AD-A131 712 THE JOINT LOGISTICS-OVER-THE-SHORE (LOTS) TEST AND EVALUATION REPORT VOLU..(U) ORI INC SILVER SPRING MD H CASEY ET AL. 05 JAN 79 ORI-TR-1412-VOL-1 1/2

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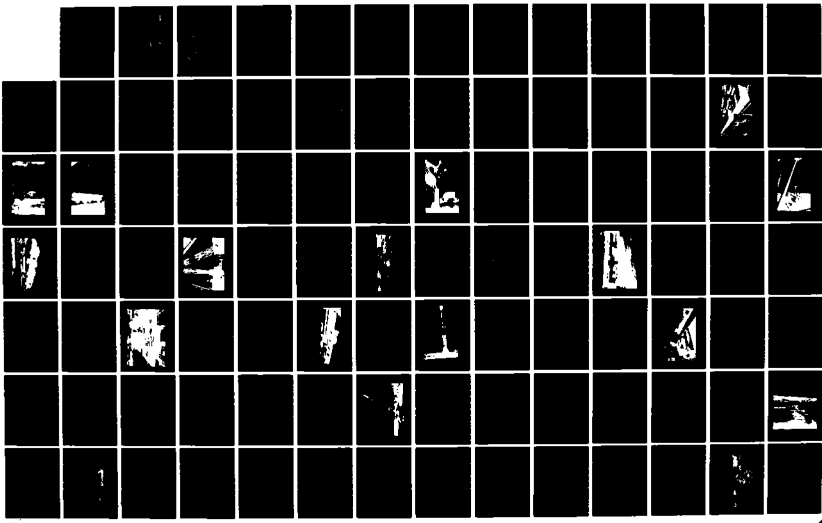

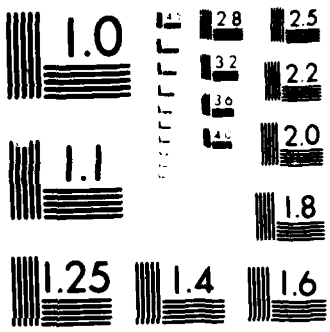

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AD A131712

DTIC ACCESSION NUMBER

LEVEL

INVENTORY

Rept. No. ORI-TR-1412, Volume I

DOCUMENT IDENTIFICATION Final, 1 Nov. 77 - 30 Oct. 78

Contract MDA-903-75-C-0016 5 Jan. '79

DISTRIBUTION STATEMENT A

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TECHNICAL REPORT No. 1412

THE JOINT LOGISTICS-OVER-THE-SHORE (LOTS) TEST AND EVALUATION PROGRAM REPORT

VOLUME I - CONDUCT OF TEST

5 JANUARY 1979

PREPARED UNDER
CONTRACT NUMBER MDA-903-7[illegible]-C-0516
FOR THE OFFICE OF THE SECRETARY OF DEFENSE
OFFICE OF THE UNDER SECRETARY OF
DEFENSE RESEARCH AND ENGINEERING
DIRECTOR, TEST AND EVALUATION
WASHINGTON, D.C. 20301

ORI
Silver Spring, Maryland 20910

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ORI TR NO. 1412	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) THE JOINT LOGISTICS-OVER-THE-SHORE (LOTS) TEST AND EVALUATION REPORT Volume I - CONDUCT OF THE TEST		5. TYPE OF REPORT & PERIOD COVERED Final Report 1 Nov 77 30 Oct 78 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) H. CASEY, G. HOLIDAY, A. GREEN, W. SUTHERLAND		8. CONTRACT OR GRANT NUMBER(s) MDA-903-75-C-0016
9. PERFORMING ORGANIZATION NAME AND ADDRESS ORI, Inc. 1400 Spring St. Silver Spring, MD 20910		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS Office of The Secretary of Defense, Office of the Under Secretary of Defense (Research & Engineering) Director Defense Test & Eval., Wash., DC 20301		12. REPORT DATE 5 January 1979 13. NUMBER OF PAGES 189-Vol.I, 226-Vol.II, 34-Exec. Summary
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office) N/A		15. SECURITY CLASS. (of this report) UNCLASSIFIED 15a. DECLASSIFICATION DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

Contracting Officer's Technical Representative - Mr. Richard Ledesma

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

			Embarkation
Air Cushion Vehicle	Breakbulk	Crane	Flag Vessels
Amphibious	Cargo	Crane-on-Deck	Heavy Equipment
Barge-TCDF	Causeway Ferry	DeLong	Heavy Lift
Barge Ships	Container	Deployment	Joint Test
Beach Handling	Containership	Elevated Causeway	LACV-3 (over)

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This is the final report on the Joint Logistics-Over-the-Shore (LOTS) main test, consisting of an Executive Summary, Volume I - Conduct of the Test, and Volume II - Analysis of Test Results. A classified report based upon the test results was published separately (ORI, Inc. TR No. 1468) dealing with LOTS requirements to support a non-mobilization contingency situation. Additional reports were published on an automated data base and a LOTS simulation model. The main test was preceeded by a one-year pretest phase dealing with deployment of LOTS equipment on a conventional breakbulk ship, a LASH, a SEABEE, and a

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LARC-LX	LOTS	RO/RO
LASH	Marshaling Yard	SEABEE
LCU	Merchant Ships	Sealift Readiness Program
Lighterage	MHE	Ship Off-loading
Loading	Mobilization	Ship-to-Shore
Logistics	OSDOC	TCDF
	Over-the-Shore	Temporary Container Discharge Facility
	Roll-on/Roll-off	

Terminal Operations
Test and Evaluation
Throughput
Transportation

(20. continued)

heavy-lift breakbulk ship for which reports were also published.

The Joint Logistics-Over-the-Shore (LOTS) test was conducted in the Norfolk-Ft. Story, Va., area during the period 8 July to 21 August 1977. The test was conducted under the sponsorship of the Director, Defense Test and Evaluation, Office of the Under Secretary of Defense for Research and Engineering, with the Army as Executive Agent and the CG of the U.S. Army Transportation School at Ft. Eustis, Va., as the Joint Test Director. The Army, Navy, and Marine Corps each provided a Deputy Director and participating test units, data collectors, and evaluation personnel for selected system elements.

The overall objective of the test was to verify the Services' capabilities for conducting LOTS sustained throughput operations. Specific test objectives for the OUSDR&E test sponsor related to equipment performance, operational techniques, and planning factors.

The primary findings were that in a LOTS environment the Services do not yet have a capability of providing bulk POL support from large tankers offshore to a corps size force or deploying a non-self-sustaining containership discharge system in a contingency situation. However, for container operations the Services can now acquire the equipments needed to support such contingencies. After equipment shortfalls are made up, LOTS type operations still involve a high degree of uncertainty in continuity of operations. Nevertheless, they remain an essential means of providing logistic support to a contingency force. The Services must provide required redundancy to safeguard against environmental and military threats.

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I. INTRODUCTION

SCOPE

This report consists of two volumes and an executive summary. It encompasses an account of the Joint LOTS test activities that took place during the period 13 July to 21 August 1977 (Volume I) and an analysis of the test results and observations (Volume II). A description of the LOTS data base with examples of data reduction extracts from the LOTS test data base and documentation for the programs used[1] and an analysis of LOTS requirements with respect to contingency planning[2] were published as separate reports. Incorporated in this report are appropriate Service comments made upon a preliminary report published 21 December 1977 of test results and analyses. Finally, this report also includes additional test data made available subsequent to publication of the comment draft report.

BACKGROUND

Throughout military history there has been a requirement to land military forces over unprepared beaches and sustain such forces in the conduct of their campaigns. This basic requirement continues to exist no matter how much weapons and tactics change.

Approximately 90-95 percent of all military lift requirements currently must go by sea and since ports, which are high priority targets, may not be available to support sealift operations, the means to conduct Logistics-Over-The-Shore (LOTS) operations will be required. In fact, technology has greatly changed and, in so doing, complicated the critical requirement to support forces overseas. Conducting LOTS operations has become more difficult due to the greater consumption of supplies, particularly POL and ammunition, and the sophistication and automation of the supply distribution systems that the Services have developed. In addition, merchant ships which have historically provided and continue to provide the backbone of this massive transport effort have also become more technically-oriented and port-dependent.

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[1] ORI, Inc., Joint-Logistics-Over-The-Shore (LOTS) Main Test Automated Data Base Reduction Programs, ORI, TR 1477, dated March 1979.

[2] ORI, Inc., Analysis of LOTS Requirements to Support a Non-Mobilization Contingency Situation (U), TR No. 1468, dated 5 January 1979.

The "container revolution," which found its economic acceptance in the early 1950's and remains the major cargo trend now and of the future, is central to the LOTS problem. Quantum jumps were made possible in terms of tonnage delivered versus manpower used by the substitution of intermodal containerization for breakbulk cargo handling. The productivity of land and sea shipping was vastly improved as more cargo was packaged, handled, and managed as a single unit. The results were reduced cost, expedited delivery, and reduced loss and damage to goods in transit. Transportation has become more equipment-intensive and less manpower-oriented.

A single modern containership (sizes vary) is more productive than 6 to 10 World War II breakbulk ships. A single containership in port requires only a fraction of the stevedore effort of a breakbulk ship and off-loads of all its cargo in hours versus days for each breakbulk ship. Modern breakbulk ships have major improvements over the older ships, i.e., hydraulically operated hatch covers, improved tie-down methods, and more powerful booms. However, the breakbulk mode of transporting and handling cargo still remains labor intensive compared to containership port operations.

The advantages of containerization and other new intermodal systems have been translated into military transportation improvements. A faster supply pipeline acts to reduce the quantities of materiel necessary to support combat forces; fewer logistic support troops increases the manpower available for combat; fewer logistic personnel reduces resources needed and increases materiel available for tactical units; and less damage and waste occurs because the supplies are better protected and more easily managed.

The current commercial containerization system requires ports and fixed facilities for the efficient discharge and loading of containerships. In wartime such ports would be high priority targets. The loss of fixed facilities with their giant container cranes, yard tractors and trailers, and other container handling equipment—the means by which quantum leaps in productivity are possible—would deny the use of a container-oriented distrubtion system when most urgently needed for sustained logistic support, especially at the initiation of hostilities.

The problems of handling intermodal systems in a LOTS environment are much more complex and extensive than for the movement of containerized cargo through a port.

- Ships are at anchor and not pierside which means that either they must be capable of loading and off-loading themselves (approximately 85 percent of the containerships are non-self-sustaining) or a ship unloading system must be available on-site.

- A ship-to-shore lightering system is required.

- A second container handling system located ashore is necessary to discharge the lighters.

- Beach equipment must often work in loose sand or on hastily constructed roads.

- Hardstands for container holding areas must also be provided in hastily constructed roads.

- Operations are much more weather and environment sensitive.

TEST CONCEPT

In 1974 the project, which later became known as LOTS, was nominated to DDR&E (T&E) for operational testing. Accordingly, following a feasibility and test definition study and necessary preliminary field tests, a joint test to evaluate the capabilities of the Services to conduct LOTS operations and to accommodate container handling systems was approved.

In addition to testing the capabilities of the Services to perform over-the-beach container operations, an important feature of the test was the s[illegible]lated deployment of outsized and heavy items of equipment from home station to a[illegible] over-seas location. Accordingly, the test was structured to evaluate the most [illegible]fficult ship-equipment loading cases. It also required the establishment of a bea[illegible] area within realistic scenario time constraints using only military persor[illegible] with on-hand equipment that would have actually been deployed and set-up in a [illegible] environment.

Throughput operations primarily focused on the movement and management of containers. However, because there are a number of highly productive barge-ships (20)[3] and because there are still a large number of breakbulk ships (about 150), cargo operations were diversified to include barges, pallets, and vehicles. This additional cargo was included principally to expand the scope of cargo management and documentation. The emphasis was placed upon containerized through-put since this is the predominant cargo ship of the future.

The LOTS test was controlled only to the extent that units were limited to their organic equipment, the availability of which in the test's non-mobilization contingency scenario was sharply constrained by certain deployment parameters. Commanders were required to organize and employ only those assets they deployed with, in order to realistically assess cargo throughput.

PURPOSE AND OBJECTIVES

The overall purpose of the Joint LOTS test was to assess the capabilities of the Services to conduct LOTS operations. The basic test objectives were to provide information that can be used by the Services to:

- Alter or Confirm:
  - Operational techniques
  - Planning factors
  - Equipment requirements
- Determine the best force structure for most efficient use of manpower.

The fundamental data and the derived information from the Joint LOTS tests are intended to provide the following:

- An overall determination of the capabilities of a LOTS system representative of that which will be available

[3] As of March 1979 there were 19 bargeships in service and two under construction.

to the Services into the early 1980's time frame; specifically its responsiveness, productivity, and reliability.

- Accurate and reliable information on equipment performance when fully integrated into a system structure and stressed in a realistic operational environment.

- A realistic assessment of each LOTS unit's capabilities (generally measured in terms of quantitative throughput) and soundness of its organizational structure, command and control, doctrine and procedures.

- An operational evaluation of Service capabilities to deploy LOTS system elements including the impact of most likely available sealift assets on system cargo discharge concepts and capabilities.

- A determination of the effectiveness of a remote processing facility for providing accurate and timely documentation for the identification, planning, control, and shipment of cargo transiting the beach complex.

- A basis for the development of LOTS force requirements to meet specified operational tasks in given contingency situations.

Specific test objectives were submitted by each Service for evaluation in preliminary field tests (pretests) held in 1976 and/or the main test in 1977. A consolidated listing of objectives was compiled by the Joint Test Directorate (JTD) and published in the LOTS main test design.[2] Each of the objectives was reviewed by the Deputy Director (Test and Evaluation), Office of the Director, Defense Research and Engineering (ODDR&E) (subsequently Director Defense Test and Evaluation, Office of the Under Secretary of Defense for Research and Engineering) for appropriateness within the approved purpose, scope, and objectives of the Joint LOTS main test.

TEST PHASES

The test was conducted in a series of operational phases keyed to different scenario conditions. These operations were:

- Deployment of selected equipment and establishment of a LOTS capability.

- "Bare beach" operations.

- Amphibious assault follow-on echelon (AFOE) operations.

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[2] Operations Research, Inc., Main Test Design of the Joint Logistics-Over-The-Shore (LOTS) Test and Evaluation Program, ORI Technical Report No. 1132, 20 June 1977.

- Joint Task Force operations.

The deployment phase and bare beach operations were depicted under a non-mobilization scenario based on limited ship availability and beach preparation time. This was essentially an Army operation and is referred to as Phase I.

The amphibious phase was assumed to be conducted under a general mobilization scenario for continuity in the transition to Phase III. This was a Navy-USMC operation with the Army providing equipment augmentation as required and is referred to as Phase II.

The final phase was a transition from the amphibious operation to an Army directed Joint LOTS operation in which elements of the Army and Navy operated the ship and shoreside container handling systems. This was Phase III and was intended to be a best case effort with the Services being permitted to bring in any equipment or systems required.

With time permitting, one full day of bare beach operations was repeated at the end of the test, allowing an opportunity to exercise better system control and improved procedures learned during the course of the test. This special repeat operation is referred to as Phase I (Repeat) or Phase I (R) and had not been an originally planned feature of the main test.

SCENARIOS

Detailed scenario descriptions and test parameters are contained in the Joint LOTS Main Test Design Report.[3] Included in the scenario and parameters was the schedule for Army forces deployment.

The test was basically structured around non-mobilization and mobilization cases to support three potential scenarios in which LOTS operations may be encountered.

Each phase included an off-load and retrograde period, the retrograde operations not being scenario-related but necessary to prepare the ship for the succeeding phase. Because of the necessity to compress time, beach preparation and such other readiness activities on one beach were conducted concurrent with the throughput activities on another beach. In this way maximum advantage could be taken of containership availability. Such preparations had to be timed so that scenario parameters were not violated and containership unloading/ retrograde not delayed.

Retrograde operations are important because of the large international demand and a relatively limited quantity of containers to meet the demand. For the test, retrograde operations were primarily an administrative necessity. Unlike a realistic retrograde of empty or mostly empty containers, the ship was

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[5] Op. Cit. See Appendix B. Scenario and test parameters are outlined in detail in this report.

reloaded with full ones. This meant that periodically extra planning and special organization were necessary, since weight distribution is critical in containership loading.

The first phase of the test concerned a quick reaction, non-mobilization situation in an undeveloped area. An Army force was tasked to off-load cargo off-shore, lighter it ashore and discharge the lighters at an unimproved beach (the "bare beach phase"). Time and equipment parameters were set to reflect fairly realistic contingency type requirements. The second phase, amphibious operations conducted under mobilization conditions, represented container and barge off-loading during the assault follow-on echelon but did not involve any deployment operations nor the actual ship discharge of barges. That phase transitioned into Phase III, the conduct of a Joint LOTS terminal operation under Army direction. The Phase III scenario made possible the deployment and use of a DeLong pier on the beach and the saturation of the DeLong and an elevated causeway (still in place from Phase II operations) by directing the container flow from one facility to the other. The final phase repeating Phase I bare beach operations, Phase I (R), was possible because there was an unused weather day of container vessel charter time remaining in which the Test Director desired to test improved control and management of assets acquired during the earlier test phases. Again, of course, it involved only Army units.

TEST OMISSIONS

The LOTS test was conducted without two notable discharge systems. specifically, systems not yet available for the discharge of tankers and roll-on/roll-off (RO/RO) ships.

Bulk POL

At this time, the Army does not have a capability to discharge tankers off-shore for the support of bulk fuel needs for a combat force ashore in a LOTS operation. The necessary equipment for pumping, storing, and distributing bulk POL have been developed and type classified. The necessary items have not been procured in the numbers required.[6] The Navy has a small system for bottom-laid or floating pipelines for small tankers. The Marine Corps has a limited capability for the storage of the POL required to support a MAF in the field.

Originally plans were made to have an MSC tanker discharge colored water simulating the different kinds of petroleum products at an anchored pipehead through a bottom line to the shore for storage and distribution. The multi-leg mooring buoy, bottom line, pumping equipment and POL storage bladders were to be installed by the Army. The Quartermaster School at Ft. Lee, Virginia, proponents of the system, notified the JTD that the POL portion of the test could not be conducted due to the expense involved and short time

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[6] Dept. of the Army Msg. PR161429Z JUL 77 to CDR FORSCOM, FT MCPHERSON, GA. Subj.: Bulk Petroleum Logistics-Over-the-Shore (LOTS) (U).

(approximately one year) remaining to accomplish the necessary procurement and funding actions. Accordingly, the bulk POL portion of the test was cancelled.

RO/RO Vessels

A large part of all cargo to be discharged is comprise of wheeled and tracked vehicles and could be shipped most expeditiously by RO/RO vessels, particularly during early deployment. However, the proper equipment and experience for the transfer of vehicles from a RO/RO ship to lighters in an open roadstead is not in-hand today. This system is an element of the Navy Container Off-loading and Transfer System (COTS) and is not scheduled to be available until the mid-1980's. This RO/RO ship requirement was deleted following review of the feasibility and test definition study and was not included in the Joint LOTS test plan.

ORGANIZATION FOR TEST CONTROL

Operational Responsibilities

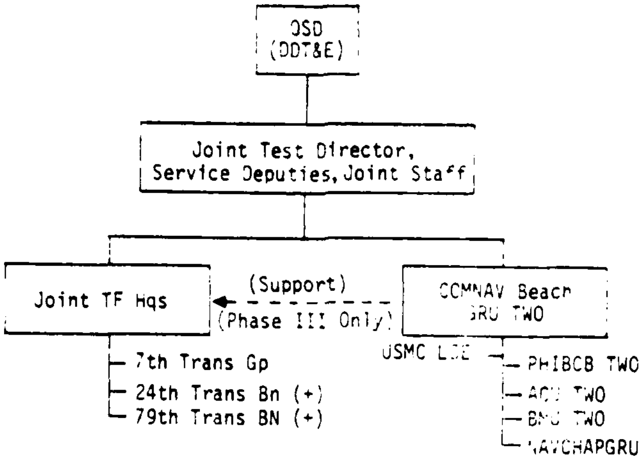
Operations overall were controlled and directed by the Director, Joint LOTS Test Directorate (JTD) and his staff. Meetings were held daily to review progress and to adjust scheduled activities as required to insure accomplishment of test objectives.

Execution of operations as set forth in the test plan and as adjusted by the JTD was the responsibility of commanders (organized as described below). The task force commanders and major subordinate units held daily operational meetings to review the day's activities and to coordinate operations for the next day. The units were organized to operate in two 12-hr shifts. The day shift worked from 0600 to 1800 hr, the night shift from 1800 to 0600 hr the next day. Plans called for feeding personnel and servicing and maintaining equipment during the shift change-overs so that a 20-hr day (10 hr per shift) would normally be available for operations.

The basic command structure for the three operational phases was as depicted in Figure 1.1. The command and control headquarters for conducting operations were a Joint Task Force Headquarters for Phase I and III, and an Amphibious Task Force Headquarters for Phase II. Support from other Service elements was arranged in advance by the designated task force commanders. Telephone lines were established from the JTF (7th Transportation Group switchboard) to each of the major operating units for direct communication/coordination. Radio nets were established by each Service. Teletype service was established between 7th Group and 24th Battalion simulating widely separated locations. Liaison officers were assigned to each task force headquarters during each phase assisting in coordinating requirements of supporting Service elements.

In each of the operational phases some changes were made in procedures although working within the organization structure as depicted below. For this reason the concept of operations and control procedures are discussed separately under each of the three phases.

PHASES I AND III— BARE BEACH AND JOINT LOTS OPERATIONS



PHASE II— AMPHIBIOUS OPERATIONS

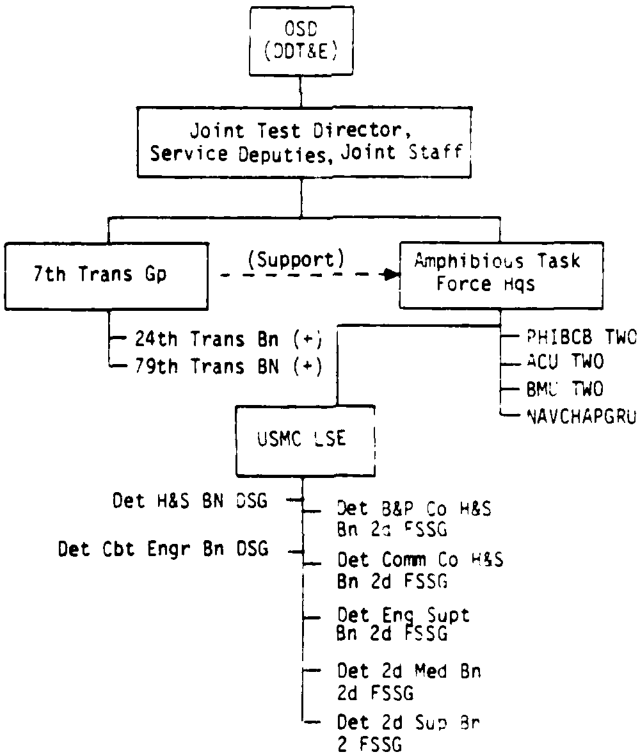


FIGURE 1.1. COMMAND AND CONTROL STRUCTURE

Data Responsibilities

In addition to the operational responsibilities for conduct of the test, the JTD was also tasked with the responsibility for the collection and reduction of test data. Service personnel were assigned as data collectors and given digital watches and data forms to record events at various stations between the ship and the final destinations of the cargo ashore. The JTD was also supported by a contractor for the collection, reduction, and reporting of data. This effort included the storage of test data on a CDC 6500 computer using the Multi-Purpose Data Management System 2000, resident at the U.S. Army Training and Doctrine Command, Data Processing Field Office, Fort Leavenworth, Kansas.

During the test limited data were processed on a local mini-computer for use as shift summaries and "Quick Look" results. These data items were helpful in guiding the test and providing material for preliminary reporting; however, the results are approximates and generally inconclusive since informational gaps do exist and inputs only were intended for use in quick turn-around reporting.

Besides the data collected by the JTD, individual Services also instrumented certain equipment and collected additional technical data on projects of special interest. However, this latter material was not generally available or suitable for this report but is being used for further in-depth Service research.

To provide operational data in greater depth and for more immediate reporting use, ORI did conduct an independent sampling data collection effort, timing selected events to the nearest second. This data has been incorporated in the report and published separately.

LAYOUT OF TEST AREA

The general organization of the Ft. Story area, location of major container handling facilities, traffic flow, control points and the operational beaches on Chesapeake Bay are shown in Figures 1.2, 1.3, and 1.4. The round trip distance between the beach and the marshaling yard was about 2.5 mi. Not shown are the relative positions of the TRANSCOLUMBIA and the C V STAG HOUND, which were anchored approximately .75 and 1.4 nmi off Blue and Red Beaches, respectively.

Container operations in each phase follow in the order of (1) ship discharge, (2) lighterage, (3) shoreside container transfer, (4) beach clearance, MHE, and truck operations, and finally (5) marshaling yard operations, MHE, and cargo management/movement control.

TEST CARGO

Test cargo was required for breakbulk ship, containership, and barge operations. The SS TRANSCOLUMBIA, the heavy-lift breakbulk ship, was loaded

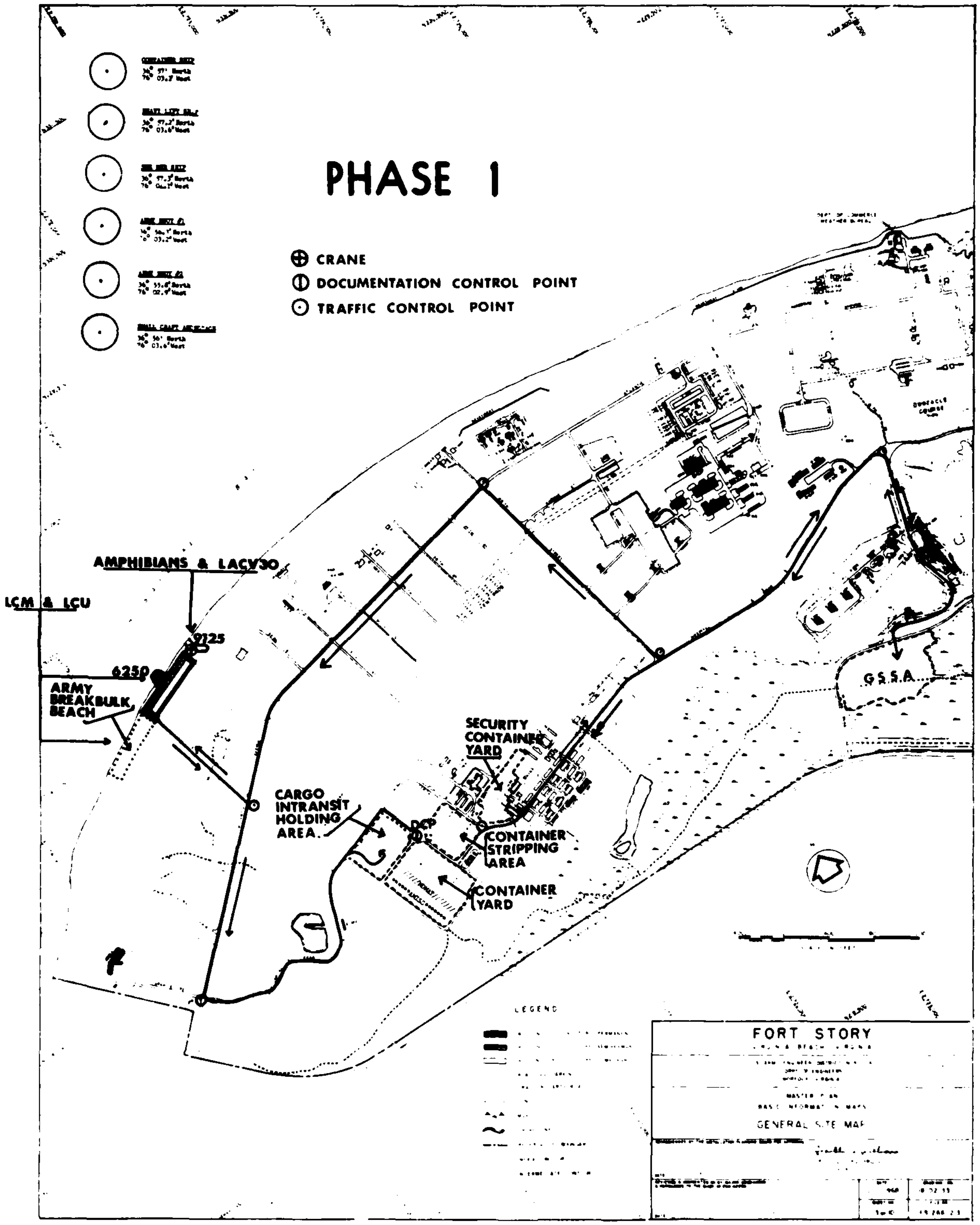


FIGURE 1.2. OPERATIONAL AREA FOR PHASE I

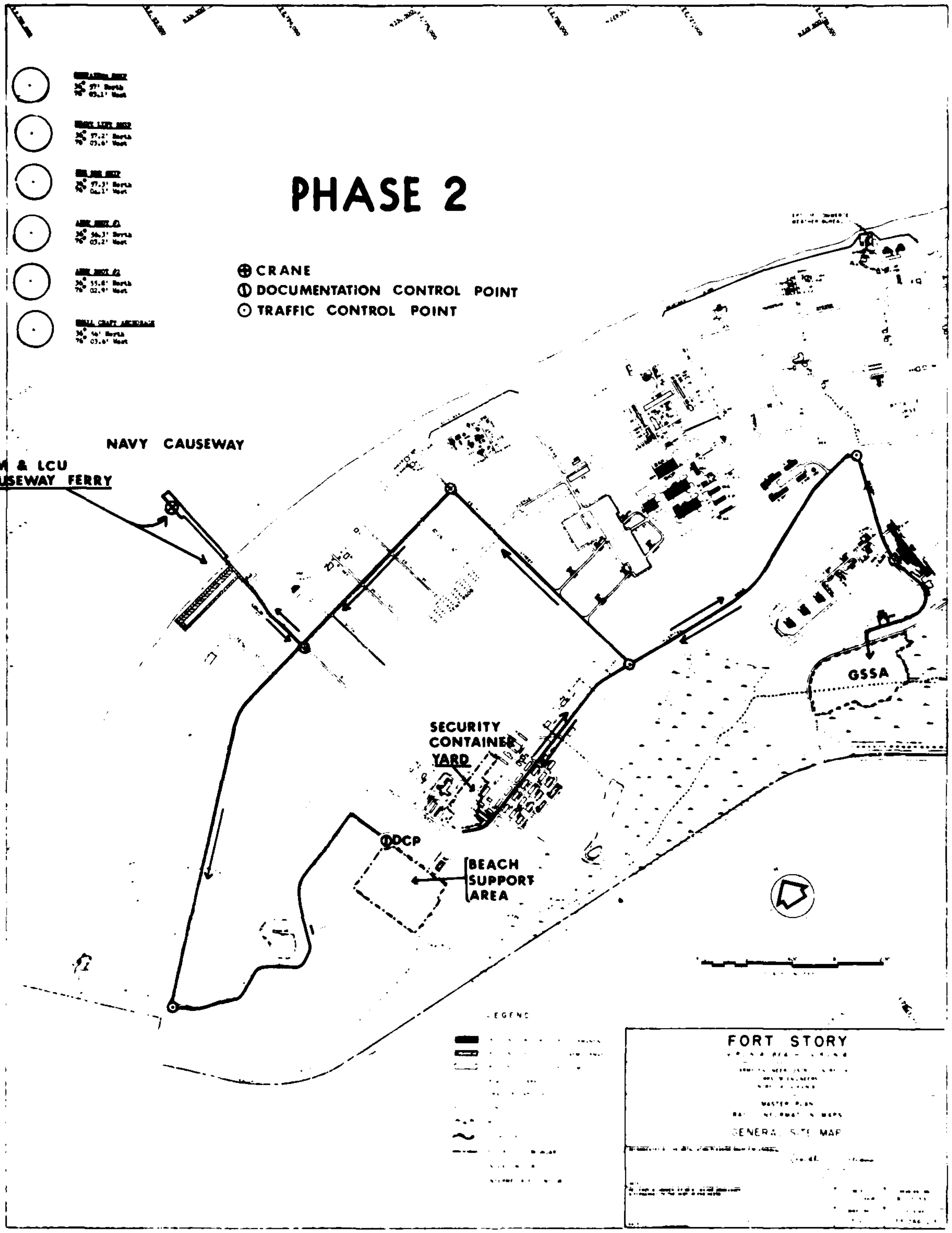


FIGURE 1.3. OPERATIONAL AREA FOR PHASE II

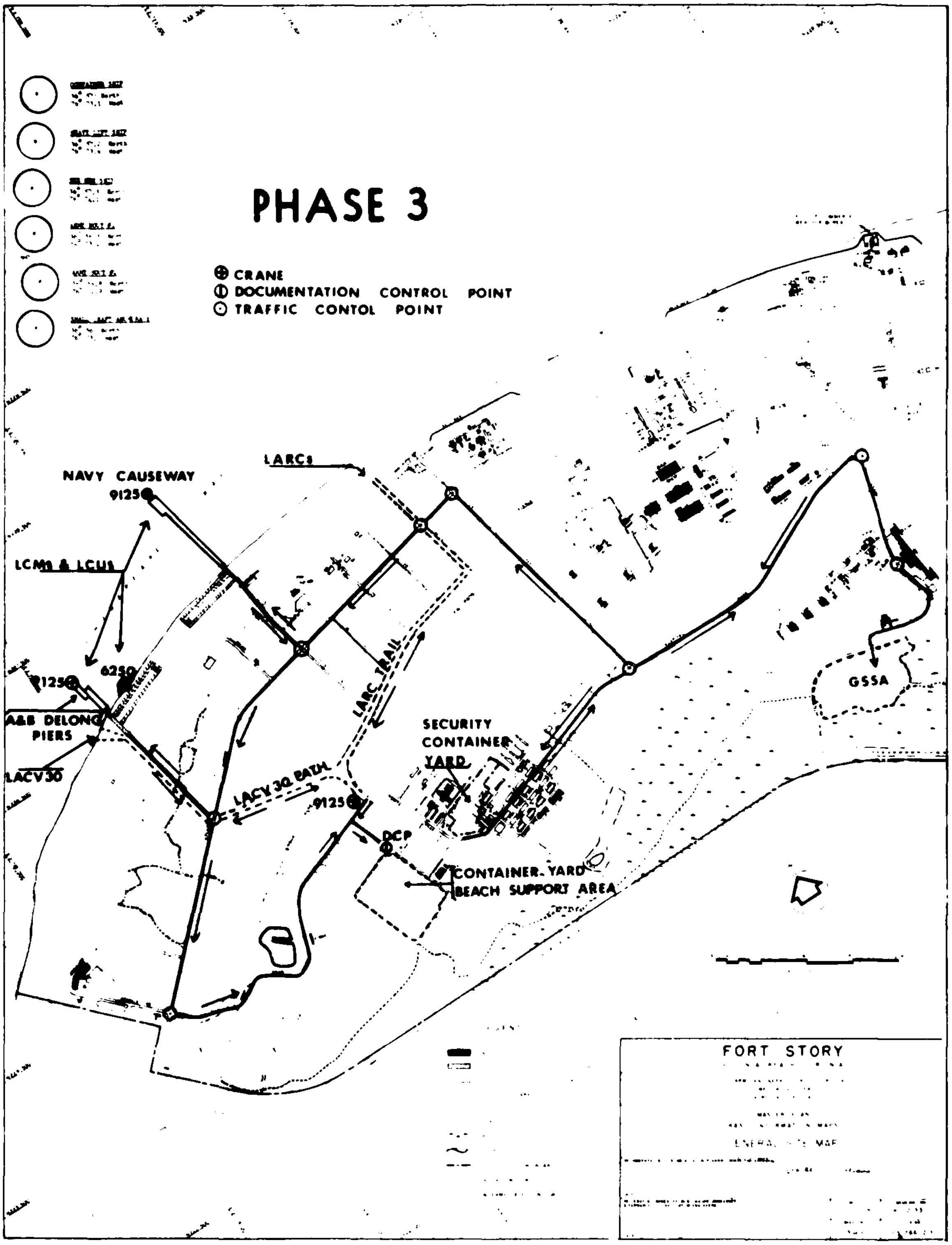


FIGURE 1.4. OPERATIONAL AREA FOR PHASE III

with LOTS heavy and outsized equipment items for the deployment evaluation and 600 tons of breakbulk cargo for throughput operations. The SS C V STAG HOUND, the exercise non-self-sustaining containership, was loaded initially with 586 20-ft containers, twenty-five 40-ft containers, and two 40-ft flatracks. Four LASH and two SEABEE barges were loaded with pallets of C-rations, vehicles and 20-ft containers.

