all assigned objectives by darkness of D-Day. The British, incidentally, handled their gliders in an unusual way. On reaching the coast of France, tow planes released gliders at an altitude between five and six thousand feet. Coasting silently to objectives, glider-borne troops gained complete surprise.

### *The Rhine*

"Operation Arena", the most ambitious airborne operation in history, was planned for March 1945 and called for six airborne divisions to strike at the heart of Germany. Four air-transported U.S. infantry divisions were to follow the initial air assault and this airborne army by itself would have created a minor front. Of interest to the Seabees is the fact that three airborne engineer battalions were included in the airborne forces.

However, Operation Arena was called off and instead an airborne corps, consisting of one U. S. and one British division, crossed the Rhine River by air in March 1945. It seized key terrain and permitted ground troops making an assault crossing of the Rhine to expand their bridgehead rapidly. This airborne operation differed from previous ones in two ways—the entire corps flew in one lift and dropped in zones within five miles of attacking ground forces.

This complex operation (Operation Varsity) required a huge number of transport planes assembled from the entire theater. For example, the U. S. airborne division used 298 parachute transports and 610 planes for towing 906 gliders. Its air column was 2 hours and 18 minutes long. Taking off from eleven dispersed airfields in England and fifteen in France, carrier planes converged over a command point and moved in three separate streams to the target area. In spite of heavy fire from the ground, the transports delivered 17,122 troops, 614 jeeps, 286 artillery pieces and mortars, plus hundreds of tons of gasoline, food and ammunition, to the corps airhead in about two hours.

Operation Varsity showed that airborne operations were now in the "big time" so far as modern warfare is concerned, and that they would have to be taken into account as another factor by both the offense and the defense. This operation is also interesting from a naval viewpoint for while it was far inland it was typical of and similar to a Navy airborne operation. The air troops were flown from hundreds of miles behind our lines, crossed a water barrier, and landed only a short distance in front of the front lines. In this respect it was much similar to the overwater airborne operation which would be necessary to secure a beachhead on a hostile shore.

### *Airborne Operations Against the Japs*

While most of the airborne fighting in World War II took place in Europe, our forces on the other side of the world made good use of planes to move and supply troops. In early 1944, our forces were fighting slowly through Burma against continuous Jap resistance and building the Ledo Road at the same time. It was decided that an airborne operation would furnish the ideal way for shutting off the Jap supply lines.

On the night of 5 March 1944, a special force of 26 tug planes took off from India and climbed 8,000 feet to clear the 7,000-foot mountains to the east. They flew 150 miles to establish an airhead 100 miles behind the enemy lines. In five days a force of over 9,000 men had been placed athwart Jap supply lines. In addition to personnel, almost 1,400 mules and ponies and 255 tons of supplies and equipment were delivered by D-plus-6. This was accomplished with 579

The reliable R 4 D (C-47)

plane sorties and 74 glider sorties. For about three months, this force was busily engaged in destroying roads, railroads, motor equipment and Japanese.

In November 1944 the Allied offensive in Northern Burma was progressing rapidly but in China the situation appeared grave. The Japanese forward elements were only 60 air miles from Kweiyang and if they took the city, they could sever the Burma Road. To block this threat it was decided to move two Chinese divisions from Burma to China. The two Chinese divisions were moved by air in 24 flying days with 1,351 sorties using C-46 and C-47 aircraft. To complete the movement the air transport flew in 25,000 Chinese soldiers, 250 American soldiers, 1,600 horses and mules, 42 jeeps, 144 artillery and mortar pieces, and miscellaneous supplies and equipment.

The notable features of this air movement were the rapid planning and efficient manner in which very large units that had no previous experience in air transport operations were carried over some of the world's worst flying terrain.

Corregidor, the island fortress in Manila Bay, was not an obvious target for airborne attack because of the apparent absence of landing areas. There were only three possible drop zones on "the Rock" the largest of which was a scant 300 by 150 yards. We knew it would be difficult to place airborne troops on Corregidor's rocky surface, and from the lack of antiairborne defenses it was quite evident that the Japs thought it was impossible.

On D-day morning in March 1945, assault boats carrying amphibious forces headed for the shores of Corregidor. At the same time, two long columns of planes flew over the island carrying a veteran parachute regiment. The landing areas were so small that a carrier plane could only drop about six paratroopers on each run. Like fighter planes bombing a target, the carrier planes continued to make passes at the landing strips until they had delivered their loads. Circling above the transports, a control plane directed pilots and paratroop jumpmasters by radio in the clear. These unorthodox tactics were highly successful. By noon of D-day, American airborne and seaborne forces were on the island's high ground shooting down at a confused enemy.

On 18 August 1945, Japan quit. On the morning of 30 August a huge fleet of troop carrier planes, assembled from all over the world, took off from Okinawa. These planes shuttled troops of an airborne division and an infantry division to Japan. That our army moved by air in the last big operation of World War II may be a forerunner of things to come.

### *Status of Airborne Operations*

On the basis of World War II experience, the U. S. today is superior in airborne operations to any other nation in the world. We should not, however, relax our efforts in further developing this new phase of modern warfare, even though we have the practical foundation of experience to evaluate new airborne equipment and techniques. Study of World War II airborne opera-

Transport plane R 5 D (C-54)

tions has established some basic and proven doctrine which can be used for guidance and planning.

Large-scale airborne operations are not feasible unless (1) air superiority is insured in the marshalling area, en route to the airhead, and above the landing zone; and (2) there are sufficient transport planes to assure an uninterrupted flow of troops and supplies to the airhead. The supply factor does not apply in a small scale raid in which the airborne forces do not intend to hold the ground.

Planes used for the transport of troops are particularly vulnerable in flight, and planes towing gliders cannot take evasive action. Planes arriving at the airhead zone are vulnerable when landing, unloading, and taking off. The need for air superiority is obvious. The Germans discovered this in 1943 when almost 100 per cent of their unescorted troop transport planes flying into Tunisia were knocked down.

To keep the air lanes free of enemy planes, our tactical air forces shoot down or drive off enemy planes. They strafe and bomb his airfields. Meanwhile, fighter bombers provide artillery support for airborne forces weak in organic artillery. They destroy enemy armor, break up his troop concentrations, silence his antiaircraft batteries. Our tactical planes spot enemy movement and radio this information to the troops on the ground. As the battle progresses, they protect the steady stream of planes that fly reinforcements and supplies between bases within our lines and the newly established airhead.

The giant Douglas "Globemaster" (C-74)

The Boeing "Stratofreighter" (C-97)

A large battle between airborne forces and ground defenders soon develops into a contest of build-ups. If the airborne forces build up men and material faster than the enemy about the airhead, they win; if not, they face annihilation. Weather, enemy activity, the number of planes used, the element of surprise, the distance from take-off fields to the airhead—these are some of the factors that affect the rate of build-up.

### *Use of Airborne Operations*

Airborne units have great strategic mobility. They can move great distances to strike with little warning; they can hurdle terrain obstacles to reach objectives inaccessible to ground troops; and their existence alone compels an enemy to disperse his forces to defend vulnerable areas.

Offensive troops somtimes find it too slow or too costly to gain ground by power alone against a solid defense. Airborne troops can then be used to envelop the enemy's "vertical flank" and attack him from the rear. Airborne soldiers cut his communications, maul his reserves, destroy his supply dumps, and overrun his positions. By hacking at the foundations of his defense they weaken it for ground attack.

This was the purpose of the airborne operation at the Rhine crossing, and this was the type of help given to our seaborne forces in Normandy when they pierced the defenses of Furtress Europa.

Frequently an enemy position such as Crete or Corregidor is strong because it is inaccessible. In the attack of an island, the airborne soldier

**Consolidated Vultee's C-99 resembles the B-36 bomber.**

is a full partner in the air-sea-ground team. Our Navy and Air Force isolate the island, preventing enemy reinforcement by air or sea. They soften up the island's defenses by bombing and shelling. Then our airborne forces land on top of the enemy while he tries to fight off amphibious troops. It is very demoralizing and makes it extremely difficult to concentrate on attackers landing in assault boats when paratroopers are dropping on top of you.

The plane is the quickest means to rush reinforcements to a unit in trouble. An enemy strong enough to threaten the unit with annihilation is often strong enough to block aid from the land or sea. An example was the desperate situation at Salerno where an airborne division flew from Sicily into the beachhead in a few hours.

There are many uses for airborne operations other than those developed in World War II. Troops can be landed from the sky to delay a retreating enemy. Dropping small airborne raiding parties to destroy important military or industrial installations is practical. After such a raid, airborne troops may withdraw by either air or water or infiltrate through enemy lines. In February 1945, a company of airborne troops withdrew by boat along with some 2,000 Allied prisoners after a successful raid on the Japanese prison camp of Los Banos in the Philippines. Airborne troops can be used to counterattack enemy airborne forces. Airborne landings are usually made in areas which are lightly defended, and it is important that mobile units —such as airborne troops—be rushed in as reinforcements for local ground troops before the enemy can establish a strong airhead.

### *Characteristics of Airborne Operations*

The basic rules of ground warfare also apply to airborne warfare. But an airborne operation requires more detailed planning and more precision in execution than does a ground operation. Accurate intelligence of the enemy is of greater importance and is more difficult to obtain. Troop movements by air are less flexible than on the ground and must progress with split-second timing. The supply plan must take into account all manner of unforeseen and pressing needs.

### *Intelligence*

In ground warfare information about the enemy can usually be obtained without unusual effort because the opposing forces are physically close together. Observation posts see and hear enemy activity; patrols penetrate his lines to note strong points, the location of heavy weapons, and reserves; and intelligence personnel interrogate local civilians. Even if a mission fails because of faulty information, there is frequently a second chance. With an airborne operation, accurate intelligence is much more important. If airborne planners seriously underestimate enemy strength in a drop area it may prove fatal. A strong enemy ground force at an airhead is capable of defeating an airborne unit in detail before it can become established.

Gathering accurate information for airborne operations is a more difficult job than it is for ground operations. There are no observation posts or patrols, and civilian reports usually come from undercover informants. These reports are hard to get, are frequently "cold", and often conflicting. Most intelligence comes from aerial photographs and observation flights. While this information is valuable it is not always easy to interpret.

### *Operations*

Airborne soldiers in gliders or planes are only passengers. The pilot is in charge and makes all decisions concerning the flight. He sets the time when the paratroop jumpmaster will give the order to jump. Conventional navigational aids are used to arrive over the general area of the drop zone, but real difficulty may be experienced in spotting the small plots of ground on which to deliver the paratroopers or air-transported soldiers. There is no powerful radio beam to guide the planes in and no huge searchlights to aid them at night. Flying in formation, they cannot circle at leisure while looking for their targets. Enemy antiaircraft fire, fog, and battlefield haze complicate their task. For this reason, pathfinder teams of airborne soldiers usually precede plane formations. The pathfinders land, locate drop zones, and use visual or radio signal equipment to "bring in" the planes or gliders.

Normally, the leading troop transports carry paratroopers. They come in at altitudes from 400 to 600 feet and a man is on the ground from 16 to 24 seconds after he jumps. Under favorable conditions, a whole parachute battalion can land in an area 500 by 800 yards in 2 minutes. Glider-borne and air-transported troops follow.