Approximately 600 pallets of miscellaneous cargo were used solely for operations with the breakbulk ship. These pallets were provided by the Transportation Corps School at Ft. Eustis. All of the pallets had been extensively used and in most cases were weathered. Some showed signs of deterioration and required repair or replacement during the test. Additional pallets of C-rations were loaded into barges for a one-time off-load and return to appropriate supply points.

The miscellaneous palletized cargo was not of uniform size. However, the pallets were estimated to average one short and one measurement ton. Quantities of breakbulk cargo are summarized in Table 1.1. They were landed at the breakbulk beach, elevated causeway and jacked-up DeLong (JUD) pier. (Barges with container are discussed in Section VI.)

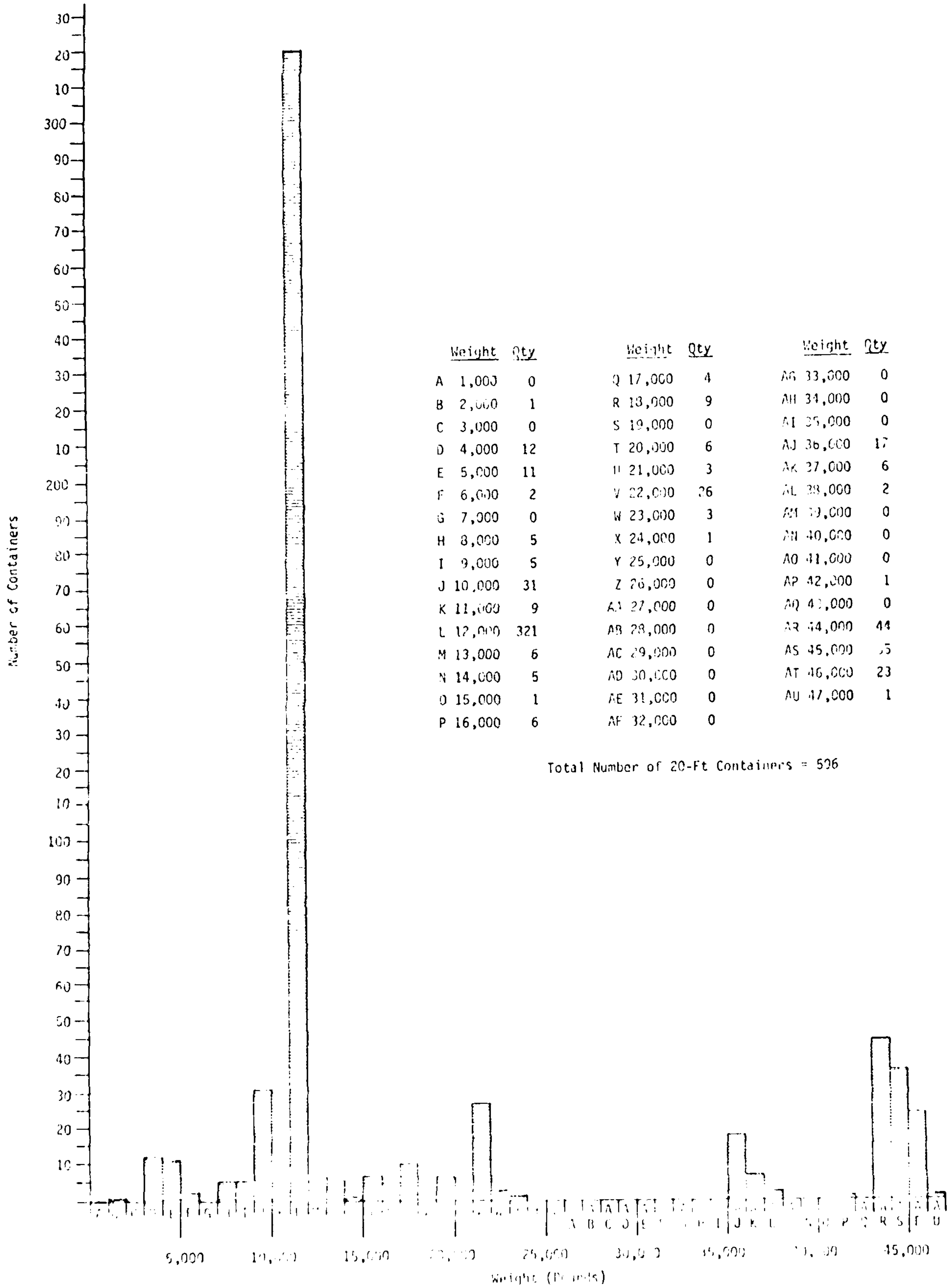
TABLE 1.1

NON-CONTAINERIZED CARGO

TYPE	AMOUNT	VESSEL	DISCHARGE BEACH FACILITY	DISCHARGE TEST PHASE
BREAKBULK	600 Pallets	SS TRANSCOLUMBIA	BREAKBULK BEACH	I
BREAKBULK	29 Pallets	LASH BARGE	JUD	III
BREAKBULK	60 Pallets	SEABEE BARGE	ELEVATED CAUSEWAY	I*
BREAKBULK	42 Pallets	LASH BARGE	ELEVATED CAUSEWAY	I*
VEHICLES	2	LASH BARGE	JUD	III
VEHICLES	6	SEABEE BARGE	ELEVATED CAUSEWAY	I*
VEHICLES	4	LASH BARGE	ELEVATED CAUSEWAY	I*

*Scheduled for Phase III; however, Navy operations personnel re-adjusted their schedule to opportunely include earlier barge discharge on a not-to-interfere basis with Army bare beach activities.

Weights of the containers were documented at the originating shipping terminals. Those containers loaded aboard ship were also weighed at the marine terminal. This information is also shown graphically as Figures 1.5 and 1.6.



Weight	Qty	Weight	Qty	Weight	Qty
A 1,000	0	Q 17,000	4	AG 33,000	0
B 2,000	1	R 18,000	9	AH 34,000	0
C 3,000	0	S 19,000	0	AI 35,000	0
D 4,000	12	T 20,000	6	AJ 36,000	17
E 5,000	11	U 21,000	3	AK 37,000	6
F 6,000	2	V 22,000	26	AL 38,000	2
G 7,000	0	W 23,000	3	AM 39,000	0
H 8,000	5	X 24,000	1	AN 40,000	0
I 9,000	5	Y 25,000	0	AO 41,000	0
J 10,000	31	Z 26,000	0	AP 42,000	1
K 11,000	9	AA 27,000	0	AQ 43,000	0
L 12,000	321	AB 28,000	0	AR 44,000	44
M 13,000	6	AC 29,000	0	AS 45,000	35
N 14,000	5	AD 30,000	0	AT 46,000	23
O 15,000	1	AE 31,000	0	AU 47,000	1
P 16,000	6	AF 32,000	0		

Total Number of 20-Ft Containers = 596

FIGURE 1.5. DISTRIBUTION OF 20-FT CONTAINERS BY WEIGHT

Weight	Qty	Weight	Qty	Weight	Qty	Weight	Qty	Weight	Qty	Weight	Qty
A 30,000	1	I 38,000	0	Q 46,000	0	Y 54,000	0	AG 62,000	0	AO 70,000	1
B 31,000	0	J 39,000	2	R 47,000	0	Z 55,000	1	AH 63,000	0	AP 71,000	1
C 32,000	0	K 40,000	6	S 48,000	0	AA 56,000	0	AI 64,000	0		
D 33,000	0	L 41,000	2	T 49,000	0	AB 57,000	0	AJ 65,000	0		
E 34,000	0	M 42,000	5	U 50,000	1	AC 58,000	0	AK 66,000	0		
F 35,000	0	N 43,000	4	V 51,000	0	AD 59,000	0	AL 67,000	0		
G 36,000	0	O 44,000	0	W 52,000	0	AE 60,000	1	AM 68,000	0		
H 37,000	0	P 45,000	0	X 53,000	0	AF 61,000	0	AN 69,000	0		

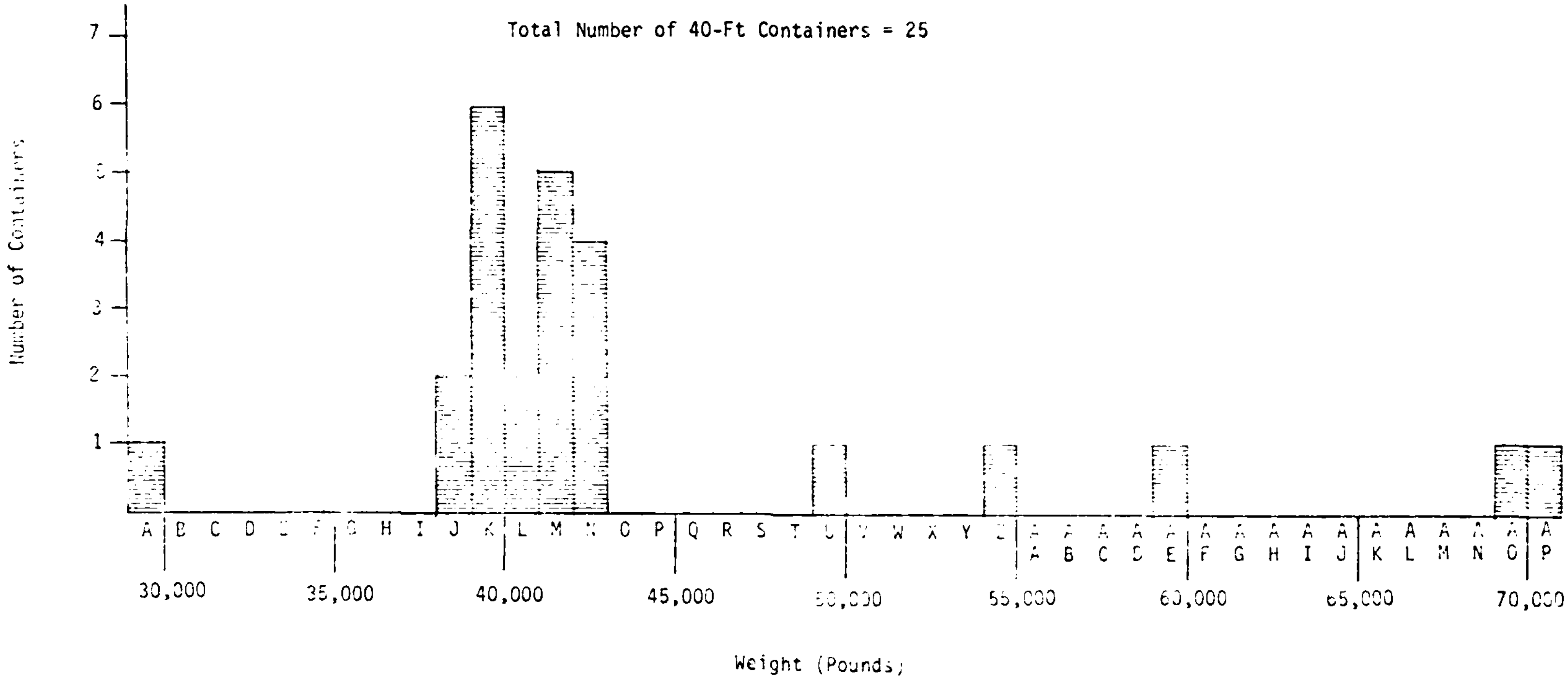


FIGURE 1.6. DISTRIBUTION OF 40-FT CONTAINERS BY WEIGHT

These two figures indicate that the majority of containers were lightly loaded. However, the weight ranges and concentrations, particularly with the 20-ft containers, were adequate for comparative studies. The number of lightly loaded containers highlighted the difficulties that were encountered in the acquisition of "real" test cargo. The available space offered by all containers amounted to 20,704 M/T. Figure 1.7 shows most of the containers to be loaded for use in the test.

FIGURE 1.7. MILVAN CONTAINERS ARE STAGED AT NORFOLK INTERNATIONAL TERMINAL FOR LOADING.

II. PHASE I - DEPLOYMENT AND BARE BEACH OPERATIONS

PHASE I BACKGROUND

Phase I operations included outloading selected major systems equipment, establishment of a shoreside throughput capability, 2½ days of container off-loading, and 2½ days of retrograde operations to prepare for the next phase. Phase I was the only phase which involved deployment, both breakbulk and container operations, and the handling of 40-ft containers (although some experimentation was done in Phase III). It was the first time that a formal military unit (the 24th Transportation Bn. and the 119th Transportation Co. (Terminal Service)(Container), in particular) was totally responsible for the off-load of a non-self-sustaining containership and the transfer and movement of containers from the ship to a marshaling yard ashore.

The operation represented a case where a U.S. Force was landed in a friendly country and port accessability was infeasible or denied. The movement of an advance party by air to the objective area to begin site preparation was simulated. Personnel and equipment were limited to that which would be allowed in a realistic contingency plan. Shortly thereafter the scenario called for loading the surface lift (the sea echelon) with all the ships necessary to deploy the container company's equipment, supporting lighterage, and mission essential items to conduct a LOTS operation. Because it was a non-mobilization scenario, only Military Sealift Command vessels could be used for deployment. This parameter limited Army LOTS equipment to only that which could be deployed on known available ships under DOD control.

To compress test time to principally that which was necessary for cargo throughput operations, only one ship, the SS TRANSCOLUMBIA, a heavy-lift breakbulk ship under long-term charter to MSC, was actually loaded. The TRANSCOLUMBIA was loaded with exercise breakbulk cargo and with heavy equipment to be used in the test. (As discussed in Volume II, a number of other ships would have been required to deploy the cargo and equipment thought to be necessary.) Figure 2.1 shows the TRANSCOLUMBIA loading a 98-long ton P&H 6250 crane and Figure 2.2 shows an 88-long ton LARC-LX being off-loaded.

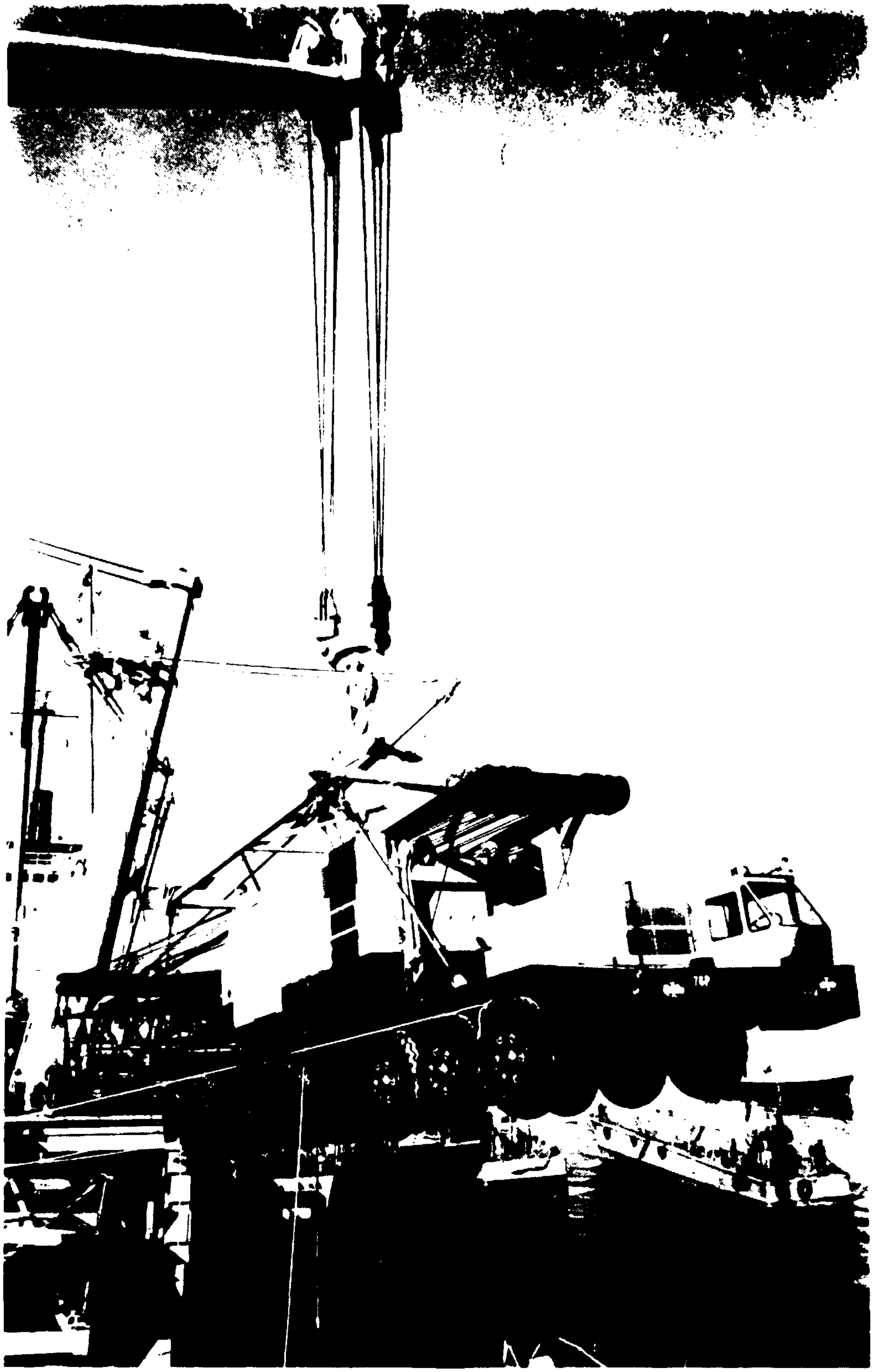


FIGURE 2.1. TRANSCOLUMBIA LOADS THE ARMY P&H 6250 MODEL CRANE, WHICH WEIGHS 98-LONG TONS

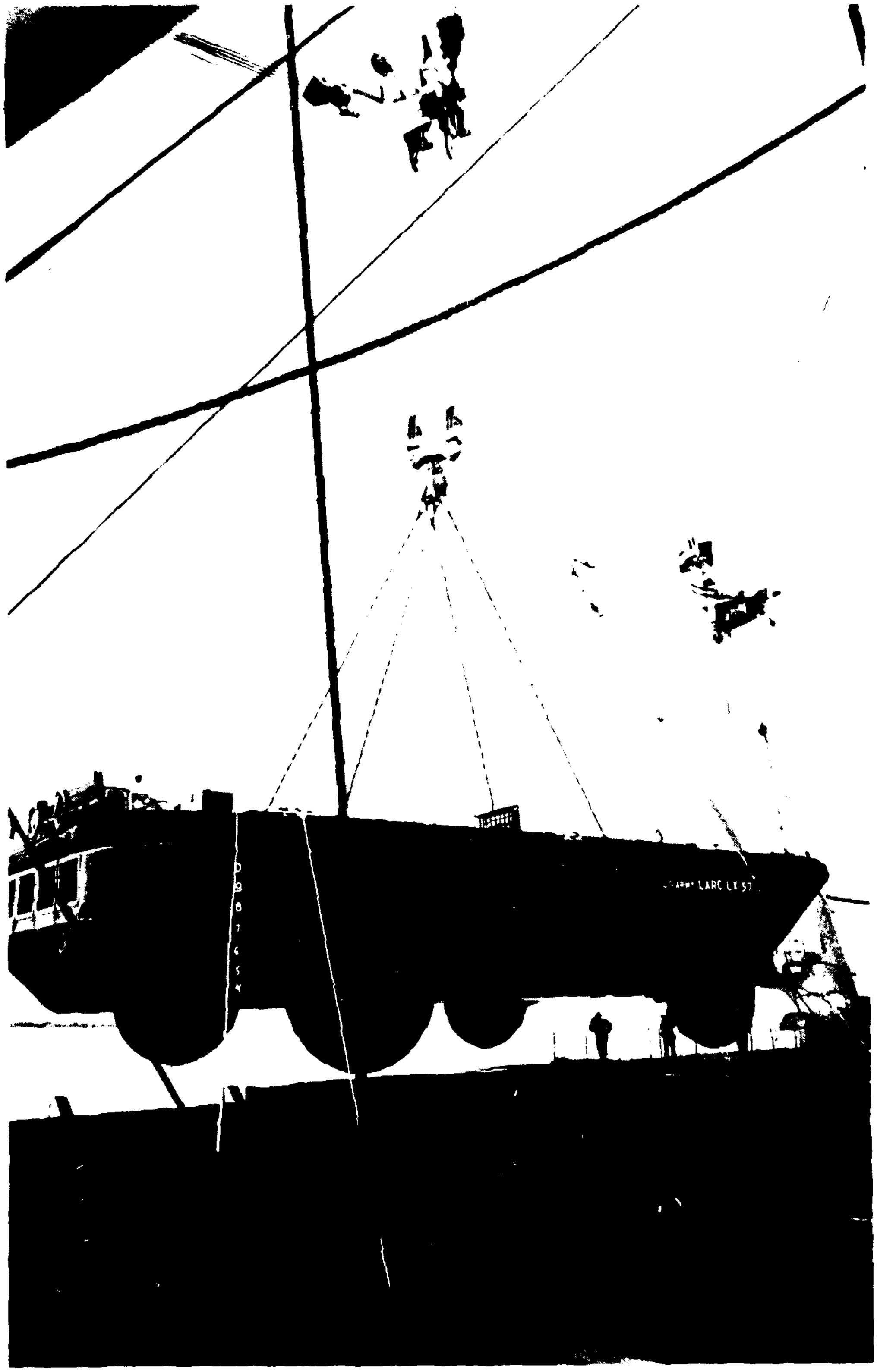


FIGURE 2.2. TRANSCOLUMBIA OFF-LOADS A LARC-LX

While the sea echelon was enroute to the objective area, the simulated airlift of troops was also accomplished, as dictated by scenario. When the sea echelon arrived, troop units were billeted, sandbags had been filled, and that site preparation which could be accomplished within the scenario parameters had been completed. Following the arrival of the TRANSCOLUMBIA, the final stage of beach preparation, which required certain heavy equipment, was easily completed within the 4-day period prescribed by test parameters. Unit activity and site preparation had to be controlled because of the late arrival of the containership.

The test had been planned so that the containership, SS C V STAG HOUND, a C5-S-73b ship chartered for 20 days by MSC from American Export Lines, would arrive after four days of beach preparation. The ship was delayed enroute for three days, so initiation of test activities was delayed and the "test clock" was halted. In the interim breakbulk operations were conducted for training of the 567th Transportation Co. (Terminal Service). The day before the C V STAG HOUND was to arrive, the TRANSCOLUMBIA was backloaded and the "test clock" was reset.

Test planning had also included two other ships. In the first case, since LOTS operations normally include all classes of supplies, it was planned to use an MSC chartered tanker, with colored water for simulation, to exercise bulk POL handling. This appeared especially desirable since a Marine Amphibious Force - MAF - or a Corps size requirements have been projected on useage requirements of over 1 million gallons of fuel per day. As mentioned, this aspect had to be omitted for lack of equipment.

The second ship considered was a bargeship for use in support of the mobilization phases. However, the ship was delayed to the extent that it could not be accommodated within the test schedule. However, SEABEE and LASH barges were used in the test.[1]

DEPLOYMENT BACKGROUND

General

Normal military organizations are routinely assigned transportation (shipping) assets to support the mission/lift requirement. However, for deployment of LOTS units this may not always be possible because certain LOTS equipment, such as LCUs and barges, can be loaded and discharged by only a very few specialized ships. Without these LOTS equipment assets, limitations (discussed in Volume II) are placed on the LOTS force which degrades their method of operations and thereby critically reduces their throughput capability.

An example of this sensitivity is the containership discharge subsystem: without a means to deploy barge-temporary container discharge system (TCDFs), at this time, cargo throughput is limited to a small number of self-sustaining containerships and breakbulk ships. The largest, fastest,

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[1] Subsequent to the LOTS main test, the SEABEE ship again became available. An evaluation was made of the in-port loading and off-shore discharge of selected LOTS equipment. See ORI Technical Report No. 1267 SEABEE Pretest Results of the Joint Logistics-Over-The-Shore (LOTS) Test and Evaluation Program, 7 December 1977.

and most productive ships (other than bargeships), have no means for self-loading and discharge and could not be used. Nearly half of the U.S. merchant fleet would be unusable. Tonnage rates would drop and more personnel, ships and equipment would be required to meet cargo objectives.

Besides having the right equipment, timing for establishment of a containerized throughput capability is critical.[2] Timing is influenced (as established in the pretest phase) by the need to disassemble large equipment so that it can be loaded and off-loaded by conventional ship booms and then reassembled once ashore at the LOTS site. Throughput rates, in turn, are influenced by the delays in establishing the LOTS system and also by equipment shortages as a result of transportation lift reductions or incompatibilities.

Thus, equipment, timing and shipping available to support deployment affect the ship types (self-sustaining as opposed to non-self-sustaining ones) that can be off-loaded, throughput capabilities, operational readiness, and contingency force resupply rates. Accordingly, these factors were considered in the test design and deployment planning for handling containerized, break-bulk and barge cargo, and were critical in the analysis of the Services LOTS capabilities:

- The troop and equipment level of effort required at the objective area;
- The shipping required and available to deploy the LOTS organizations and equipment determined to be necessary; and
- The operational time-frame for initiating throughput support.

The fundamental problem to deployment of a LOTS system that is capable of conducting container and barge operations is the size and weight of the unit equipment. Table 2.1 lists the equipment and problems associated with handling these items. The list represents the largest and heaviest items from currently available LOTS system resources.

It was recognized that special efforts would be required to embark selected equipment aboard merchant ships, which in most cases had never been done prior to the Joint LOTS Test and Evaluation Program. In order to load most of these items aboard typical merchant ships, Service units had to do certain disassemblies, fabricate special lifting slings and spreader bars, modify lighters, and develop unique loading/off-loading techniques. Follow-on tasks were then necessary to make these equipment items operational in a LOTS

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[2] Throughput, as used in this report, generally refers to the movement of cargo from ship to and through an intransit storage ashore (marshaling yard - Army or logistic support area - U.S. Marine Corps).

TABLE 2.1

LOTS EQUIPMENT SELECTED FOR EMBARKATION

Equipment Item Selected For Test Loading	Problem Area For Deployment	Weight (In Long Tons)	Size (L)x(W)x(H) In Feet	Problem Resolved
300-ton Crane, Admin. Disassembly	Size, Height Reassembly, LCM-8 modification	54.9	42.3x12x13.5	yes
300-ton Crane, Tactical Disassembly	Size, Weight	98	57.6x12x13.5	yes
1466-Class LCU	Size, Weight	180	119x34x17.8	yes
1646-Class LCU	Size, Weight, Slings	151.8	135.3x29x17	Sling not available
LCM8	Weight, Slings	58	73.5x21x14	yes
Sideloader	Slings	64	41x12.5x11.7	yes
Frontloader	Slings, Lifting Points	49.3-75.9 *	30.5x13.2x16.5	yes
140-ton Crane, Tactical Disassembly	Sling	42	48.5x11.3x9.4	yes
LACV-30	Size, Sling	27.7	76.3x33x21.5	yes
3x15 Causeway	Size, Weight	60	90x21.3x5.1	yes
DeLong B barge, with crane	Size, Weight	656	150x60x10 **	yes
LARC-LX	Size, Weight	88	12.5x26.6x15.3	yes

*Subject to the amount of disassembly

**Length does not include boom overhand and height does not include crane and foundation.

environment. This was largely accomplished in CY 1976 in a pretest program.[3] A conventional breakbulk ship from the MSC charter fleet was tested first[4] as it is one of the most common ships available for deployment. A second test involved a Lighter-Aboard-Ship (LASH) vessel[5] and involved barge breakbulk and vehicle discharge operations off-shore. The third pretest involved a heavy-lift breakbulk ship[6] in support of both bare beach and improved beach operations including the use of a TCDF. It was intended that a NSS containership be used as a deployment augmentation vessel but following an engineering analysis and investigation of the cost, utility, and research involved, this pretest was cancelled.[7] One other pretest in which a SEABEE was to be used was originally cancelled due to non-availability of the ship and a report was produced.[8] However, following the LOTS main test a deployment evaluation was conducted.[9] A recapitulation for equipment test loaded and the ships they were loaded on is listed in Table 2.2.

These preliminary tests (see Figure 2.3) were valuable in shaping the deployment phase of the LOTS main test. For the most part, the container handling equipment was new and personnel were inexperienced in using the equipment and working with the newer ship types. Deficiencies in rigging, operational procedures, training, and scheduling were identified that otherwise would have detracted from the main test (or capability to respond to a contingency).

For the LOTS main test all equipment and personnel were manifested as if an overseas deployment was being executed. In some cases equipment and personnel were manifested and phased into the test site on a schedule representative of an airlift for an advance force and a follow-on main body; others were manifested for the sea tail.

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[3] Operations Research, Inc., Designs of Preliminary Field Tests for the Logistics-Over-The-Shore (LOTS) Test and Evaluation Program, ORI Technical Report 993, 6 January 1976.

[4] Operations Research, Inc., Report on the Results of the Conventional Breakbulk Ship Pretest of the Joint Logistics-Over-The-Shore (LOTS) Test and Evaluation Program, ORI Technical Report No. 1037, 29 October 1976.

[5] Operations Research, Inc., LASH Ship Pretest Results of the Joint Logistics-Over-The-Shore (LOTS) Test and Evaluation Program, ORI Technical Report No. 1121, 7 March 1977.

[6] Operations Research, Inc., Heavy-Lift Breakbulk Ship Pretest Results of the Joint Logistics-Over-The-Shore (LOTS) Test and Evaluation Program, ORI Technical Report No. 1168, 25 July 1977.

[7] Operations Research, Inc., Report on the Cancellation of the NSS Containership Pretest of the Joint Logistics-Over-The-Shore (LOTS) Test and Evaluation Program, ORI Technical Report No. 1075, 1 October 1976.

[8] Operations Research, Inc., Report on the Cancelled SEABEE Pretest of the Joint Logistics-Over-The-Shore (LOTS) Test and Evaluation Program, ORI Technical Report No. 1148, 15 June 1977.

[9] ORI, Inc., SEABEE Pretest Results of the Joint Logistics-Over-The-Shore (LOTS) Test and Evaluation Program, ORI Technical Report No. 1267, 7 December 1977.

TABLE 2.2

SHIP-EQUIPMENT TESTS CONDUCTED

DEPLOYMENT TEST ITEM	MERCHANT SHIPS			
	Conventional Breakbulk	LASH	Heavy-Lift Breakbulk	SEABEE
300-ton Crane Tactical Disassembly			X	
1466-Class LCU			X	X
1646-Class LCU				X
300-ton Crane Administrative Disassembly	X	X		
LCM8	X	X	X	X
Sideloader		X	X	
140-ton Crane Tactical Disassembly	Failed	X	X	
3x15 Causeway sections (Navy)	X	X		X
Frontloader			X	
DeLong B barge,with crane				X
LACV-30	X			X
LARC-LX			X	X

FIGURE 2.3. TRANSCOLUMBIA LOADS AN ARMY LCU

Shipping Assets

For deployment in the quick response scenario, Phase I, it was assumed that certain key MSC assets would be available. These total assets consist of 22 conventional breakbulk ships, three RO/RO vessels (one with a 2-LCU lift capability[10]), and two heavy-lift breakbulk ships.

In addition, the scenario permitted the call-up of Sealift Readiness Program (SRP) assets from the merchant fleet. Under the SRP there were 67 additional breakbulk ships, 14 self-sustaining containerships, 35 non-self-sustaining containerships, and 8 LASH vessels. These vessels are back-ups for the MSC nucleus and charter fleet assets. The SRP is exercised and administered through MSC and the berth line operators. The SRP as of 26 June 1978 included all merchant ships for which an operating subsidy is paid, all merchant ships carrying DOD cargo, and all future vessel constructions for which a construction differential subsidy is paid. The SRP provides for the phased call-up of designated ship types if certain conditions and tests are met. However, in the 10 years that an SRP has been in effect, it has never been used nor have its mechanisms for a call-up ever been tested.

Realistically, whether in a minor contingency or a mobilization scenario, LOTS deployment requirements would normally be consolidated with all other deployment requirements. Shipping priorities and allocations are made at the JCS level, but without consideration for specialized or preferred shipping requirements. For example, MSC's two heavy-lift ships theoretically could be tasked with loading combat vehicles while LCUs, for example, would have to wait because conventional ships are unable to load them. Throughput time would be lost in establishing a LOTS capability because the Army cranes have to be detail disassembled so that conventional breakbulk ships can deploy them.

DEPLOYMENT REQUIREMENT

The non-mobilization, quick response scenario was designed to evaluate a LOTS capability that could be task organized and deployed with available Military Sealift Command (MSC) shipping. The Army LOTS equipment inventory includes DeLong barges/piers which exceed all MSC lift capabilities and, for the non-mobilization scenario, ruled out the use of semi-fixed pier facilities. Because of the lack of its semi-fixed beach facilities, this "worst case" scenario was referred to as the "Bare Beach Phase." The deployment requirement, simply stated, meant that all LOTS personnel and equipment had to be phased into the objective area as if deployed upon MSC shipping and the Phase I beach requirements had to be largely accomplished within four days. A test requirement was that only equipment required and organic to participating units could be used.

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[10] Although designed with this lift capability in mind, MSC is not able to determine if an LCU lift has ever been made on the GTM ADM WM CALLAGHAN, the ship referenced. In addition, MSC has also determined that certain limitations would be necessary in using the ship as a RO/RO, although its lift-on/lift-off capabilities would still be available. See Volume II of this report.

Routine deployment shipping data and manifests had to be submitted for subsequent evaluation. This was accomplished, for the most part, whether the cargo was loaded aboard the TRANSCOLUMBIA or administratively positioned.