There is a certain amount of disorganization when airborne troops first land, especially in a night drop. Since they land near their objectives to achieve maximum surprise, they often get into a fight immediately after hitting the ground. Despite the initial confusion, airborne units must organize rapidly and attack quickly and aggressively before the enemy has time to prepare his defense. Fanning out to widen their airhead, airborne troops seize assigned objectives and prepare to beat off counterattacks.

Their ability to beat back counterattacks and hold what they have seized decides the success or failure of the operation. Airborne troops are offensive forces until they hit the ground. However, since they lack adequate transportation, artillery, and tanks, they cannot sustain offensive action. This is one reason why, in World War II, we did not drop airborne troops too far from ground or seaborne forces who could link up with them at an early date. Through surprise, lightly-armed troops can achieve spectacular results, but they are not equipped to hold on indefinitely when surprise is over. The enemy can outmatch them in tanks and heavy guns.

Despite the use of pathfinders and careful preliminary planning, airborne units sometimes drop in the wrong area. All airborne soldiers must therefore have a clear picture of the overall operation and must be briefed thoroughly beforehand.

**Fairchild's "Packet" (C-82) was the "Flying Boxcar" of the air.**

In ground warfare, supporting troops can expect routine protection from their infantry but this is not always true of an airborne action. Units of an airborne team do not always land in the right order so that every unit must be prepared to fight as infantry in defending itself.

*Logistics*

An airborne soldier lands with the minimum weapons, ammunition, and equipment necessary for his initial task. From then on, he is almost entirely dependent on his air supply line. Severed from this source, he cannot last long against a strong enemy. First supplies are often dropped from planes but this method of delivery has drawbacks. Packages are scattered over a large area, some may fall into enemy hands, and airborne troops in a fight may not be able to spare the men needed to pick them up. Gliders come in next with supplies and then powered planes follow. As airborne engineers improve landing strips, more planes with more supplies can land more quickly.

A landing area in an airborne operation would make the busiest commercial airport look quiet by comparison. Gliders in double tow come in at the rate of 15 or 20 per minute. Long lines of powered planes hit landing strips, then taxi rapidly to unloading areas. Planes crack up and must be removed immediately before they create a traffic bottleneck. Meanwhile, enemy artillery, or even small arms fire, may be hitting the field and adding to normal confusion.

Planes leaving the airhead may sometimes fly back with a load of wounded. This is not easy

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Fairchild's C-119 is an improved version of the "Flying Boxcar."

Fairchild's C-120 carries a large cargo "pod" under its belly.

in the heat of battle and with little transportation available to move the wounded to air strips. When the occasion demands, special medical teams fly into the airhead to assist an airborne unit's organic medical personnel. The evacuation of wounded and the movement of supplies and reinforcements to support an offensive are some of the most difficult problems of modern warfare. In airborne warfare of the future the logistical aspects may be the major limiting factors.

*Planes*

In reviewing air transportability, one should have a practical knowledge of the characteristics of the planes available for large-scale air movements. The trend in transport planes is always towards larger aircraft with greatly increased payloads. This is reflected in the new models being constructed and flight-tested. They carry a tremendously heavy cargo and an unbelievably large number of troops.

Any study of air transportability based on these new and future types is misleading. There is generally only one (the prototype) in existence and this pilot model may never be available in sufficient numbers for air movements of a substantial size. Even if these new giant transports were used for air movements while still in the testing stage, it would be unnecessary for the CEC officer to be familiar with the cargo characteristics. In such an improbable situation, every detail of the planning and loading would be handled by a special unit.

As far as the CEC officer and air transportability are concerned, we can check off the new outsize planes and instead become familiar with air transports actually being used now. As Navy men, we will consider the seaplanes first. With the exception of the Martin *Mars* we do not have large seaplanes designed specifically for the air transport of personnel and material. The *Mars* is an efficient personnel carrier but it is rather slow by current standards. It has a satisfactory payload and can carry equipment the size of a jeep, but is difficult to load without special equipment. In addition, a sufficient number of planes are not available for making an air lift of any considerable size.

The twin-engine Martin *Mariner* (PBM) is still available, and the PB2Y2 saw some service as a personnel carrier, but neither of these planes is suitable for cargo or personnel transport. They were designed basically as patrol bombers for long range missions and are not really suited for other service. The Navy does not have available a sufficient number of seaplanes of a type suitable for large air movements.

Since the seaplanes available to the Navy for large-scale air movements are limited we will turn to land planes. Here again our interest will center on transport planes currently available and likely to be available for the next 2 or 3 years. In this field the Navy is using the R5D (C-54) and the Fairchild C-119. The Marines are getting the C-119 with the Navy designation R4Q. Also, the Navy is getting the Douglas C-118A (R6D)—a cargo version of the DC6-A, and the Lockheed C-121 (R7Q). Many CEC

**Lockheed's "Constellation" (C-121) is another giant of the air.**

**The Chase C-122 is the CG-18 glider with motors.**

officers may be familiar with the Douglas (R4D) and the *Commando* (R5C) and question the advisability of using the C-118A, C-119 and C-121 which are Air Force transports.

The R4D (C-47) is an excellent and thoroughly reliable plane. It is basically a 1934 design, however, and does not meet current requirements. Though still used as utility aircraft, it has been superseded by larger planes with greater payload and longer range. To a lesser degree, the same limitations apply to the R5C (C-46). Although the R5C has almost twice the payload of the R4D, a longer range, and is still in operational use, it is considered obsolete and is no longer being procured.

The four-engine Douglas *Skymaster* with various modifications, is used by the Navy, Air Force and commercial air lines. The Navy calls it an R5D, the Air Force a C-54, and the airlines a DC-4.

The CEC officer involved in planning or preparing planes for an air movement is not much interested in the technical features of an aircraft. His chief interest is *how much* the plane can carry—how many people and how much gear. Also, *what kind* of gear can be put aboard. This is what is commonly known as "payload."

Payload for a plane is not as simple as the tonnage capacity of a ship. The cargo capacity of a ship is relatively static while the payload of a plane varies widely depending upon the type of load carried. The computation of the payload for a particular flight must make allowance for all pertinent factors. The payload of an R5D can be considered as five tons for medium to long range and about nine tons for short range. These figures are only general for this type of aircraft, and do not apply to any one plane on a specific flight. For instance, on the Berlin airlift, the payload was ten tons for a flight of less than 250 miles.

The cargo compartment of the R5D is 43 feet long and 8½ feet wide at the deckline. There is about 7½ feet overhead clearance in the center but it tapers sharply toward the sides. The cargo door is eight feet wide and 5½ feet high and is located at the rear on the port side. Its size limits the size of items of equipment that can be loaded.

The R5D carries 35 passengers but 50 or more can easily be carried within the limits of the payload. Fittings are provided for 36 litters when the aircraft is used for evacuation.

The ¼-ton truck (jeep) is the largest vehicle that can normally be loaded without some disassembly. The ¾-ton truck and the 1½-ton weapons carrier can be loaded if they are partially stripped. One of the difficulties in loading is that the bottom sill of the cargo door is nine feet from the ground and is located on the left side of the cargo compartment. This means that vehicles have to be turned 90° in order to be moved forward in the cargo compartment which complicates and slows down loading and unloading. Ramps are used for loading vehicles and jeeps can be loaded with a ¼-ton trailer in tow. It is also possible to load the 105-mm howitzer, although the standard prime mover for this weapon cannot be carried.

Any equipment and supplies which can be handled through the cargo door can usually be loaded. In other words, anything the size of a jeep or smaller. This includes all types of supplies and practically the entire list of basic weapons of infantry units. Some aids such as the fork-lift truck, must be provided to boost these loads but are not always available. Loads that can be man-handled can usually be loaded from the body of a regular 2½-ton cargo truck backed up to the aircraft. To find how many R5D aircraft it will take to move a unit by air we use the plane payload. By assuming a fixed payload commensurate with the flight radius and knowing the weight of personnel, equipment and supplies, we can calculate the number of lifts required. The weight of equipment and supplies should be readily available in tonnage data files and 220 pounds can be used as the weight of a soldier together with his weapon, ammunition, rations, and combat gear.

The Fairchild C-119 (R4Q) is an improved version of the C-82 *Packet* or *Flying Boxcar*. The C-119 is a twin-engine transport with a high twin-boom tail assembly which permits the fuselage to be shaped like a rectangular box. It is specifically designed as a troop and cargo carrier. Military freight can be loaded up a ramp and through clamshell doors which open up the entire rear of the square-sided cargo hold. Loading at truck bed level (about four feet from the ground) is a particularly valuable transport feature, and a side loading door is also available at the forward end of the hold.

The cargo compartment is a rectangular box 36 feet 11 inches long, 9 feet 10 inches wide, and 8 feet high. This is only slightly smaller than a standard railway boxcar. The C-119 can carry a maximum payload of 15 tons for 500 miles, approximately 12 tons for 1,000 miles, or about 10 tons for 1500 miles.

The basic mission of the C-119 is to deposit a maximum load of personnel, supplies, or equipment at a base 750 miles out and return without refueling. It is designed to carry 42 troops as a normal load but can accommodate 64 troops as a maximum load. Rigged as an ambulance plane, it can carry 38 litter patients with four attendants and the flight crew of five. Strap suspension litters can be installed in 20 minutes.

Paracans of supplies suspended from the ceiling of the cargo hold, on an electrically-operated monorail, are released on signal through a hatch in the forward end of the hold. Jump doors on each side of the cargo compartment provide rapid exit for paratroopers. Troops and equipment can be dropped simultaneously, permitting a closer grouping on the ground.

The C-119 can also be used as a glider tow plane. Because of its versatility and the ease with which it can be adapted to many types of operations, the C-119 is one of the best of the transport planes.

The characteristics of two of the outstanding and widely-used transport planes have been described here. Numerous other types of cargo planes, which incorporate important improvements in their design, are being developed but have not reached the production line stage.

**The Chase C-123 is the CG-20 glider with motors.**

**The Douglas C-124 can carry a light tank.**

**Sample loads for the C-124.**

The principles which govern the employment of cargo planes in an air transport operation will apply with equal force to the new type planes. Therefore, familiarity with many types of cargo planes is not essential, but knowledge of loading techniques and how transport planes are used will be valuable regardless of the future types you may encounter and work with.

### *Air Transportability*

The CEC officer working in the role of ground officer responsible for arranging supplies for air movement is going to be vitally concerned with the practical details of preparing the aircraft.

He will need to know those characteristics of the transport aircraft which restrict the size and weight of cargo that may be carried. They are as follows:

1. Size and location of the cargo door.
2. Height of the cargo door from the ground.
3. Size of the cargo compartment.
4. Strength of cargo floor.
5. Location and strength of cargo tie-down fittings.
6. Number and type of seats.
7. Allowable cargo loads.
8. Maximum gross loads.
9. Limitations on position of center of gravity.
10. Availability of loading aids.

The bulk of the work is concerned with loading, lashing, unloading, and computing and checking balance. For this reason, there are four principles which should be remembered and understood.