Only key, large and heavy items were embarked since routine cargo and other vehicle loading and handling were not central to the LOTS test. The advance party and main body sections were assumed to have been air-lifted to the LOTS site. Based upon movement data submitted by the 7th Transportation Group, a total of 1,261 Army personnel, 86,477 cu ft of cargo, and 176,244 sq ft of vehicles and lighters would have been deployed to support the Phase I LOTS scenario.[11] This is exclusive of POL and Army activities that were used to support the test such as laundry, shower, and bakery units that would normally follow the deployment of the LOTS operational units. Excluded also are support and other units that interface with the LOTS transportation units such as the General Support Supply Activity (GSSA) detachment, line haul truck units (estimated at approximately battalion size), and the like. These calculations do, however, take into account approximately 51,000 cu ft of consumable supplies that would have accompanied the LOTS force. Table 2.3 contains a listing of the LOTS force for this phase and the air and sea-lift requirements, including special lifting requirements for each unit.

Other U.S. Army Forces Command exercises and operational commitments precluded the use of detailed warning, alert, and execution order procedures. However, the LOTS pacing items are the cranes and their disassembly, preparation, and movement. These were closely followed. Actual deployment to Ft. Story and beach preparations paralleled the LOTS main test design requirements. One minor exception was the use of an R&D test road grader in lieu of dozers for beach road net preparation. The dozers were available and did beach work but the small road grader was borrowed from the Marine Support Element on the adjacent beach.

PHASE I, DEPLOYMENT OPERATIONS

Preparation Activity Highlights

Preparation for deployment included disassembly of the P&H 9125 (140-short ton lifting capacity) and P&H 6250 (300-short ton lifting capacity) cranes for loading aboard ship. Since the ship to be used, the TRANSCOLUMBIA, has a 240-long ton lifting capacity, only minimal disassembly was necessary which, in turn, helped reduce the time and complexity for subsequent installation of the cranes for use ashore.

Data collected show that disassembly of the 140-ton crane took approximately 7 hr. In earlier pretests this time was on the order of about 13 hr.

[11] Subsequent to the Joint LOTS test, Army test planners and participants questioned the need and suitability of the 25 LARC-XVs (a medium amphibian company) for a mission of this nature. This employment is discussed further in Volume II of this report.

TABLE 2.3

PHASE I (BARE BEACH) DEPLOYMENT REQUIREMENTS

Unit	AIRLIFT				SEALIFT			Special Lift Requirements
	Personnel	Cube	Square	Weight	Cube	Square	Weight	
Headquarters and Headquarters Co., 24th Transportation Bn	93	463	1,036	54,268	1,080	301	28,424	
119th Transportation Co. (Terminal Service) (Container)	251	1,207	234	37,684	12,394	44,597	4,105,805	1-62[illegible] 2-9125 [illegible] 6-Fr[illegible] 6-Sid[illegible]
329th Transportation Co. (Heavy Boat)	148	-	234	15,560	-	49,278	4,876,350	10-LCU
1098th Transportation Co. (Medium Boat)	100	-	234	15,560	-	26,970	2,333,432	17-LCM-8
497th Engineer Co. (Port Construction)	203	-	9,730	951,863	1,960	3,540	267,442	1-Diving barge
567th Transportation Co. (Terminal Service)	135	-	-	-	-	2,132	237,758	
[illegible] Transportation Co. (Heavy Amphibian)	88	-	59	2,550	532	7,815	893,766	4-LARC-LX
331st Transportation Co. (Medium Amphibian)	164	114	290	17,676	3,291	18,597	1,380,721	25-LARC-XV
491st Transportation Det. (Cargo Documentation)	8	-	-	-	5	-	25	
544th Transportation Det. (Trailer Transfer Point)	16	899	282	91,243	603	282	40,470	
LACV-30 Det	20	-	-	-	12,000	5,883	191,504	2-LACV-30
Transportation Co. (Medium Truck)	30	-	-	-	207	4,680	376,258	
LOTS Force Supplies [illegible]	-	-	-	-	51,325	-	1,052,300	
TOTAL	1,261	2,683	12,14[illegible]	[illegible]	[illegible]	164,075	15,7[illegible]55	

The major preparations consist of removal of the bustle and main counterweights and the disconnection of the block and boom sections (except for the boom foot). Finally, these items were loaded on trailers for shipping.

The 300-ton crane, assisted by a 140-ton crane and a frontloader equipped with fork tines to reduce time, required only about 9 hr for disassembly and loading of component parts on trailers. Like the 140-ton crane, the major steps in preparing the 300-ton crane are removing the blocks and unreeving the cable, disconnection of the boom sections (except for the foot), and removal of the counterweights. In addition, however, it also requires removal of jackfloats, outriggers, and operator's module.

Loading/Off-Loading

The loading of the SS TRANSCOLUMBIA, the MSC long-term charter heavy-lift breakbulk ship, was accomplished by civilian stevedores over a two-day period, July 27-28. Approximately 600 tons of exercise breakbulk cargo was loaded first. The heavy equipment included items that had been loaded in a pretest eight months earlier. Outloading performance generally indicated improvement due to the experience gained. Off-loading was conducted 30 July from an anchorage off Blue Beach, Ft. Story, in calm seas but with intermittent showers. The equipment off-load operations were conducted by stevedores of the container company who were relieved by hatch gangs of the breakbulk company for discharge of the exercise cargo. Table 2.4 contains the load and off-load times. Lashing and unlashing times are not included since these activities do not interfere with boom operations. Figure 2.4 shows a 140-ton crane being off-loaded.

While the equipment was being landed, beach preparations were in the final stages for Phase I (Bare Beach) operations. The cranes were reassembled on the beach. A small jetty was constructed during one tide out of sections of an old barge, sandbags, loose sand, and timbered mats. (This process is described in detail later.) When beach cranes were in position and ready for operations, deployment was considered completed for Phase I.

Containership Loading

The containership used throughout all phases of the test was the C V STAG HOUND, a C5-S-73b non-self-sustaining containership with a capacity for 1,070 20-ft equivalent units in 40-ft cells. The vessel has an overall length of 610 ft, a beam of 78 ft, a full load displacement of 22,080 long tons, and a speed of 20 knots. The ship was built in 1969 and was considered for this test as being representative of a modern containership. (See Figure 2.5.)

Loading operations commenced at 0700, 4 August 1977, at Norfolk International Terminal. Commercial stevedores and equipment operators performed the loading without any direct military assistance. Approximately 586 20-ft, twenty-five 40-ft containers, and two 40-ft flatracks loaded with vehicles were loaded into and above bays 2 through 8. Bays 1 and 9 were left vacant. Figure 2.6 is a sampling of the commercial stevedores' cycle rates for two bays, 4 and 7. Containers were loaded at a rate of nearly 2 min. each.

TABLE 2.4

LOAD/OFF-LOAD TIMES (IN MINS) FOR SELECTED LOTS HEAVY EQUIPMENT
ON SS TRANSCOLUMBIA DURING THE MAIN TEST
(Routine Operational Delays Included)

Item	28 July Loading* (Minutes)	30 July Off-Load to Lighter* (Minutes)
XM 872, Semitrailer	13	16
Ottawa Model 50 Truck-Tractor	7	23
Lancer-Boss Sideloader	82	63
LCM8	32	48
P&H 9125 Crane	55	35
P&H 6250 Crane	40	33
LCU, 1466-class	75	93
Clark 475B Frontloader	56	58

*Does not include lashing times, since this operation does not necessarily interfere with the loading/off-loading process or timing.

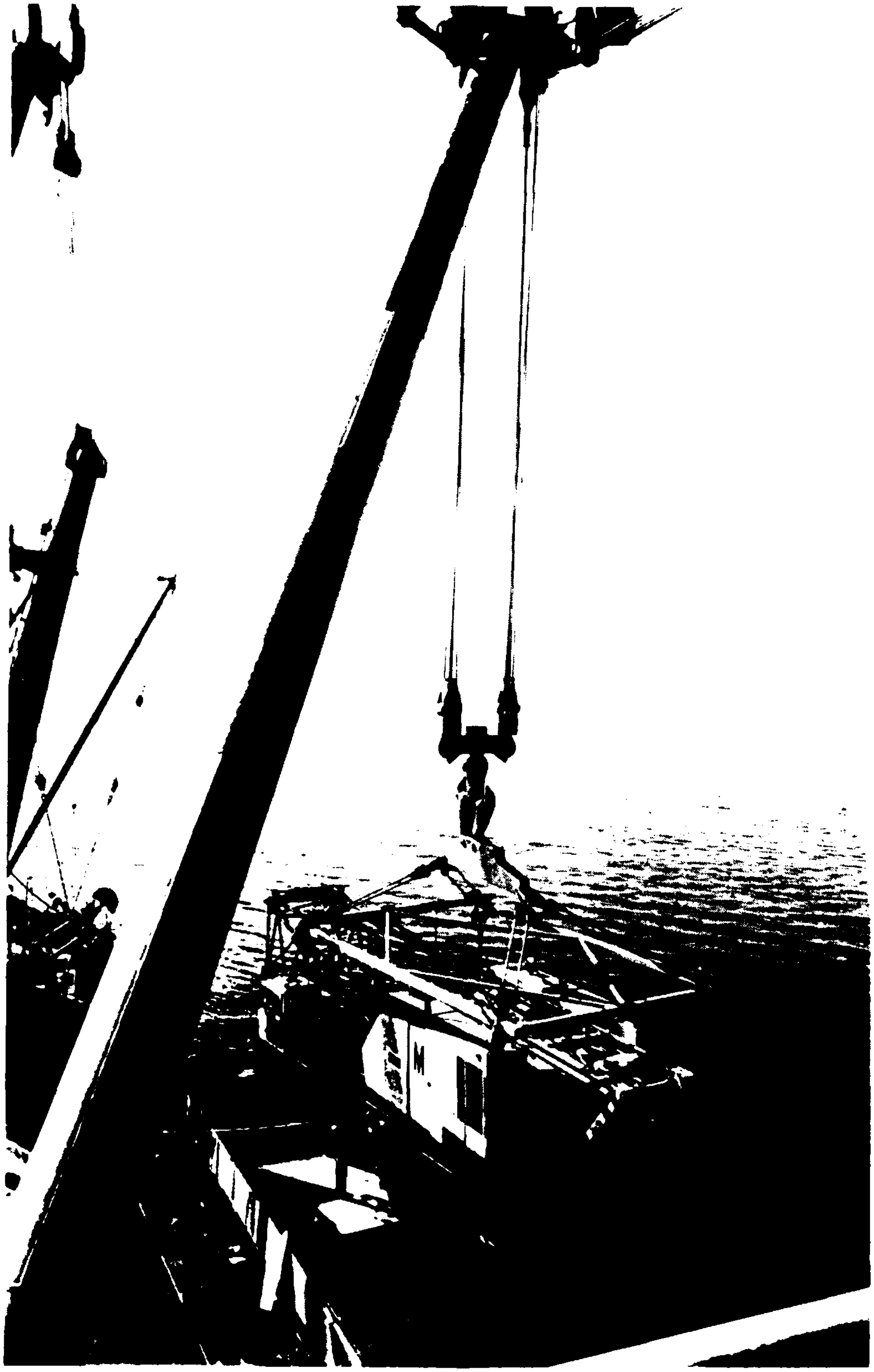

FIGURE 2.4. AN ARMY P&H MODEL 9125 TRUCK CRANE IS OFF-LOADED INTO AN LCM8

FIGURE 2.5. THE SS C V STAG HOUND ARRIVES TO PREPARE FOR THE LOTS MAIN TEST

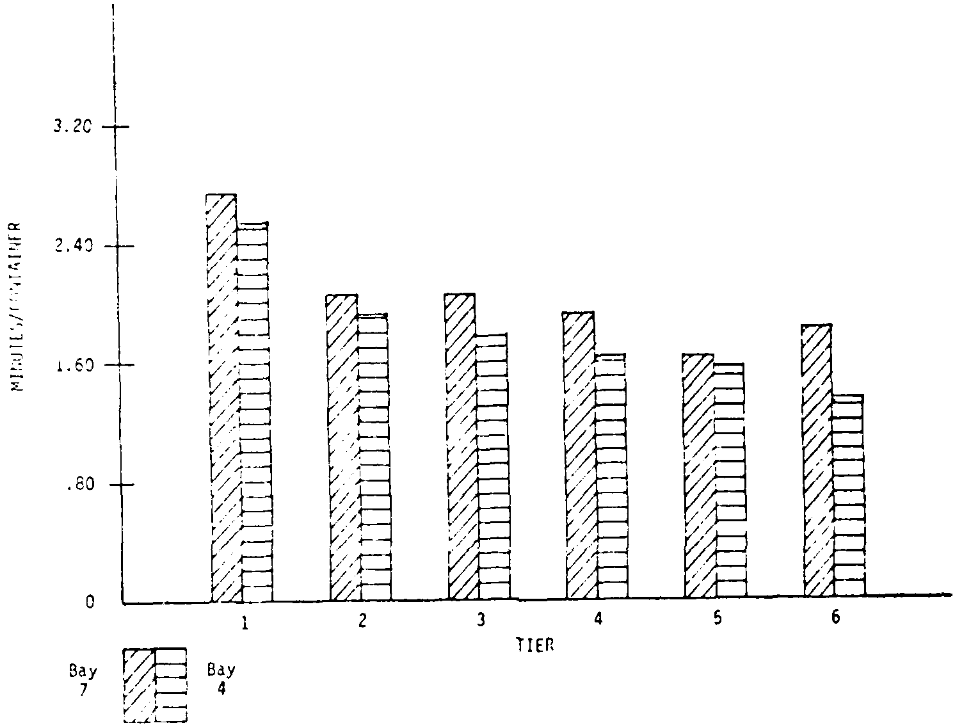

FIGURE 2.6. SAMPLING OF COMMERCIAL STEVEDORE CYCLE RATES

In addition to the loading of containers, two hatch bridging kits and a 200-ton crawler crane were loaded. The crane, needed to help discharge the ship at the LOTS site, was a Manitowoc 4100 W model, and was selected by the JTD based upon Navy recommendations. The hatch bridging kit provided a sturdy platform for the crane to rest and move upon. Before either could be loaded, however, modifications to the ship were necessary.

The modifications included the welding of stiffeners to the hatch coamings on bays 2 through 7. These stiffeners were required to reinforce the coamings for supporting the crane-on-deck package. Also included was the welding of D rings on the deck between the bay covers. These rings were to provide the anchoring fixtures for the lashings which were to secure the hatch bridging kits. The modifications were actually made during the container loading without any significant interference.

The crane was staged alongside the ship on a barge at the beginning of the second day of loading. The crane was hoisted onto the centered hatch bridging kit over bay 7 by a 350-ton floating crane. The hoist was conducted with minor delays to adjust the sling to reach proper center of gravity locations. The lift required approximately 2.25 hr and 1 hr to secure it. Considerable difficulties were experienced when the crane's counterweights were hoisted aboard for fitting.

Three counterweights were staged on the pier and were loaded aboard, one at a time, by a pierside gantry crane. The gantry crane was unable to spot the first two counterweights because of clearance problems caused by the Manitowoc's over-hanging aft mast assembly. After a number of tries and a 2-hr delay, a manual chain fall arrangement was used to lower the counterweights to a correct position for attachment. The third counterweight was spotted for attachment directly by the gantry crane without difficulty. The counterweight assembly required nearly 4 hr.

All containership loading, ship modifications, and crane reassembly were accomplished in 22 hr. Figure 2.7 shows the crane being positioned.

BEACH PREPARATION

General

Beach preparations for Phase I consisted of installation of:

- Command and control facilities,
- General messing accommodations,
- Parking and limited vehicle servicing facilities,
- First aid tent,
- Truck roads, staging areas, turnarounds, and load/off-load points,

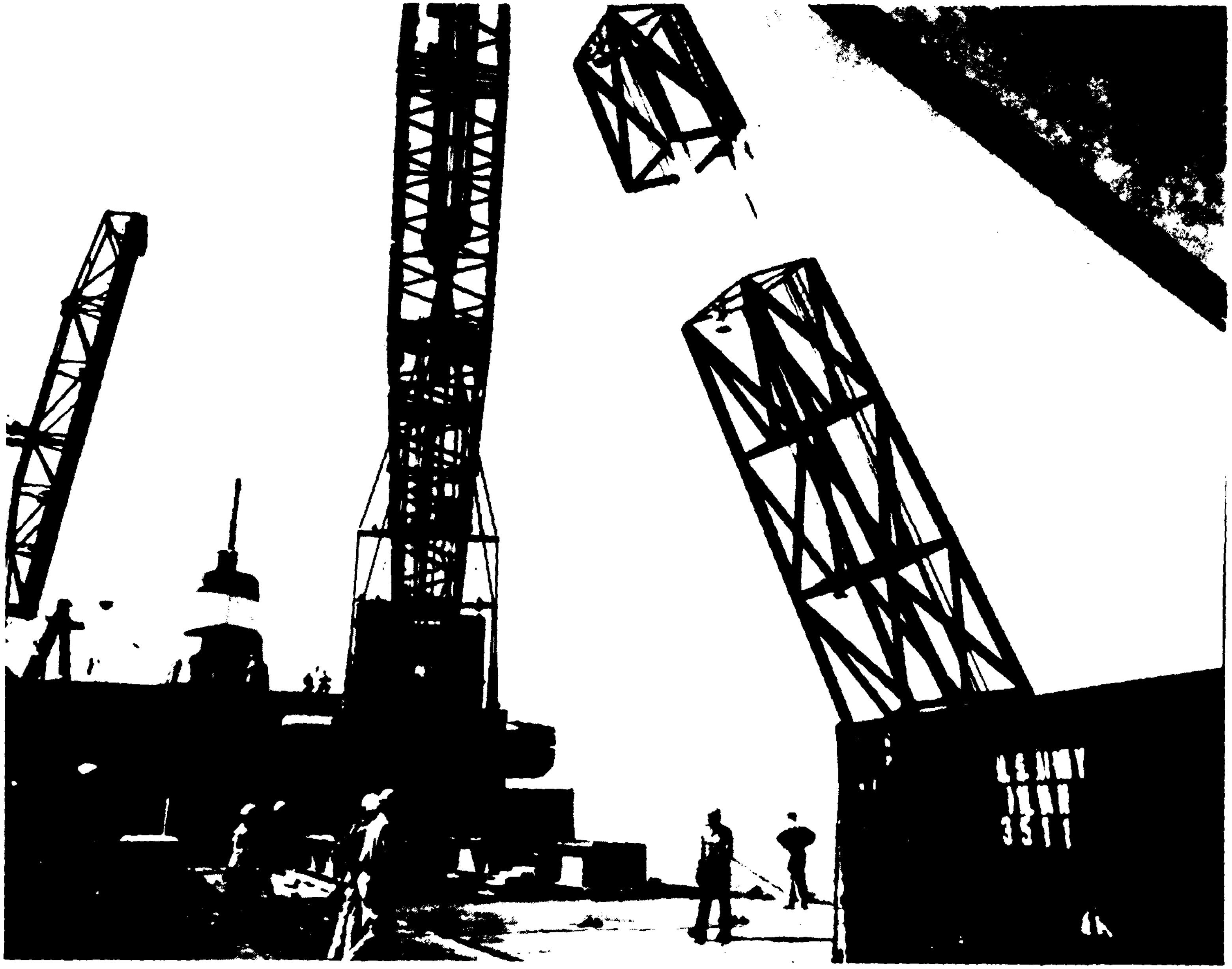

FIGURE 2.7. 200-TON CRANE LOADED. A 200-TON LIFTING CAPACITY CRAWLER CRANE IS LOWERED UPON A HATCH BRIDGING SET FOR EMPLOYMENT AS A CRANE-ON-DECK CONTAINERSHIP DISCHARGE SYSTEM. A 350-TON LIFTING CAPACITY FLOATING CRANE WAS USED TO POSITION THE CRAWLER CRANE WHICH WEIGHED APPROXIMATELY 117 TONS.

- Amphibian discharge point, and

- Jetty for 300-ton crane operations.

Essentially three major efforts were involved. The preparation of roads, staging areas, and load/off-load points was the most time-consuming and was essentially accomplished during the period 13-27 July. This event primarily involved Army personnel but the use of Advanced Multi-purpose Surface Systems (AMSS) required Marine Corps assistance, since AMSS had been a Marine Corps developmental project. The installation of the Amphibian Discharge Point was accomplished 30 July - 1 August and the assembly and installation of the 300-ton crane jetty was accomplished 3-4 August. All of these activities were done on an intermittent basis.[12]

Preparation of the site for bare beach operations was largely accomplished by the 497th Engineer Co. (Port Construction), which was also tasked with construction of the sand berm for LACV-30 operations, roads for beach clearances, jetty for the 300-ton crane, and roads and aisles for the marshaling area. This was in addition to the 497th Engineer Company's normal responsibilities for installation of the jacked-up DeLong pier, maintenance of mooring systems, provision of lighting, and minor beach engineering responsibilities.

Extensive preparations were required before soil stabilization operations could begin. To support these functions a road grader and AMSS equipment and personnel assistance were obtained from USN/USMC sources. In all, more than 32,000 cu yd of sand was displaced to provide adequate beach drainage and berm lines for the protection of equipment and roadways.

Red Beach

The major egress for Red Beach, where the Army conducted its breakbulk and container operations (see Figure 2.8), was an unimproved road between the shoreline and Atlantic Ave. (an improved road that paralleled the beach). This egress was widened considerably and made into a dual lane road, consisting of one lane of Momat and one lane of AMSS materials and covered a distance of approximately 900 ft.

A connecting road on the beach parallel to the shoreline (see Figure 2.9) provided a loop for tractor-trailer staging, approach, turnaround, loading, and departure. The shoreline side of the loop was double lane to allow for vehicle passing and loading near the amphibian discharge point and crane on jetty. There, M-19 airfield matting was used to provide the extra width. The back side of the loop was single lane and served primarily as an approach and

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[12] A delay in the arrival of the containership made it necessary to draw out beach and site preparations in order to maintain troop activity. These activities could have been compressed, if required. See analysis contained in Volume II of this report.

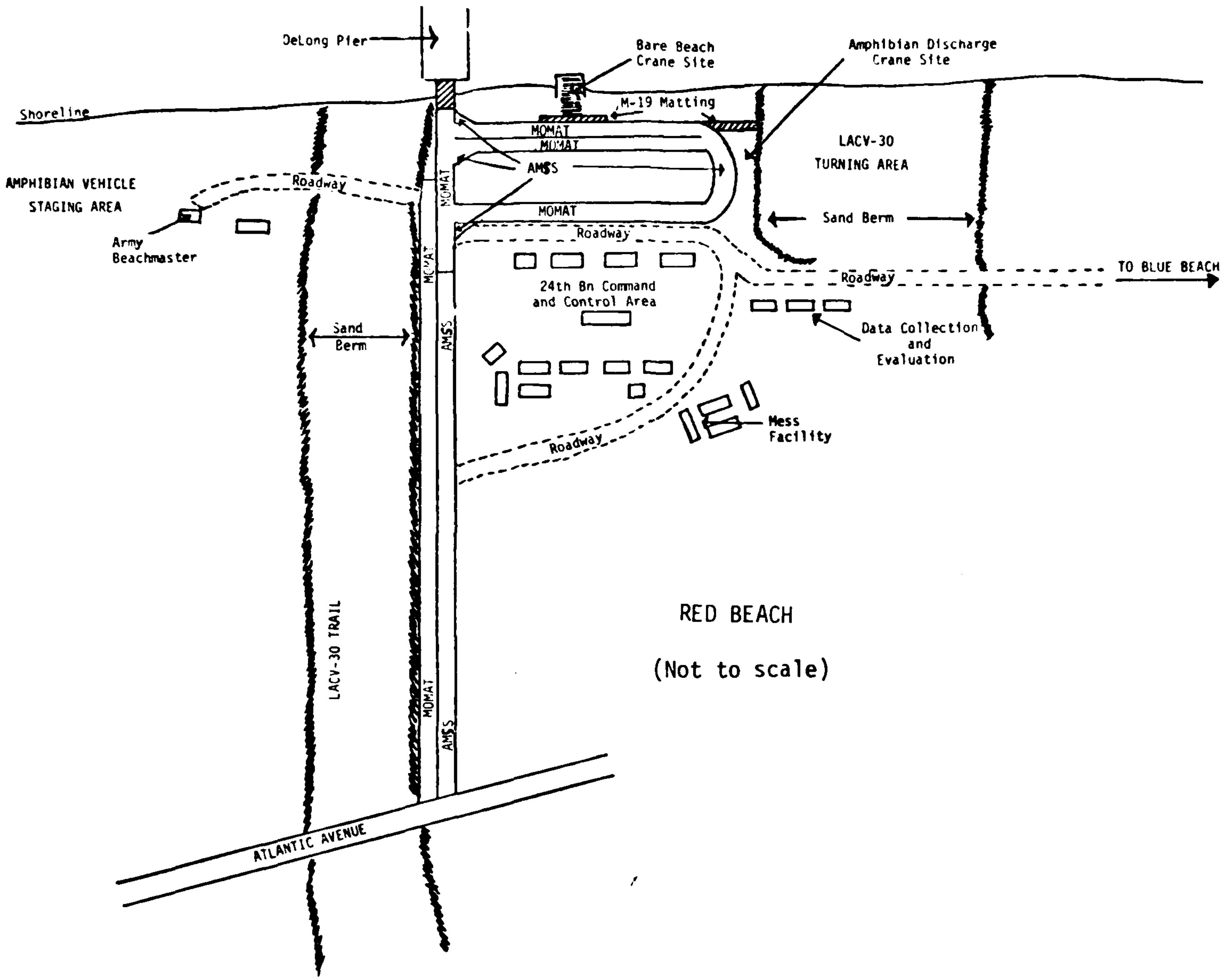

FIGURE 2.8. RED BEACH. SITE FOR ARMY OPERATIONS IN PHASE I.

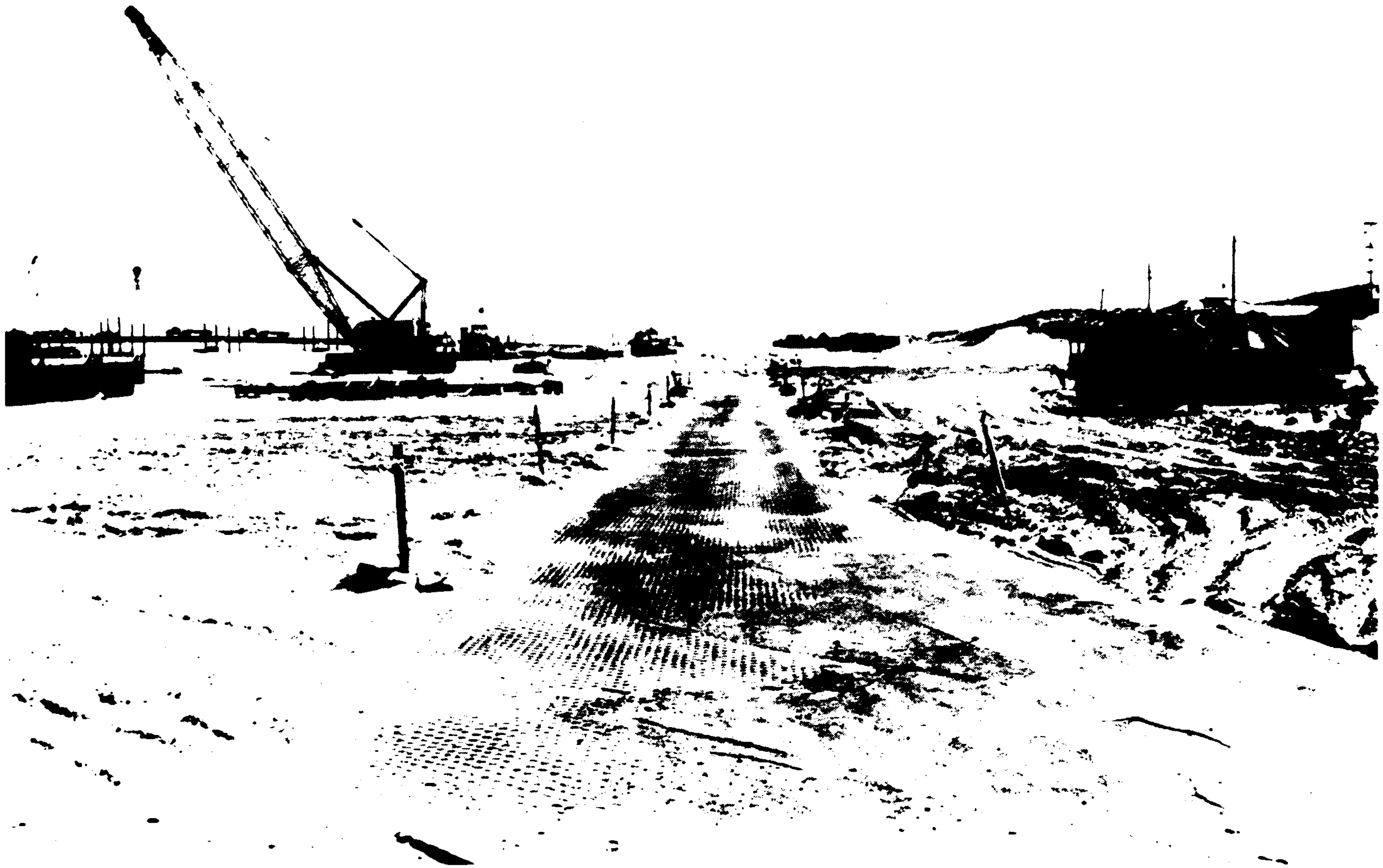

FIGURE 2.9. BACKSIDE PART OF THE RED BEACH LOOP FOR TRACTOR-TRAILER TURNAROUND

queue area for tractor-trailers awaiting loads. The long side of the loop, which paralleled the beach, were constructed with Momat while the corners and end section near the amphibian discharge point were surfaced with AMSS. Additional AMSS was used to round off the corners where the loop intersected with the main egress.

Most of the AMSS application was performed by a 6-8 man team. The dispensing unit, which includes storage tanks for each of the three elements of the compound, was trailer-mounted and towed by a 5-ton dump truck. For the smaller patching requirements a 400-lb portable dispensing system was used from the bed of the dump truck. Using the trailer-mounted dispensing system, 2,000 sq ft (one coat) was applied per hour. Generally, three coats were used.

AMSS uses a compound of resin, a catalytical chemical, and an agent that accelerates the hardening process when applied over a fiberglass cloth. This creates a surface designed to withstand vehicular traffic normally associated with beach operations. Initially some problems were experienced in applying the AMSS and additional applications were necessary in certain areas. This problem was attributed to the fact that the AMSS was applied during conditions of high heat and humidity which partially inhibited the chemical reaction.

A LACV-30 trail, constructed earlier for use in Phase III, was maintained during the course of the test by the 497th Engineer Company. The total amount of such effort expended on this test could not be determined. However, for bare beach operations all work was accomplished within scenario parameters.

Approximately 65 rail tie mats (3 rails secured to 15 ties) were constructed to support the movement of the 300-ton crane to the jetty and for the decking on the jetty. Miscellaneous efforts such as lighting, communications and command post installations were completed during the period 15-24 July. Work was accomplished on an intermittent basis and did not include weekends or nights.

Amphibian Discharge Point Site

Some site preparation was necessary in the establishment of an Amphibian Discharge Point (ADP) for the transfer of containers from amphibians to tractor-trailer units. (See Figure 2.10.) The site was designed around a 140-ton capacity crane situated at one end of the Red Beach truck turnaround and about 130 ft from the high waterline. The crane, with its long axis perpendicular to the shore, off-loaded LACV-30s from its left side and LARC-LXs and LARC-XVs from its side facing the sea. The crane deposited containers on its right side for pick up by a frontloader which, in turn, loaded the tractor-trailer units.

Both the ADP and the jetty cranes used the Red Beach truck turn-around road for staging vehicles waiting for loads. Actual loading was accomplished on the section of road nearest the beach, allowing space on the inside of the beach road for passing. At the ADP a section of M-19 matting was laid from the road back to the crane so that tractor-trailer units could back up to the crane

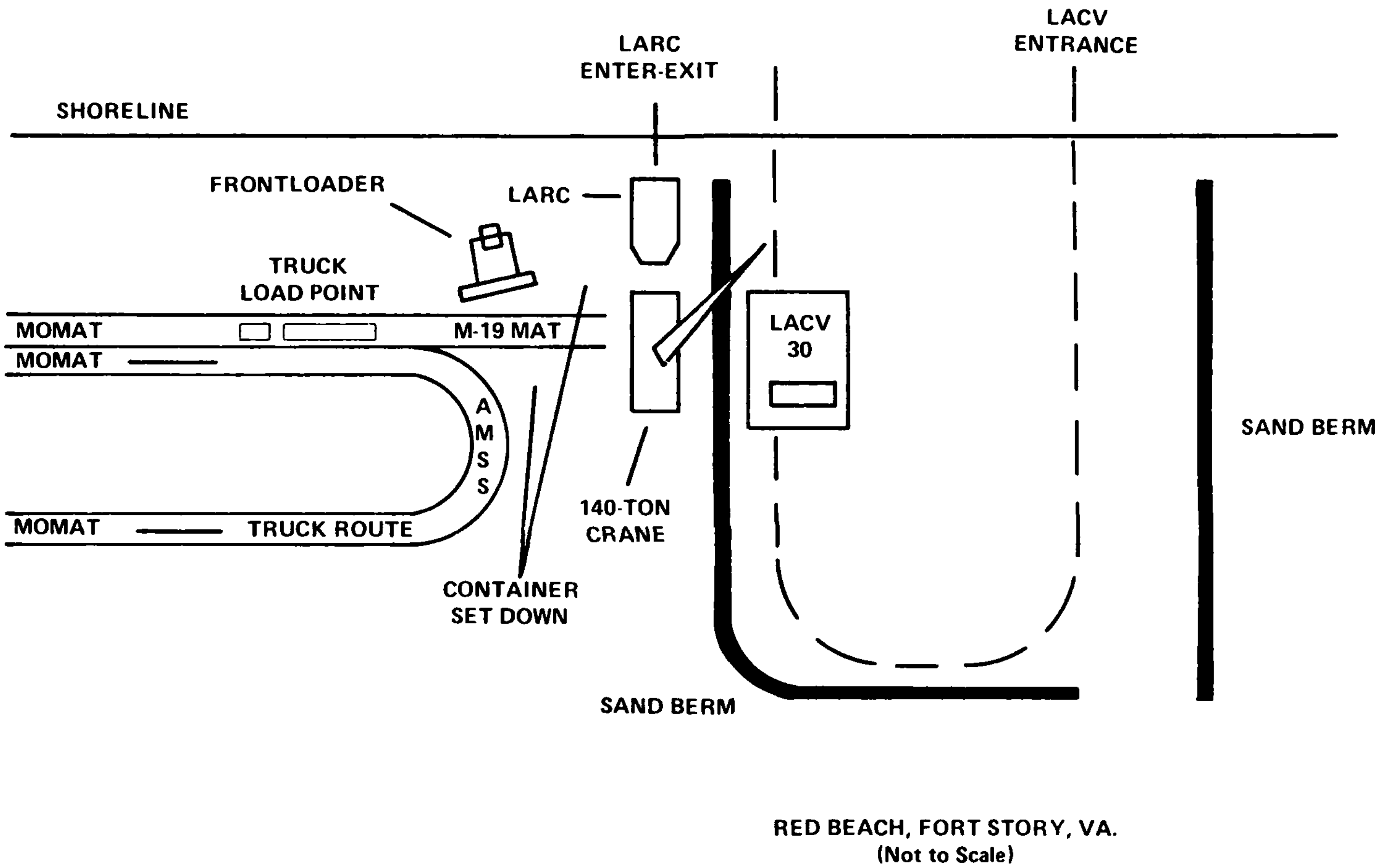

FIGURE 2.10. RED BEACH, FORT STORY, VA (Not to scale)

for direct loading and then pull forward once loaded. This extension was not needed since a frontloader was used to load vehicles.

A sand berm, approximately 3 ft to 5 ft high, was constructed to provide a turning area for the LACV-30s and to provide some protection for the crane from the blowing sand caused by the LACV-30s. The LACV-30s entered the beach at a point approximately 250 ft east of the crane, completed a 180-degree turn using the berm as a cushion to facilitate the turn, and positioned themselves alongside the crane. Containers were off-loaded by the crane and placed on the beach. The LACV-30 then departed the beach in a straight line from its position by the crane.

ADP site preparation, therefore, consisted of crane positioning and assembly (discussed later), burying pilings on both sides of the crane for its outriggers to rest on, and construction of the LACV-30 sand berm. These activities began on 30 July and were completed by the next day, except for the sand berm. The sand berm was constructed 1 August on an intermittent basis over approximately an 8-hr period mostly using just one dozer but up to four dozers and a scoop loader toward the end of that period. Table 2.5, in order of sequence, gives the times required for these events.

TABLE 2.5
ADP SITE PREPARATION

Event	Date	Time
Off-load crane across beach	30 July	29 min.
Reassembly of crane	30 July	7 hr
Positioning crane	31 July	1.5 hr
Bury pilings	31 July	50 min.
Construct sand berm	1 Aug.	8 hr
Total		17.0 hr

Construction of Jetty at Beach

To use a crane to unload landing craft at a beach site the crane must be able to reach out from shore a substantial distance. During the planning for the LOTS test it became clear that the reach of even the 300-ton capacity crane was not great enough to reach from the beach at Ft. Story to a grounded landing craft. As test planning progressed a temporary jetty was proposed to solve the crane on beach problem. The jetty would permit operations for a few hours each side of high tide during the bare beach phase. This was a compromise between the long length of jetty that would be required for round-the-clock operations, or no jetty at all, where operations would be restricted to high tide. During the planning before the main test a trial was made using salvage construction material as the jetty framework. This trial proved the construction and operation to be feasible, at least during periods when the surf is not more than about 1-ft high, a circumstance that prevailed at Ft. Story during the planning and the main test period.

The construction of the jetty followed a well organized and rehearsed plan. An outer framework or shell, made from salvaged sections of reinforced decking from pontoon sections, was erected at low tide. This shell protected the sand fill which supported the 300-ton capacity crane on a wooden platform. The front end pre-fabricated section was put in place at low tide (0400) on 3 August and the whole structure was completed before noon. (See Figure 2.11.)

FIGURE 2.11. JETTY COMPLETED. THE JETTY FOR THE ARMY'S 300-TON (LIFTING CAPACITY) CRANE WAS INSTALLED IN 8 HR. ALL SECTIONS WERE PRE-POSITIONED ON THE BEACH AND INSTALLATION WAS BEGUN AT LOW TIDE.

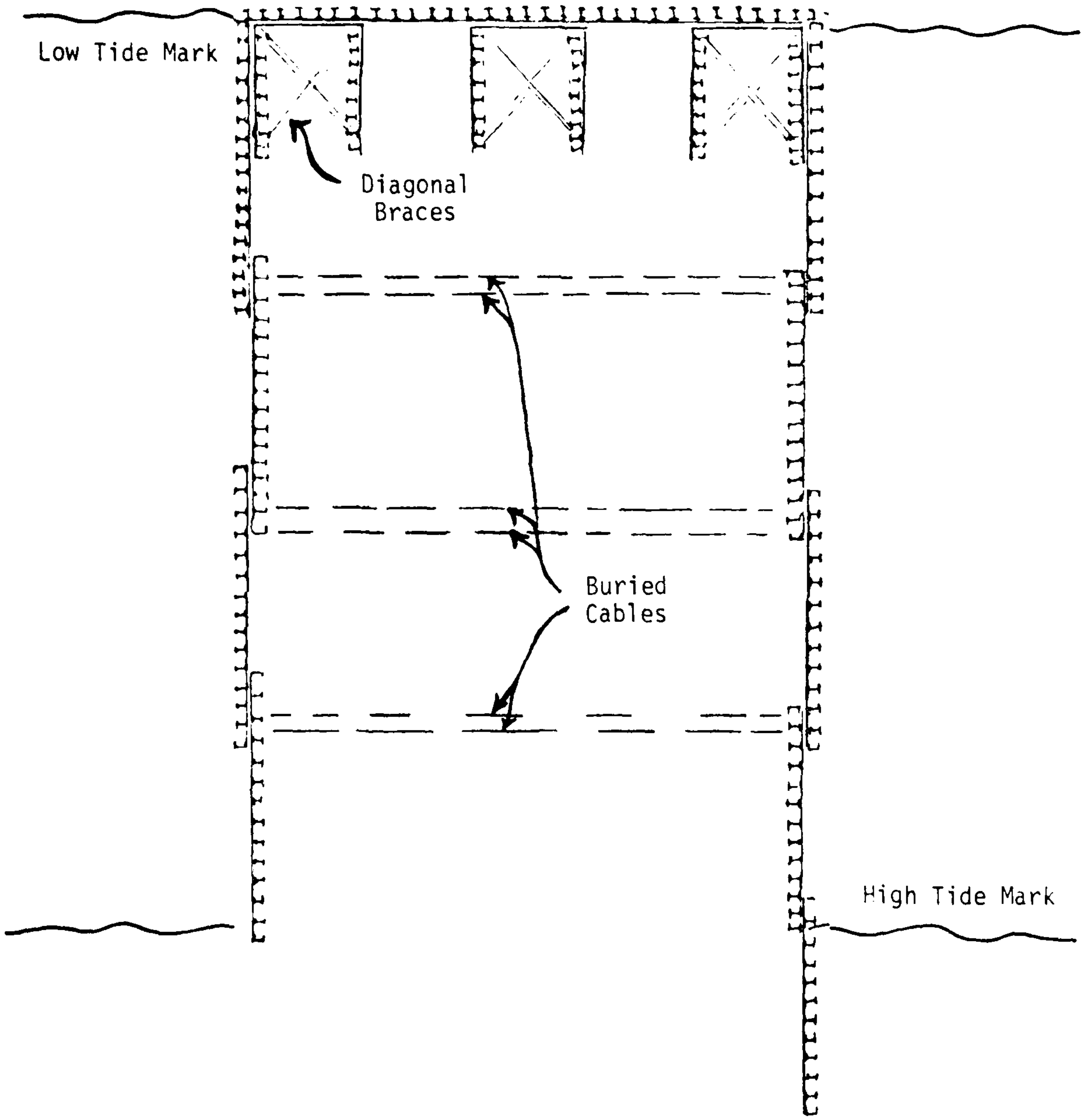

FIGURE 2.12. SCHEMATIC SKETCH OF SAND JETTY PROTECTIVE FRAMEWORK FOR BEACH CRANE

Each plate used to fabricate the seaward end section was approximately 6-ft high, and 10-ft wide. The assembled section was in the form of a six-tongued letter E (see Figure 2.12). The backbone of the letter was a lineup of five plates across the front, parallel to the beach and facing the sea. These plates were welded into an assembly about 42 ft across. The other six plates were perpendicular to the front piece, and formed the tongues of the E, as shown in the sketch.

The first step in the erection was to pull the prefabricated end section forward to the edge of the water at low tide. Three bulldozers did the towing. Cables from the bulldozer winches were fastened to the section at its base and made about a 45-degree angle with the horizontal. This provided a part lift, part drag force that prevented sand from snowplowing in front of the section. Diagonal braces inside the structure kept the bulldozer towing forces from distorting the structure during the move. The total distance moved was about 40 ft. This was accomplished in 15 min.

The next steps involved bolting side plates to extend the right and left flanks of the structure shoreward, and placing sandbags along the base of the structure inside and out. The bolting and sandbagging were done simultaneously. (Bolts were used to permit ready dismantling later.) Bulldozers and a small crane were used to position the plates; bolt holes were burned through the plates and 1-in. bolts drew the plates together. Three bolts were used for each plate, together with homemade washers cut by torch from half-inch plate. A large number of sandbags - 1,000 was estimated - were used to line the bottom edges of the plates and to fill two 6 in. x 8 ft gaps across the front in the salvaged metal plates. The two operations took a total of 5 hr.

To prevent pressure from the sand confined inside from spreading the sides of the structure apart, guy wires were used to connect the sides together. There were two wires to connect each opposite pair of plates, one about 18 in. above the base, and the other about 5 ft above. The wires were left slack; they were not intended to act unless the sides began to move apart. All guy wires were buried by the sand used to fill in the center of the structure. The fill-in operation was done by three bulldozers and the guy wires installed only after the sand had been built up to a level about where the wires would be installed. Filling with sand and installing guy wires were essentially completed in an additional 3 hr. As the project neared completion, the finishing work was left to a few men compared to the 30 or more used during the initial 5-hr period. Thus, while the whole job took about 8 hr, it could well have been done in less time.

Marshaling Yard

An AMSS pad approximately 125 ft x 14 ft was constructed and used only once during the test. It was tested by a sideloader and did not withstand the heavy axle load. The AMSS "rippled" under the weight of the sideloader and the test was terminated before further damage was done.

There were minor back-blading operations. However, this activity was considered normal and no substantive engineering efforts were undertaken since the site was already cleared and had access roads. Because the Army frontloaders were able to operate within the marshaling site without soil preparation and trucks used only the existing prepared roads, minimal time was spent preparing the site.

PHASE I, ORGANIZATION FOR OPERATIONS

During Phase I, an Army operation, the Joint Task Force commander tasked the CO of the 24th Transportation Battalion to conduct the operations with attached operating units. The operation of the four container handling cranes - the crane-on-deck, and crane on B DeLong barge at shipside, and the crane on a jetty, and crane for discharge of amphibians at shoreside - were the responsibility of the 119th Trans. Co. (Terminal Service) (Container). Lighterage control, beach clearance truck operations, documentation and management of cargo, and marshaling yard operations were under battalion control.

In addition to container operations, breakbulk cargo was to be discharged from the TRANSCOLUMBIA and off-loaded at Red Beach adjacent to the container handling facilities. This mission was assigned to the 567th Trans. Co. (TS), which was task organized with supporting elements to conduct breakbulk operations.

For the accomplishment of cargo accountability and movement control, the documentation sections organic to the two terminal service companies were pooled as a unit. This is consistent with current doctrine for a battalion, 2-terminal-service-company-size beach operation. (See U.S. Army FM 55-70.)

PHASE I, CONCEPT OF OPERATIONS

The general plan was for the TCDF to off-load containers from the ship to amphibians and the COD to load landing craft. Priority under the hook was to go to the LACV-30 to maximize the utilization of that craft. During low water the landing craft were to loiter off-shore until there was sufficient depth at the jetty for the beach crane to reach them. In the event no landing craft were available, a BC barge was to accept containers in order to keep the COD operating. (The barge was never used.)

At shoreside the beach crane on the sand jetty was to off-load landing craft, and during low tide, containers from LARC-LXs and LARC-XVs when a queue formed at the amphibian discharge point (ADP) crane. Priority for unloading at the ADP crane also was to go to the LACV-30.

All containers were to be cleared by truck immediately from the beach to the marshaling yard for temporary storage, segregation and documenting for movement. Selected containers, up to about 75 per day, were to be forwarded to consignees.

Due to limited space, container deliveries to consignees were restricted to one main service support area where the containers remained on trailers until returned during retrograde operations. All cargo was processed through the marshaling yard. No shipments were made direct from the beach to consignees.

Concurrent breakbulk operations were handled in the normal manner, separate from container operations, except for battalion control. The 567th Trans. Co. (TS) discharged palletized cargo from the heavy-lift cargo ship into landing craft tasked to support the operation. The shore platoon forklift operators unloaded the landing craft and assembled the cargo on the beach.

START OF OPERATIONS

Operations commenced at 0600 on a clear day with moderate wind and calm seas. All operating personnel for ship discharge operations, data collectors, and supervisors were loaded on lighters by about 0530 hr. Landing craft for transporting breakbulk cargo and containers were standing by at stations near and inboard of the two ships. The Army barge-TCDF was under tow enroute from Little Creek, Va. The shore cranes at the jetty and amphibian discharge point were readied for container operations, but the jetty crane was found to have a cable problem which delayed its start. Yard tractors and container transporters were standing by from about 0650 hr anticipating an early start. Breakbulk operations began about on schedule.

BREAKBULK OPERATIONS

Lighterage

During the early stages of breakbulk cargo off-loading, LCUs and LCM8s were used. The off-loading rates were the same for both craft. Sufficient craft were on-call which precluded any significant idle time for the ship's booms.

Some craft experienced difficulties crossing sandbars and beaching at low tide. D-7 dozers were used to winch several lighters over the sandbars at the beaching site. As a rule, sufficient craft were able to beach during the favorable tidal conditions to keep the beach transfer facilities active throughout the less favorable times.

Shipboard Operations

Approximately 600 pallets of cargo were equally divided between holds No. 3 and No. 4 in the SS TRANSCOLUMBIA. Off-loading commenced on 1 August and was terminated on 8 August, with retrograde operations necessary about every 36-48 hr in order to continue breakbulk cargo throughput.

The off-loading operations followed Army standard operating procedures. Each hold contained one supervisor and 7-8 cargo handlers. In the lighter were another two cargo handlers, plus a forklift operator if the lighter was an LCU. Assisting the boom operator was a signalman usually located on deck above the lighter moored at the side of the ship.

Table 2.6 illustrates the hold productivity based on data taken during the early and latter stages of the off-load.

TABLE 2.6

HOLD DISCHARGE PRODUCTIVITY

Date	Average Boom Cycle	Average Pallets Per Lift	Productivity (Pallets/hr)
1 August	11.33 min.	4.39	23.14
2 August	7.50 min.	3.15	25.20
6 August	5.96 min.	3.32	33.47
7 August	6.42 min	4.56	42.50

Shoreside Operations

Two rough terrain forklifts were used to off-load LCM8s. Three were generally used in LCUs. Pallets were usually off-loaded directly onto waiting trucks which hauled the cargo inland to the in-transit storage area in the marshaling yard. From there documentation teams under battalion control tallied the cargo and cleared it for movement from the beach to the marshaling yard. Table 2.7 illustrates the forklift productivity at Red Beach where the transfers were made. (An analysis of breakbulk discharge and handling rates in terms of total unit capability is contained in Volume II.) Shoreside handling was terminated 7 August with a final retrograde to the ship where the pallets were loaded into barges for subsequent use or return. (See Figure 2.13.)

TABLE 2.7

FORKLIFT PRODUCTIVITY (BREAKBULK OFF-LOAD) AT RED BEACH

Date	Average Cycle* Time	Average Pallets Per Trip	Productivity Pallets/Hour
1 August	7.68 min.	2.00	15.62
2 August	7.05 min.	1.87	15.91
6 August	7.46 min.	2.04	16.40
*Cycle = Lighter to truck and back to lighter.			

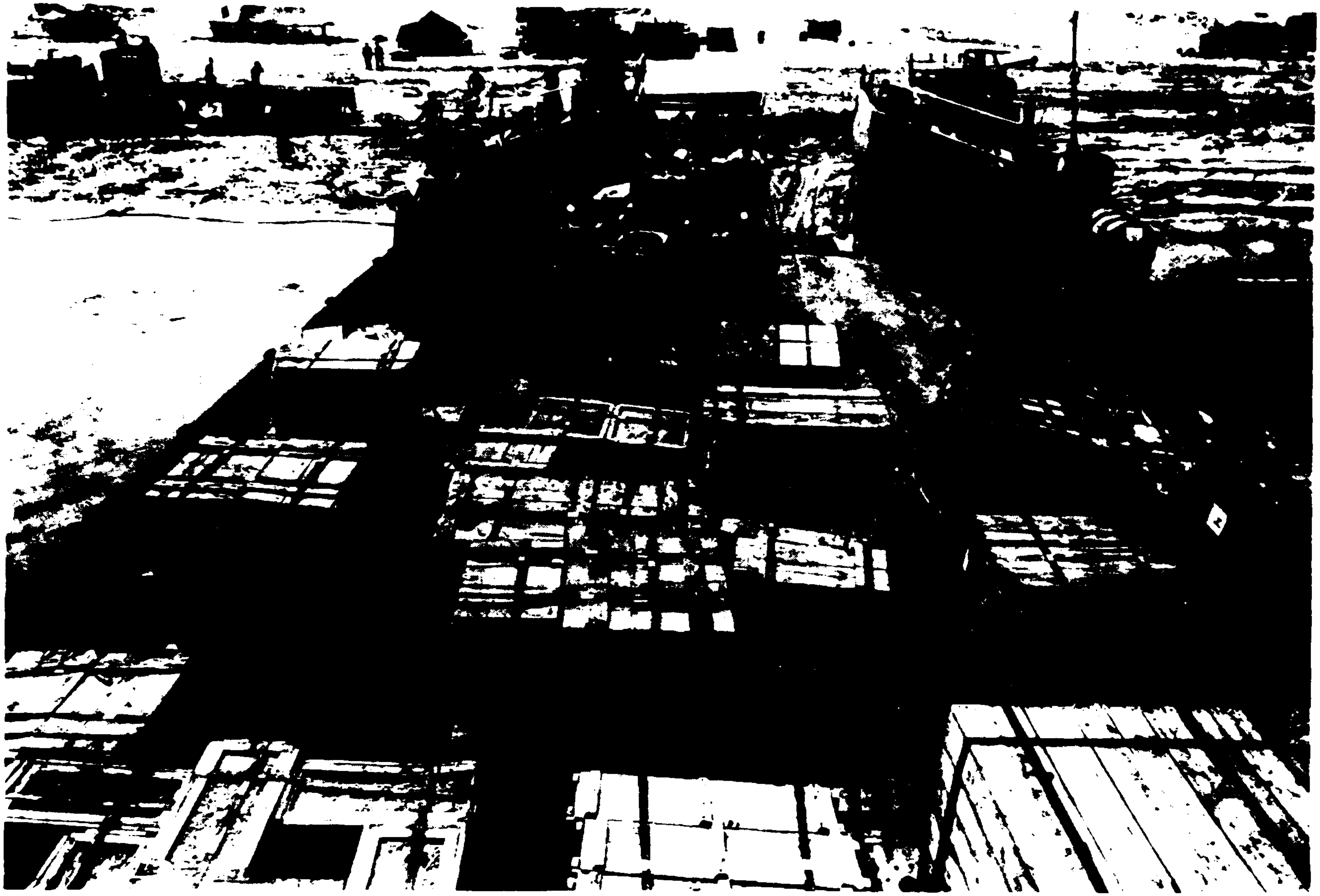

FIGURE 2.13. AN ARMY 6,000 LB. CAP. FORKLIFT OFF-LOADS PALLETIZED CARGO AT RED BEACH.

PHASE I, CONTAINERSHIP OPERATIONS

Crane-on-Deck

Background. The crane-on-deck (COD) unloading system, a Navy developmental project, called for a 200 or 250-ton lifting capacity crawler crane as a COD. Following a competitive bid, a Manitowoc 4100W was leased from a commercial firm for use in all phases of the test. The crane's characteristics are listed in Table 2.8.

TABLE 2.8

CHARACTERISTICS OF THE MANITOWOC 4100W

Total Weight (lb)	356,660
Counterweights (lb)	122,000
Length of Crawlers (ft)	26.5
Width of Crane (ft)	
Crawlers extended	21.1
Crawlers retracted	18.6
Width of Track (in)	48
Rated Lift Capacity (tons)	200
Boom Length Tested (ft)	90
Boom at Pin Connected Joints	
Width (in)	95
Depth (in)	95

Hatch Bridging Kit. The hatch covers on non-self-sustaining containerships do not have sufficient strength to support the crane. A hatch bridging kit, developed by the Navy to support the crane, transfers the weight and dynamic forces from the tracks of the crane to the load bearing members of the ship. The bridging kit must be capable of transferring the maximum forces generated by the weight of the crane itself, plus the weight of the heaviest container to be hoisted under dynamic conditions, (i.e., acceleration from the moving loads and from the maximum sea states experienced during unloading). The kit must also provide a means for the crane to move in order to off-load containers otherwise out of reach. The kit was designed to be usable, with some modifications, on several classes of NSS containerships and is believed suitable for use on approximately 67 percent of U.S. flag containerships.

The hatch bridging kits that were tested consisted of two steel girders with wood dunnage on the top surface of each girder. The length of a girder is about 43 ft, which is slightly longer than a hatch cover over a 40-ft container cell. Each girder is 50 in. wide and 36 in. high and weighs 36,000 lb. The girders supporting the crane are secured to the deck of the ship by four wire lashings at the end of each girder.

During container transfer operations the COD is supported above one hatch cover by a girder under each track while off-loading from another hatch. The remaining two girders are stored within reach of the crane. The crane is moved by positioning the unoccupied hatch bridging girders to span the adjoining hatch. The girders previously occupied by the crane are then relocated alongside the crane to be available for the next move.

COD Working-Ship Activities

During off-load and retrograde operations certain activities were necessary in addition to container handling. Once containers on deck had been off-loaded, for example, hatch squares had to be opened and closed. In addition, the crane had to be relocated periodically.

COD Relocations. The COD is shown in Figure 2.14 at its initial location on a cover over bay 7. From there it discharged containers from bays 6 and 8. When these two bays were empty, the COD moved from bay 7 to bay 6 where it discharged containers from bays 5 and 7. The off-load terminated with the COD on bay 6. Retrograde operations were then begun. The COD, after completing operations from bay 6, returned to its initial position on bay 7 and completed retrograde operations from there. The COD was then ready to follow the same sequence of moves during the next phase of the test. For the first move, the crane required 144 minutes and the second relocation required 181 minutes. Subsequent relocations by the COD in other phases took about 30 to 60 percent less time. An analysis of crane relocations is contained in Volume II of this report.

COD Hatch Cover Handling. Bays 2 through 8 on the C V STAG HOUND have similar hatch covers with the port covers being narrower than the starboard covers. The port hatch cover measures 41 ft long, 26 ft wide, and 27 in. high; it weighs 28 tons and covers three cells. The starboard hatch cover measures 41 ft long, 35 ft wide, and 27 in. high; it weighs 32 tons and covers four cells.

The COD crew used two methods for storing hatch covers. The initial method involves removal of a hatch cover from a hatch adjoining the COD and placing it on top of an adjacent bay. For example, when the COD was located on bay 7 the covers from bay 6 were stowed on bay 8 and vice versa. As the test progressed another method of storing hatch covers was developed. In this method that hatch cover was placed on the opposite side of the same

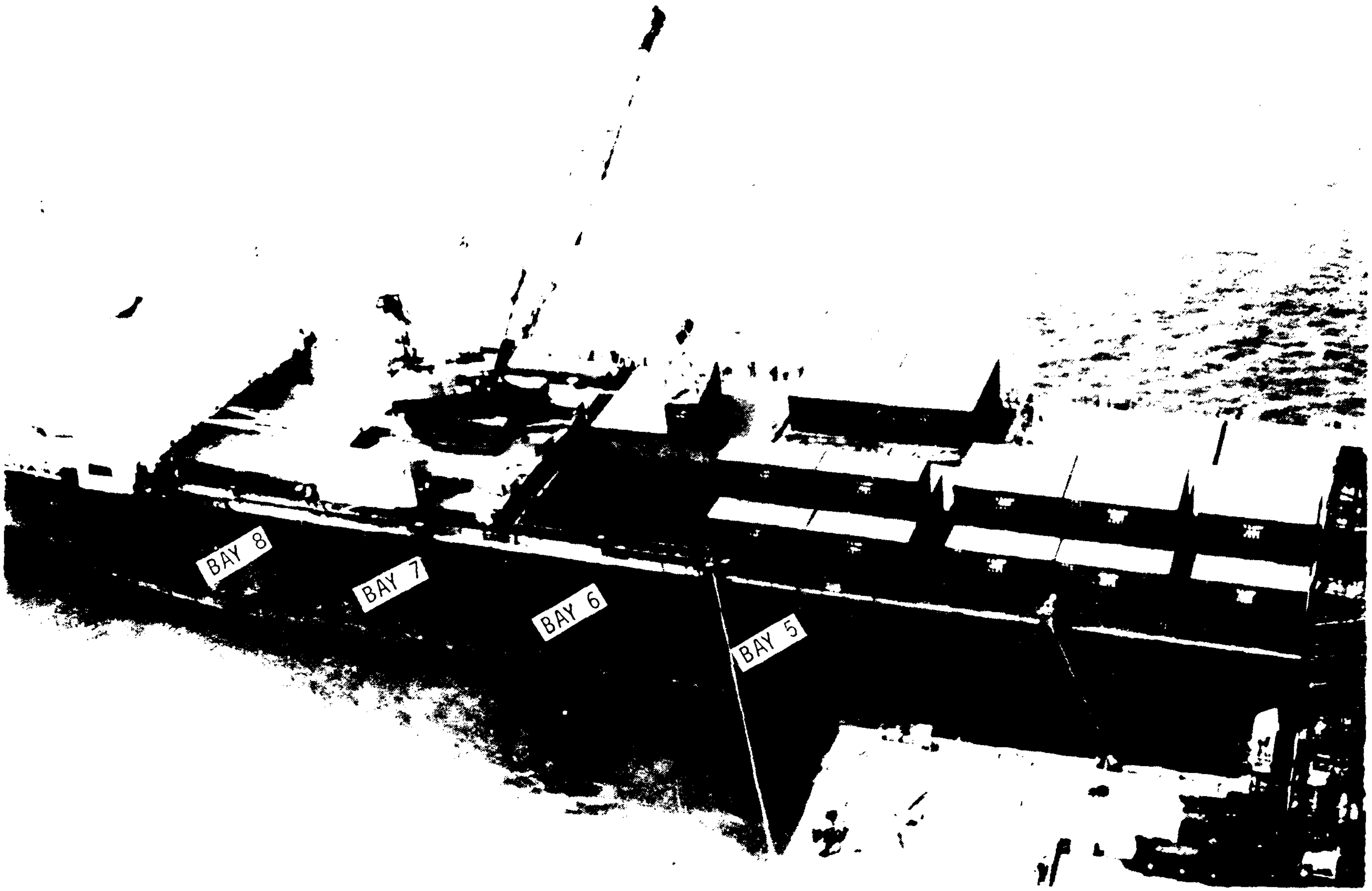

FIGURE 2.14 THE COD ON THE DECK OF THE C V STAG HOUND

bay. This method worked even though the starboard cover extended over the port cover by 9 ft. A pedestal which is located on the deck of the port side of the ship outboard of each bay helped in supporting the starboard cover when placed on the port side.

The COD employed a 40-ft spreader bar to lift the hatch covers. Since most of the containers used in the test were 20 ft long, the lifting of a hatch cover usually required changing the spreader bar before and after a hatch cover was lifted. In total, at each location the COD had to handle four hatch covers. Power tag lines were observed to be effective in controlling bay cover pendulation during the opening and closing of hatches. (See Figure 2.15.)

The Army deck crew had two types of hatch operations to conduct, depending upon whether or not there were containers stowed on deck. These operations were:

- Open or close a hatch, or
- Close/open one hatch and open/close a second hatch.

A single hatch opening or closing varied from about 17 min. to about 44 min. A two-hatch operation, on the other hand, varied from about 41 min. to about 80 min. (Further discussion is contained in Volume II of this report.)

COD Operations, Phase I

In Phase I, the LOTS scenario involved the unloading of a NSS containership using two CODs operated by Army personnel. Since only one COD was available, the TCDF was used in place of a second COD. The Army managed and operated both the COD and the TCDF and provided the stevedore crews for the ship. The lighters serviced by the COD were also from Army units. The number of container transfers for the COD by day and by shift is given in Figure 2.16 for Phase I. The COD average container transfers for a 24-hr period was 64 which was far short of the single crane target of 150 containers. In Phase I, which covered a period of nine shifts, the COD transferred a total of 286 containers.

FIGURE 2.15 CRANE-ON-DECK OPENS A HATCH

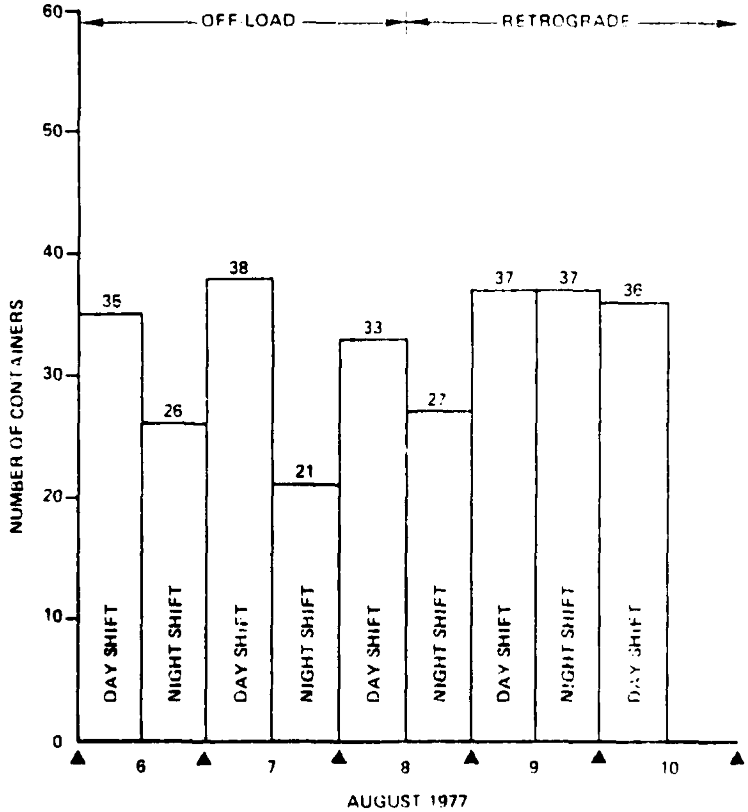

FIGURE 2.16. COD CONTAINER PRODUCTIVITY BY DAY AND NIGHT SHIFT FOR PHASE I (Includes 20- and 40-ft containers and 40-ft flatracks.)

The COD encountered several start-up problems in Phase I causing delays and reducing container throughput. One such problem involved the two point hook-up of the COD to the spreader bar. This hook-up caused the long axis of the spreader bar in its natural position to be at a 90-degree angle to the long axis of the containers stowed on the ship. Consequently, the tag line handlers on the ship had to manually rotate the spreader bar through a 90-degree angle so the spreader bar would be correctly aligned over the container to be lifted. Using two tag line handlers in the holds proved to be inadequate and later the number of handlers was increased to four to make the operation proceed faster. Also, in Phase I, short manual tag lines made controlling the spreader bar difficult.

As a result of rotating the spreader bar for each container transfer the crane lines became twisted on three occasions during Phase I. This stopped COD operations for periods of 34 min., 15 min., and 71 min. so the lines could be untwisted. In Phase II the two blocks of the crane were attached to each other with a metal bar to prevent the lines from becoming easily twisted.

In Phase I the day shift throughput always exceeded that of the night shift. The average number of container transfers decreased from 39 for the day shift to 23 for the night shift. One reason for this reduction was that Army personnel used only the ships' lights which were insufficient. The lighting at night hindered the COD operator's ability to see the signalman as he moved about the deck of the ship following the container being transferred.

As noted in other sections of this report, lighter succession caused delays in the ship unloading process and this was particularly true for COD night operations. For example, when there were "awaiting lighter" delays the average time was 43 min. per shift during the day shift, but there were delays totaling up to 2 hr 5 min. for one night shift according to the data collection reports. The increase at night in awaiting lighter time greatly reduced the throughput for this shift and is one of the easier delays that can be prevented.

The method used to moor lighters at the COD in Phase I changed in Phases II and III. In Phase I mooring consisted of lighter crews throwing mooring lines up to the stevedores on the deck of the ship. Often several attempts were required before the stevedores on the ship caught the mooring lines. Two mooring lines were used to secure the lighter to the ship. The method used during Phases II and III involved the lowering of a single mooring line from the deck of the ship to the lighter. The lighter, continuing under reduced power, provided a constant tension to the line thereby holding its position.

Considerable time was also lost during Phase I for COD refueling. The Army deck crew refueled the COD for the first time during the night of 6 August 1977, requiring 154 min. A very slow hand-operated fuel pump was used. Again, during the night shift of 9 August 1977, refueling of the crane required 165 min.

The LOTS main test was the first time that a crawler crane with a hatch bridging kit had been used by the Services to discharge a NSS containership. The COD system was not available for the LOTS pretests. Many delays encountered in Phase I were due to inexperience in operating the COD, and working on a non-self-sustaining containership and with other unfamiliar equipment.

Barge-Temporary Container Discharge Facility

Background. The barge-temporary container discharge facility (TCDF), consisting of a crane mounted on an Army B DeLong barge, was tested during the LOTS exercise as the second means for unloading containers from a non-self-sustaining containership into lighters. The three main components of the facility, all items in the Army inventory, can be seen in Figure 2.17. They are:

- The B DeLong barge,
- The 300-ton capacity P&H 6250 truck crane[13], and
- A pair of B DeLong ramps, used in this case as a combination of load-spreaders and as a vertical spacer to raise the crane so the boom can clear the deck edge to reach the center of the ship.

When in use, the barge is moored alongside the ship. The crane, reaching all cells up to the centerline of the ship, transfers containers into lighters. When all the containers within reach have been unloaded, the barge is moved so it can reach other containers. The TCDF can work from either side of the ship. While in the LOTS test only one barge-TCDF was used, the Army intends to use two for unloading a single ship. This permits unloading or retrograde to proceed with containers being handled on both sides of the ship and helps prevent listing or excess fore and aft trim. The TCDF characteristics are contained in Table 2.9.

The TCDF facility is currently the only means available within DoD to unload non-self-sustaining containerships in a LOTS operation. It has critical limitations, the magnitude of which have yet to be established. Three major ones are:

- Operations in a Seaway - When waves make the barge roll or pitch the crane boom tip swings in a substantial arc, and container operations become difficult or must stop. This is discussed in further detail in Volume II in the analysis of the TCDF.
- Effects of Barge Motion on Crane Stresses - The 300-ton capacity truck crane was designed as a land crane. Putting it on a barge that can list in response to loads, or that will pitch, heave, or roll in response to a seaway,

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[13] This is one of two 300-ton capacity cranes in the terminal service (container) company's Table of Organization and Equipment (TOE). The second crane was used on the beach as the crane-on-jetty.