1. The payload must not be exceeded.
2. The load must be properly distributed so as not to exceed the allowable unit loading on the cargo compartment deck.
3. The load must be properly balanced.
4. The cargo must be properly loaded and lashed.


**Northop's C-125 is adaptable to the Arctic.**

Most of this knowledge can be acquired by normal study or experience but some of it warrants a more detailed explanation.

### *Payload*

Those factors which influence the payload (weight of cargo including passengers) have already been mentioned. From another viewpoint, payload is the useful lift remaining after allowances have been made for the weight of the plane, the crew, gasoline, oil, miscellaneous extras, and certain necessary safety factors.

For a particular plane on a specific flight all the load factors are fixed, with the exception of the payload. If the calculated safe payload is exceeded something may fail, and the only thing that can "give" is the safety factors. Lowering the safety factors is extremely dangerous. An overloaded plane is sluggish in flight, consumes fuel at an exorbitant rate, and may crash on landing or takeoff. The "maximum gross weight" is often the limiting factor in computing and checking payload.

**Northop's C-125A in flight.**

The CEC officer assigned as ground officer for an air movement will not be expected to compute payload. That task is a responsibility of the Air Force. The payload limit for a plane will be furnished in the early planning stage, and the important point is—*it must not be exceeded*. Overloading the plane will endanger the aircraft, the crew, the cargo, and the passengers. In a large-scale troop movement payload calculations are much too close to permit any overloading. Weight is generally the critical factor in aircraft loading. With most military cargo, a full payload does not fill the cargo compartment, but although there may be plenty of room left in a loaded transport aircraft, it cannot be assumed that all this space can be filled with additional gear.

### *Load Concentration*

Distributing loads over the deck of the cargo hold, and assuring that the allowable unit loading will not be exceeded, is a comparatively simple matter. For example, the allowable unit load for the cargo deck may be 150 pounds per square foot, while the concentrated loads on the wheels and trail piece of a 105mm howitzer may exceed this limit. The area over which the loads must be spread can be easily determined by dividing each concentrated load by the allowable unit deck load. This gives the required area in square feet. Then lumber of a suitable size and rigidity, such as 2x4s, 2x12s, etc., can be selected to support the concentrated loads and distribute them over sufficient deck area. This lumber is usually braced and fastened together to form a convenient and easily-handled frame.

In most cases suitable pallets can be constructed for accommodating dense loads. They provide a strong platform for air cargo without adding too much weight, and are easier to handle, during loading and unloading, than most of the other forms of packaging. For these reasons, pallets are widely used in airborne operations.

Basically, load distribution on the cargo deck is nothing more than a question of weight-density. When a weight-density is too great it is reduced by spreading it over a larger area.

*Balance*

Transport aircraft loading is basically "weight and balance control." "Weight control" means observing the payload figure set by the Air Force. "Balance control" boils down to proper location of aircraft cargo weights.

A loaded transport aircraft must be in balance in two directions. The first is lateral—or sideways toward the wings. Balance in this direction is not too difficult to achieve since the cargo compartment is long and narrow and is centered on the longitudinal axis of the aircraft. Cargo is always located near the center line and consequently will not influence the lateral balance greatly. Lateral balance is usually obtained "by inspection" during loading, which means that heavy items of cargo are located on or near the center-line or are balanced about this line.

Balance longitudinally (fore and aft) is much more important since the position of the cargo in this direction makes a great difference. Longitudinal balance concerns the location of the center of gravity (CG) of the aircraft. With lateral balance correctly maintained, the CG is located somewhere along the centerline (longitudinal axis) of the aircraft. In order to specify any given point along that line, the longitudinal axis is scaled off in inches. The zero point where the scale starts can be any conveniently and easily located point on the plane. For simplicity, the nose of the aircraft is usually selected as the zero point and the scale is graduated in inches toward the rear. The points along the scale are called "Station Numbers", and station number markings are stenciled on the frames or inside the fuselage. With this scale the CG can be located from the nose. For example, where the CG is 300 inches from the nose, it can be said that the CG is at "Station Number 300".

Loading cargo into an aircraft will shift the CG, so that the points farthest forward and farthest aft to which the CG may move, and still permit the aircraft to be flown with acceptable safety factors, must be calculated and established. The distance between these points is known as "CG travel". The basic principle in loading (that the load must be properly balanced) can be stated in more understandable language by saying—the CG of the loaded aircraft must be between the two station numbers set as the limits to CG travel. This may seem too technical an explanation for ground officers working on an air movement but it is important to understand why the cargo must be spotted accurately in the cargo compartment, and why balance considerations and not convenience must govern loading.

**The Chase CG-18 all metal glider.**

Knowing how cargo placement affects the CG of the aircraft is an aid to good loading practice. The CG of most transport aircraft is located well forward in the cargo compartment. Heavy items of cargo must be stowed well forward in the compartment and only light cargo, if any at all, is loaded in the after sections. A heavy cargo item located at the station number

**The Chase CG-20 glider.**

of the CG, will not shift the CG, but when the cargo is moved to the rear, the CG moves aft and the aircraft becomes tail-heavy. When the cargo is moved forward, the CG moves forward and the aircraft becomes nose-heavy. The effect of such movement is a function not only of the weight, but also of the distance from the original CG, or its moment arm. A weight located away from the CG produces a moment about the CG. A moment is a product of weight times distance or moment arm. This means that a 200-pound box located 100 inches to the rear of the CG will have exactly the same effect on the longitudinal stability of the aircraft as a 100-pound box located 200 inches to the rear of the CG, since in both cases the moment (weight x distance) is the same.

In order to make sure the loaded aircraft is in proper longitudinal balance, it is necessary to compute the CG and check it against allowable limits. This is not really complicated and may be done arithmetically. However, the most expedient way of determining the CG, and the way it is normally done in practice, is to use the "Load Adjuster", a slide rule specifically designed for this computation. The final determination of the longitudinal stability (location of the CG) is the responsibility of the pilot or plane commander because it directly affects the safety of the aircraft in flight. However all ground officers engaged in aircraft loading must understand the importance of proper positioning of cargo even though they do not have final responsibility.

*Lashing*

Another basic principle—that cargo must be lashed securely—logically accompanies the rules for weight and balance control.

Accurately computing the cargo position required for longitudinal stability is useless if the cargo shifts on take-off or landing and changes the balance. Where shifting cargo in a ship at sea can be very serious, in a transport aircraft in flight it can be disastrous. In addition to changing the stability, the shifting cargo may seriously damage the aircraft and endanger the passengers in the cargo compartment.

In an air movement, loading and lashing of cargo is normally done by troops under the technical supervision of the pilot or crew chief of the aircraft. A variety of materials can be used as lashings. For moderate to heavy loads, ½-inch Manila line is the best and most commonly used lashing. It has a working strength of 2000 pounds. Chain, with a working strength of 3,900 pounds, is used for extremely heavy loads. Some planes are equipped with kits that contain lengths of chain, pull-jacks for tightening, and devices to hold the chain tight. Light bulky cargo can be held in place with nets. These nets are particularly useful when the cargo lacks the strength to sustain heavy lashing or where there is no place to attach other lashing.

**Tow-bar for glider tug.**

Lashing must secure the cargo from movement in three directions—laterally, fore and aft, and up. The heaviest lashings are placed to prevent the forward movement of cargo in the event of a crash landing or other sudden deceleration.

Transport aircraft are provided with "tie-downs" or fittings to which the cargo lashings can be secured. Some of these tie-downs are in the deck and others are located along the lower inside of the fuselage. The lashing crew must be taught to use the tie-downs and not to secure lashings to any convenient frame or tubing. Not all the tie-downs are of the same strength. For example, the R5D has some 40 tie-downs in the deck that will sustain an upward pull of 800 pounds, 25 that will carry 200 pounds, and 16 that will hold 2,500 pounds.

*Loading and Unloading*

There are various methods for handling the diversified cargo that goes into a military transport plane, ranging from simple hand loading to specialized techniques such as conveyor-belt loading. All types are not applicable to all transport aircraft, but familiarization with the numerous cargo handling processes will allow the ground officer in an air movement to select the most efficient method available.

Current cargo loading techniques are somewhat inefficient for large military transport planes and become even less suitable to the large, double-deck, heavy (25-ton payload) aircraft being developed. They consist primarily of depositing a pallet load of freight on the cargo floor at the door opening by means of a fork-lift truck. Then individual boxes are manually carried into the cargo compartment and are stacked and nested into position.

Heavier cargo is deposited on the doorsill by fork-lift trucks, external hoists, or cranes. Then these heavy cargo items are pushed by brute force, pried with crowbars, and rolled on steel pipe until they are finally positioned. This type of cargo loading usually results in damage to door openings, floors, fuselage frames, and cargo. When such methods are applied to the ever-increasing payloads of modern aircraft they result in many wasted man-hours and the plane is grounded for too long a period during loading and unloading.

As payloads increase in size and weight the type of cargo becomes more diversified. Transport planes will continue to handle the customary low and medium density cargo and, to an increasing extent, will also be required to handle high density cargo such as construction equipment, machinery, portable repair shops, radar trailers, missile launchers and other concentrated-weight items. Personnel transportation will, of course, always be necessary.


Helicopter litter operations.

In inspecting and evaluating the loading requirements for modern military air transport it is apparent that:

1. Ramp loading will be required for vehicles.
2. Hoist loading will be required for crated engines, aircraft spares, machinery and similar items of concentrated weight.
3. High cargo compartments will be required to carry military vehicles. Therefore, auxiliary floors will be required to utilize the resulting high cargo compartment for low density cargo.

Many different methods can be employed to facilitate cargo loadings of large transport aircraft: Dollies and pallets with preloaded cargo speed up loading at small sacrifice in payload; fork-lift trucks can be used inside and outside an airplane; trucks can be positioned at openings; and hoists furnished as airplane equipment can be utilized. Ramps, integral with the airplane or as ground equipment, are almost a necessity for large vehicles and can be used for handling many other types of loads. Also, there will always be some cargo which can be handled most efficiently by hand at some stages of loading.

It would be impossible to enumerate or evaluate all the transport plane characteristics, cargo types, situations, and special conditions influencing the choice of loading and unloading methods. The CEC officer who may be assigned as ground officer in an air movement will have to solve each loading problem as it arises since no two will be exactly the same. Grasp of the principles stated here and familiarization with air transportability may be of some aid in such an assignment.

### *Air Transport Developments*

At present, cargo aircraft are the subject of a tremendous amount of research and development. Much of this work is a result of both World War II experience and military applications in the use of bigger and better transport planes. In the initial phases of a sudden emergency, we would, of course, rely upon present types of military and civilian cargo aircraft.

**Small fields can accommodate helicopters.**

However, development of the larger, advanced types of cargo aircraft would be much more rapid under wartime pressure and will also take place, but at a slower pace, during peacetime. So, we can expect great progress in airborne operations and we will see the new large cargo aircraft in routine use in any event.

The general development program for cargo aircraft is given in the following, and some of the goals are to:

1. Develop a medium cargo airplane capable of transporting 16,000—20,000 pounds in tactical operations (C-119).

2. Develop a heavy cargo airplane capable of transporting 50,000 pounds in tactical operations (C-124).

3. Produce an 8,000-pound-payload glider (CG-18) and ultimately to develop an 8,000-pound-payload light-assault airplane capable of equalling glider landing performance (C-122).

4. Produce a 16,000-pound-payload glider (CG-20) and a 16,000-pound-payload medium-assault airplane with glider landing performance (C-123).

5. Improve helicopters for use as cargo aircraft (H-16, H-17).

6. Improve techniques and equipment for dropping heavy loads by parachute.

7. Develop tracked landing gear, deceleration devices, jet assists, and related equipment to permit operations from small unprepared fields.

8. Develop detachable fuselages, together with fuselages that can be dropped, thus extending the possibilities of cargo handling and dropping (C-120).

### *New Aircraft*

Some of the aims stated above are well on the way to accomplishment. Aircraft which meet the specifications are in the design or experimental and testing stage while others are being produced and delivered. Some of the most promising projects are listed below.

The C-47 (R4D) of World War II was one of the standard planes used by our paratroopers. It took nine of them to carry a company. Today, three *Flying Boxcars* (C-119s) will do the job.

The Douglas C-124 is a bigger version of the C-74 and is designed to carry 50,000 pounds, 1,000 miles and return. It can carry heavy ground force equipment, or 222 fully equipped troops, or 138 litter patients, or a great variety of mixed cargo. It loads and unloads through clamshell nose doors and up a nose ramp. It has an electric elevator amidships and two power-operated power-traversing, cranes with a total capacity of 16,000 pounds that travel on two overhead rails for the entire length of the cargo compartment. The C-124 can accommodate an M-24 light tank or a 155-mm gun.

The Boeing *Stratofreighter* (C-97) is a cargo version of the famous B-29 bomber. It can carry 136 troops, has a top speed of more than 375 mph, a combat radius of 1,100 miles, and a 4,000-mile maximum range.

Convair's C-99 is a six-engine cargo plane resembling the B-36 bomber. It can carry 400 men, has a top speed of over 300 mph, and a maximum flying range around 8,000 miles.

One trouble with these huge planes is the restricted number of fields on which they can land because of high-ground pressures and long runways required. Two systems being developed to reduce ground pressure are track landing gear and multiple wheel landing gear. On a C-82, the track landing gear decreases the ground pressure from 70 to 25 pounds per square inch but has the disadvantage of decreasing the payload by 1,200 pounds.

Reducing the length of takeoffs and landings reduces runway lengths required and, as a consequence, reduces the work in building airfields and greatly increases the number of fields available. Reversible propellors and jet assisted takeoffs (JATO) are being used to reduce landing and take-off runs. Undrawn nylon ropes, steel cables, reverse JATO, parachutes and other devices are being used and tested.

One of the major delaying factors in an airborne operation is the time it takes to unload a plane at the airhead and to reload it at the air base. This is particularly serious when planes are scarce and must do a lot of shuttling. To eliminate this delay a plane with a cargo compartment called a "pod" has been designed and tested, and is now in production.

This plane is the Fairchild C-120, and is essentially a C-119 with a detachable cargo compartment, which can be towed on the ground by a prime mover. The basic airplane is designed to fly with or without the cargo compartment. The plane detaches the pod as soon as it lands, and since the pod is equipped with wheels it can be quickly towed from the landing strip. The transport plane, freed of the weight of the pod, returns to the initial take-off field with less consumption of gasoline, where it picks up another pod already loaded with troops or supplies.

Gliders have been greatly improved. The CG-4A of World War II carried 13 men besides a pilot and co-pilot. The new CG-18 light assault glider carries 30 men in addition to its crew.

The CG-18 and CG-20 are all metal, salvageable type gliders, and will undoubtedly replace the CG-15A, which is constructed of tubular steel, wood and fabric, and is subject to rapid deterioration. Also, the CG-15A is limited to a 3,800-pound payload, which is now insufficient for assault operations.

The C-122 and C-123 are powered versions of the CG-18 and CG-20, and are presently being service tested. Should these aircraft prove successful, they will replace the CG-18 and CG-20 gliders since they will be capable of the same role and will have the advantage of power.

The 300-foot tow used on gliders in World War II is too long because it lengthens the air column and makes control more difficult. Improved tow ropes and tow bars are being experimented with and show promise of good results.

Some airborne development workers believe that a better powered plane, perhaps the helicopter, which can land wherever the glider can, will replace the glider altogether. They also claim that within five years a plane of this sort will eliminate the need for paratroopers. The Navy and Marine Corps is at present taking the lead in helicopter research, and it is hoped that a ship of this type will eventually be built which can lift loads as large as light earth handling equipment (4,000 to 6,000 pounds) for building airfields, plane-servicing equipment, damaged critical machines, and repair parts.

The H-16 and H-17 helicopters are the two models now being developed. The H-16 is in the prototype stage and will have a load capacity only slightly less than that of a C-54. The H-17 has ram-jet propulsion which greatly increases its load-carrying capabilities.

The misplaced troop and cargo drops of World War II emphasized the need for effective pathfinding equipment. Panels, smoke, flares, and radio equipment such as the *Rebecca-Eureka* set were used. The Rebecca component of this set is in the plane and sends a signal to the Eureka component on the ground. Eureka picks up the signal and automatically sends it back on another frequency. The change in frequency tells the plane's pilot how close he is to the

**The Piasecki helicopter (XH-16) can transport the cargo pod of the Fairchild C-120.**

landing area and permits him to land near the Eureka. A recently developed pathfinding set sends infra-red ray signals from the ground to the plane. The naked eye cannot see the infra-red ray, so that this device helps pathfinder signalers to escape enemy detection. For this same reason, infra-red equipment is being developed to aid airborne forces to communicate while in enemy territory.

Considerable research is also being conducted in dropping heavy equipment by parachute. At present experiments have been made principally with 105-mm howitzers and jeeps, but even heavier drops are contemplated. A similar project is the *Speed-pak* now being used on commercial aircraft, which permits additional cargo to be stowed on the exterior of the plane.

### *BUDOCKS RESEARCH*

Concurrently with the development of bigger planes to carry heavier equipment, the Navy is making its equipment lighter and less bulky for air transport. The chief aim of the airborne material development program of BuDocks is to adapt advanced base equipment, structures, and utilities to air transport. This program is producing items which weigh and cube less but which will perform the same functions as well or better, than similar currently used items.

Four pieces of lightweight equipment which have been developed by BuDocks and have proved an outstanding success are the motor grader, electric generator, engine-driven welding unit, and the air compressor.

The lightweight motor grader and the air compressor have already been mentioned. So far as air transportability is concerned, the chief points of interest are a weight reduction of 5,000 pounds in the motor grader and 4,200 pounds in the air compressor. In addition both units are smaller in size than comparable ground machines.

The 60-kilowatt electric generating set, one of a series, was designed with a 3,500-pound savings in weight and resulted in a generator weighing only 3,000 pounds. The new unit also incorporates some unique and valuable features which make it a distinct departure from conventional designs.

The lightweight electric driven welding unit now weighs 1,250 pounds as against 2,900 pounds for the older type unit. In addition to the 1,650-pound weight saving the new unit is sturdily constructed, flexible in operation, and much smaller in size.

BuDocks is also concerned with the savings that may be effected by proper airborne packaging, but since this field of endeavor falls more properly within the functions of BuSandA, we have only a technical interest. However, airborne structures and equipment and the lightening and disassembly of equipment is a BuDocks function. Consequently research and development in these fields will continue for every item that can be adapted to air transport.

# CHAPTER XII
# REDEPLOYMENT

REDEPLOYMENT AS USED HERE is simply the name given to the operation of transporting units to a new site after they have completed their tasks at the advanced base. There are numerous reasons for such a movement. The theater command may require a number of bases at widely separated locations within the theater; the combat forces may have moved forward far enough so that new advanced bases are needed up ahead to support them; or the strategic and tactical situation may require construction of more advanced bases.

Regardless of the reason for such a movement, the unit being redeployed is going to bump into some new and different "headaches". When first "shipping out" from the States many of those things, such as planning, training, and supply were already done for the unit. In redeploying to a new site much of this work must be done by you and your unit.

The problems involved in moving to the new site are so varied and so dependent upon local conditions that no standard rules have been written for guidance and there is no basic doctrine to which you must conform. In many ways this is an advantage, for you can base your actions on the best precedent possible; the hard, practical experience in the campaign you have just completed. Here, perhaps more than anywhere else, the success of the operation depends upon the resourcefulness, initiative, and experience of the individual.

### *Regrouping*

The first step in redeployment may involve a minor, but fair-sized movement in itself. It is very likely that the unit will be assembled in a rear area before it is sent forward to the new site. In an island area, such as the southwest Pacific in World War II, this may require the unit to board ship. In other cases it may involve either a short or long trip by motor transport and rail.

If the outfit is to retain the bulk of its equipment and supply during the regrouping, then the movement to the rear area will be of major proportions and entail a lot of work.

Your redeployment work will be with Seabee groups like this.

Some problems of redeployment come immediately after the unit receives the alerting notice or the order for the movement. The first question which arises is in regard to equipment, that is—"What shall we take and what shall we leave behind?" The alerting notice or movement order may or may not indicate how the unit will dispose of its equipment. Even where disposition of equipment is covered by the directive, the Seabees, with their well-known ingenuity may have improvised, and become so attached to some workable gadget that they want to keep it, or equipment disposal may not be detailed in its entirety.

So you may be responsible for selecting your own equipment. By this time you will have finished your first campaign and will have a good knowledge of the capabilities of organizational and other equipment which may have been furnished to, or acquired by your unit. Although it may be difficult to obtain in the regrouping phase of redeployment, you should uncover as much information as possible about the new operation and the new advanced base site to which you are going. With all this information at hand you can weigh factors such as mission, time, available labor, and economy, and decide what equipment shall be released or retained.

## PROGRAM

Before your Seabee unit ever reaches the assembly or staging area a program should be planned in order to utilize all available time to prepare for the next assignment. This program will, in most cases, be planned and prepared by the officers of the Seabee unit. It may be affected by the future mission and may be influenced by policies originating in higher headquarters, but the execution of the program will be a unit responsibility. And it is important that the program be placed into effect immediately after arrival in the assembly area.

**Men should be given the opportunity for religious worship.**

**Sports are an important part of the recreation program.**

### *Rehabilitation*

One of the first considerations in the regrouping operation will be to bring all the men in the command into the best possible physical and mental shape. This is not so difficult a job as it might appear to the inexperienced. For one thing, the average member of the unit is *not* going to be a dejected, wornout physical wreck, as the man returning from the combat zone is so often pictured.

The Seabee returning from the advanced base in the combat zone may be somewhat tired from overwork and may have lost some weight. Even though he served under the worst of conditions his fatigue will completely disappear with two or three days rest, at the very most. Some loss of weight was probably good for most individuals and probably improved them physically. It may be assumed, therefore, that the great majority of your Seabees will arrive in the regrouping area in good condition. They will neither need nor want any pampering. What they will want most of all is a *change;* any change. Just so it is not what they have been doing in past months.