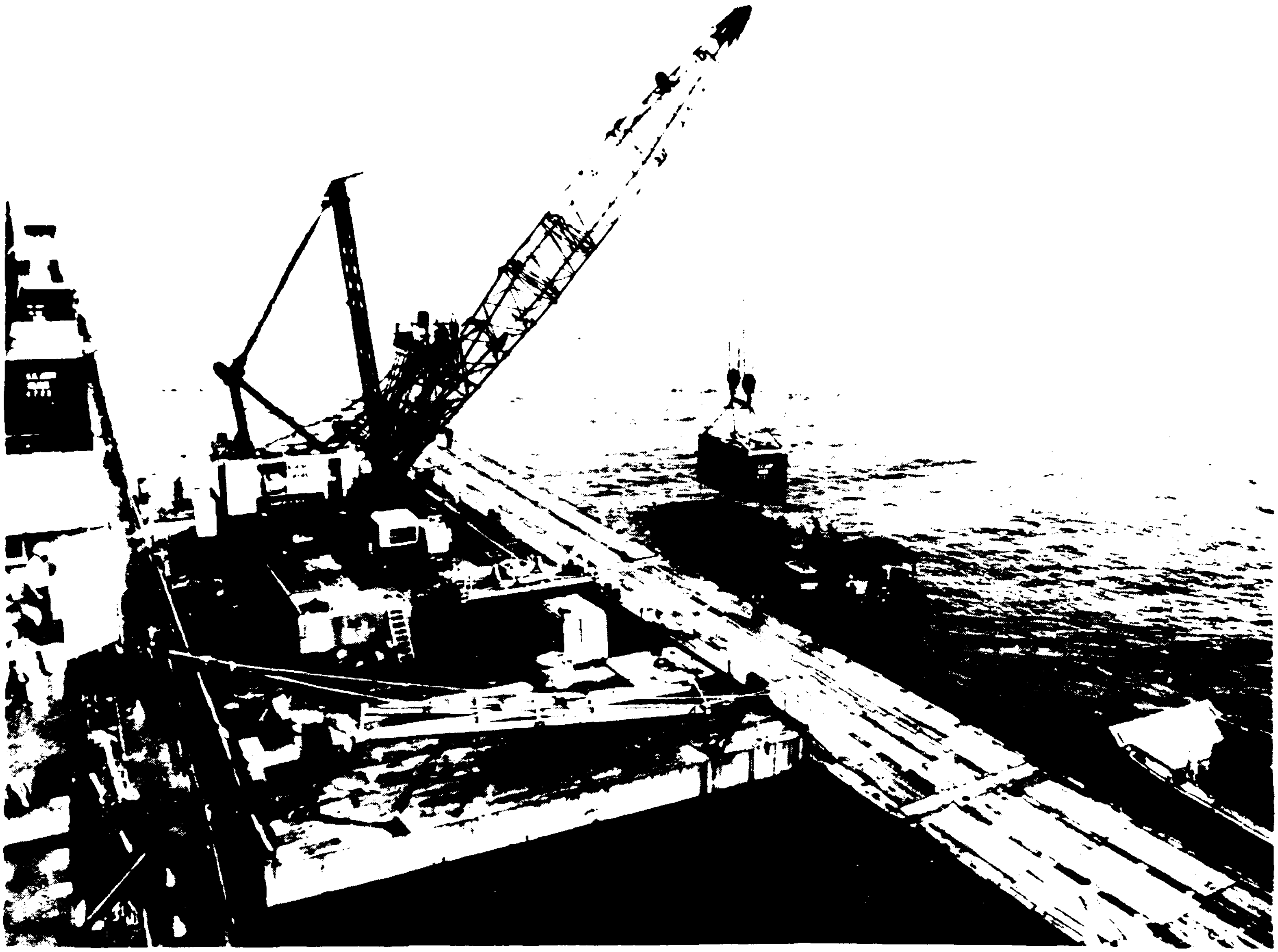

FIGURE 2.17 BARGE-TCDF LOADING 20-FT CONTAINER INTO LARC-LX. Note elevated cab that permits operator to see operations from above ship-deck level. Also note floating causeway sections used for convenience in tying up lighters and off-loading containers.

raises questions about the capability of the crane to safely lift loads under various conditions. As a temporary measure the crane was substantially derated, using guidance from the manufacturer.

- Deployment - Speedily and safely deployable only by SEABEE ship (see Deployment and Analysis).

TCDF Working-Ship Activities

To accomplish off-load and retrograde operations the barge-TCDF, like the COD, had to accomplish certain administrative or working-ship functions, specifically crane relocations and hatch openings/closings. These necessary activities interrupted container handling but had to be accomplished periodically.

TCDF Relocations. The TCDF made two types of moves, from one hatch to the next along only one side of the ship and from one hatch on one side of the ship to another on the other side of the ship. Since the barge is not self-propelled, the Army used three LCM8s to move the TCDF. Two LCM8s were positioned bow-to-bow alongside the barge TCDF and the third LCM8 was positioned at the end of the barge. This procedure was generally used in Phase I whether the move was just along the side of the ship or around the ship's bow to the opposite side. One one occasion only a LARC-LX was used to assist in alongside maneuvering. Repositioning along one side only varied from 20-90 mins. During off-loading only one move to the opposite side of the ship was necessary and that relocation required about 102 mins. These intervals are based upon the time the crane halted container operations until it was ready to start again.

TCDF Hatch Cover Handling. Like the COD the barge-TCDF had either one or two hatch cover openings/closings. Similarly, the TCDF also had to use a 40-ft spreader bar to lift the hatch cover and place the cover on an adjacent hatch. During Phase I, hatch cover handling on the average required 27 mins. for a single hatch opening/closing, varying from about 23-36 mins. Just one two-hatch operation (close one hatch and open an adjacent one) was recorded and it required about 31 minutes.

TCDF Operations, Phase I

The number of container transfers made by the TCDF during each day and night shift in Phase I is shown in Figure 2.18. The overall average during the phase was approximately 76, based on nine shifts.[14] On the first day of Phase I, at 0800, the barge TCDF was still being towed against the tidal current and a 10-knot wind by three LCM8s. However, by 0940 it was moored and the first container had been transferred to a LACV-30.

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[14] Nine containers were worked in a short part of the 10th shift, but these are counted in the average for nine shifts.

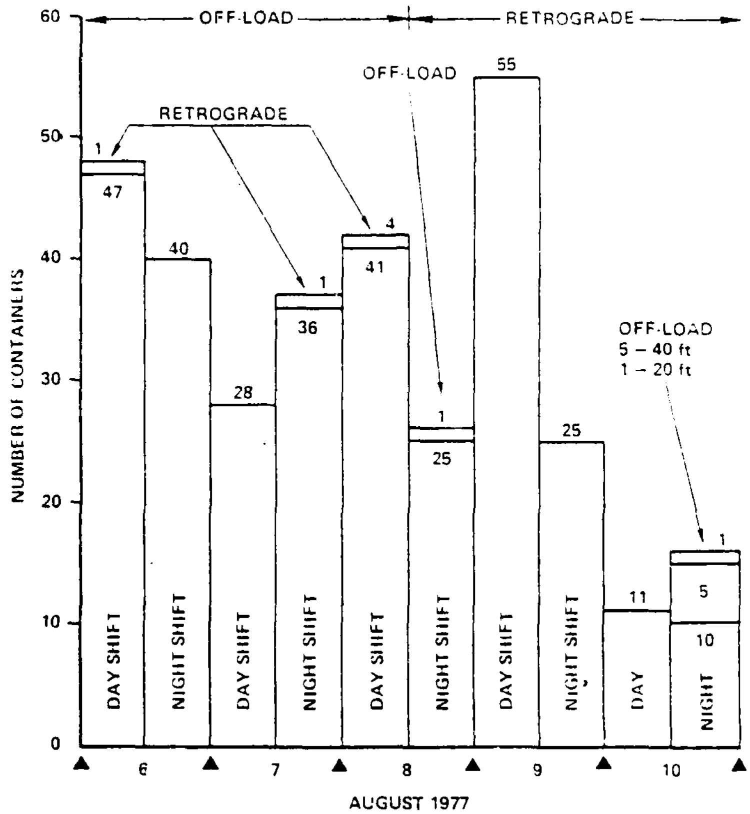

FIGURE 2.18. BARGE-TCDF CONTAINER PRODUCTIVITY BY DAY AND NIGHT SHIFT FOR PHASE I (Includes 20- and 40-ft containers.)

During the first shift power tag lines were used on the TCDF. These lines were capable of turning a container in azimuth, so that it could be placed either athwartship on a lighter, or parallel to the lighter centerline. The tag lines had been tried in a previous test, but still required adjustments. Their use was abandoned after it was found that they fouled during operations below decks. Afterwards the tag lines had to be rotated manually.

In general, the TCDF had to wait several minutes almost every time a loaded lighter was replaced at the loading point by an empty lighter. Only during later phases of the test were the lighters stationed closer to the ship, so that a lighter was able to quickly succeed a departing one. (Note that this is a matter of lighter management rather than TCDF capability, but it is reflected in the TCDF throughput statistics).

Another source of delay was the moving of ship hatch covers. As with the COD, the 40-ft spreader bar had to be substituted for the one used on 20-ft containers. During the first phase this was a slow operation, sometimes taking a full hour. In later phases the time was substantially reduced as ways to speed the process were learned.

PHASE I, LIGHTER OPERATIONS

General

During Phase I, 6-10 August, approximately 620 containers and 1,000 short tons of breakbulk cargo were transported, including both off-load and retrograde operations. Lighterage worked both the containership and breakbulk ship until breakbulk operations were terminated on 8 August. Breakbulk off-loading was conducted 6-7 August and retrograded from 7-8 August. After that all lighters transported containers. Commencing the night shift of 8 August, container retrograde was conducted through 10 August. Table 2.10 summarizes Army lighter resources, their cargo-carrying characteristics, and general employment in Phase I of the test.

TABLE 2.10

SUMMARY OF ARMY LIGHTER, CARGO CHARACTERISTICS, AND EMPLOYMENT
PHASE I OPERATIONS

Lighter		Cargo Capacities		Operational Employment		
	Resources Employed	Weight Capacity (Short Tons)	20-ft Container Spaces	Load Site	Off-Load Site	Avg Transit Time (In Min.)
LACV-30	[illegible]	23.7 fully fueled	2	TCDF	ADC	4-4.5
LARC-LX	[illegible]	60	2	TCDF, COD	ADC BBC	13-14
LARC-XV	[illegible]	15	1	TCDF	ADC	14
LCM-8	14	64	2	TCDF, COD	BBC	[illegible]
LCU*	5 Cntr 5 BBlk	[illegible] 180	5-7 -	COD H-L BB	BBC LBS	11 11

* The LCU mix available included two 1671-class LCUs while the remainder were all 1466-class. The 1671-class carried no more than five 20-foot containers per craft, while the 1466-class carried up to seven containers.

Key: ADC - Amphibian Discharge Crane
BBC - Bare Beach Crane
BBlk - Breakbulk
Cntr - Container
H-L BB - Heavy-Lift Breakbulk Ship
[illegible] - Lighter Loading [illegible]

For lighterage the Army attached a heavy boat company (LCUs), a medium boat company (LCM8s), a medium amphibian company (LARC-XVs), a heavy amphibian detachment LARC-LXs), and a LACV-30 detachment to the 24th transportation battalion. Two new 1671-class LCUs, which are a slight variation from the Navy's 1646-class LCUs, were included in the heavy boat company. In all there were six different types of lighters to support Phase I.

Concept for Employment

The employment of lighters was largely driven by the assumed capabilities of shoreside discharge cranes to off-load lighters. In Phase I there were only the crane-on-jetty and the amphibian discharge crane to off-load lighters. Use of the crane-on-jetty was restricted during low tide periods -- assumed at first to be ±3 hr -- because landing craft (LCUs and LCM8s) grounded out beyond the 90-ft radius of the crane due to the shallow beach gradient or off-shore sandbars.

Within that radius the crane-on-jetty could lift 20-ft containers fully weighted (22.5 short tons). To minimize the resulting degradation of throughput during low tide it was planned that the emphasis in lighterage loading would shift to amphibians until beaching conditions were more favorable for landing craft.

It was thought that a considerable number of amphibians would be required, since the transit time of the LARC-LXs, the most capable of the wheeled amphibians,would be rather lengthy. (It was, in fact, only about 13-14 min.) Therefore, a LARC-XV company was attached to the 24th Transportation Bn. to help fill the gap by lightering containers weighing 15 short tons or less. It was assumed that the LACV-30s would occupy most of the time for one of the ship cranes because of its fast transit capability. Once tidal conditions had changed, the LCUs and LCM8s would assume more of the throughput burden, although the LACV-30 would continue to work to its capacity.

Amphibian vehicles normally do not travel as fast (except the LACV-30) or as well in the water as landing craft,nor on land as well as trucks. Where they excel over both is in their capability to cross sandbars and tidal flats. Therefore, to maximize this advantage and shorten amphibian turnaround time, they were off-loaded on the beach about 50 yd inland from the high waterline. Trucks hauled the containers from there to the marshaling yard. In this fashion amphibian productivity (containers per hour per vehicle) could be fully utilized.

Lighters also influenced certain operational procedures. A determination was made as to which lighters could best be loaded at which ship cranes. The LACV-30 essentially provided the basis for two decisions. First, since careful positioning of a container on its deck was necessary for tie-downs and -- it was thought -- for the craft's center of gravity, one particular crane was preferred. As noted, the TCDF crane operator had better visual contact with lighters and could position the container faster and easier; therefore, the LACV-30 was loaded by the TCDF 92 percent of the time.

Secondly, the LACV-30 nearly always was given priority over other lighters both at the beach and the ship. All other craft had to wait or be waved off if the LACV-30 was ready to pick up a load so that the LACV-30's rapid ship-to-shore transit capabilities could be demonstrated. It was hoped that this would also stress the vehicle.

Results

Phase I was begun during a low tide period (low tide was about 0800). The first lighters, which began carrying containers shortly after 1000, were indeed amphibians,but the beach bottleneck as a result of low tide did not materialize since organizational problems in getting deck and crane crews started at the ship essentially prevented any queue from building off-shore. The first landing craft, an LCM8, departed the ship about 1000 but did not attempt an approach to the beach until about 1115 and about 12 min later was in position for off-loading. The first amphibian, a LACV-30, off-loaded at 1006 at the amphibian discharge crane.

Nearby at the breakbulk discharge site one LCU began its approach to the beach about 1000 but failed in an attempt to beach. It was about 1130 before another LCU beached satisfactorily. The assumption that lighters would have difficulties beaching within 3 hr of low tide initially appeared true for LCUs. No earlier attempt was made to assess LCM8 capabilities to breach the sandbar. Later, after repeated landings at the crane-on-jetty, the screw wash from the landing craft appeared to have scoured a channel so that the operational window at the jetty was improved. Nevertheless, low tide did continue to be a disruptive factor for lighter off-loading at the jetty.

Tables 2.11-2.14 list the types of lighters and number of trips made by each during Phase I operations. Off-loading was conducted for container operations from 0600 on 6 August through 1800 on 8 August. Because of the relatively small quantity of exercise breakbulk cargo (about 600 short tons), concurrent breakbulk off-load operations were conducted from only 0600 on 6 August through 0815 on 7 August. An administrative retrograde of breakbulk cargo was conducted 7-8 August in order to load a LASH barge for subsequent use in the test. The remainder of the breakbulk cargo was loaded on a BC barge for retrograde from the exercise site.

TABLE 2.11

PHASE I SUMMARY OF ARMY LIGHTER OPERATIONS DURING OFF-LOAD (20-FT. CONTAINER)

Lighters	Number Available	Number of Transits Made	Number of Containers Transported	Avg Number of Transits/Craft	Avg Container Loads
LACV-30	2	77	106	38.5	1.38
LARC-LX	3	39	77	13.0	1.97
LCU	5-10*	15	67	2.5	4.47
LCM8	13-14*	36	36	4.5	1.00
LARC-XV	7	35	35	5.0	1.00
Total	31-38	202	321	N/A	N/A

* Containership lighterage resources varied subject to requirements for supporting breakbulk operations.

TABLE 2.12

PHASE I SUMMARY OF ARMY LIGHTER OPERATIONS DURING OFF-LOAD (40-FT CONTAINERS AND FLATRACKS)

Lighters*	Number Employed	Number of Transits Made	Number of Containers Transported	Avg Number of Transits/Craft	Avg Container Loads
LARC-LX	3	16	16	5.33	1.0
LCU	3	3	6	1.00	2.0
LCM8	5	5	5	1.00	1.0
Total	11	24	27	N/A	N/A

*Included in Table 2.11

TABLE 2.13

PHASE I SUMMARY OF ARMY LIGHTER OPERATIONS DURING RETROGRADE

Lighters	Number Employed	Number of Transits Made	Number of Containers Transported	Avg Container Loads
LACV-30	2	58	98	1.7
LARC-XV	15	41	41	1.0
LARC-LX	3	44	83	1.9
LCU	9	15	61	4.1
LCM8	14	36	36	1.0

TABLE 2.14

PHASE I SUMMARY OF ARMY LIGHTER OPERATIONS DURING OFF-LOAD (BREAKBULK)

Lighters	Number Employed	Number of Transits Made	Number of Short Tons Transported	Avg Number of Transits/Craft	Avg Short Tons Loaded*
LCU	4	7	556	1.75	79.4
LCM8	1	1	44	1.00	44.0
Total	5	8	600	N/A	N/A

*Assumes one pallet weighs one short ton.

PHASE I, SHORESIDE TRANSFER

Amphibian Discharge Crane

Background. The crane used to unload/retrograde containers from amphibians (LACV-30, LARC-XV, LARC-LX) was a P&H 9125 140-ton capacity truck crane. Figure 2.19 shows the crane in operation. Table 2.15 provides the crane's basic characteristics.

TABLE 2.15

P&H 9125 140-TON TRUCK CRANE BASIC CHARACTERISTICS

Capacity:	140 tons (at 12-ft reach)
Length:	Bumper to bumper 32.8 ft
Width:	11.05 ft
Height:	14 ft
Weight:	Without 100-ft boom: 162,127 lb

This crane was one of two utilized on the beach during Phase I off-loading. It was used solely with amphibians carrying 20-ft containers. (The other crane in Phase I was the P&H 6250 300-ton capacity crane on a jetty, discussed later. Two 140-ton cranes are authorized in the TOE of an Army transportation company (TS) (container). The second 140-ton crane was used in Phase III and is also described later.

Concept of Off-Load Operations. The 140-ton amphibian discharge point (ADP) crane was positioned approximately 130 ft inland of the high tide line. The LARC-XVs and LARC-LXs approached directly across the beach to a position under the crane boom. The container was off-loaded by the crane and placed on the beach. The LARCs would then back into a 90-degree turn and depart the beach on the same route as they had entered.

The sand berm, which was approximately 3 ft to 5 ft high, provided a turning area for the LACV-30s and some protection for the crane from the small sand storm caused by the LACV-30s. The LACV-30s entered the beach at a point approximately 250 ft east of the crane, completed a 180-degree turn, and positioned themselves alongside the crane. Containers were off-loaded by the crane and placed on the beach. The LACV-30 then departed the beach in a straight line from its position by the crane. The berm separated the area between where the LACV-30 operated and where the LARCs operated so that there was little interference between them.

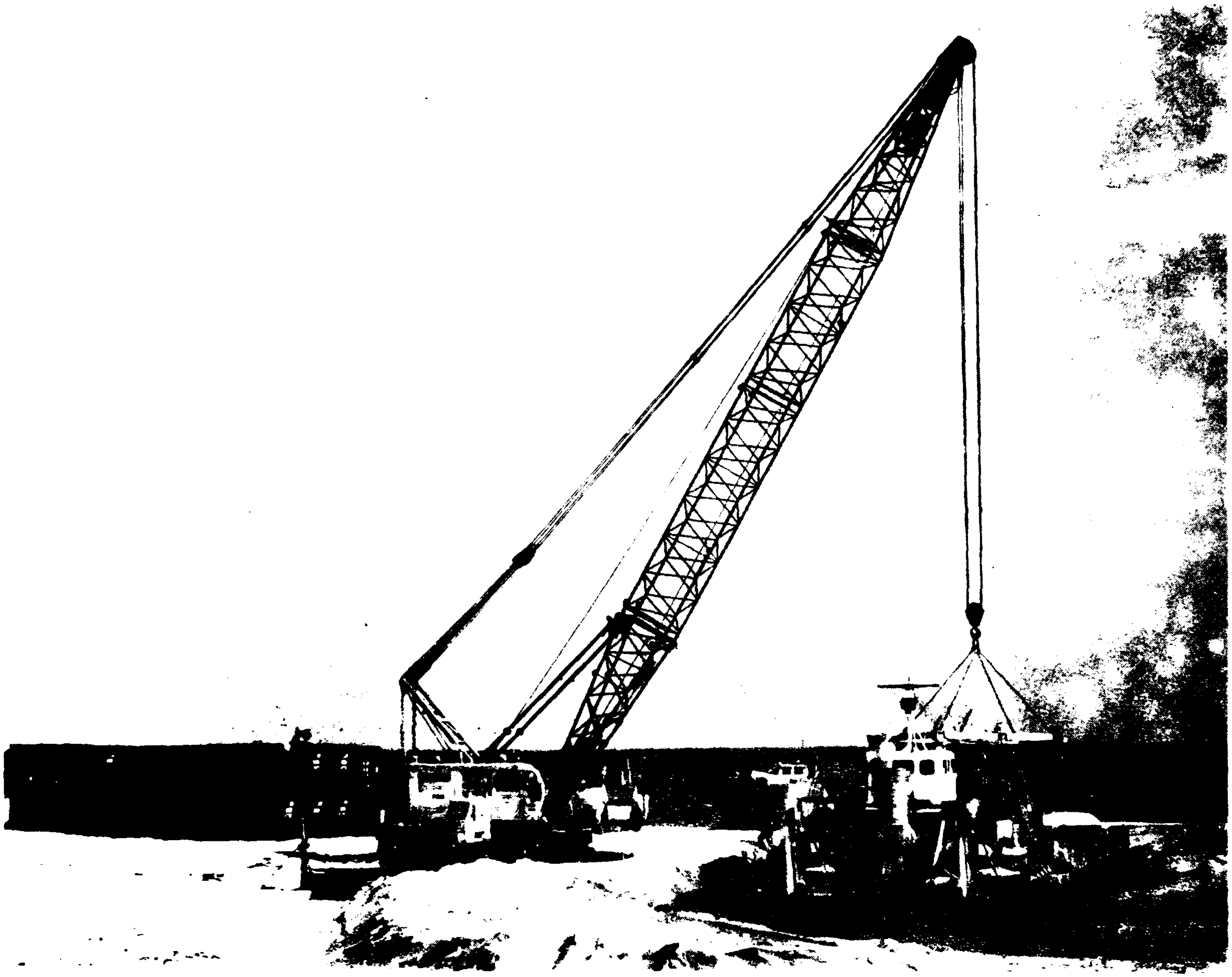

FIGURE 2.19 ADP CRANE OFF-LOADS LACV-30

Once the containers were placed on the beach, they were lifted by a frontloader, transported to and placed on a trailer. A yard tractor then hauled the trailer with container to the marshaling yard.

ADP Crew Size. The ADP crew size varied from 7-9 personnel, depending upon the shift. Night operations required the addition of a floodlight unit operator. On occasion the signalman and crane operator relieved each other during the shift.

Crane operator(s)	1-2
Signalman	1
Stevedores	4
Frontloader operator	1
Floodlight unit operator (night)	(1)
	7-9

Preliminary Operations. Certain preliminary functions were necessary in order to deploy and establish the amphibian discharge crane in its operational position on Red Beach. They were:

- Tactical disassembly
- Transport to port-of-embarkation
- Loading aboard the heavy-lift breakbulk ship
- Transport to point of debarkation
- Unloading off Red Beach
- Lighter from ship to shore
- Off-load from lighterage at beach
- Reassembly on Red Beach

These operations were conducted smoothly without encountering significant delays or problems. The times required to accomplish these functions, except for highway and ship movements, are contained in Table 2.16.

TABLE 2.16

AMPHIBIAN DISCHARGE CRANE
(P&H 9125 140-TON CRANE) READINESS TIMES

ACTIVITY	TIME
Tactical Disassembly	7 hr
Ship Loading	55 min
Ship Unloading	35 min
Lighter to Beach	59 min
Off-load across Beach	29 min
Reassembly on Beach	7 hr

Throughput Operations. The amphibian discharge crane conducted off-load operations in Phase I during both shifts on the first two days and on the first shift of the third day. Table 2.17 broadly summarizes crane utilization for the Phase I off-load period. The most productive off-load shift was the last one (day shift of 8 August) when 52 containers were unloaded; although it should be noted that during this time the crane was not taxed by amphibian unloading requirements.

TABLE 2.17

PHASE I ADP CRANE UTILIZATION

Activity	Minutes	Percent
Operating	1,388	40.0
Awaiting amphibians	1,459	42.0
Weather hold (thunderstorm)	155	10.5
Repair, maintenance, refuel, etc.	370	4.5
Unknown delays	108	3.0
	3,480	100.0

During the crane operating periods, 196 containers were off-loaded. This is an average of about 7 min per container but does not represent maximum operating capabilities of the amphibian discharge crane since the supply of containers to the ADC was sporadic. Further discussion and analysis is contained in Volume II of this report.

Surge Period. The busiest single period for the ADC occurred during the night shift of 7 August when the 300-ton crane on the jetty was deadlined after a container was dropped.

From that point (about 0200) all off-loading was switched to amphibians. Within a period of about 4 hr the ADC transferred 30 containers from 21 amphibians without any appreciable delays to the amphibians. In fact, the maximum amount of time any amphibian spent on the beach was 15 min. At that time a LACV-30 had the longest wait, about 9 min, while the ADC completed its off-loading of two containers from a LARC-LX.

During this peak busy interval the ADP established an amphibian average beach turnaround time of 8½ min. Amphibians were timed once they started across the waterline until they started back empty across the waterline on the return trip to the ship. This time included queue time if the crane was working, positioning within the crane's off-loading position, discharge time, and withdrawal from the beach once empty. None of the amphibians had any queue time on the beach in an empty status during this period.

The crane at the ADP worked very rapidly when there were containers available. On the average a crane cycle (begun once the amphibian was in the off-load position and terminating when the crane's spreader bar came to a rest or was grossly over the next container, if one was available) was about 3 and 1/3 min per container. The fastest complete cycle recorded was 2 min and the slowest time was 4.8 min. Even though the other beach crane was not in operation, there was still a total of 1.9 hr within the 4-hr surge period in which the crane was inactive and waiting for amphibians. During this period it could have supported even more amphibians.

Amphibian Turnaround Time. During Phase I off-loading, the ADC discharged 196 containers from 138 amphibians, an average of about 1½ containers per amphibian. On the average amphibians spent 10.4 min on the beach being off-loaded. This time was calculated from the moment the amphibian crossed the waterline on its approach until it crossed the waterline on its return. Table 2.18 summarizes turnaround activity.

TABLE 2.18

PHASE I SUMMARY OF ADP OFF-LOAD OPERATIONS

Lighters	Number Transits	Number Containers Off-loaded	Average Container Load	Average Turnaround Time*
LACV-30	74	102	1.38	10.64
LARC-LX	32	62	1.94	12.57
LARC-XV	32	32	1.00	7.78
CUMULATIVE	138	196	1.42	10.42

* The time required for a lighter to approach the amphibian discharge crane queue, have its cargo off-loaded, and clear the ADP area so that the next lighter can be off-loaded.

<u>Retrograde Operations</u>. The amphibian discharge point retrograded 188 containers (which were, of course, fully loaded) and also off-loaded another 4 during the 2½-day retrograde period of Phase I. During this interval the most containers the crane handled in one shift was 69, 17 more than during the most productive off-load shift. This was attributable simply to the fact that more amphibians were used in the retrograde period than landing craft. Turnaround time on the beach was on the average about 17 min per amphibian. Table 2.19 summarizes amphibian activities at the ADP during the retrograde period. (It should be noted that some containers were back-loaded to amphibians by the crane-on-jetty.)

TABLE 2.19

PHASE I CONTAINER TRANSFERS AT THE ADP DURING RETROGRADE

AMPHIBIANS	8 AUGUST (Night Shift Only)		9 AUGUST (Both Shifts)		10 AUGUST (Both Shifts)		ADP RETROGRADE TOTALS	
	NO. TRANSITS	NO. CNTNRS	NO. TRANSITS	NO. CNTNRS	NO. TRANSITS	NO. CNTNRS	NO. TRANSITS	NO. CNTNRS
LACV-30	14	20*	26	49	19	32	59	101
LARC-LX	10	18*	16	32	6	12	32	62
LARC-XV	7	7	11*	11*	.	11	29*	29*
TOTALS	31	45	53	92	36	55	120*	192*

*Includes containers off-loaded.

Summary of ADP Operations. During Phase I the ADP off-loaded 200 containers (including four during the retrograde period) and retrograded 188, handling a total of 388 containers during the five-day period. This involved 138 transits during off-loading and 120 during retrograde for a total of 258. At no time did the ADP fail to keep pace with the flow of containers dispatched to that site. At one point, the ADP was the only facility operating on the beach and during that period averaged about 3 1/3 min per container cycle. Even at that pace the crane still had approximately 1.9 hr of slack time in the 4-hr surge period. Figure 2.20 summarizes the off-load and retrograde productivity at the amphibian discharge point by each shift.

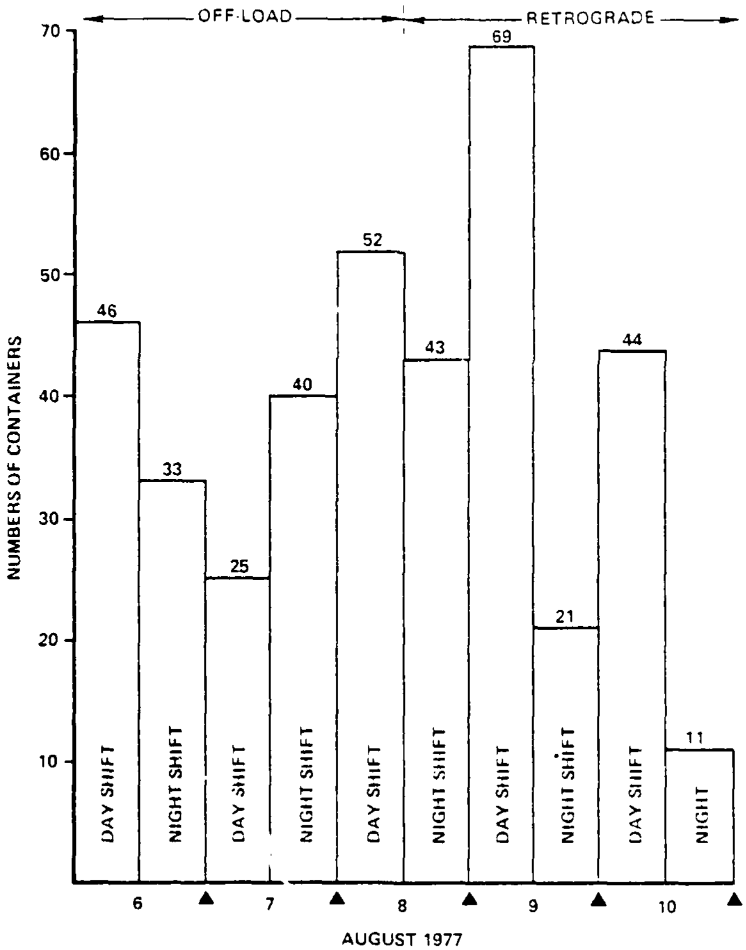

FIGURE 2.20. AMPHIBIAN DISCHARGE POINT CONTAINER HANDLING SUMMARY

Crane-on-Beach Jetty

Background. The crane used to transfer containers from the jetty (bare beach crane site) was a P&H 6250 model 300-ton capacity crane. Its characteristics are as noted below:

TABLE 2.20

P&H 6250 300-TON TRUCK CRANE BASIC CHARACTERISTICS

Capacity:	300 tons (nominal call-out)
Length:	57.6 ft (without boom)
Width:	12.0 ft
Height:	13.5 ft
Weight:	177 short tons

In the bare-beach phases of the LOTS test the crane on the beach jetty moved a substantial number of containers during the high water periods of the tidal cycle when landing craft could get close enough to the crane. The jetty provided a platform for the crane which permitted the crane to move further out into the water than it otherwise could. In this way the crane's reach was extended thereby increasing the total time during which container transfers could be accomplished. (See Figure 2.21). The crane could reach 55 ft seaward from the end of the jetty for a fully weighted 20-ft container.

At low tide landing craft grounded out too far from the P&H 6250 crane for it to reach the containers. Since extra landing craft were available, the two shipboard cranes loaded containers into them during low tide periods and they functioned as a temporary storage facility. These loaded lighters waited until the tide rose enough for them to be unloaded at the crane-on-jetty.

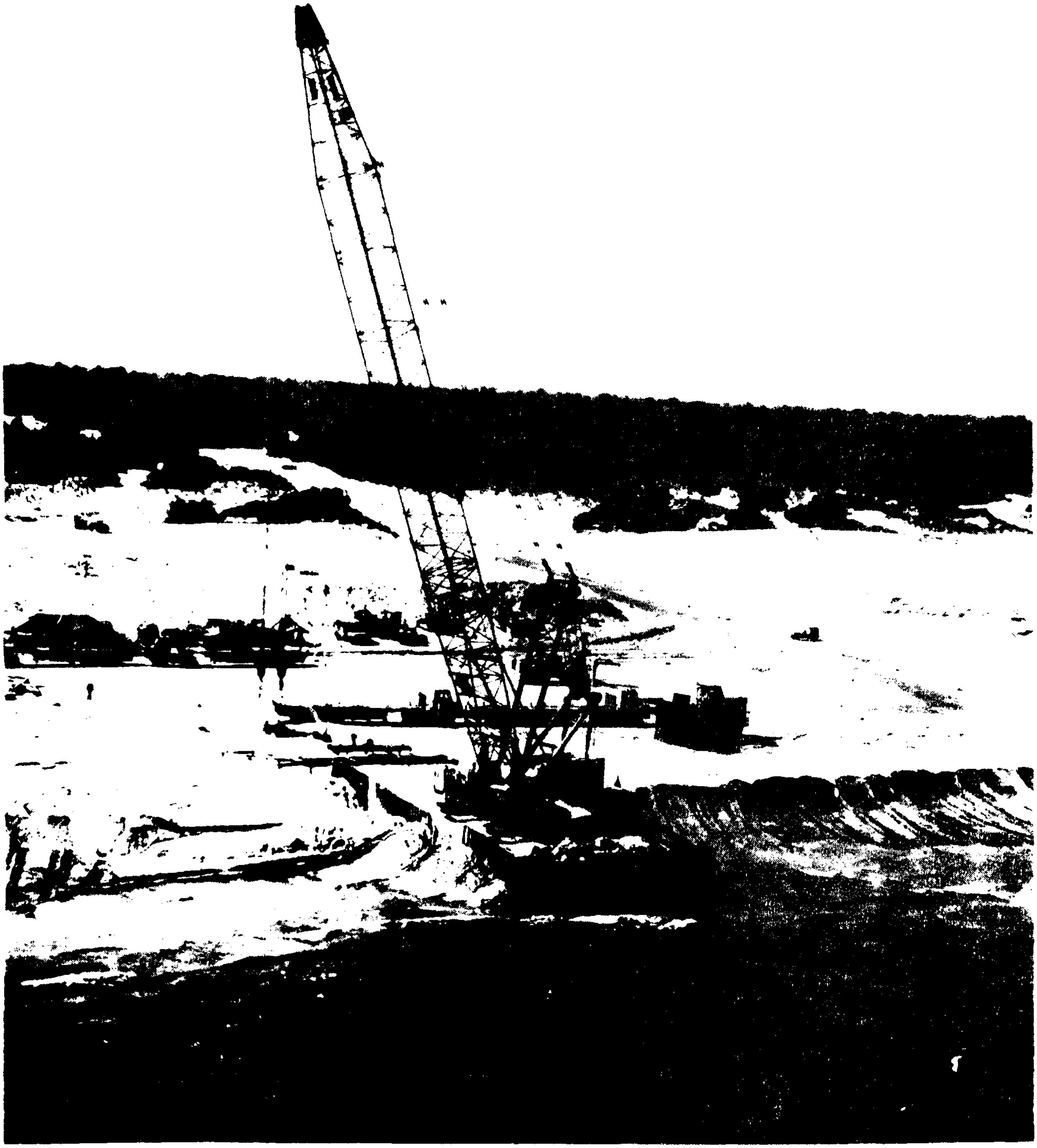

FIGURE 2.21. JETTY READY FOR OPERATIONS. The jetty was in place throughout the exercise but used only in Phases I and I(R).