Hot coffee is a morale builder.

Also, what is even more important, *men should never be left sitting around idle.* Letting them loaf is the worst thing that can be done in any situation. Such inaction always leads to trouble. They may have been dodging bombs, bullets, and shells, or working day and night for months. But fear or fatigue did not rule their emotions. What the men hated most of all was the monotony. What they wanted most was a change of scene and a change of activity.

Now that they are in a rear area there is opportunity for this in the form of recreation, training, or new duty. Unless some program is put into effect immediately they will lapse into a monotonous routine every bit as bad as the one they just left.

### *Recreation*

Recreation plays an important part in rehabilitation because it pays some big dividends. However, it takes careful arrangement. If the unit is near a city or other large population center recreation is relatively easy to arrange. But the regrouping area will often be in an isolated location. A complete recreation schedule must then be worked up.

There is always one rule to observe in any recreation program for servicemen. That is—*don't supervise it too closely.* The Seabee, like any adult, desires some freedom of choice in selecting his type of recreation. If men are required to participate in recreation according to a rigid schedule and with attendance mandatory at certain specified activities, the program becomes as dull, and unpleasant as drilling.

It is better to provide as many recreational facilities as possible and let the men participate in them as they wish. Some will engage in team sports, some in individual athletic activities, some in shows or music, and some may even want to just read or play cards. Of course, any of these activities will fall within allotted periods and should have some other guidance to make them successful. But for other than guidance, there should be as little supervision as possible.

The recreation programs for Seabees will be as varied as the number of battalions. It is impossible to standardize programs since there are too many variables at each site and in each outfit. But all recreation programs should have common objectives. They should:

1. Develop confidence, spirit, and ability within the individual.

2. Eliminate demoralizing and destructive influences.

3. Develop *esprit de corps* in all members of the battalion.

Any recreation program which provides for constructive use of leisure time, healthy emotional outlets, and diversion from personal worries will achieve these objectives.

The choice of recreational activities is almost infinite. Sometimes there is local diversion. For instance, the Pacific was a fisherman's heaven. A naturalist could work in an almost untouched field on the reefs and in the lagoons. In Australia there was sometimes an opportunity to hunt animals not found stateside. Other localities furnished odd regions suitable for trips.

Good chow-wagons on the work also help morale

Sports, games, contests, and special events can be organized outdoors or indoors as they traditionally furnish the majority of recreation for active Seabees. Maximum participation is best obtained when such activities are on an informal basis. Every man in the unit should be encouraged to participate, however.

Movies, shows, and musical and dramatic entertainments are always well received by a unit. If the regrouping area is near a community, you may be fortunate enough to get civilian talent. If not, the amateur shows presented by groups of entertainers from the unit always play to a sympathetic (but sometimes loudly derogatory) audience.

Dances are well-liked and can be arranged if the unit is close enough to a community to obtain dancing partners.

Innumerable hobbies may be pursued by individuals as well as by groups. Musical and orchestra practice is probably the leading group hobby, although many are interested in hobbies such as manual arts, model making, photography and various kinds of nature specimen collections.

A club or recreation room where the Seabees can gather, sit down and relax with a beer in hand while swapping stories is almost indispensable in any rest or restaging area. Such associations and contacts obviously make for a well-knit outfit.

The foregoing are but a few examples of the many activities that may be incorporated within a recreation program. There is a good chance that the CEC officer may at some time find himself planning or organizing a recreation program. Any of the activities listed above and most other ones are going to require some careful management on his part to be successful.

### *Athletics*

The part of the recreational program concerned with athletics is important enough to the morale of the unit to deserve special mention. As an officer in a battalion you should place particular emphasis on having every man participate in some phase of athletics. The athletics protion of the program should be as well-rounded as possible in order that each man in the battalion will be attracted to one feature or another. Some men prefer individual competitive sports such as boxing or wrestling, others prefer individual non-competitive exercises like swimming, while others like competitive team sports such as baseball or volleyball. Personal preferences are unimportant so long as the selected athletic activity is available to the Seabee and he gets regular exercise in his chosen sport.

The Seabee in the combat zone is leading a pioneer type of existence where his continued good health and even his very life may depend on physical fitness. Regular participation in athletics is the quickest and most pleasant way of achieving this.

### *Bringing the Unit up to Strength*

In the operation just completed the unit probably suffered some casualties. Sickness, accidents, perhaps some battle casualties, transfers, and other causes contributed to the loss. Also, under the stress and strain of battle conditions, or the intense pressure of hard work in the combat zone, some misfits may have been revealed within the unit, and replacements for them are necessary to bring the complement to full strength.

The misfits discovered are not necessarily all "psycho" cases. The nervous, unstable individual is hospitalized immediately when he "cracks up". But, though they are extremely few in number, there are some men temperamently unsuited to stand the rigors of a campaign. They get by without "cracking up" but they are fairly close to the borderline. They do not accept trying situations with the same nonchalance as the other men. Nor do they react normally to the severity of combat condi-

**Disease is prevalent among natives. Keep your camps away from their villages.**

**Amphibious operations may be part of the redeployment training.**

tions. Also, there are a few who may be somewhat deficient physically and have deteriorated in that respect during the campaign just finished. While these men have gotten by so far they are not dependable. In combat, where teamwork is so essential, every man must be able to rely without question on his mates. There is no assurance that "misfits" and physical deficients are not going to break down during the next operation. They must be transferred out of the unit.

Replacements are screened before they are shipped to your battalion. But they should be tested again. They should be placed on an informal probationary footing before being given definite job assignments, especially when they are "green" men. This gives them a chance to benefit from the assistance furnished by the veterans of your unit. Also, by observing their actions when working with their fellow Seabees they can be better fitted into the battalion. The shakedown period in the reassembly area is the best time for training and integrating replacements for it is there that you have a period free of the distractions and pressures of the combat zone.

Association with the battalion veterans during the preparatory phase of the next operation gives an opportunity for instilling the new replacements with a spirit of teamwork. Although this *esprit de corps* is an intangible factor it is one of the most vital when the going gets tough. Pride in their battalion can drive the men to greater heights of endeavor than any form of coercion. It can assure the success of a job when obstacles seem insurmountable.

*Training*

Training for individuals is another phase of rehabilitation for which the battalion officers are responsible and for which a program must be planned and organized. Volumes have been, and can be, written about this feature of Seabee work but here only a few of the points of importance during the redeployment phase of the operation will be touched upon.

Replacement personnel will have received their component training before reaching the unit. They will come from three sources; first, trained technical personnel from other than training schools, much in the manner of key ship personnel being returned to new construction; secondly, trained personnel turned out by Navy technical schools; and third, rated men from recruit training. The component personnel—for team training—are assembled and work with the equipment similar to that of the component to which they will be assigned. Certain components will not require this component training period, but ship and boat repair, CB's, radio stations, and so on will require it. The length of this component training is variable depending on the mission of the component.

In addition to individual training, your outfit will need refresher unit training to sharpen up the veterans as well as to fit the new men into the battalion team. Unit training is the tactical training phase where the unit receives final training in field operations. Tactical training includes training in sanitation, first aid, camp installation, camp defense, general drills, bivouac, etc. It comprises those subjects designed to teach the men to perform the necessary maneuvers as a military unit for establishing an installation in the proximity of the enemy where men and material can be strategically placed and housed, preparatory to or even simultaneously with the performance of the technical mission assigned. Specifically stated,

**Airborne operations may also be part of the training in this day and age.**

tactical training consists of showing the men how to disembark from their ship under combat conditions, how to hit the beach, dig in, set up sanitation facilities, live on field rations, pitch tents, handle motorized equipment and fire-arms, and move cargo to the storage sites. In short, how to get the unit in readiness for performance of the technical mission assigned.

Two portions of the training can well stand special emphasis. They are familiarization with weapons and physical fitness. If the Seabees have just come off an operation where they did not use their weapons, they will need some additional training to sharpen up rusty shooting skills. The Seabees accompanying assault units

**Equipment rehabilitation results from this kind of equipment operation.**

might be involved in a battle at any time or be harried by snipers or machine gun nests passed over by the Marine assault waves. Skill with their weapons can enable the Seabees to eliminate quickly such dangers and save themselves many casualties. Also, when Seabees liquidate these isolated islands of enemy resistance themselves they do not have to call back Marines who may have their hands full up front and can ill spare the men.

Physical fitness is extremely important in the combat zone. There is no substitute for it. The environment of the Seabee in combat may be compared to an animal in primitive surroundings. Everything depends on physical fitness. It is the same in combat. If you can stay quick and strong your chances for survival are better.

A physical fitness program, therefore, is a prerequisite for any operation. Daily training in exercises designed to build strength and develop coordination and quickness must be given to everybody. Tests should be made at frequent intervals to determine progress and to give a standard for attainment by individuals. Even though a high level of physical fitness is attained and not used for fighting or dodging bullets it will toughen the men so that they can withstand the arduous labor and long hours of work which may lie ahead.

One well-known battalion C.O. of World War II had the importance of physical fitness brought home to him rather tragically. On a long hike between two points on Okinawa two members of the party became tired and sat down on a log to rest. The other members of the party were in better physical shape and kept on going. The Japanese registered a motar shell hit directly on the two men who had lagged behind. Thereafter the battalion C.O.'s convictions concerning physical fitness were more firmly rooted than ever.

### *Repair of Equipment*

During World War II, the unit being redeployed was often directed to take all of its equipment along when it moved into the regrouping area. In this case repair of equipment was a big part of the rehabilitation program.

Theoretically, this should not be much of a problem. However, the constant use to which equipment is put in rushing an advanced base to completion, plus unusual operating conditions, may cause a high rate of breakdown or require extra maintenance. Also, facilities for maintenance may be primitive, thus contributing to the difficulty of making repairs, even though the unit may have a skilled and efficient repair crew.

An even greater influence in swelling the "deadline" of equipment is the extreme difficulty of obtaining spare parts. For anyone who has not experienced this problem it is not easily visualized. Here in the States, when a piece of equipment or a motor vehicle breaks down, it is a simple matter to call at any of a dozen different nearby shops or garages and pick up the spare part necessary. At an advanced base, essential spare parts are often nonexistent. A major breakdown may result in a piece of equipment being set aside indefinitely or abandoned. It is not simply a question of a temporary delay until it can be repaired. So far as value to the operation is concerned the disabled equipment is often considered a total loss.

**Mud and rock increase the equipment "deadline."**

For these and other incidental reasons the unit is going to have a big job in putting the organizational equipment into good shape for the next operation. The CEC officer who is given primary responsibility for repair work holds the reputation of the outfit in his hands, for the success of the next operation may well depend on what shape the equipment is in. If it is not possible to put a motor vehicle or production machine into first class operating condition it might just as well be dumped over the side, for there is no use wasting shipping space or maintenance work on it. The space and work can be better used on something else.

**Regardless of the place or era, military operations require a lot of marching.**

Spare part shortages in the regrouping area will be the biggest maintenance headache. The Navy allows 25 per cent of the money value of all machines (other than the very simple types) for replacement during the estimated life. Based on calculated usage rates a 90-day supply of repair parts accompanies each machine, this amount being in accordance with initial issues of allowances for advanced base functional components. However, actual usage rates do not always conform to expected figures. Shortages occur. For instance, in the Pacific islands volcanic rock wore tires down rapidly, and when coconuts wedged in between dual wheels they caused all sorts of trouble. In combat zones, shrapnel cut tires to pieces in a very short time.

During the early part of World War II tires were so critical that no spares were issued with a machine. Replacements were on a 3-months basis. In fact one entire Seabee brigade would have been immobilized on Tinian after a month of operation except for one battalion which had been fortunate enough to obtain spare tires at Pearl Harbor.

Improved supply procedures may alleviate many of the spare parts shortages in future operations. But the problem is inherent and not completely curable. If enough production and shipping is allocated to eradicate spare parts trouble, then logistics are probably at fault, and should be diverted to the production of more of the end items.

There is one other problem which sometimes occasions a lot of work at the regrouping area. It is the major rebuilding of equipment. During wartime emergencies machines are either put to uses for which they were never intended or are forced to do heavier work than that for which they were designed. For example, during the last war, bulldozers were used for digging coral urgently needed for airfield surfacing. They broke their axles repeatedly but the airstrip job was completed on time. To solve this problem the unit needs skilled mechanics and the well-known Seabee ingenuity. A combination of these usually keeps equipment operating.

**An example of what a "rush" job can do to equipment.**

### *New Equipment*

As frequently happened, the unit moving to the regrouping area left all of their equipment at the advanced base they had just built. Ordinarily, when this happened it was because a higher headquarters wanted the equipment left in the locality to provide maintenance for the installation. In this case your unit will be outfitted with a full complement of new equipment when it arrives at the regrouping area.

**Salvage dumps often furnish spare parts for repairs.**

Good maintenance facilities can be improvised.

The difficulties experienced in getting new equipment in shape will, of course, not be nearly so great as those of repairing worn machines. Regular procedures for routine maintenance of equipment must be set up, for as yet there has been no machine invented that will operate very long without maintenance. Operators and mechanics must be familiar with the capabilities and repair techniques of the new machines. Some servicing may have to be done to remove all traces of overseas packaging and put the machines into operating condition.

One important point to observe when readying the equipment is to check and inspect it to assure that all parts are present and operating. One Seabee battalion in World War II left the West Coast with all their equipment but the "crowd" for the power shovels. The "crowd" is a cog which permits the operator to give the shovel a forward push when digging. Lack of this small part prevented the use of the power shovels as such in spite of the many opportunities for their use in the combat zone. For 18 months these shovels were employed as clamshells or drag-lines until the "crowds" could be obtained.

### *Officers' Refresher*

Officer training before a new operation is just as important as training the men. For that reason, refresher courses should be organized. They should have the prime purpose of giving the unit officers as much information as possible regarding the work at the proposed new advanced base. This refresher training might be called "briefing", but is actually much more comprehensive.

Even if the unit officers are exceptionally skilled at their jobs they may well benefit from a course which gives a clear picture of the situation and the job to come.

Although governing principles remain constant, no two advanced base operations are the same. The terrain may be entirely different on the new operation, the type of construction may not be at all like that on the job just ended, the enemy may be disposed in an entirely different fashion and his attacks may vary, our own command organization may be set up along new lines and result in a completely different eche-

Non-repairable equipment should be dumped over the side.

loning. In general terms, these represent only a few of the many differences between two separate operations. No matter how skilled the officer staff may be, to be properly prepared they must be schooled in the details of the new situation. Also they should be given as much of the strategic and tactical picture as is permissible so that a better understanding will be gained of their role and its importance in the coming operation.

Much of the information disseminated to the unit officers will derive from intelligence reports and be presented with the headquarters staff interpretation. The unit officers should also be given an opportunity to evaluate intelligence data applicable to their jobs in the light of their past experience and in the way it affects their jobs in the new operation.

### *Echeloning*

Practically all officers with advanced base construction experience during World War II emphasize two requirements for officers of units being redeployed. These are, (1) to be acquainted with the new command organization and (2) to be familiar with the echelon schedule (echeloning).

Familiarity with the new command (which may vary considerably from the old command in character) prevents operational friction and enables the officer to get quick decisions and action.

An understanding of the relationship between the construction schedule and the echelon schedule is a major factor in assuring a smooth-running advanced base operation. As a basic step in the planning, the theater commander will have indicated to the CNO when he requires the various components making up the new advanced base, and the echelon in which they are to arrive at the base. The CNO then echelons the shipping of the base unit according to the field request and the availability of components.

The echelon schedule ordinarily gives first priority to unloading the construction equipment and construction personnel. There must be a careful balance between these two. However, the water-front facilities and equipment are the foundation on which every base activity rests. A great waste of manpower, equipment,

Seabee "know-how" can accomplish equipment repairs without the usual facilities.

and shipping space occurs when a unit arrives on an advanced base only to find that because of other construction priorities it cannot function. It is worse than useless because it becomes a drain on functioning units.

### *Storage and Assembly*

Supply is not primarily a job for Seabee outfits. However, because of their ability and versatility they may very likely be called upon to set up supply dumps and assist in the storage and assembly of supplies.

A huge quantity of supplies will be assembled in the regrouping area to support the proposed advanced base establishment. Many supply items will have to be uncrated, serviced, and put into operation. Other items will have to be repackaged and re-marked for various reasons; some because packages were broken in transit or the markings became illegible, others because large quantities should be broken down into smaller portions for distribution.

To understand fully how materials are assembled and marked for an advanced base, we will review the procedure from the beginning. In the process of assembling components, the allowance lists, *Advanced Base Initial Outfitting Lists (Detailed)* for each component are posted showing exactly what material has been assembled with the component. The material is marked in accordance with the latest revision of the *Navy Shipment Marking Handbook*. A posted copy of the allowance list for each component is given to the supply officer of the advanced base unit and to the appropriate com-

**Checking and greasing is a vital part of field maintenance.**

ponent officer so that each knows exactly what is being assembled and how to locate it within the component. The material for the Bureau of Yards and Docks' contribution to the components is approximately 65 to 70 per cent of all the material required for an advanced base. This is another reason why Seabees will be used to such a great extent for handling and arranging supplies. Due to the size and bulk of the equipment, this material should be handled separately from the other component material.

### *SHIPPING*

After materials and personnel have been assembled in the regrouping area, and after rehabilitation, replacement, training, and outfitting are completed, the operation enters the shipping (amphibious) phase.

The theater commander sets the exact date when the various echelons of material and personnel in the amphibious force will arrive at the new advanced base site. Material and personnel are ordered to the port of embarkation. A large amphibious operation will be mounted from a number of ports of embarkation. The material and the personnel are finally united and loaded aboard the vessels assigned to the particular movement. Normally, material is outloaded at various ports at the same time and makes a rendezvous at sea.

The initial echelons of the amphibious assault force will usually be combat-loaded, following the rule of "last in, first out." The personnel usually ride the same ship as the material in combat-loaded vessels. Copies of the loading plans of the vessels are furnished by the ports of embarkation to the commander of the new advanced base, to the supply personnel, and to the officers-in-charge of the various components included. Later shipments may be of the commercial load type.

### *HITS, RUNS, AND ERRORS*

Early in the redeployment phase and preferably before the "briefing" of the unit officers on the new operation, a conference session should be called to review the campaign just ended.

All officers of the unit should be present at the conference, and its purpose will be to point up the errors and omissions of the past campaign, and to bring out any improved techniques which may have developed.

The agenda for the meeting must be carefully prepared, otherwise it may deteriorate either into a series of recriminations or an ordinary "bull" session. No individual should be personally reprimanded during the conference and the discussion should be directed objectively at the subjects being reviewed.

It is well to preface the discussion of errors and omissions with a short resume of the successful accomplishments of the unit. This is usually possible unless the past operation was a complete "flop", in which case your outfit would not have been assigned to a new project of this nature.

Criticism of errors and omissions should always be constructive, and any hint of the "Monday-morning-quarterback" opinion should be avoided. Conducted properly, these conferences can be valuable in correcting mistakes and improving efficiency in the future. By delineating policy and explaining proper courses of action to follow on work projects the officers are given definite standards to guide them.

# APPENDIX A

## SUMMARY OF FUNCTIONAL COMPONENTS

| Code | Component | Dominant Bureau |
|---|---|---|
| A | ADMINISTRATON | |
| A1 | Administration (Large) | Docks |
| A2 | Administration (Medium) | Docks |
| A3 | Administration (Small) | Docks |
| A4 | Administration (PT Base) | Docks |
| A4A | Administration and Command Harbor Defense (Large) | Docks |
| A4B | Administration and Command Harbor Defense (Small) | Docks |
| A5 | Intelligence Office (Large) | Docks |
| A6 | Intelligence Office (Medium) | Docks |
| A7 | Shore Patrol Company HQ | Docks |
| A8 | Military Government | Docks |
| A9 | Miltary Government (Special) | Docks |
| A10 | Legal Office | Docks |
| B | HARBOR CONTROL AND DEFENSE | |
| B1 | Harbor Entrance Control Post | Ships |
| B2B | Harbor Patrol | Ships |
| B3 | Underwater Detection Components | Ships |
| B3A | Underwater Detection Equipment | Ships |
| B3B | Supplemental Underwater Detection Equipment Housing | Ships |
| B3C | Herald Component | Ships |
| B3D | Attack Plotter Component | Ships |
| B3E | Magnetic Loop Component | Ships |
| B3F | Hydrophone Component | Ships |
| B3G | Sonobuoy Component | Ships |
| B3H | Mobile Radar Component | Ships |
| B5A | Boat Pool | Ships |
| B5B | Barge Pool | Docks |
| B5C | Lighterage | Docks |
| B7 | Surface Detection Radar | Ships |
| B8 | Minesweeping | Ships |
| B9 | Fleet Moorings | Docks |
| B10 | Navigation Aids | Docks |
| B11 | Port Director (Large) | Ships |
| B12 | Port Director (Medium) | Ships |
| B13 | Port Director (Small) | Ships |
| C | COMMUNICATIONS | |
| C1A | Radio Station (Large) | Ships |
| C2A | Radio Station (Medium) | Ships |
| C3A | Radio Station (Small) | Ships |
| C4 | Radio Station Air Base (Large) | Ships |
| C5 | Radio Station Air Base (Small) | Ships |
| C6 | Radio Station Airfield (Front Line Combat) | Ships |
| C7 | Visual Sta Oper Base (Large) | Ships |
| C8 | Visual Sta Oper Base (Small) | Ships |
| C9 | Radio Sta Harbor Defense | Ships |
| C10 | Fleet Post Office | Docks |
| C12 | Internal Comm. (Large) | Docks |
| C13 | Internal Comm. (Medium) | Docks |
| C14 | Internal Comm. (Small) | Docks |
| C17 | Teletypewriter System | Ships |
| C19 | RPIO | Docks |
| C20 | Communications Center | Docks |
| C23 | Radio Sta Command HQ | Ships |
| C24 | Communications Utility | Ships |
| C25A | Mobile Comm. (Large) | Ships |
| C25B | Mobile Comm. (Medium) | Ships |
| C25C | Mobile Comm. (Small) | Ships |
| C26 | Electronics Installation Detachment (Large) | Ships |
| C26A | Electronics Installation Detachment (Small) | Ships |
| C27 | Communications Supplementary Activities Components | |
| C27A | Large Intercept and D/F Comp. | Ships |
| C27B | Area (Theatre) Exploitation | Ships |
| C27C | Advanced Exploitation Comp. | Ships |
| C27D | Supplementary Unit Afloat | Ships |
| C27E | Interpretive Component | Ships |
| C27F | Manual Intercept Component | Ships |
| C27G | Radio Printer Unit | Ships |
| C27H | Advanced VHF Analysis | Ships |
| C27J | D/F Station | Ships |
| C27K | D/F Net Control | Ships |
| C27L | Advanced Signal Analysis | Ships |
| C28 | Radio Photo Facility | Ships |
| C29 | Trans. Line Material Comm. (Large) | Docks |
| C29A | Trans. Line Material Comm. (Small) | Docks |
| D | SUPPLY | |
| D1 | Storage and Supply Facil. (Large) | SandA |
| D2 | Storage and Supply Facil. (Medium) | SandA |
| D3 | Tank Farm (Large) | Docks |
| D4 | Tank Farm (Medium) | Docks |
| D5 | Stores Component | SandA |
| D9 | Petroleum Products | SandA |
| D10 | Storage and Supply Facil. (Small) | SandA |
| D11 | Drum Filling Plant | Docks |
| D12 | Supply Component (Small) | SandA |
| D19 | Material Recovery (Large) | SandA |
| D20 | Disbursing Office (Large) | SandA |
| D21 | Disbursing Office (Medium) | SandA |
| D22 | Disbursing Office (Small) | SandA |
| D24A | Ships Store Facil. (6000 men) | SandA |
| D24B | Ships Store Facil. (4000 men) | SandA |
| D24C | Ships Store Facil. (2000 men) | SandA |
| D24D | Ships Store Facil. (1000 men) | SandA |
| D24E | Ships Store Facil. (250 men) | SandA |
| D24F | Ships Store Facil. (100 men) | SandA |
| D26 | Mobile Packaging Component | SandA |
| D27 | Freight Terminal | SandA |