Jetty Crane Concept of Operations. It was planned that the 300-ton crane would be disassembled to its tactical configuration[15] at Ft. Eustis, transported by LCU to the Naval Supply Center pier area at Norfolk, and loaded aboard the TRANSCOLUMBIA. Once fully loaded the ship would sail to the Ft. Story objective area and there the crane would be lightered ashore by LCU (an LCU was included in the load list to represent deployment of this capability) for reassembly. Once the jetty was completed, the crane was to be driven over timbered mats onto the jetty for off-load operations.

The crane was positioned on the jetty so that the center of rotation for the crane was approximately 35 ft from the seaward end of the jetty. (See Figure 2.22.) The jetty provided a seaward extension of crane reach approximately 70 ft beyond what would have been possible if positioning had been limited to near the high water line. In this position lighters could beach to either side of the crane concurrently or one lighter could beach directly in front of the jetty.

The crane did not off-load containers directly to tractor-trailers. Containers were lifted from the lighters and spotted on the beach where frontloaders moved them to tractor-trailers. This method expedited the discharge of lighters since the crane did not have to carefully position the container on a trailer. One frontloader was used to do all the tractor-trailer loading except for some of the 40 ft containers which were loaded directly onto the tractor-trailers by the crane.

Crane-on-Jetty Crew Size. The crew to man the jetty crane was about the same size as that required for the amphibian discharge point. The crew consisted of:

Crane operators	2
Signalman	1
Stevedores	4
Frontloader operator	1
Floodlight unit operator (night only)	(1)
	8-9

Preliminary Operations. The administrative move from Ft. Eustis to the Norfolk Naval Supply Center for ship loading and the subsequent "deployment" to Ft. Story for ship off-loading and crane reassembly on the beach were

[15] Tactical disassembly for the P&H 6250 crane is defined as the minimum disassembly necessary for deployment overseas. In this configuration the crane has all sections of the boom -- except the boom base -- removed along with the counterweights and outrigger floats. This reduces the crane's weight from approximately 177 short tons to about 110 short tons.

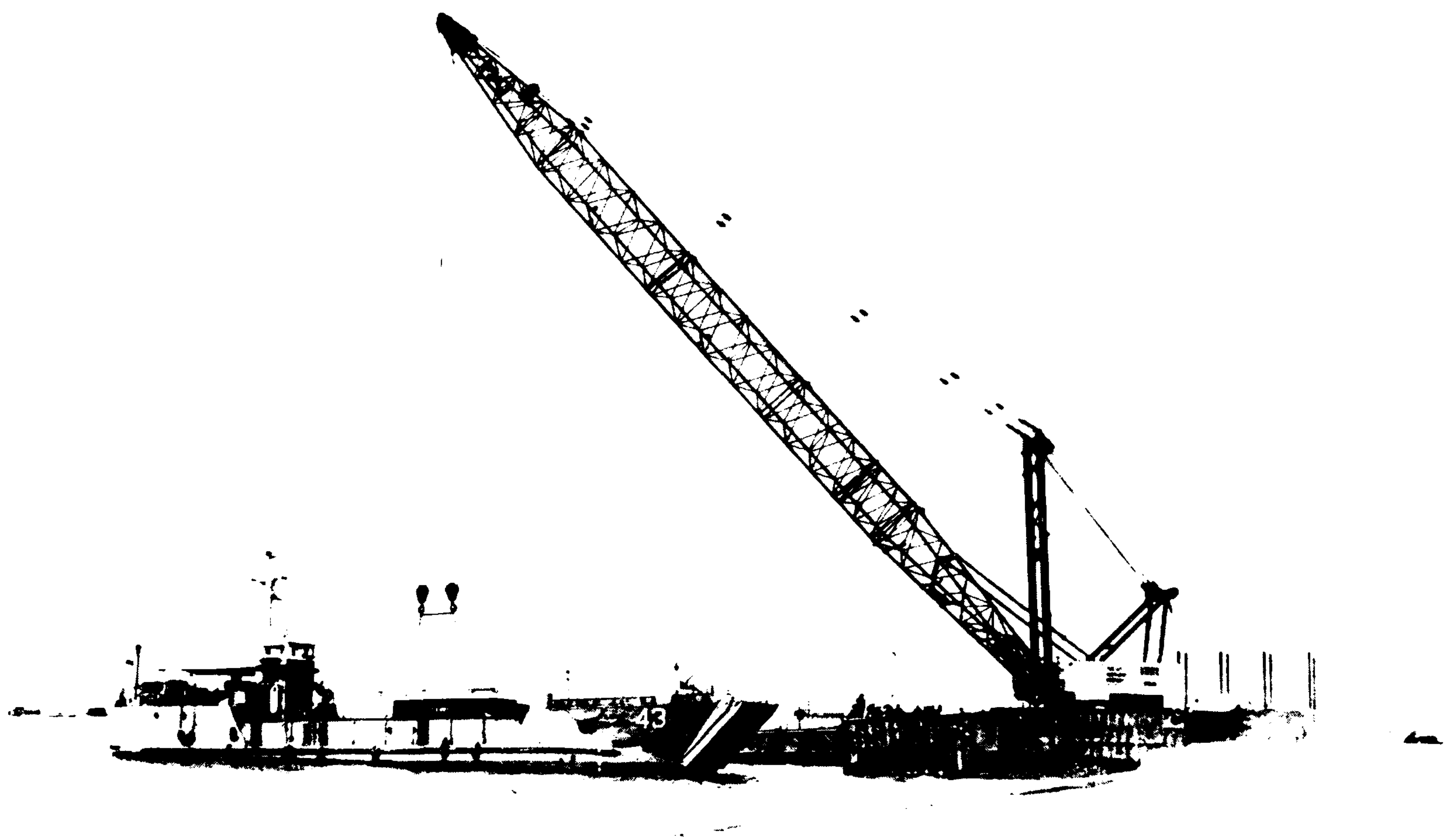

FIGURE 2.22. 300-TON CRANE ON JETTY. The 300-ton crane on the sand jetty reaches for a container in a grounded LCU. When this picture was taken the tide was about halfway between high and low.

conducted without significant problems. Table 2.21 below provides the times required (except for certain lighterage peculiar events such as mooring and beaching).

TABLE 2.21

DISASSEMBLY AND REASSEMBLY TIMES (HR)
FOR 300-TON BEACH JETTY CRANE

Event	Time Required
Tactical Disassembly	8.67
Ship Loading	0.67
Ship Unloading	0.40
Transit to Beach	0.60
Off-load Across Beach	1.75
Reassembly on Beach	6.00
TOTAL	18.09

Throughput Operations. During Phase I the crane-on-jetty off-loaded a total of 137 containers during the 2½-day (five shifts) off-load period. In this period no high waves were experienced at the jetty. Table 2.22 generally summarizes crane utilization to support off-loading for this phase.

TABLE 2.22

PHASE I SUMMARY OF JETTY CRANE ACTIVITY

Activity	Minutes	Percent
Operating	938	33.15
Maintenance*	728	25.72
Waiting for cargo	658	23.25
Waiting on lighter maneuvers	192	6.78
Unexplained delays	314	11.10
Total Time Jetty Crane Active	2,830	100.00

* Includes time lost during the 7-8 August dropped container incident.

The above activities occurred over a 3,600 min continuous span, during which time was also lost due to low tides and the inability of landing craft to beach. This is discussed in further detail below and in Volume II of this report. However, it should be noted that analysis and observation have confirmed that most of the "Unexplained Delays" in the data base were actually delays due to non-availability of cargo.

The jetty crane was the only beach crane that handled the 40-ft containers. Lighterage had to beach in close proximity to the jetty in order for the crane to off-load the 40-ft containers (weighing up to 35 short tons) and the heavily loaded 20-ft containers (weighing up to 23.5 short tons). On some occasions tentative container lifts had to be postponed until the lighter could make a closer beaching. Generally, however, the center of lift presentation for a container with a weight in excess of 20 tons was within 20 ft of the jetty.

Two 40-ft flatracks loaded aboard the containership were also handled by the crane-on-jetty. One arrived in an LCM8 and the other in a LARC-LX. No problems were encountered with either lift.

In one instance the crane lifted a 20-ft container (#3720, weighing 44,380 lb) and was swinging it towards the shore when the crane began to tip. The operator quickly released the container, thereby averting a potentially castastrophic event. This incident occurred about 0140 during the night of 7-8 August. The crane used a near-maximum reach to lift the container from an LCU. In swinging the container toward shore the crane began to capsize. The crane operator prevented capsizing by jettisoning the load which landed in water about 1-2 ft deep. Observers noted that the rear end of the crane, with counterweights, lifted 6 ft from normal level. The crane was not operated for the remainder of the shift and part of the next. A crane company representative was summoned to ascertain the cause and verify after repairs had been made that the crane could be operated safely. Examination of the outrigger footprints showed no sinkage of the crane outriggers during the incident, although the footprints of the outriggers on the side away from the load were displaced about 18 in.

Low Tide Delays. Landing craft in Phase I generally did not beach during about a 6-hr period centered around low tide. However, to provide the crane-on-jetty with some activity some LARC-LXs and LARC-XVs were dispatched to the 300-ton crane for off-loading. Figure 2.23 illustrates the distribution of transfers at the jetty crane in half-hour intervals with respect to the tidal cycle. Landing craft arrivals are indicated on the figure by a "O".

During favorable tidal periods the 1466-class LCUs with four to seven containers did not appear to have any significant problems beaching close enough to the crane to off-load all containers without repositioning the craft. The 1644-class LCU was loaded with only four containers per transit in Phase I and its beaching characteristics appeared similar to those of the other class LCU. However, there were no definitive opportunities to test and make comparisons between the two classes of LCUs.

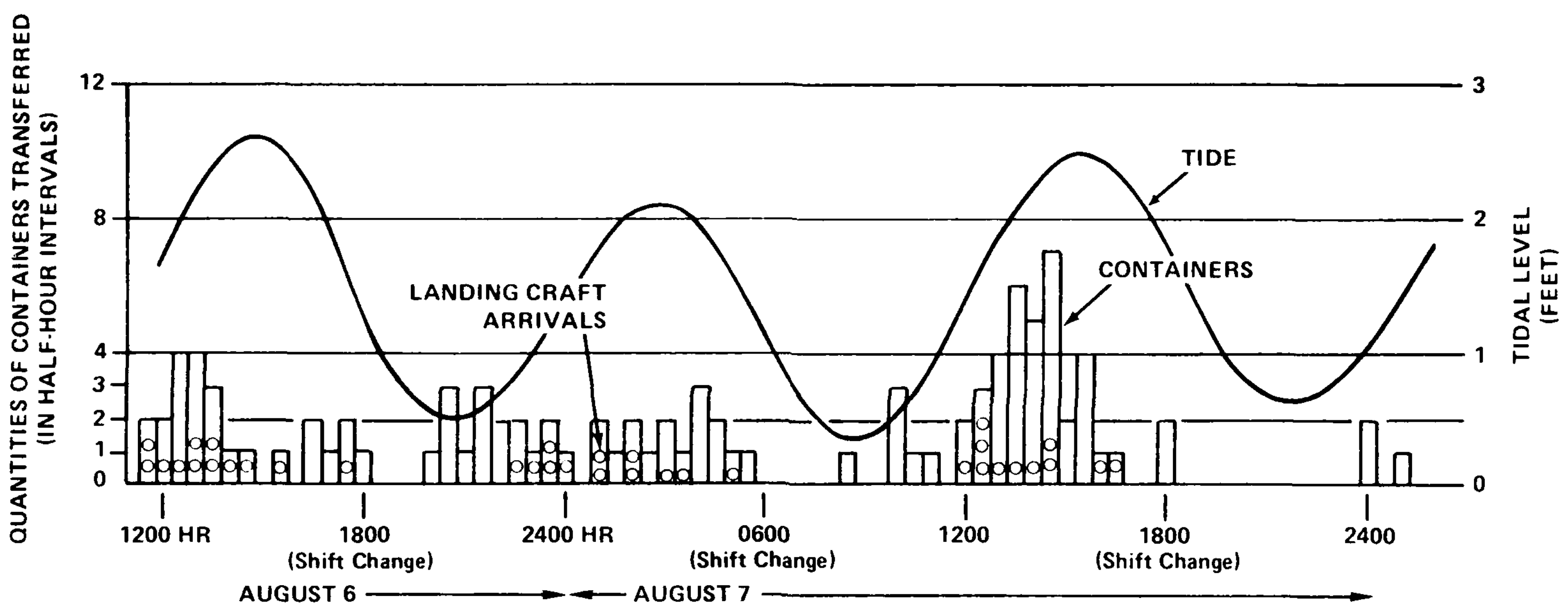

FIGURE 2.23. JETTY CRANE CONTAINER TRANSFER IN HALF-HOUR INTERVALS, PHASE I (Also shows landing craft arrivals (o) in half-hour intervals, and tide level.)

No special attempts were made with LCM8s to beach and off-load during periods when beaching conditions became marginal for LCUs. Some LCM8s were landed during such periods but this was not a conscious shift to exploit the greater maneuverability and lesser draft of an LCM8.

Crane Stability. A problem observed for a crane on a sand jetty is the capability of the sand in the platform to resist the forces generated by the crane in working. There was some evidence of the sand yielding to the dynamic forces under the crane footings causing leveling problems. The footings were timber mats under the crane outriggers, which acted as load spreaders. At one time observers noted sand erosion occurring within about 2 ft of the crane footing. This erosion was stopped by using additional sandbags to stop the water action at a point well below the outrigger level. This erosion did not become serious during the test period, but higher waves could well have presented serious problems to the crane. The ability to move the crane quickly ashore out of reach of high waves was a safety feature that kept risk to an expensive item of equipment to an acceptable level.

Lighter Turnaround Time. During the Phase I off-loading period, the crane-on-jetty discharged 137 containers from 79 lighters. This total included twenty 40-ft containers and two flatracks.[16] Table 2.23 summarizes the primary results of these transfer operations. The average turnaround time for a lighter at the jetty crane was based upon the interval a lighter spent from the time it beached until the time it retracted. (Prolonged periods at the beach not related to container activities were not included.)

Retrograde Operations. The crane-on-jetty retrograded 125 containers (which were still fully loaded) onto 72 lighters and off-loaded five 40-ft containers during the retrograde period of Phase I. The jetty crane would have been inactive during the last shift except for the necessity to discharge the 40-ft containers before Phase II began. Table 2.24 summarizes the lighterage activity at the jetty crane. Like the off-load period, the retrograde period placed greater emphasis on the use of amphibians than landing craft. In fact, 35 percent of the lighters at the jetty crane were amphibians as opposed to LCUs and LCM8s.

The crane worked at a rather sporadic pace with cycles varying from 4.5 to 23 mins per container, depending upon the frequency of lighters and truck arrivals with containers. Turnaround time at the crane-on-jetty (that is, from the time a lighter beached until the time it retracted) was on the average about 15 mins for all lighters, varying from 4 mins for a LARC-XV, 9 mins for a LARC-LX, 8 mins for an LCM8, and 46 mins for an LCU. On the average the crane had to wait about 20 mins between lighters, although there were 28 instances in which there were overlaps.

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[16] Five additional 40-ft containers were off-loaded on the last shift of the retrograde period, since no 40-ft containers were to be used in Phase II.

TABLE 2.23

PHASE I SUMMARY OF JETTY CRANE LIGHTER OFF-LOAD OPERATIONS

Lighters	Number Transits	Number Containers Off-loaded		Average Container Load (TEU)*	Average Time At Beach (Mins)
		20 Ft	40 Ft*		
LCU	17	63	6	4.41	36.31
LCM8	40	35	5	1.13	16.13
LARC-LX	18	13	11	1.94	15.47
LARC-XV	3	3	0	1.00	8.50
LACV-30	1	1	0	*	*
TOTALS	79	115	22	2.01	19.96

* The LACV-30 carried two containers but off-loaded one at the Amphibian Discharge Point before arriving at the jetty crane.

TABLE 2.24

PHASE I CONTAINER TRANSFERS AT JETTY CRANE DURING RETROGRADE

Lighters	8 August (Night Shift Only)		9 August (Both Shifts)		10 August (Both Shifts)		Jetty Crane Retrograde Totals	
	No. Transits	No. Cntnrs	No. Transits	No. Cntnrs	No. Transits	No. Cntnrs	No. Transits	No. Cntnrs
LCU	1	4	12	48	2	9	15	61
LCM8	7	7	18**	18	10	10	35	35
LARC-LX	3	5	2	4	8*	11*	13*	20*
LARC-XV	-	-	7	7	7	7	14	14
TOTALS	11	16	39	77	20	30	77*	130*

*Includes off-load of five 40-ft containers.

**One container was loaded first and then another container was substituted. This event has not been included here.

Summary of Crane-on-Jetty Operations. The jetty permitted the 300-ton lifting capacity crane to reach 70 ft farther to seaward than would have been possible if the crane would have had to operate from the high water line. The tactical disassembly, ship loading and off-loading, transit to the beach, off-load at the beach and reassembly were conducted in about 18 hrs. Lighters were able to beach on both sides of the crane during favorable tidal periods (discussed further in Vol. II of this report). The crane was actually operating only about 1/3 of the off-load period and about 1/2 of the remaining time it was either waiting for cargo or halted for maintenance reasons.

During the off-load period the crane discharged 137 containers from 79 lighters. Uninterrupted crane cycles averaged about 6 mins per container. Lighters on the average spent about 20 mins on the beach, varying from an average of about 8½ mins for a LARC-XV with one container to about 36 mins for an LCU with an average load of about 4½ containers. Figure 2.24 summarizes by shifts off-load and retrograde activity.

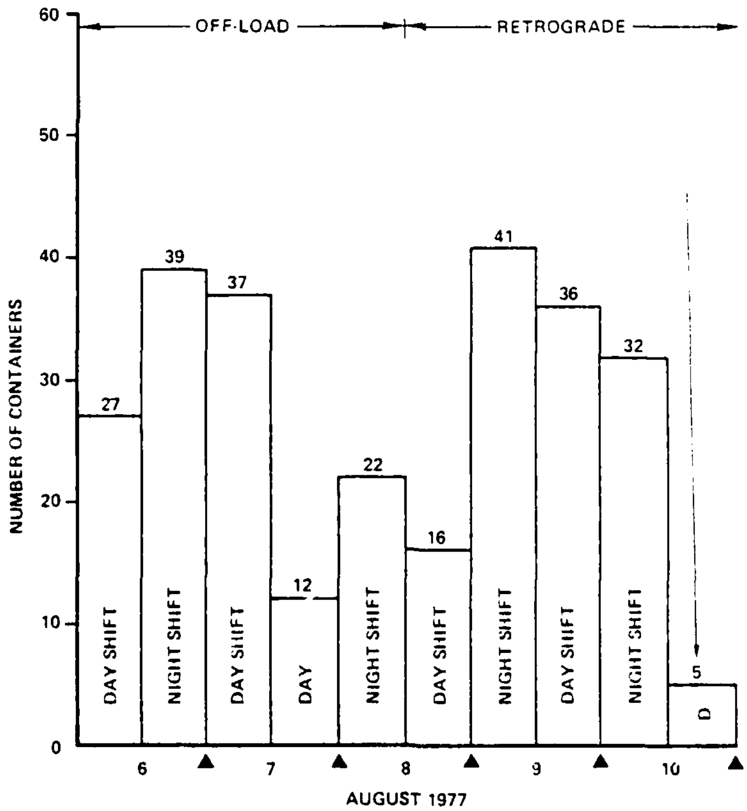

FIGURE 2.24. PHASE I SUMMARY OF CRANE-ON-JETTY OPERATIONS
(INCLUDES 40-FT CONTAINERS AND FLATRACKS)

During the retrograde period the jetty crane transferred 130 containers involving 77 lighters, including the off-load of five 40-ft containers. Lighters spent an average of 15 minutes on the beach being loaded, varying from about 4 mins for a LARC-XV with one container to about 46 mins for an LCU with an average load of about four containers.

The jetty crane had only one mishap. During an extended reach involving a heavy container, the crane nearly capsized while rotating the load toward the beach. The load had to be jettisoned. However, because of the sudden release of the 22.2-ton container, the crane had to be deadlined for approximately 12 hours until repairs, adjustments, and safety checks could be made.

Frontloader Employment on the Beach

The frontloader (see characteristics, Table 2.25), deployed aboard ship and used for the first time in a LOTS test, played a key role in beach transfer operations. To reduce cycle times of the amphibian discharge and beach jetty cranes, no attempt was made to use the cranes for loading containers directly onto trailers. Instead, the crane deposited the containers onto loose sand where a frontloader picked them up and loaded them onto trucks.

TABLE 2.25

CLARK FRONTLOADER 475B 50K MODEL BASIC CHARACTERISTICS

Vehicle Data	With Tophandler	Without Tophandler
Length	40 ft 2 in.	30 ft 1 in.
Width*	18 ft 0 in.	13 ft 2 in.
Height	16 ft 5 in.	16 ft 5 in.
Weight**	75.94 LTons	77.55 STons

* Tophandler extends for 20 to 40-ft containers.
** For deployment a 15-STon removable counterweight can decrease these weights.

During Phase I two frontloaders were able to work both the 300-ton bare beach (jetty) crane and the 140-ton amphibian discharge crane without difficulty. Table 2.26 summarizes frontloader operations when employed in tandem with the amphibian discharge crane during off-loading. The data concern only those periods in which the frontloader had containers to work, and the normal delays incurred during these periods, such as a truck slow in arriving, are included but delays in which there were no containers available to work are not.

TABLE 2.26

FRONTLOADER OPERATIONS

Working Containers on Beach From ADF Crane to Tractor-Trailers	Average (In Minutes)
Time until pick-up (from spreader bar detached until frontloader lifts container)	1.36
Load trailer (from lift near crane to final seating on trailer)	2.37
Container clears area (frontloader disengages and backs off, truck gets underway)	0.34
TOTAL ELAPSED TIME	4.07

The frontloader's role at the amphibian discharge point crane was relatively simple. As soon as the crane's spreader bar was detached the frontloader moved forward to engage its tophandler with the container. The frontloader then backed off approximately 80 ft, turning 90 degrees so that it could load the container onto a trailer spotted on the beach turnaround road. As soon as the container was properly seated on the truck, the frontloader disengaged its tophandler, raised it, and backed off. The driver then locked each corner fitting to the trailer and drove off.

The frontloader, which can also be used as a 25-ton forklift by removing the tophandler and substituting tines, added another degree of flexibility to the container company. As a forklift it was used to assist in the placement of railroad tie mats for off-loading the cranes from lighters and for assisting in the reassembly of the cranes. In addition, its tophandler was used to assemble boom sections for the cranes, greatly reducing chance denting of the boom. The forklift capability was also used to assist in placing the counterweights on the cranes which helped reduce crane assembly time. (Further discussion on the frontloader is contained in the paragraphs dealing with marshaling yard operations, where the frontloader was also employed.)

PHASE I, YARD TRACTOR-TRAILER TRANSPORTER OPERATIONS

Background

Twenty-eight Ottawa yard tractors and XM872 34-ton dual purpose trailer transporters of the 119th Terminal Service Co. were used to move containers from the beach to the marshaling yard and for their return during retrograde operations. The tractor was designed for use within a fixed port area where the vehicle would move over relatively short distances on the dock and in container stacking areas. The 40-ft dual purpose trailer can be used on line haul or local haul for both breakbulk cargo and containers (20-ft to 40-ft in length) and loads up to 34 tons. An analysis of the suitability of the equipment for operations in a LOTS environment is contained in Volume II of this report.

The yard tractor and XM872 trailer combinations were used for beach clearance during Phases I, III and I(R) and in all phases of retrograde operations. The units moved on a route to and from the marshaling yard as indicated in Figure 2.25. The beach entry-exit road was graded and surfaced to support two-way truck traffic. The beach turnaround road (see Figure 2.26) provided for one-way traffic and sufficient waiting area for a truck queue for the two beach cranes. The surface was composed of fastened MOMAT sheets reinforced at connections with the entry-exit road with overlapping sheets of AMSS.

At the marshaling yard documentation point, vehicle and container numbers were logged and the driver was directed to an off-loading point. There the container was off-loaded by a frontloader or sideloader of the 119th Terminal Service Co., after which the vehicle was dispatched back to the beach. Delivery to General Support Supply Activity (GSSA) consignees was accomplished by other vehicles (5-ton tractors with milvan chassis) and did not interfere with the availability of the yard tractor-trailer transporters.

Tractor-Trailer Employment

In general, the tractor-trailer operations were well organized and responsive to beach clearance requirements. Traffic control was particularly effective and was reflected in the rapid turnaround times accomplished throughout the exercise. A summary of Phase I tractor-trailer operations is set forth in Table 2.27.

For Phase I the tractor-trailers were spotted along the turnaround road in order to be immediately available for loading at either the 300-ton crane on the jetty or the 140-ton amphibian discharge crane. As the tractor-trailers were loaded and cleared the loading sites, empty units moved forward in the queue. Additional trucks were dispatched to the beach to keep the waiting line filled until all units assigned to the shift were committed. Due to the short turnaround distance to and from the marshaling area, vehicles were dispatched to the beach only as needed to avoid blocking the entry road. The number of vehicles required to adequately support a LOTS operation of a given average workload is addressed in Volume II.

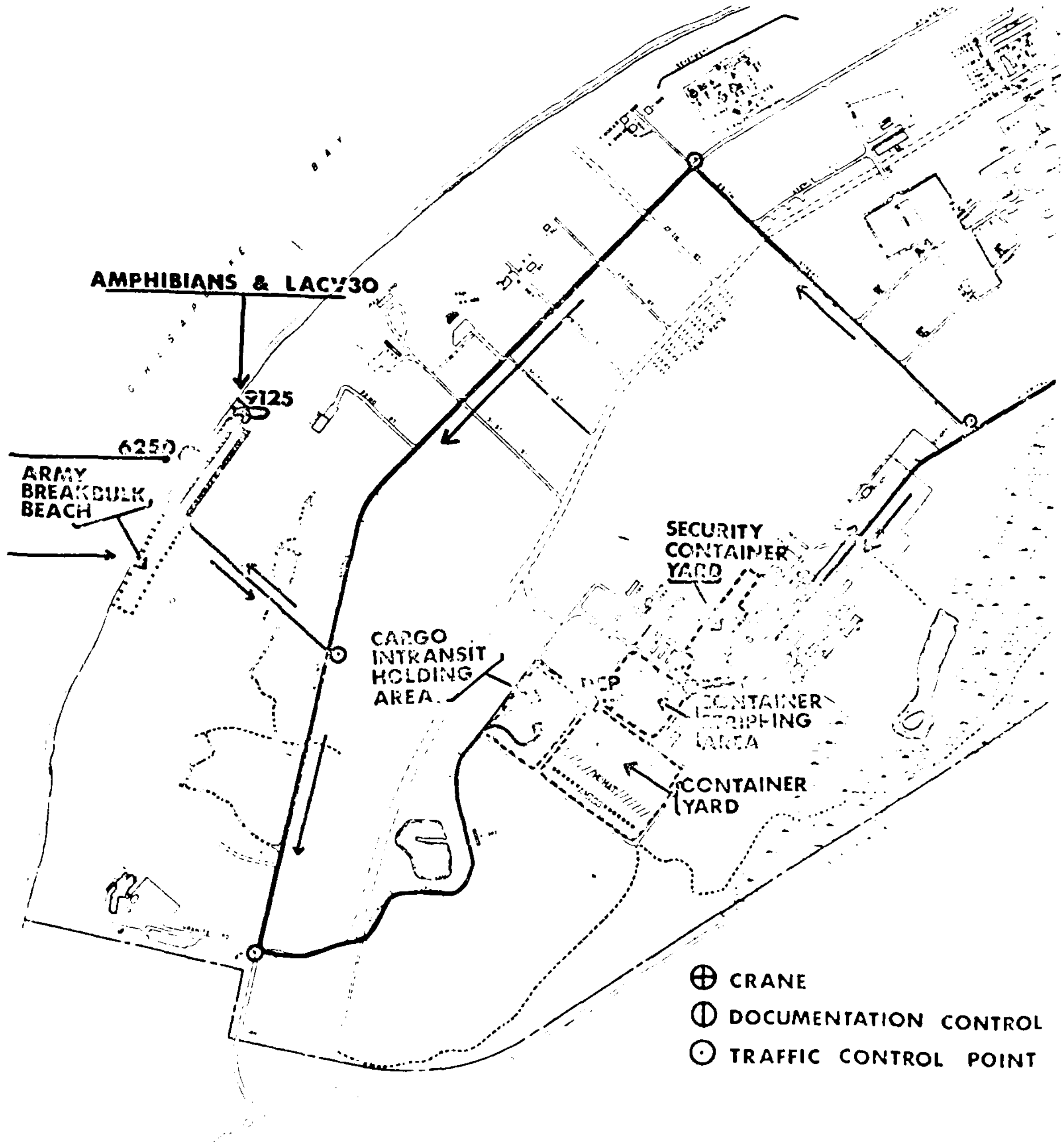

FIGURE 2.25 TRUCK ROUTE - BEACH TO MARSHALING YARD AND RETURN

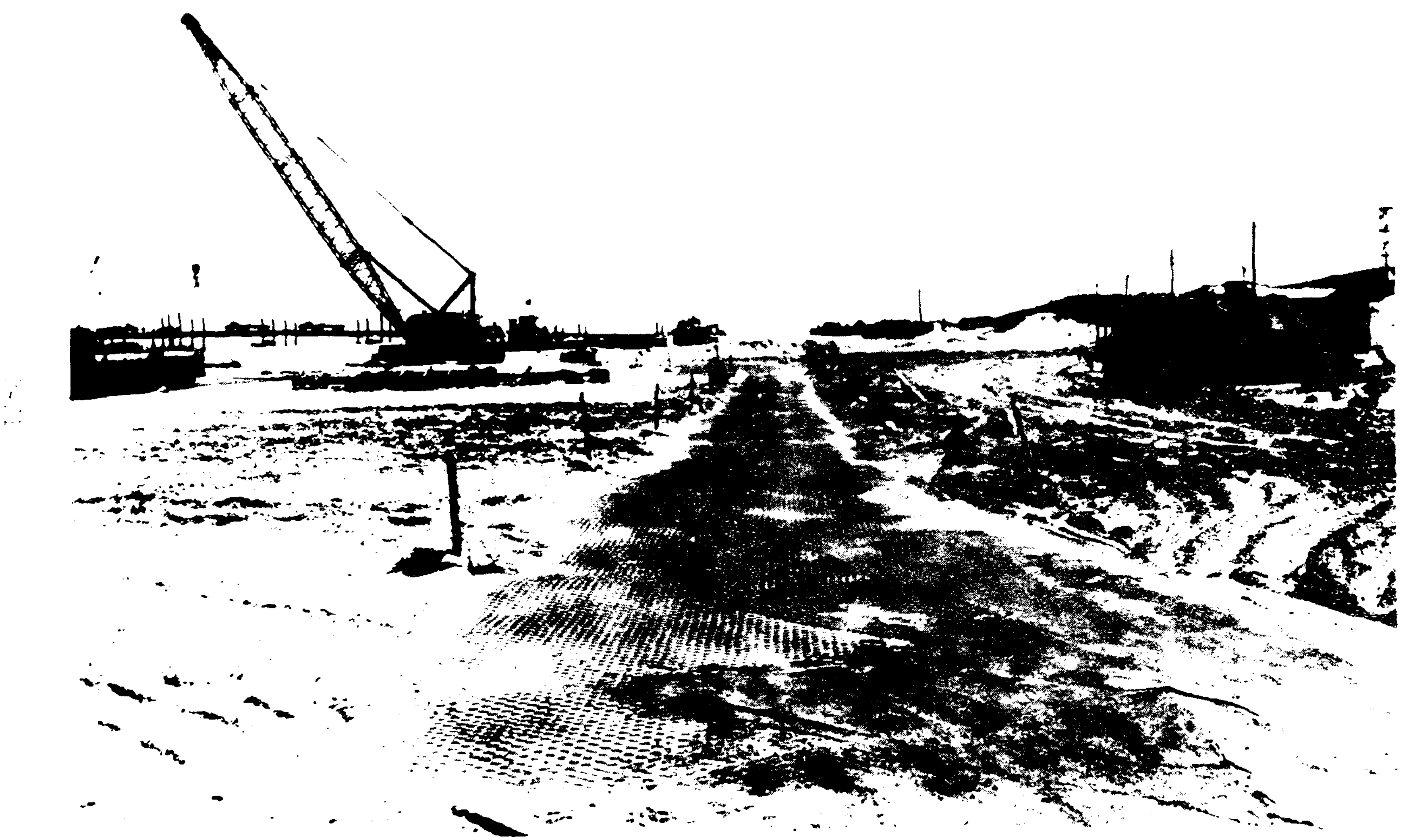

FIGURE 2.26 ENTRANCE TO BEACH TRUCK TURNAROUND ROAD

TABLE 2.27

PHASE I YARD TRACTOR-TRAILER OPERATIONS

	No. Units Used		Trips (under load)		Containers			
					Forward		Retrograde	
Date	Shift 1	Shift 2	Shift 1	Shift 2	Shift 1	Shift 2	Shift 1	Shift 2
6 Aug	14	14	65	65	65	65	0	0
7 Aug	15	14	69	43	69	43	0	0
8 Aug	18	14	80	102	80	9	0	93
9 Aug	16	14	82	95	0	0	82	95
10 Aug	15	10	35	10	0	0	35	10

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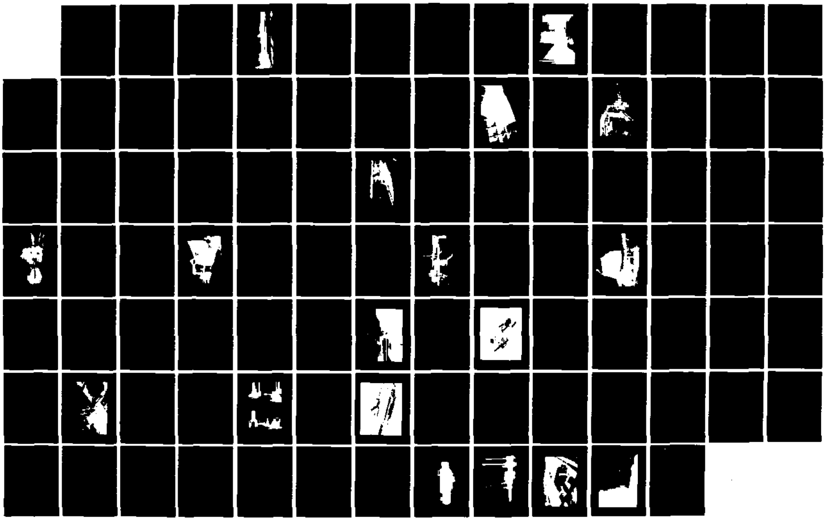

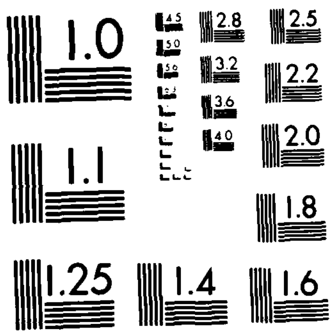

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Traffic control points were established at all critical points (intersections) to insure priority of movement to loaded trucks over local traffic. Documentation control points were also set up at the beach and marshaling yard exit-entry points. These served the dual purpose of vehicle control and cargo accountability, and support of the data collection effort. Roadside scanners were also installed to test the feasibility of the equipment for real time reporting of vehicle and container movements in conjunction with the evaluation of the mobile Remote Processing Facility (RPF).

MARSHALING YARD OPERATIONS, PHASES I, III, AND I(R)

General

Marshaling yard operations were conducted by the Army during Phases I, III, and I(R). The marshaling yard area was located approximately one mile by road southeast of Red Beach. The return route to the beach was an additional 1.5 miles. A special GSSA area was established .9 miles east of the marshaling yard as a consignee. Interconnecting hard surface road routes were available from the beach road access point on Atlantic Avenue to the marshaling yard and the GSSA.

The purpose of the marshaling yard was to provide an interim storage facility for containers off-loaded from the containership, pending later transport to GSSA consignees. Additionally, during retrograde operations the marshaling yard was utilized to store containers received from GSSA consignees, pending their transport to the beach for retrograde containership loading. In addition to containerized cargo the marshaling yard also provides a facility for the storage, documentation, and repair of palletized cargo during breakbulk operations.

Support Requirements

The following equipment from the Table of Organization and Equipment (TOE) of the 119th Terminal Service Company was allocated to support the total, two-shift mission of the marshaling yard:

- Four frontloaders with two operators each
- Six sideloaders with one operator each
- Two 4,000-lb forklifts with two operators each
- Six lighting sets with two masts each
- Approximately 25 personnel, including the MHE operators noted above, maintenance personnel, and six documentation control personnel.

Since the marshaling yard workload during the test did not reflect the full scale sustained operations (i.e., limited shipments to consignees, unstuffing of only a sample number of containers, etc.), the above listing of personnel and equipment should not be considered as the total required for normal operations. See Volume II, Marshaling Yard Operations for further discussion and analysis.

Minimal grading was the only preparation required for the marshaling yard because of the existing road net, cleared container stacking area and surfaced stowage area and fencing in the security yard.

Concept of Off-Load Operations

Containers were transported by tractor-trailer from the beach to a documentation control point at the marshaling yard. At this point the tractor operator was directed to an unloading point. There frontloader or sideloader operators were given container storage locations by voice and hand signal. The container was off-loaded from the trailer and transported to its assigned storage position. Documentation control, stowage records, and other operational records were accomplished manually. The tractor-trailer then departed empty via the return route to the beach.

An alternative concept was tested utilizing the LACV-30 and LARC-LX for direct delivery of 20-ft containers between the containership and the marshaling yard, eliminating the beach container handling systems from the cycle. An amphibian discharge crane (P&H 9125) was established immediately adjacent to the marshaling yard (see Figure 2.27) at the confluence of a LACV-30 path and a LARC-LX trail from the beach.

Organization

Marshaling yard layout and operations were generally conducted in accordance with Army standard operating procedures.[17] The marshaling yard operating area was subdivided into functional areas as indicated in Figure 2.28. They were:

- The primary container yard, for stowage of 20-ft containers by frontloaders.
- The retrograde/intransit holding yard for 20-ft containers returning empty from GSSA consignees, handled by frontloaders.
- The documentation control point for tractor-trailers carrying containers.
- Damaged equipment stowage/repair.

[17] U.S. Army FM55-70.

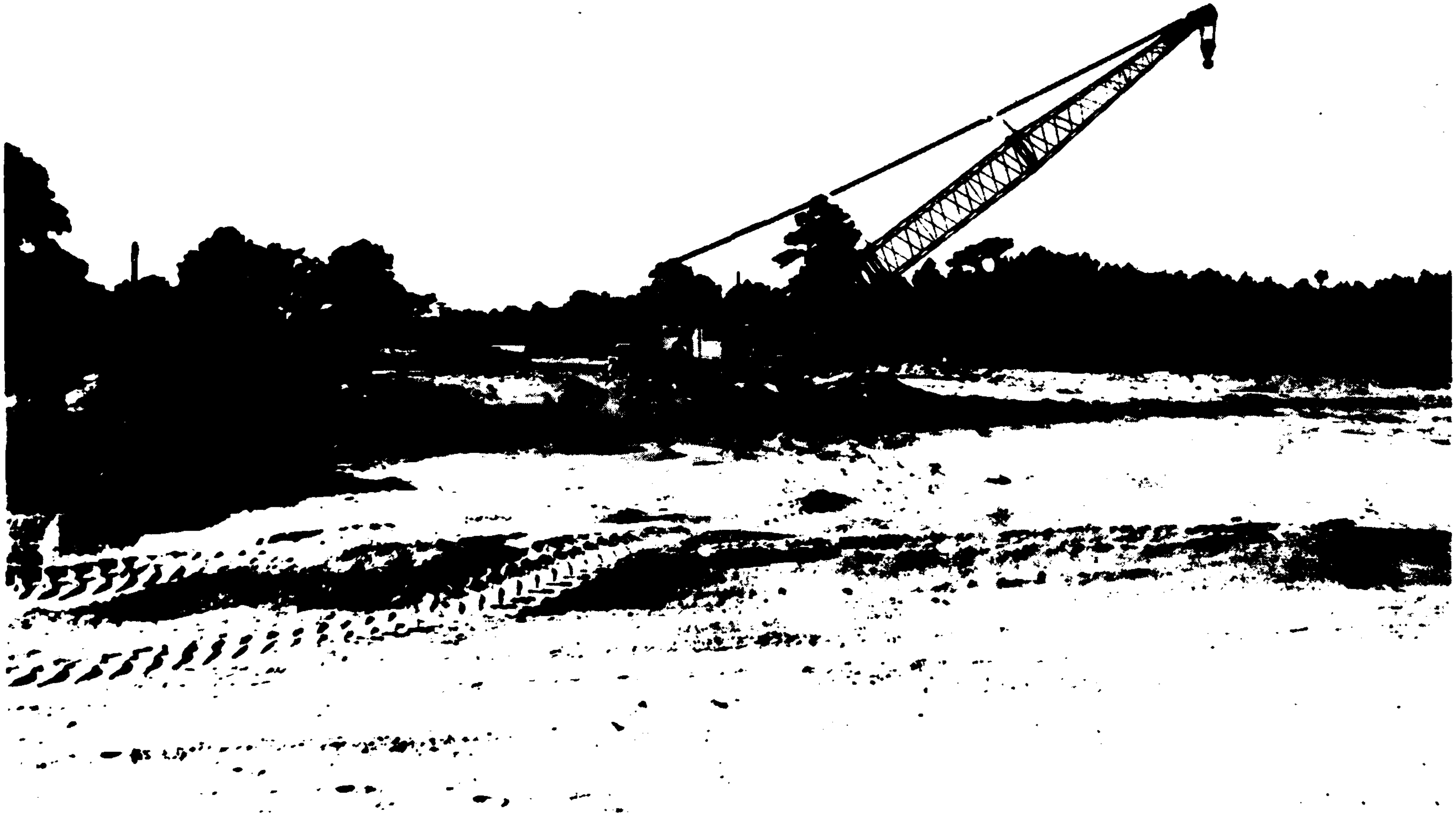

FIGURE 2.27. MARSHALING YARD AMPHIBIAN DISCHARGE POINT CRANE. A 140-ton lifting capacity crane was positioned at the edge of the marshaling yard for a demonstration of delivery of containers by amphibians.

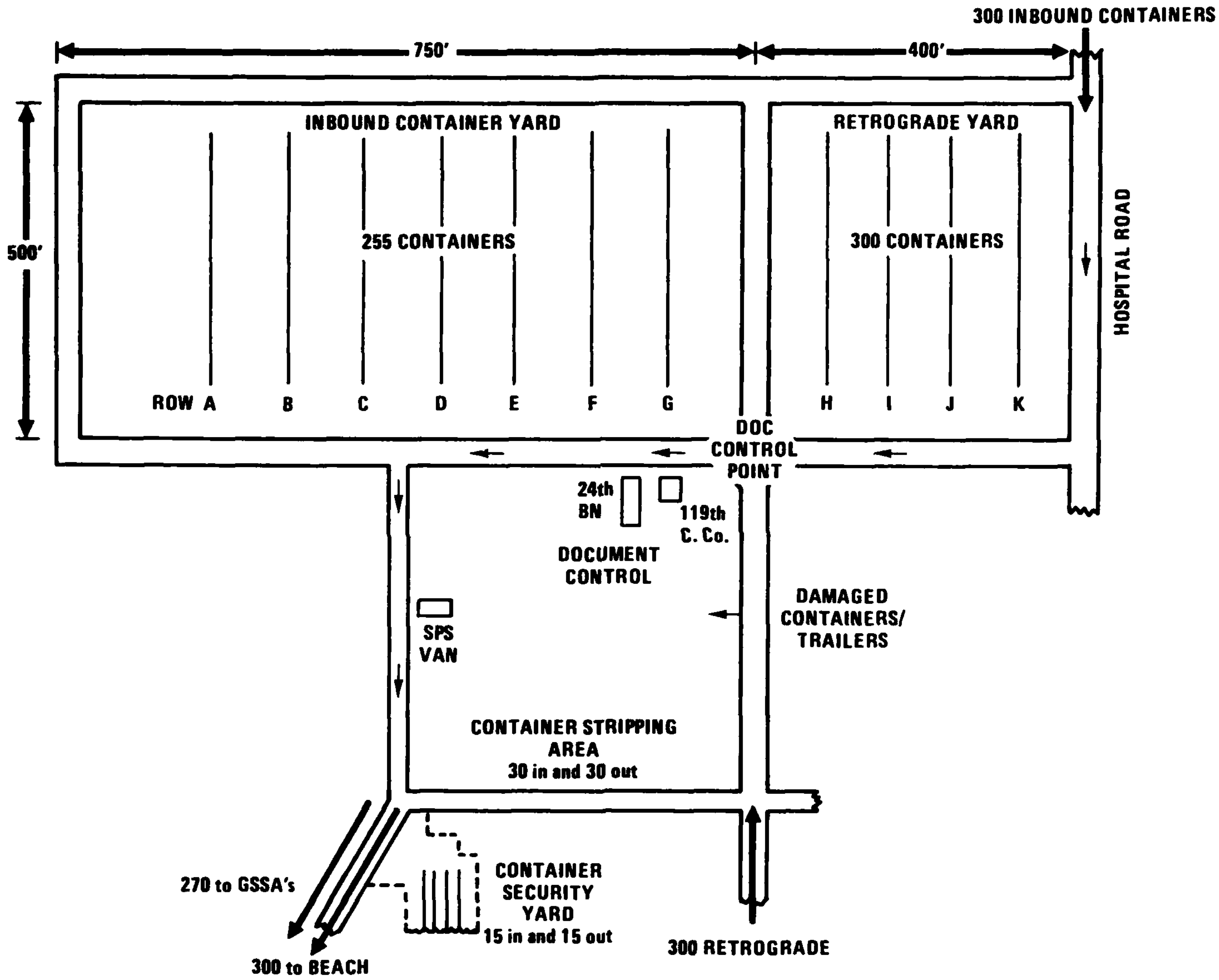

FIGURE 2.28. ARMY MARSHALING YARD ORGANIZATION

- Container stripping (unstuffing) area.

- Security yard, for selected 20-ft containers, all 40-ft containers, and flatracks. Unloading performed by sideloaders.

- Typical unloading points.

Stowage plans varied for the different phases. In Phase I the container yard plan called for seven rows, A through G, each 20 containers long, two wide, and two high, for a total of 560 containers. The retrograde yard plan called for four rows, unmarked, each twenty containers long, two wide, and two high, for a total of 320 containers. The security yard plan called for two 20-ft container rows, H and I, each fourteen containers long, one wide, and two high, and two 40-ft container/flatrack rows J and K, each seven units long, one wide, and two high; for a total of 56 20-ft containers and 28 40-ft units.

Additional storage of a limited number of containers was available in the repair and unstuffing areas. Total storage potential for Phase I was in excess of 900 20-ft containers and about 28 40-ft units, plus the stripping and repair areas. Specific alphabetical rows were designated for "light" containers only, other rows for "heavy" only, and the remaining rows were mixed, "light and heavy."

The security yard was not used in Phase III or Phase I(R). Accordingly, in Phase III rows H, I, J, and K were moved to the retrograde yard and utilized for 20-ft containers. In Phase I(R), a more realistic storage plan called for segregation by commodity and consignee in anticipation of shipment for unloading at destinations after the LOTS test was completed.

Documentation Control

The documentation control center in the marshaling yard was operated by the 24th Transportation Battalion, Cargo Accounting Detachment. This detachment of approximately 45 personnel was task organized with personnel from the 119th Terminal Service Company, the 567th Breakbulk Company, and the 491st Transportation Detachment (C.D.). A number of these 45 personnel were assigned to other operational functions in the marshaling yard as well.

The documentation control objective was to:

- Record arrival/departure of containers in the marshaling yard.

- Assign containers to appropriate stacking locations within the marshaling yard.

- Maintain current records of container storage locations.

- Respond to orders from the 1st Corps Support Command Movement Control Center (MCC) pertaining to the shipment of containers to GSSA consignees, and to support retrograde operations.

GSSA Support

Three General Service Support Activity consignees were established within one geographic site at Ft. Story. One medium truck company, with M-818 tractors and milvan chassis, and a trailer transfer point detachment were assigned to support the GSSA function. Additionally, approximately 100 milvan chassis were assigned for GSSA transport and on-chassis storage. Forward moving containers were routed from the marshaling yard to GSSA consignees by the Movement Control Center (MCC), as were containers moving in retrograde from the GSSA consignees to the marshaling yard. The objective during Phase I was to move 75 containers per day to GSSA consignees. MHE was not assigned to GSSA operations, since unstuffing activities were not planned and the containers remained on the chassis.

Marshaling Yard Storage Location

Throughput at the marshaling yard varied from phase to phase. Stowage records of container locations were maintained manually by both the 119th Container Company and the 24th Transportation Battalion Documentation Control Center. Inaccuracy of the storage location records resulted in some delays in searching by frontloaders for containers (light or heavy) as requested from the beach. Also, a number of "heavy" containers were retrograded to the beach when "light" containers had been requested.

Sideloader Employment in the Marshaling Yard

The sideloader operations took place on a hardstand, fenced area separated from the main marshaling yard. (See Figure 2.29.) Sideloaders which weigh over 70 short tons without load, are normally employed only in large container ports where their large size and heavy axle loads can be accommodated in container stacking areas. (See Table 2.28 and Figure 2.30.)

TABLE 2.28

LANCER BOSS, 3500 SERIES, GENERAL CHARACTERISTICS

Vehicle Data	With 20-ft mast (20 ft to 40 ft x 8 ft x 8 ft) for stacking containers three high)
Length	41 ft
Width	12 ft 6 in.
Height	16 ft 1 in.
Weight	147,500 lb

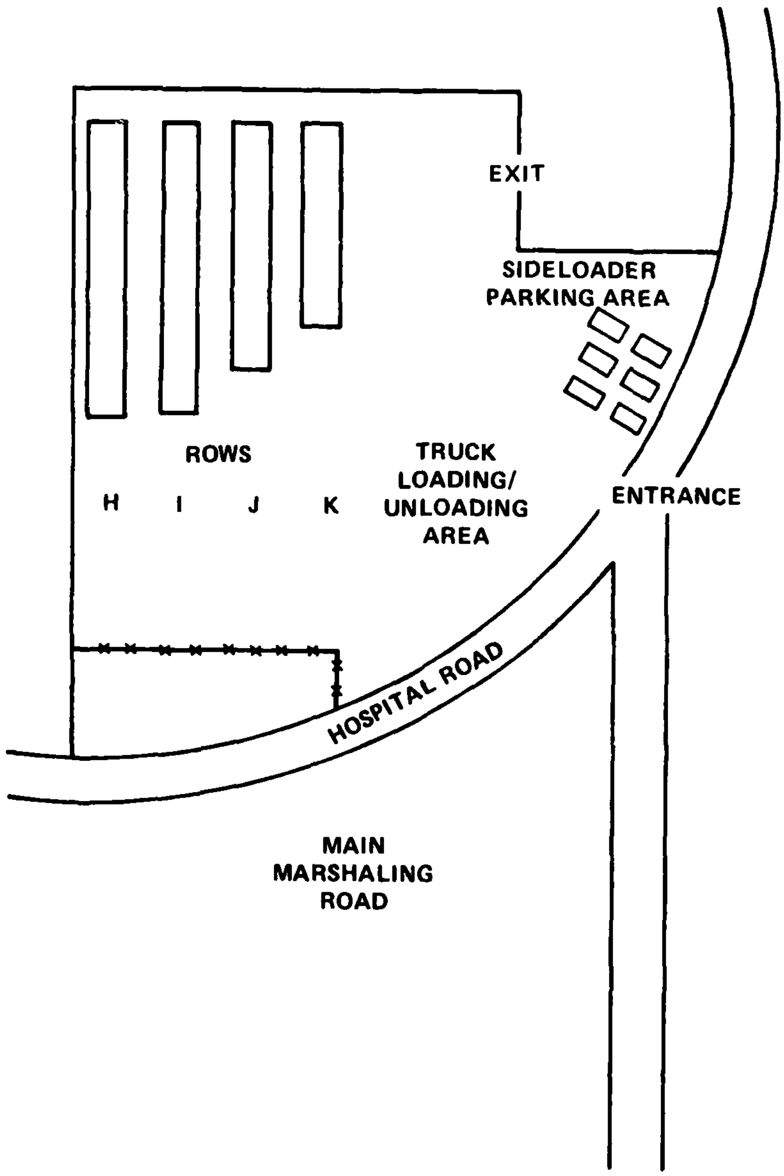

FIGURE 2.29. MARSHALING YARD HARDSTAND AREA FOR SIDELOADER OPERATIONS

FIGURE 2.30. U.S. ARMY SIDELOADER. The sideloader above is shown in a narrow aisle stacking containers. The lightly-surfaced pavement broke up under the combined weight of the sideloader and loaded container.

The sideloaders were purchased to operate in fixed ports. They were included in the test to determine if they had any marginal value in a LOTS operation and to supplement the six frontloaders on hand.

The operations plan called for yard tractor-trailer units to enter the hardstand parking area and halt at a designated unloading point. Six sideloaders were parked along the fence line to the immediate right of the entrance. Three sideloaders were operated during each shift. With the exception of substitutions on two occasions because of a minor equipment failure and an accident with a yard tractor, sideloaders T-7, 8 and 9 worked the day shift and T-10, 11 and 12 the night shift. The great majority of the 20-ft containers was handled in the main marshaling area.

Sideloader activity, except for a few demonstrations for official visitors, terminated on 9 August. For retrograde, milvans were removed by sideloaders from stacked rows and positioned nearby for subsequent relocation to the main area in the marshaling yard. During sideloader operations 236 container transfers/relocations were made, with an average cycle time of about 9.25 min.

Since the LOTS test, the primary mission of the container handling terminal service company has been changed and the sideloader deleted from the TOE. Frontloaders will be used for both LOTS and fixed port operations.

Frontloader Employment in the Marshaling Yard

In the main marshaling yard two frontloaders each shift were used for loading and unloading vehicles. When a truck halted the corner fittings were unlatched, and a frontloader moved over the container and engaged its top-handler. The truck departed shortly after it was unloaded. The frontloader with container then proceeded to a nearby storage location. It then either stowed containers on the ground or stacked them two-high. Since there were two frontloaders, no significant truck queues developed and one frontloader would wait briefly for the next truck.

The only significant problem that was observed with the frontloader concerned ground-to-vehicle communications. Because of the frontloader's noise a change of storage locations or other necessary instructions could not be readily made and to some degree delayed spotting containers.

Container Unstuffing

In the test a limited amount of container unstuffing was accomplished. Five milvans, mounted on milvan chassis, were used to test a modified 4,000-lb lifting capacity rough terrain forklift. A standard container ramp (432-in. length x 70-in. width, x 38-in. height) was attached to the chassis. (Characteristics of a 4,000-lb forklift are contained in Table 2.29.

TABLE 2.29

4,000-LB ROUGH TERRAIN FORKLIFT BASIC CHARACTERISTICS

Length	192 in.
Width	79 in.
Height	96.5 in.
Weight	9830 lb

The forklift had been modified to enter a milvan for unloading operations. It had the driver's overhead protective frame removed and the operator's seat lowered. This permitted the forklift to pass under the milvan's 84-in. clearance. The vehicle presented a silhouette with the top of the steering wheel as the highest point.

Even after these modifications were made, the forklift cleared the overhead restrictions only by a few inches. When driving into a milvan, the operator was forced to duck below and to the side of the steering wheel. This procedure significantly reduced his ability to judge the side clearances.

In addition, difficulties were experienced with the width clearances on the ramp. Normally, there is about a 6-in. clearance on each side. Also, the angle presented by the forklift, while still on the ramp, to the nearest pallets of a fully loaded container precluded any engagement by the tines. These pallets had to be pulled onto the ramp in order to be lifted.

There did not appear to be any significant problems unloading the containers once the forklift was able to get inside the milvans. Usually two men assisted the driver getting through tight clearances. Because of the safety considerations relative to the forklift's movements on the ramp, cycle times were not consistent, inconclusive, and therefore not included in this report.

PHASE I, CARGO DOCUMENTATION AND MANAGEMENT

Background

General policies and procedures required for the management and control of material moving through the Defense Transportation System are contained in DOD Regulation 4500.32-R. The instructions, coding, and documentation formats are designed for automatic data processing applications. However, the required documents can be manually completed and entries reduced to meet the needs and capabilities of a small terminal for beach operations such as that portrayed in the LOTS test. Fully automated systems are in operation at U.S. Army military terminals overseas (Yokohama, Pusan, Okinawa, Rotterdam, and Bremerhaven) employing the Department of the Army Standard Port System (DASPS). Prior to the LOTS test terminal service units deploying to areas [illegible] supported by these military terminals planned to accomplish all documentation requirements manually. In either case, manual or with an automated capability the assurance of having manifests on hand for all vessels enroute has always been questionable in view of the limited communications available for logistics traffic in a task force. As an emergency means manifests can be delivered by courier in advance of ship arrivals. The only other alternative is to use the ocean manifests on board the ships until an adequate communications link is established.

In the year prior to the LOTS test steps were taken by the Army to develop a small, deployable communications and remote processing facility (RPF). The U.S. Army Communications Command (USACC) was requested to provide the required AUTODIN network and RPF as prescribed by current Department of the Army policy. The USACC has the responsibility to provide the RPF units wherever it is determined a supporting data processing installation is non-existant. The RPF was designed to meet minimum documentation requirements of a LOTS operation, insure timely receipt of manifest data, and greatly reduce the manual workload. The unit was put together from USACC resources and was used in the test to demonstrate the need for and worth of such a unit ... not to test a proven operational system or to imply that the test unit as equipped was the final answer.

Support Equipment

The RPF equipment consisted of a 1K memory unit (PDP-16), a card reader, printer, and keypunch along with necessary operator furniture (desk, chair, filing cabinet). The above items were mounted in a modified 8 ft x 8 ft x 20 ft refrigerator milvan. A power unit mounted on the van provided electric power for the equipment and installed air conditioning.

A separate van immediately adjacent to the RPF contained the terminal equipment for the Container and Chassis Identification and Reporting System (CCIRS). This developmental project was an add-on test item for evaluating its capability for providing real-time location of containers during the exercise.

A Corps Support Command transceiver was truck mounted and located next to the two vans and a second Corps Support Command transceiver was set up near the Digital Subscriber Terminal Equipment (DSTE) installed at the Ft. Story Communications Center. This transceiver link was to relay the data to the RPF. The Corps Support Command's communications equipment is obsolete and inadequate for providing the required data link for the RPF. It cannot handle the number of characters required for transceiving MILSTAMP data. Therefore, the AUTODIN at the Ft. Story Communications Center was used for the data link.

Concept of Employment

The concept of employing the mobile RPF in the test was to have Eastern Area, Military Traffic Management Command (EAMTMC) transmit the ocean manifest data the same way it normally does to fixed ports overseas. The RFP is currently a card reader printer unit and had to receive the manifest data from a supporting computer at Ft. Eustis. In a contingency situation the supporting computer would be at a logistic base, such as at Corps Support Command, unless a computer and dedicated communications link were provided to the terminal unit responsible for the port and beach operations. In the case of the LOTS test, the computer used was the SPS test bed unit at Ft. Eustis. An AUTODIN data link was established between Ft. Eustis and Ft. Story communications center.

Documentation outputs were planned to be kept to a minimum for terminal cargo accounting, cargo disposition instructions, and Transportation Control Movements Documents (TCMD) for truck delivery to consignees. If the manifest data arranged had been timely, complete, and accurate it would have sufficed for planning the discharge, onward movement, and accounting for cargo. This would have been done on the basis of the designated consignees, required delivery dates, and the priority of the commodity associated with the controlling transportation control number (TCN) assigned to the container. It should be noted that many sea vans contain consolidated shipments of more than one shipping unit so that the identity of other items is masked under that of the "lead" TCN. Thus, the terminal commander has only limited visibility of the items transiting the beach. However, he does have the information required for accounting for all cargo received, on hand, and shipped. He can also respond to changes in consignees, priorities, etc., but such requests must be made in terms of sea van numbers associated with the controlling TCNs.

The RPF was not deployed by ship during the deployment phase in order to provide maximum training, equipment and data checkout time at Ft. Eustis. Since the van is a standard 8 ft x 8 ft x 20 ft container it can be stowed in any 20-ft container cell. Deployment by highway and positioning by a rough terrain forklift had been accomplished in the Heavy-Lift Breakbulk Ship Pretest in November, 1976. However, it has never been deployed aboard ship.

Throughput Documentation

Breakbulk cargo operations were conducted in Phase I to evaluate the capability of the Army terminal unit, in this instance the 24th Transportation Bn., to manage both breakbulk and containerized cargo. The ship discharge and transfer of breakbulk cargo at shoreside were performed separately from container operations in keeping with Army doctrine which uses two different terminal service companies. One is organized and equipped for breakbulk and the other for container operations.

Terminal documentation teams tallied the breakbulk cargo discharged from ship, transferred from lighters on the beach, and moved by truck and unloaded in the marshaling yard. Container tallies were handled in a similar manner. When the container arrived in the marshaling yard the container and seal numbers were checked and stow location assigned and recorded. The TCMDs were updated and filed in the "In Yard" suspense data file. At this point all containers would normally be sorted by consignee and, with TCMDs prepared in advanced, would be ready for line haul to destination.

The Support Command Material Management and Movement Control (MMC and MCC) teams were provided manifest data which they reviewed. The teams selected shipments to be diverted, reconsigned and/or moved at lower or higher priorities. These instructions were passed to the Transportation Movements Office (TMO) for action by the 24th Transportation Bn. cargo accounting teams in the marshaling yard.

From the start some difficulties were encountered. The first was relatively minor and did not seriously delay operations. The breakbulk cargo was packed in cases which were old and in some instances falling apart. Since more than one off-loading was to be done, time was taken to replace the old labels and repair a number of the broken boxes.

The second problem area was major and disrupted the use of the RPF for the production of all documentation and report requirements planned for the test throughout Phase I and II. This problem area was directly relatable first to the late receipt of the manifest data, and second to the data being incomplete and containing numerous errors.

Cargo manifests are required by a terminal at least 72 hr prior to ship arrival. This gives the receiving terminal enough time to correct errors and prepare tallies, TCMDs, customs documents (when applicable), coordinate port clearance and transport by mode (rail, highway, etc.) to consignee. With the outloading port, Norfolk International Terminal (NIT), only a short distance away, the manifest was received as the exercise was starting without a 3-day period to prepare for the operation. This loss of time was especially critical when associated with the receipt of an incomplete manifest.

About 40 percent of the manifest data was not received with the initial manifest transmission. Eventially, the full manifest was transceived to Ft. Story: 55 percent on Friday, 5 August; 40 percent on Sunday, 7 August; and the remaining five percent on Thursday, 11 August. At that point Phase I operations had concluded and the ship had already been backloaded. The failure at the terminal to receipt for the containers as they arrived at Norfolk activated the purging action within the system. This is the way the system was designed. The artificiality of the advance arrangements and movements staging containers at the terminal more than 45 days in advance of lift by carrier set the stage for the problem. Even this would not have created difficulty for the ADP system if receipts had been reported when the containers arrived.

In the absence of the required manifest data the terminal cargo accounting team used manifest data received and worked manual container lists for the balance, while taking action to reconstitute the lost data. The cargo accounting team frustrated the containers not shown on the manifest while reconstructing the lost data. This was done rather than attempting to open the containers for content identification and preparation of manual TCMDs.

The use of transportation data from the RPF to support the battalion in planning daily operations and current status (e.g., number of containers discharged and cleared to the marshaling yard, forwarded to consignees, etc.) was limited. The battalion operations staff relied upon manual reports received by radio, telephone, and courier to provide the information they required. The staff needed information on as near to real time as possible and on operational aspects that the RFP was not prepared to provide. This is not surprising since the system was primarily designed and equipped to provide timely documentation for cargo movement and accountability. Its periodic reports on daily operations can provide an inventory of containers on hand, received, and dispatched. However, the system provides this accounting as historical reports—not real time data for operational decisions.

In preparing for the retrograde operations to reload the ship prior to commencing Phase II, the task of preparing the stowage plan was given to the OIC of the Cargo Accounting Team. This effort distracted the officer from the pressing job of supervising the operation of the marshaling yard, correcting the documentation problems, and getting the RPF fully operational at the earliest possible time. Additional reporting requirements were also laid on to support the manual system which remained in operation until the end of the exercise.

Listings were on hand of milvans loaded with cargo at Ft. Eustis and the depots at Richmond and Mechanicsburg. Some inaccuracies in weights were found in these lists when compared with the scale weights from the outloading terminal at NIT. However, the weights were accurate enough generally for segregation and marking as "heavy" and "light" commodity groups to support LACV-30 and backloading operations. The latter were important since the heavier containers had to be stowed in lower spaces than lightweight ones to insure proper backloading of the containership anchored off-shore.

During ship discharge the containers were cleared from the beach to the marshaling yard and accounted for by container number. The MMC/MCC play was initially limited to the selection of containers from the incomplete manifest data for movement to consignees (designated as General Support Supply Activities at a nearby location). The cargo disposition instructions were delivered to the Army cargo accounting team which pulled the shipping documents (TCMDs) for the truck movement to all consignees, making any necessary changes. Then the TCMD copies were transferred from the "In Yard" file to the consignee file. As can happen in actual operations, on two occasions consignee changes arrived after the containers had already been delivered to the originally designated consignees. In such instances in actual operations the Transportation Movements Office (TMO) would take the follow-up action to trace the containers and get them diverted, if possible, while enroute.

All of the equipment in the RPF mobile van worked well. Even during the most demanding surges TCMDs were on hand for GSSA shipments, and by Phase III, with the system fully operational, status reports were running only about one hour behind movement cut-off cycles.

The equipment of the CCIRS worked well with the exception of an occasional equipment failure. The recurring problem was caused by wrong orientation of milvans on trailers. The tags used during the test were relatively expensive.[18] To keep the cost reasonable for the test, only one tag was fastened to each milvan. With only enough scanners to man one position at each critical point, the milvans had to be loaded on the trailers only one way--with the doors to the rear so the label could be read by the scanners from the right hand side of the road. As milvans were stacked in a row from one side by a frontloader, quite frequently a frontloader would lift from the opposite side for loading a trailer thereby reversing the orientation of the milvan. When the trailer passed the scanner the truck would be reported to the computer as passing empty rather than under load.

PHASE I, SUMMARY

During this initial phase of the test, operations were generally characterized by learning to operate with new equipment and developing new procedures while attempting to get a large interactive system operating smoothly. Some of the difficulties were:

- Long pauses were observed at the ship while cranes waited for lighters;
- A reluctance to shift from large heavy landing craft to medium landing craft near periods of marginal tide conditions to reduce delays at the jetty crane;
- Shipboard night operations had inadequate lighting;
- Personnel were unfamiliar with some of the tie-down equipment for the COD; and,
- The TCDF initially lost time in being repositioned because of tidal current problems and deck organization.

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[18]The tage is a passive transponder type made of plastic with bonded micro-integrated circuitry. The memory has the data encoded; the roadside scanner receives the signal from the tag and transmits it to the control computer.

These areas of difficulty are primarily attributable to a first-time-ever effort by Service personnel to operate a complete LOTS system in a realistic environment. Performances improved as the test progressed. (Further discussion is contained in Volume II of this report.)

During Phase I 620 containers were handled; of these 352 were off-loaded and 268 retrograded. The peak number handled in a 24-hr period was 154, which was accomplished the second day of retrograde; and the second peak number was 147, which was attained the first day of off-loading. Except for the first day, in which start-up difficulties were anticipated, the daily target was 300 containers handled per day. The first day's target was 150 containers and was nearly attained. However, all attempts during the remainder of Phase I fell well short of the 300-containers-per-day target.

It was apparent that shoreside systems were not heavily taxed by the container flow from the ship. The tide and off-shore sandbars did pose some difficulties for landing craft. But breaching the sandbar was not aggressively ateempted and the slow discharge rate from the ship did not apply pressure to do so. The amphibians had no problems negotiating the beach. Both landing craft and amphibians were not well controlled at ship and the cranes were delayed as a result.

Under the priorities established for lighterage use during Phase I bare beach operations, the two LACV-30s transported 204 containers, LARC-LXs 160, LCUs 128, LCM8s 72, and LARC-XVs 76. The amphibians accounted for 69 percent of the total number of containers transported; the landing craft 31 percent.

III. PHASE II - AMPHIBIOUS FORCE OPERATIONS

PHASE II, BACKGROUND

Phase II was distinct from Phase I. Phase II was designed to portray an improved beach for amphibious forces in which containers were the principal type of cargo. No breakbulk ship operations were included but some breakbulk cargo and containers were off-loaded from LASH and SEABEE barges concurrent with Phase I activities just prior to the actual start of Phase II. No container unstuffing was accomplished during Phase II. The primary objective was to test the capability of the Navy-Marine Corps to off-load a follow-on echelon of an amphibious force that may have to be lifted, at least in part, by containership.

At Marine Corps request, actual deployment of USMC equipment was not included in the LOTS test, although the Marine Corps 30-ton mobile crane and the Lightweight Amphibious Container Handler (LACH) had never been loaded aboard merchant ships. It was assumed that the elevated causeway and all Navy and Marine Corps equipment had been deployed in amphibious ships with the assault echelon. Earlier the Marine Corps had expressed an interest in loading troop and other shelters in the hold of the containership. However, this was dropped in later planning.