| Code | Component | Dominant Bureau |
|---|---|---|
| D28 | Adv. Materials Handling Comp. | SandA |
| D29 | Nav. Overseas Air Cargo Terminal (Large) | SandA |
| D29A | Nav. Overseas Air Cargo Terminal (Small) | SandA |
| D30A | Base Repair Parts Supply Facility (Large) | SandA |
| D30B | Base Repair Parts Supply Facility (Medium) | SandA |
| D30C | Base Repair Parts Supply Facility (Small) | SandA |
| E | SHIP AND BOAT REPAIR | |
| E1 | Ship Repair (Large) | Ships |
| E1A | Ship Repair (Augmentation) | Ships |
| E3 | Ship Repair (Medium) | Ships |
| E5 | Ship Servicing | Ships |
| E6 | Landing Craft Base Repair | Ships |
| E6A | Landing Craft Spare Parts (Large) | Ships |
| E8 | Repair Small Boat | Ships |
| E9 | Repair Small Amph Craft (motor) | Ships |
| E9A | Mobile LVT Repair | Ships |
| E10 | SLCU Maintenance Component | Ships |
| E10A | Landing Craft Spare Parts (Small) | Ships |
| E11 | PT Operating Base Repair | Ships |
| E12 | PT Major Engine Overhaul | Ships |
| E13A | Minesweep Equip. Repair | Ships |
| E13B | Minesweep Equip. Repair Augmentation | Ships |
| E13C | Minesweep Equip. Maintenance Spare Parts for 4 DMS Vessels | Ships |
| E13D | Minesweep Equip. Maintenance Spare Parts for 4 AM Vessels 220' | Ships |
| E13E | Minesweep Equip. Maintenance Spare Parts for 4 AM Vessels 180' | Ships |
| E13F | Minesweep Equip. Maintenance Spare Parts for 4 AMS Vessels | Ships |
| E20 | Base LVT Repair | Ships |
| E21 | PT Sqdn Portable Base Equip. | Ships |
| E22 | Landing and Patrol Craft Repair (Mobile) | Ships |
| E24 | Carbon Dioxide Generating Plant | Ships |
| E25 | Material Reclamation and Reconditioning Component | Ships |
| E26 | 50-Ton Marine Railway and Storage Yard (Large) | Docks |
| E26A | 50-Ton Marine Railway and Storage Yard (Small) | Docks |
| F | CARGO HANDLING COMPONENTS | |
| F1 | Cargo Handling Bn | SandA |
| F2 | Cargo Handling Consumables | SandA |
| G | MEDICAL AND DENTAL | |
| G1A | Hospital — 1,000 Bed | Med |
| G2 | Hospital — 600 Bed | Med |
| G4 | Hospital — 200 Bed | Med |
| G5 | Dispensary — 100 Bed | Med |
| G6 | Dispensary — 100 Bed, Mobile | Med |
| G7 | Dispensary — 50 Bed | Med |
| G8 | Dispensary — 25 Bed | Med |
| G9 | Dispensary — 10 Bed | Med |
| G10 | Dispensary — 10 Bed, Mobile | Med |
| G11A | First Aid Sub — Dispensary | Med |
| G13 | Dental Component | Med |
| G14 | Dental Component, Mobile | Med |
| G15 | Dental, Prosthetic Component | Med |
| G16 | Dental, Prosthetic Component, Mobile | Med |
| G17 | Entomological Survey Comp. | Med |
| G18 | Epidemiology Component | Med |
| G19 | Malaria and Epidemic Control | Med |
| G20 | Spectacle Service Component | Med |
| G22A | Sanitation and Rodent Control | Med |
| G24 | Medical Supply Storehouse (Large) | Med |
| G27 | Dental Clinic (Large) | Med |
| G28 | Dental Clinic (Medium) | Med |
| G29 | Dental Clinic (Small) | Med |
| H | AVIATION | |
| H9 | Aircraft Combat Oper (Basic) | Aer |
| H10 | Additional Oper Equip LP | Aer |
| H11 | Additional Oper Equip SP | Aer |
| H12 | Supp. Aircraft Main. Equip | Aer |
| H14A | Aviation Tank Farm (Large) | Docks |
| H14B | Aviation Tank Farm (Medium) | Docks |
| H14C | Aviation Tank Farm (Small) | Docks |
| H14D | Ready Aviation Gasoline Storage | Docks |
| H15A | Airfield Construction Material | Docks |
| H15B | Seaplane Ramp and Parking Area | Docks |
| H16A | Aerological (Large) | Aer |
| H16D | Aerological (Arctic) | Aer |
| H17A | Photographic Laboratory (Large) | Aer |
| H17B | Photographic Laboratory (Medium) | Aer |
| H17F | Photographic Laboratory (Squadron) | Aer |
| H18A | Photo Interpretation (Large) | Aer |
| H19B | Adv Air Combat Intelligence Cen. | Aer |
| H19C | Air Combat Intelligence (Air Base) | Aer |
| H21B | Printing Plant, Litho Reproduc (14 x 20) | Ships |
| H21C | Printing Plant, Litho Reproduc (22 x 34) | Ships |
| H22 | Air Transport Oper (Landplane) | Aer |
| H23 | Air Transport Oper (Seaplane) | Aer |
| H25 | High Intensity Airfield Lighting | Aer |
| H26 | Air Navigational Aid (Large) | Ships |
| H27 | Air Navigational Aid (Medium) | Ships |
| H28 | Air Navigational Aid (Small) | Ships |
| J | ORDNANCE | |
| J1 | Base Ordnance Shop | Ord |
| J2A | Base Armory Component | Ord |
| J2B | PT Base or SLCU Ord. Shop | Ord |

# APPENDIX B

## LIST 1
## MAJOR ITEMS OF EQUIPMENT
## U.S. NAVAL CONSTRUCTION BATTALION
## (ADVANCED BASE FUNCTIONAL COMPONENT P–1)
## BUREAU OF YARDS AND DOCKS

| Item | Quantity |
|---|---|
| *AUTOMOTIVE* | |
| TRUCK, ambulance, ¾ T, 4 x 4 | 1 |
| TRUCK, jeep, ¼ T, 4 x 4 | 18 |
| TRUCK, weapons carrier, ¾ T, 4 x 4 | 16 |
| TRUCK, cargo, 2½ T, 6 x 6 | 8 |
| TRUCK, cargo, 4 T, 6 x 6 | 1 |
| TRUCK, dump, 2½ T, 6 x 6 | 38 |
| TRUCK, tank, 750 gal, 2½ T, 6 x 6 | 1 |
| TRUCK, oil field, 2½ T, 6 x 6 | 1 |
| TRUCK, sewage, 750 gal, 2½ T, 6 x 6 | 1 |
| TRUCK, tractor, 2½ T, 6 x 6 | 1 |
| TRUCK, wrecker, 4 T, 6 x 6 | 1 |
| TRAILER, cargo, ¼ T, 2 wl | 8 |
| TRAILER, cargo, 1 T, 2 wl | 4 |
| TRAILER, cargo, crash, fire/decont, 2 wl | 1 |
| TRAILER, grease/lube, 1 T, 2 wl | 1 |
| TRAILER, low bed, 25 T | 1 |
| TRAILER, mach shop, 4 wl | 1 |
| TRAILER, pipe or pole, 13 T | 1 |
| TRAILER, semiplatform, 13 T | 1 |
| TRAILER, dolly, F/13 T, semitrailer | 1 |
| TRAILER, tank, water, 300 gal, 2 wl | 1 |
| TRAILER, wood-working shop, 2 wl | 1 |
| *CONSTRUCTION, WEIGHT HANDLING AND SHOP EQUIPMENT:* | |
| BARGE, pontoon, 3 x 7 w/propulsion units | 2 |
| BREAKER, paving equipment, w/compressor | 1 |
| CLEANER, steam, trailer mounted | 1 |
| COMPRESSOR, air, 210 cfm, trailer mounted | 2 |
| COMPRESSOR, air, 315 cfm, trailer mounted | 1 |
| CRANE, crawler, ½ cuyd, w/boom, dragline, clamshell and drag bucket | 1 |
| CRANE, crawler, ¾ cuyd, w/boom, dragline, shovel, clamshell and drag bucket | 1 |
| CRANE, crawler, ¾ cuyd, w/boom, dragline, backhoe, shovel, clamshell and drag bucket | 1 |
| CRANE, crawler, 1½ cuyd, w/boom, dragline, shovel, clamshell and drag bucket | 1 |
| CRANE, truck, ¾ cuyd, w/boom | 1 |
| CRUSHER, rock, jaw type, 60 T/hr | 1 |
| DITCHER, wheel type | 1 |
| DIVING APPARATUS, deep water | 1 |
| DIVING APPARATUS, shallow water | 4 |
| DRIVER, pile, attachment for crane | 1 |
| GRADER, drawn, 12 ft blade | 1 |
| GRADER, motor, 12 ft blade | 5 |
| GREASING EQUIPMENT, skid mounted | 1 |
| MIXER, concrete, 7 cuft | 1 |
| MIXER, concrete, 16 cuft | 2 |
| PUMP, diaphragm, single, 3,000 gph | 4 |
| PUMP, centrifugal, 3 in, 20,000 gph | 4 |
| ROLLER, road, 3 wl, 10 T | 1 |
| ROLLER, road, tandem, 8 T | 1 |
| ROLLER, road, sheepsfoot, 2 drum | 2 |
| ROOTER, tractor drawn, 3 tooth | 1 |
| SCRAPER, carryall, 10 cuyd | 4 |
| SCRAPER, carryall, 12 cuyd | 4 |
| SPREADER, sand and gravel, 10 ft | 2 |
| TRACTOR, 28,700 to 40,000 lb DBP, w/dozer, front and rear PCU | 4 |
| TRACTOR, 28,700 to 40,000 lb DBP, w/dozer, front PTO and rear PCU | 3 |
| TRACTOR, 28,700 to 40,000 lb DBP, w/dozer, front PTO and rear winch | 1 |
| TRACTOR, 17,251 to 25,000 lb DBP, w/dozer, front PCU and rear winch | 2 |
| TRACTOR, 17,251 to 25,000 lb DBP, w/dozer, front and rear PCU | 3 |
| TRACTOR, 17,251 to 25,000 lb DBP, w/dozer, front PTO and rear PCU | 3 |
| TRACTOR, 12,001 to 17,250 lb DBP, w/dozer, front and rear PCU and 5 T crane | 2 |
| TRACTOR, 12,001 to 17,250 lb DBP, w/combination front loader, 2 cuyd, and blade | 1 |
| *MACHINES, POWER, SHOP:* | |
| DRILL PRESS, floor, 21 in | 1 |
| FORMING MACHINE, 18 ga, 3 ft 6 in | 1 |
| LATHE, brake drum, 9 in | 1 |
| LATHE, precision, 14 in | 1 |
| PLANER-JOINER, 8 in | 1 |
| PRESS, hydraulic, 100 T | 1 |
| SAW, power, hack, 6 in | 1 |
| SAW, circular, portable | 8 |
| SAW, circular, overhead, 12 in | 1 |
| SAW, circular, overhead, 16 in | 2 |
| SHAPER, metal, 24 in | 1 |
| *MISCELLANEOUS:* | |
| Construction and mechanical tools, all trades | |
| Surveying equipment | |
| Office and drafting equipment | |
| Building material, general (Limited supply) | |
| Blasting Equipment and supplies | |
| *HOUSING:* | |
| Complete camp facilities including housing (tent or hut), personal gear, ship's store, etc. | |

| *Item* | *Quantity* |
|---|---|
| ***BUREAU OF AERONAUTICS*** | |
| *PHOTOGRAPHIC EQUIPMENT:* | |
| CAMERA, motion picture, 16 MM | 1 |
| CAMERA, still, ground, 4 x 5 in. speed graphic | 1 |
| PRINTER, contact table, model 5 x 7 in. negative | 1 |
| NOTE.—All necessary equipment to take photographs, develop film and print pictures included. | |
| ***BUREAU OF MEDICINE AND SURGERY*** | |
| *SURGICAL AND MEDICAL EQUIPMENT:* | |
| TABLE, operating, field type | 1 |
| UNIT #17, furniture set, tent | 7 |
| UNIT #35, dental operating outfit | 2 |
| UNIT #40, radiographic outfit | 1 |
| NOTE.—Drugs, linens, instruments, bandages and other necessary items included. | |
| ***BUREAU OF ORDNANCE*** | |
| *SMALL ARMS AND SPECIAL WEAPONS:* | |
| Carbine, .30 cal | 1118 |
| GUN, machine, .30 cal | 16 |
| GUN, machine, .50 cal, w/ground and AA mount | 8 |
| LAUNCHER, rocket, 3.5 in | 8 |
| LAUNCHER, grenade | 42 |
| PISTOL, .45 cal | 12 |
| PISTOL, very, signal | 5 |
| RIFLE, automatic, .30 cal | 15 |
| NOTE.—All of the above items furnished complete with mounts, spare parts, accessories and standard infantry gear. | |

| *Item* | *Quantity* |
|---|---|
| ***BUREAU OF NAVAL PERSONNEL*** | |
| *ADMINISTRATIVE MANUALS, BLANK FORMS:* | |
| Manuals and administrative pamphlets necessary for administrative guidance | |
| NAVPERS forms, blank | |
| Recreation Kit, Library and cash allotment for welfare | |
| ***BUREAU OF SHIPS*** | |
| *MOTION PICTURE PROJECTOR, COMMUNICATIONS, UNDERWATER DETECTION:* | |
| PROJECTOR, motion picture, 16MM, sound | 2 |
| RADIO EQUIPMENT, portable | 6 |
| RECORD PLAYER | 1 |
| SONAR, echo sounding equipment, portable | 1 |
| *MISCELLANEOUS:* | |
| Chemical Warfare Defense Equipment | |
| ***BUREAU OF SUPPLIES AND ACCOUNTS*** | |
| *PROVISIONS, FUEL, HOUSEKEEPING SUPPLIES:* | |
| C-4 Ration | 5 days |
| 5-in-1 Ration | 10 days |
| Type B Rations | 15 days |
| Total | 30 days |
| FUEL, includes gasoline, diesel oil, lubes, greases and antifreeze (where required) | 30 days |
| *MISCELLANEOUS:* | |
| BEDDING | |
| MESS AND GALLEY GEAR | |
| SHIPS SERVICE SUPPLIES, including laundry, tailor and barber | |
| SPECIAL CLOTHING | |
| NOTE.—The above included for arctic, cold, temperate and tropical. | |

# APPENDIX C

## *FORM FOR A CONSTRUCTION PLAN*

CLASSIFICATION

Issuing Headquarters
Place
Date and Hour

Task Unit No.

Construction Plan No.

Basic References: (List here those basic references which provide the authority and the source of planning information, e.g., Operations Plan and/or Base Development Plan.)

Chart or Map References:

### Part I

### *INFORMATION*

1. *General Situation:* (Such information of the general situation as may be essential for subordinate units to understand the current situation, with particular emphasis on factors influencing construction.)
   a. Possible interference with construction operations by enemy forces.
   b. Military forces of allied nations in the area which will influence the construction effort, e.g., possible assistance to be expected of allied forces or tasks to be performed for allied forces.
   c. Attitude of local population, availability of local labor, method and chain of command for dealing with local authorities.
2. *Organization and Troops:* (Show here the organization of the Base Command and the Construction Forces. List the subdivisions or construction units which will comprise the construction forces, together with names and ranks of commanders.)
3. *Construction Assumptions:* (List here assumptions which are an essential part of the plan. These should be limited to those which would result in a substantial change in the plan if they are not found to be valid, e.g., such an assumption might be that certain existing facilities will be available for the use of the base, whereas if these facilities are destroyed the construction task would be drastically changed.)

### Part II

### *TASK*

4. *Task Assignment:* (Describe here the overall task to be accomplished by the command as a whole, together with the general time requirements for accomplishment, i.e. operational and final completion dates. Describe individual construction tasks comprising the overall task in separate project orders. Each project order should assign responsibility for accomplishment of an individual construction task to one or more subordinate units, and should indicate the time requirement for that individual task, i.e. the operational and final completion dates.)
5. *Effective date:* (State here the time at and/or the conditions under which this Plan is to be placed into effect. If the time and/or conditions are different for various subordinate units, this should be specifically indicated. If desired, reference may be made to Project Orders.)

### Part III

### *LOGISTICS MATTERS*

(Where instructions are not applicable to the command as a whole but different for various subordinate units, this fact must be clearly indicated in applicable paragraphs. If desired, detailed instructions to subordinate units may be given in Project Orders. If so, the applicable paragraph should make reference to the Project Orders.)

*Section A—Marshalling Area*

6. *Furnishing Material and Services:* (Define responsibilities, procedures, and methods.)
7. *Loading:* (Define responsibilities, procedures, and methods.)
8. *Training and Rehearsals:* (Describe requirements.)
9. *Readiness:* (Describe requirements.)

*Section B—Objective Area*

10. *Unloading of Construction Materials, Supplies, and Equipment:* (Describe procedure and indicate responsibility for unloading and transportation to supply dumps.)
11. *Construction Material Supply Dumps and Depots:* (Give planned location and state who is responsible for establishment and operation, and when.)
12. *Transportation of Construction Materials, Supplies, and Equipment:* (Describe procedure and indicate responsibility for transportation from dumps and depots to job site.)
13. *Logistic Support to be Provided by Others:* (Describe services to be performed by others, in addition to those mentioned in paragraph 10, 11, and 12, above.)
14. *Logistic Support to be Furnished Others:* (Describe any tasks, other than those included in paragraph 4, which are to be performed for others.)
15. *Requisitioning of Construction Materials, Supplies, and Equipment:* (Describe procedure and indicate channels for procurement, including local materials.)

## Part IV

## ADMINISTRATIVE MATTERS

(If certain administrative procedures vary for subordinate units, this fact must be clearly indicated and the responsibilities of each subordinate unit defined in applicable paragraphs.)

16. *Communications:* (Indicate communications methods and procedures in the objective area, by phases if applicable.)
17. *Preparation of Maps, Drawings, and Layouts:* (Define the responsibility of subordinate units for surveys, and the preparation of maps, site layouts, and construction drawings. State whether or not approval is required, and if so, by whom.)
18. *Reports:* (Describe reports to be submitted, and to whom.)
19. *Base Defense:* (Indicate command relationship and the responsibility of subordinate units.)
20. *Internal Security:* (Define responsibility of subordinate units. Also mention any conditions requiring special precautions.)
21. *Passive Defense:* (Define responsibilities, procedures, and methods.)
    a. Dispersal
    b. Protective Construction, personnel shelters, and camouflage
    c. Chemical warfare defense
    d. Radiological warfare defense
    e. Bacteriological warfare defense
    f. Disaster control
22. *Unauthorized Construction:*
    a. Requests for construction of unauthorized projects. (Describe procedure and channels for referring requests for construction of unauthorized facilities to higher authority for decision.)
    b. Emergency construction. (Describe responsibility for and limits of authority of unit commanders to construct facilities necessary to cope with emergency condition. Indicate procedure for reporting construction effort of this type.)
23. *General:* (Describe any pertinent administrative matters not covered in paragraphs above.)

*Enclosures:*

(1) List of Authorized Construction Projects, Priorities, and Required Operational and Final Completion Dates. (Group according to task assignment to subordinate units, refer to appropriate project orders.)
(2) Echelon and Shipping Schedules for Construction Unit(s), Equipment, Materials, and Supplies. (Indicate items earmarked for the use of specific subordinate units, and also items considered to be part of a common pool.)
(3) Schematic Layouts and Maps.
(4) Project Orders (if required).

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U. S. GOVERNMENT PRINTING OFFICE: 1951—953172