With the exception of the barge-TCDF and two frontloaders from the Army and a leased crane on the elevated causeway, all shipboard and beach assets used during this phase originated from Navy and Marine Corps inventories. Special training was conducted for the Navy and Marine Corps operators for all non-organic equipment. The only non-naval personnel involved were the leased equipment technical representatives and the Army frontloader operators.

Land transport to and from the Logistic Support Area (LSA), where the containers were stored, was primarily from Marine Corp assets, augmented by some Army Milvan chassis. Army personnel and equipment were used only to augment LSA operations. The primary system of cargo control and accountability was a manual one with personnel stationed in the LSA, on the approach road to the elevated causeway, and at the LACH operating area.

All of the shore operations were conducted at Blue Beach either at the elevated causeway or the LACH operating area. These cargo transfer facilities operated independently and on a non-interfering basis.

General command and control were exercised by the Naval Beach Group, located on Blue Beach. Many of the lessons learned by observing Army operations during the previous phase were incorporated in the Navy-Marine Corps operational planning.

Weather conditions were normal for this period with temperatures averaging 82 degrees and with occasional late afternoon-early evening shower activity. Sea conditions were generally smooth and did not adversely affect operations.

PHASE II, BEACH PREPARATION

Beach preparation for Phase II, although accomplished by Navy and Marine Corps personnel with their organic equipment plus an experimental road grader (a John Deere JD 670 model), was largely an administrative activity. Figure 3.1 depicts the general area of beach operations.

On Blue Beach, 31st Street was extended approximately 435 ft to the end of the elevated causeway. (See Figure 3.1.) As with all AMSS installations, the roadway was graded with ditches on both sides. The fiberglass cloth was placed over the roadway and both ditches and sprayed with a resin compound. After the AMSS had dried over the cloth, normally a period of less than 2 hr, a second application was then made. Both ditches were then filled with sand after the compound had dried, providing an anchor or the roadbed and a trap for the sand beneath the AMSS.

Supplementing the AMSS roadway was a staging area constructed out of Momat. Momat is produced in 12 ft x 48 ft rolls and is a fiberglass-like material with a rough surface. Approximately 40 rolls of Momat provided a staging area surface of about 192 ft x 120 ft. Sheets were bolted together and staked to the ground along the outside perimeter. Later, additional anchoring was provided when a 3-5 ft sand berm was constructed along the outer edges. This was necessary because heavy wind gusts caught the outside edges, and, after eroding away some of the sand underneath, tended to lift the Momat up.

Beach preparations began at 0700 on 14 July and were generally completed by 22 July, although some patching, reinforcing, and storm repair were subsequently accomplished. (During the 8-day period a 2-day administrative time-off allowance was given to Marine Corps personnel. Thus, six days of preparation were involved.) Equipment items used are contained in Table 3.1. Special items, in addition to the items in Table 3.1, normally available were a 5-ton truck and a trailer with the AMSS spray applicator, the LACH, and the road grader mentioned above. The number of Marine Corps personnel involved in beach preparations wa about 30. Most of the effort was spent laying the Momat staging area and b lting the sections together.

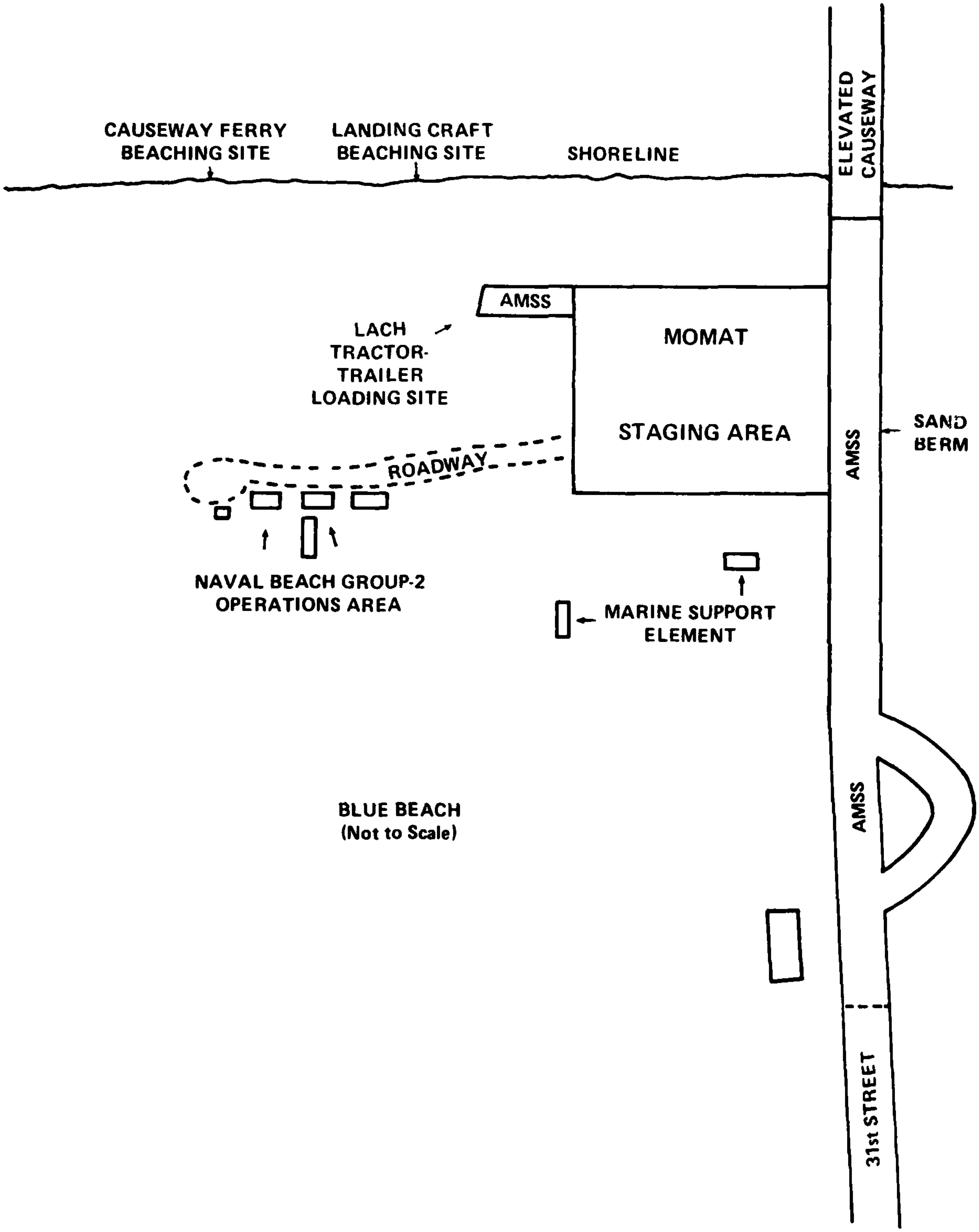

FIGURE 3.1. BLUE BEACH - SITE FOR NAVY AND MARINE CORPS OPERATIONS IN PHASES II AND III

TABLE 3.1

MARINE SUPPORT ELEMENT EQUIPMENT
USED IN THE JOINT LOTS MAIN TEST

ITEM	QTY ON HAND
M-52 Tractor	15
M-127 Trailer	18
M-543 Wrecker	3
M-54 Truck	9
M-35 Truck	5
M-151 Truck	6
AN/MRC 110 (radio)	1
Drott Crane	3
Truck, Forklift (10,000 lb cap.)	4
Truck, Forklift (6,000 lb cap.)	2
Tractor 8230 (crawler)	1
Tractor MRS 100	2
M-131 Refueler	1
M-49 Refueler	1
M-880 Truck	2
M-886 Ambulance	1
M-274 Repair Van	1
Dolly Converter	2

PHASE II, CONTAINERSHIP OPERATIONS

General

In Phase II the LOTS test scenario called for two CODs to discharge and retrograde the NSS containership. Accordingly, it was necessary for the barge-TCDF to simulate a second COD. The Navy manned and operated both ship unloading systems and provided the stevedore crews for the ship. The Navy unit responsible for containership operations was the Cargo Handling and Port Group (NAVCHAPGRU), an organization normally organized and equipped only for breakbulk operations. (See Figure 3.2.)

Crane-On-Deck (COD)

As with the Army, Navy experience with the COD before the test was limited to training sessions at the US Naval Amphibious Base, Little Creek, Va. There the crane was operated on the hatch bridging spans on the ground to simulate procedures that would be used aboard ship.

COD Operations, Phase II. During Phase II the COD operated about 9.4 shifts, terminating operations about 2130 on 15 August. Within this period the COD off-loaded 225 containers and retrograded 195, for a total of 420 transfer operations or a rate of about 90 per day. The peak number transferred in a

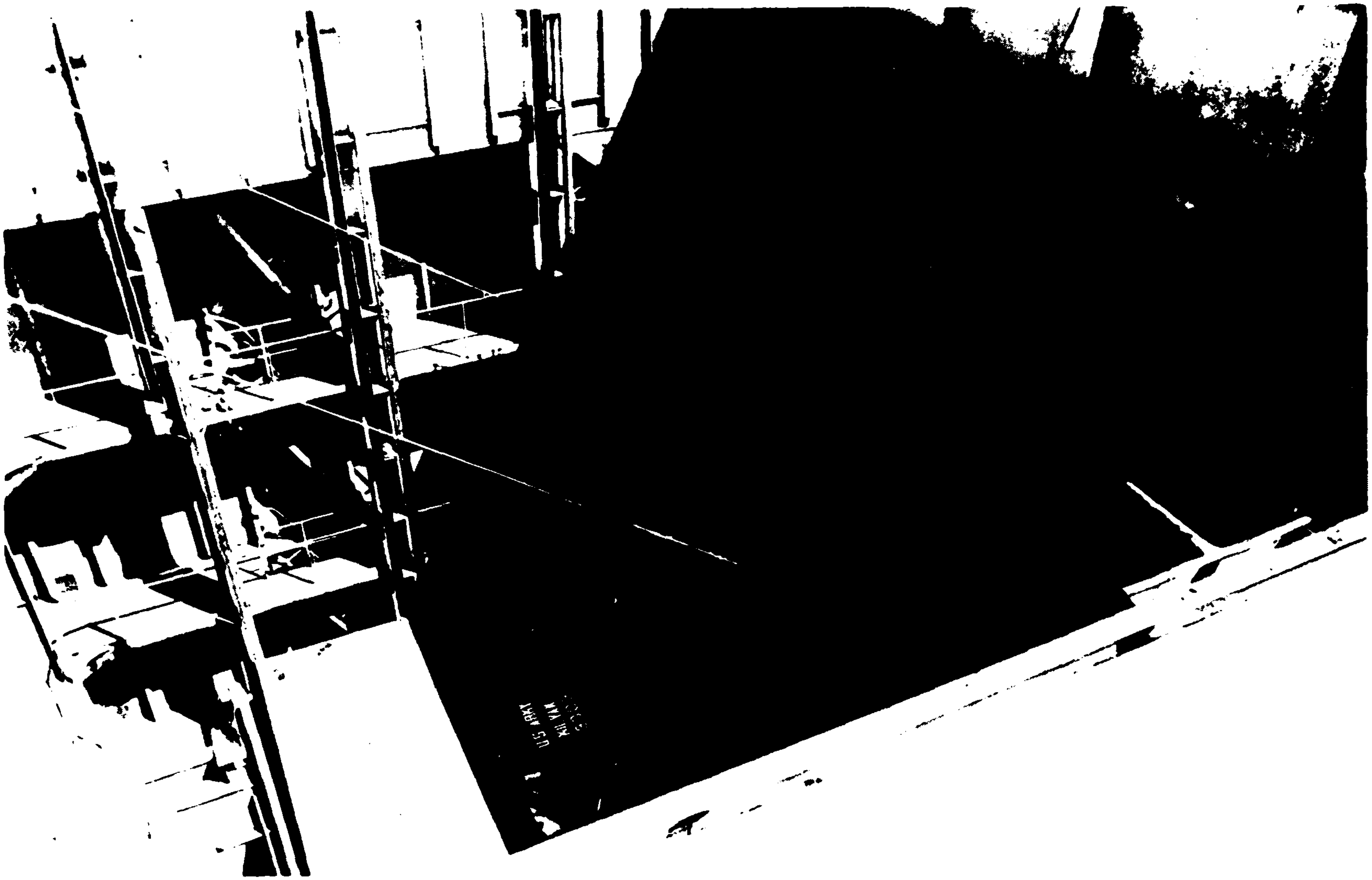

FIGURE 3.2. A CONTAINER IS OFF-LOADED FROM A CELL USING MANUAL TAGLINES.

single shift was 63, which happened once during off-loading and once during retrograde. The lowest number transferred was 20, which occurred during the last night of retrograde when backloading objectives were met early. The first night of retrograde was also poor (25 loaded) due to a slow start, an excessive ship list (about 3°), and some crane maintenance difficulties.

The average day shift (including both off-load and retrograde operations) transferred about 52 containers. The night shift had 36 containers on the average or about 18 percent less. Having observed the Army in Phase I, the Navy increased the number of spotlights to correct the poor shipboard lighting. The additional lighting helped, but observers still thought that the lighting was insufficient.

Navy crane operator and signalman inexperience with container crane operations was evident from time to time. Hand signals were not standardized and often confused. On one occasion the COD was deadlined for nearly 2 hr when the hook was two-blocked at the boom tip as the boom was being topped down.

A decrease in "awaiting lighter" time for the COD was noted in Phase II compared to Phase I, particularly for the night shift. The average period during ship off-loading between lighters at the COD was just under 9 min for an LCU. The LCM8s, however, could succeed a loaded lighter in an average time of about 2.6 min. During retrograde average lighter succession times were slower, about 9.25 min and 5.7 min for LCUs and LCM8s, respectively. (See Figure 3.3.)

On the average an LCU was alongside the C D about 31 min during ship off-loading and about 33 min during the retrograde period. An LCU had an average load of 3.81 containers during the off-load period and about 3.87 containers during retrograde. This equates approximately to 8 min per container but does not account for various "working ship" requirements (see Vol. II), such as hatch openings, crane relocations, maintenance, and other activities. Figure 3.4 summarizes container transfer productivity by shift for the COD in Phase II.

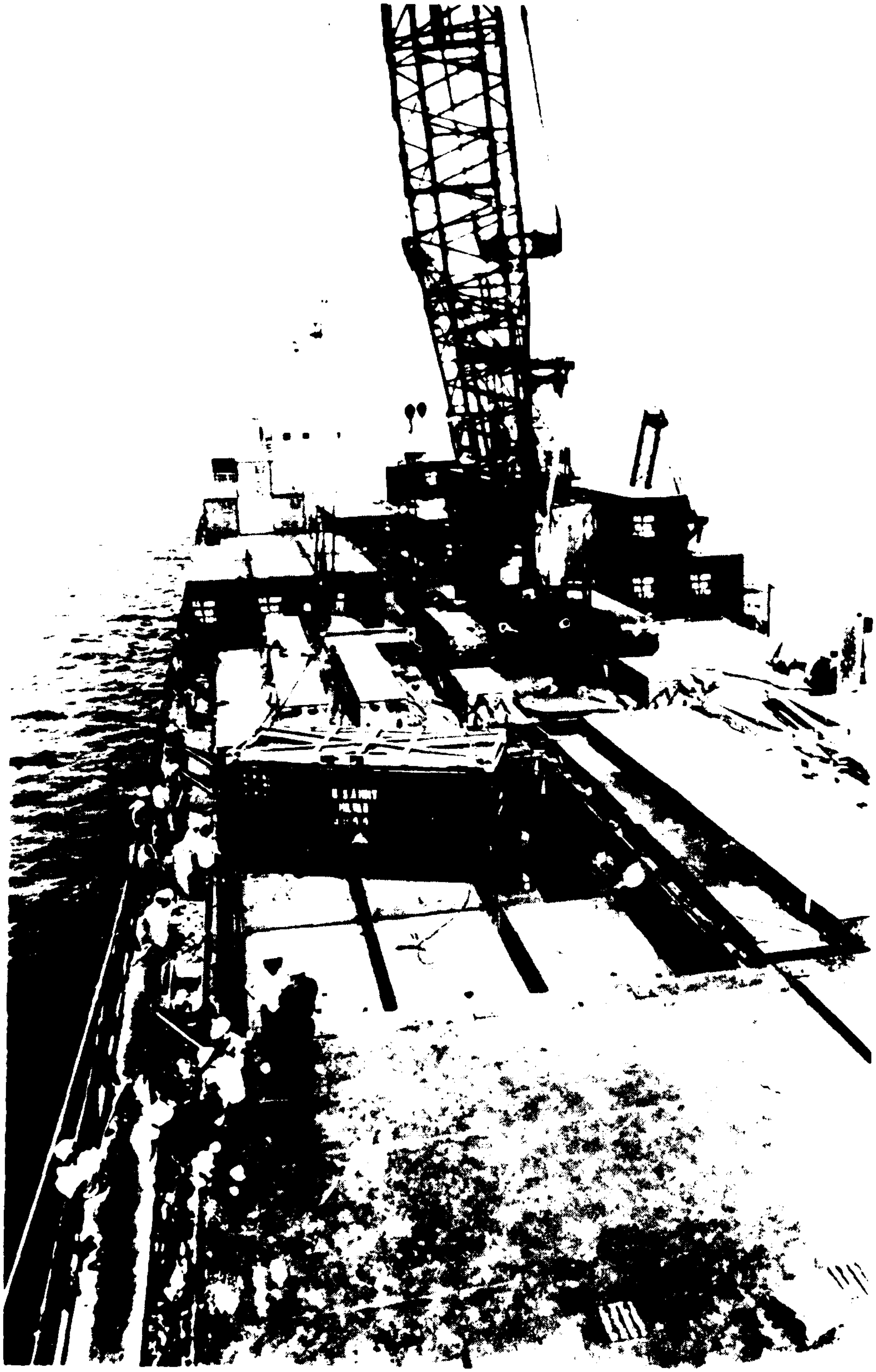

FIGURE 3.3 THE CRANE-ON-DECK AWAITS A LIGHTER.

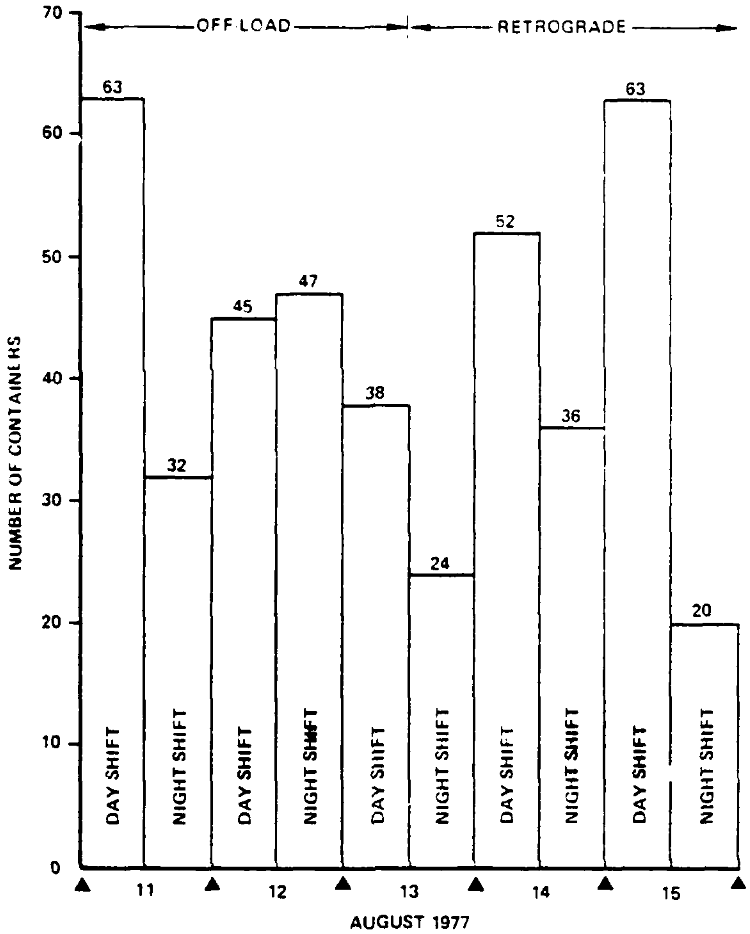

FIGURE 3.4. COD CONTAINER PRODUCTIVITY BY DAY AND NIGHT SHIFT FOR PHASE II

COD Relocations. The Navy was more familiar with the Peck and Hale type tie-downs for the crane and hatch bridging kit. Thus, they did not have the same difficulties as the Army initially did with relocating the COD from one hatch to the next. The Navy, like the Army, had to move the crane once during off-loading and once during retrograde. On the first occasion the move required 75 min and the second required 79 min, including time to tie-down the spans and change rigging on the crane back to the container slings. Included in this time, however, was the test artificiality of having to also reposition the Navy's instrumentation van which was recording data from instruments installed on the crane. In the first case 34 min extra were required to rerig from the slings used to lift the first two hatch bridging spans to a container sling, move the instrument van, and then rerig the slings needed to move the last two spans after the crane had been shifted forward. The second relocation of the van required only 14 min.

Crane Refueling. Data collected on crane refueling is not very precise since refueling usually took place as one shift was being completed and the next shift was beginning. As a result, other activities tended to interrupt the process.

The procedure generally used was to bring fuel pods in LCM8s alongside the ship. The crane had to remove its container rigging and attach a sling, and lift the refueling pods up on deck where the crane was actually fueled. The Navy used a power fuel pump instead of a hand fuel pump used by the Army and was able to save time. The crane has a 315 gal capacity tank. The first time the crane was refueled by the Navy (on 11 August), it required 97 min. After that, periods from approximately 30-60 min were spent refueling.

Crane Maintenance. In addition to other halts such as for weather, crew change-over, and routine maintenance in Phase II, the COD also lost more than 10 hr due to unscheduled maintenance requirements. The longest deadline period was 2.4 hr on 11 August due to an oil pressure problem. This delay included time to have a representative from the crane leasing company check the engine. In another instance 1.8 hr was lost due to an operator's error. For the most part the Navy used container slings instead of spreader bars. When the spreader bars were used, they caused periodic short delays, some of which lasted about 15 min. One delay of approximately 1.5 hr was not identified. Normal operator maintenance was performed during the first hour of the shift and sometimes refueling was still in progress.

COD Hatch Cover Handling. Procedures for opening and closing hatch covers for the Navy were similar to the Army's. One of the few differences was the number of personnel used. The Navy would use a minimum of 13 (the hatch gang) and sometimes more if the TCDF hatch gang were available.

Six single hatch opening/closing events took place. That is, a hatch was either opened or closed, which involved the switch from a 20-ft spreader bar to a 40-ft one, the attachment and lift-to-land of the hatch cover, and the switch back to the 20-ft spreader bar. The times averaged about 30 min. The most difficult part of this evolution was the fitting of the 40-ft spreader bar to special locking devices on the hatch cover. Nearly one-third of the time or about 10 min was spent trying to accomplish this feat.

Three two-hatch opening/closing events were recorded. This procedure involved the same rigging changes as before for lifting the hatches but instead of just one hatch being opened or closed a second hatch also had to be closed or opened. Two of these events took place at night and required 68 min and 47 min respectively. A third event, which took place the last morning, required 36 min.

Barge-Temporary Container Discharge Facility (TCDF)

For Navy personnel the LOTS main test was their first opportunity to operate the barge-TCDF at sea. Some pretest experience was obtained on the James River but the training had been limited. Navy operational procedures were generally similar to the Army's with respect to the TCDF.

Barge-TCDF Operations, Phase II. During Phase II the TCDF transferred 416 containers in the 10 shifts it operated, for an average daily rate of about 83 container transfers per day. Within this period 233 containers were off-loaded and 183 retrograded. The peak number handled by the Navy in a 24-hr period was 107 containers which were off-loaded on the second day of operations, and the next highest peak was the first full day of retrograde (14 August) in which 95 containers were retrograded. The lowest number handled was 54, which occurred during the 24 hr period when off-loading was completed and retrograde was just starting (13 August). The retrograde period got off to a slow start and the TCDF night crew back-loaded only 11 containers.

The average day shift for Phase II transferred 50 containers while the night shift transferred 34, about 20 percent less. Again, lighting problems hindered night operations, probably more so than with the COD, and sometimes a flashlight was used in an attempt to improve communication with the TCDF operator.

Productivity on the TCDF was influenced by the use of causeway ferries as a hedge against the non-availability of lighters. The causeway ferry positioned against the TCDF for the duration of the shift (or until fully loaded), while LCUs and LCM8s were moored outboard and had loading priority. As a result, the TCDF nearly always had a lighter available. But delays were experienced on the order of .5-3 hr in causeway ferry succession or in repositioning available space on the causeway ferry within reach of the TCDF.

Lighter Succession Time at the TCDF. The average time between lighters at the TCDF (that is, from the departure of one lighter to the time the next lighter was ready to load) was 5.76 min for LCUs and 3.64 min for LCM8s during off-loading. During retrograde it was 9.14 and 2.33 min for LCUs and LCM8s, respectively. On the average an LCU was alongside the TCDF for 31 min during off-loading and 40 min during retrograding. An LCM8 spent 5.73 and 10.4 min alongside for off-loading and retrograding, respectively.

TCDF Relocation. Navy procedures for moving the TCDF varied somewhat from the Army's. If the current was favorable, lines were slackened and the TCDF was allowed to drift into the next operating position and lines were then shifted and secured. When propulsion was needed to move the TCDF, a 3 x 14 causeway warping tug and LCM6 causeway tender boats were used. The first time the TCDF was moved around one end of the ship (the stern), however, two Army LCM8s moved it, while a third one was standing by. That move required approximately 1.5 hr before the TCDF was back in operation. Moves in which the TCDF was shifted from one spot to another along the same side of the ship required about .5 to 1 hr. The longest move (around the ship) required about 1.5 hr and the fastest about .45 hr. Altogether, over the 10 shifts, the Navy spent more than 6 hr repositioning the crane.

Crane Refueling. Data are not complete on TCDF refueling but generally the crane was refueled at least once a shift. The times recorded for the refueling operation varied from about .5 to 1.5 hr. The procedures were generally the same as with the COD, a fuel pod from a lighter was lifted to a position on deck near the crane, the crane was refueled, and the pod was returned to a lighter for movement ashore. Sometimes loading and off-loading of the fuel pods was accomplished during container operations if no lighters were near.

Barge-TCDF Container Productivity. A summary of barge-TCDF container handlings during Phase II is shown in Figure 3.5.

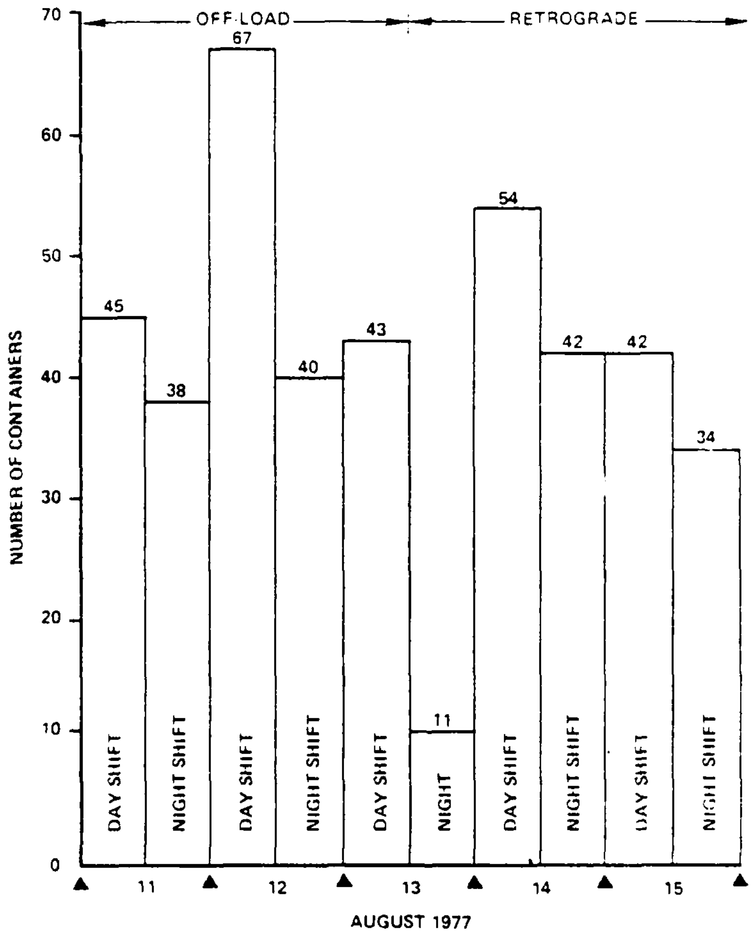

FIGURE 3.5. BARGE-TCDF CONTAINER PRODUCTIVITY BY DAY AND NIGHT SHIFT FOR PHASE II

PHASE II, LIGHTER OPERATIONS

Operational Summary

During Phase II, in which approximately 458 containers were off-loaded and 378 retrograded, lighterage worked between the TCDF or COD at the ship and the elevated causeway or a LACH off-loading site on the beach. Primary control over lighterage was exercised at the beach by the Naval Beach Group headquarters. However, when required alongside, the ship would order a lighter from the nearby boat pool. Three types of lighterage were used: 1610 and 1646-class LCUs[1], LCM8s, and two four-section causeway ferries. Table 3.2 summarizes the resources available, cargo carrying capacities, and operational employment for the Navy lighters.

Concept for Employment

The Navy concept of lighter employment was to give priority at all cranes to LCUs. LCM8s were to be used sparingly and then only when one container remained to be off-loaded before a new operational event, such as a hatch opening, was to take place. In addition, to minimize delays due to non-availability or slow mooring procedures of LCUs and LCM8s, a causeway ferry usually was left alongside the TCDF. The causeway ferry was then used as an auxiliary drop point in the absence of other lighters until no more containers could be loaded aboard it. This varied from 8-14 containers. Once loaded, it was then dispatched to the beach.

Lighter Operations

During Phase II the majority of the containers were carried by LCUs. Table 3.3 summarizes the 5-day workload by lighter types for Navy craft at ship and shore nodes. During the five days of operations in Phase II, there were about 229 transits initiated, including those events in which lighters were loaded, called back, and off-loaded at their departure station (before completion of the transit) because of bottlenecks, or for other reasons. In effect this resulted in some double handling, generally at the beach, and is reflected in Table 3.3.

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[1] The 1610-class LCU is similar in most respects to the 1646-class LCU. For convenience, the two classes are grouped together and referred to as the 1646-class since there were no observable operational differences and most were of the 1646-class.

TABLE 3.2
NAVY LIGHTERAGE EMPLOYED
IN PHASE II

RESOURCES			CARGO CAPACITIES			OPERATIONAL EMPLOYMENT			
TYPE	No. Used This Phase	Avg. Used Per Shift	Weight Capacity (Short tons)	20-Ft Container Spaces	Avg. No. Containers Per Trip	Fwd Movement Load Site	Fwd Movement Off-load Site	Retrograde Load Site	Retrograde Off-load Site
LCU	11	8	180	5	3.82	TCDF/COD	El.C/W LACH	El.C/W LACH	TCDF/COD
LCM8	12	2.5	60	2	1	TCDF/COD	El.C/W LACH	El.C/W LACH	TCDF/COD
C/W Ferry (4-section, 3x15)	2	1.3	100*	4*	10.9	TCDF	LACH	LACH	TCDF/COD

* The capacity of each causeway section is 100 tons. The load limitation is a function of the freeboard desired. The quantity of containers stowed is dependent upon the discharge method ashore; more could be stowed if positioned athwartship to the causeway, but in this case the LACH required fore and aft storage.

TABLE 3.3
SUMMARY OF PHASE II LIGHTER OPERATIONS

AT SHIPSIDE

LIGHTER TYPES	OFF-LOAD OPERATIONS				RETROGRADE OPERATIONS			
	NO. TRANSITS		NO. CONTAINERS		NO. TRANSITS		NO. CONTAINERS	
	COD	TCDF	COD	TCDF	COD	TCDF	COD	TCDF
LCU	57	47	219	181	40	34	156	128
LCM8	6	15	6	15	12	5	12	5
C/W FERRY	0	4	0	37	2	3	27	50
TOTALS	63	66	225	233	54	42	195	183

AT THE BEACH

LIGHTER TYPES	OFF-LOAD OPERATIONS				RETROGRADE OPERATIONS				
	NO. TRANSITS		NO. CONTAINERS		NO. TRANSITS		NO. CONTAINERS		
	El. C/Way	LACH	El. C/Way	LACH	El. C/Way	LACH	El. C/Way	LACH	Front-Loader
LCU	77	31	299	108	54	20	207	77	0
LCM8	2	19	2	19	9	8	9	8	0
C/W FERRY	1	3	6	31	0	5	0	54	24
TOTALS	80	53	307	158	63	33	216	139	24

As in Phase I operations were most seriously affected awaiting lighters at the ship and at the beach. There were no significant queues formed during the off-load period awaiting discharge at the beach, but there were lighter queues at the ship for loading. In the retrograde period there were loaded lighter queues waiting for time alongside the ship. Vol. II of this report discusses these queues and the rate of succession of lighters at the ship.

The loads carried by lighters varied somewhat. Although the 1646-class LCU normally can carry five containers without difficulty, four or less were loaded by the Navy in consideration of tidal, beach slope, and sand bar conditions. Table 3.4 lists the frequency and size of LCU container loads. LCM8s carried only one container on each transit (although two containers are possible) during both the off-load and retrograde periods.

TABLE 3.4

LCU CONTAINER LOADS

LIGHTER LOAD SIZE	OFF-LOAD	RETROGRADE
LCUs with 4 containers	88%	83%
LCUs with 3 containers	9%	16%
LCUs with 2 containers	3%	1%
	100%	100%

Causeway ferry loads varied considerably. The causeway ferry normally has a shallow draft in comparison to other lighters and with a towed speed of 4-7 knots, combined with the lifting force of a 2-3 ft or greater surf, it nearly always crosses sandbars and attains a dry ramp. On the other hand, its length makes it difficult to maneuver and it requires powerful tugs or pusher boats for propulsion. Thus, for the test it seemed better suited for beaching operations and discharge by the LACH than for the elevated causeway, which required some causeway ferry maneuvering in currents and surf conditions to moor.

An attempt was made to bring the causeway ferry alongside the elevated causeway. A strong cross-current resulted in an abort the first time after causing a considerable delay to the crane on the causeway. On the second attempt, it was moored in 20 min. the entire procedure required 1 hr.

Containers on the causeway ferry were loaded at the ship with their long axes fore and aft, as opposed to a perpendicular axis (athwartship). This type of loading was necessary so that the LACH on the beach could straddle the containers and off-load them. Four causeway ferry transits were made during the off-load period with loads averaging 11.25 containers per trip. During the retrograde period five transits were made with loads varying from 12-14 containers from the LACH operating site. When the Navy borrowed an Army (Caterpiller model) frontloader, 24 were loaded because the frontloader positioned the containers athwart the ferry and thereby used the space more efficiently.

PHASE II, SHORESIDE TRANSFER SYSTEMS.

Elevated Causeway

Background. The introduction of the elevated causeway (see Figure 3.6) during the LOTS main test at Ft. Story marked its first employment on the East Coast. It also was only the second time that actual container operations had ever been conducted on this experimental item.

The initial testing and subsequent container operations were conducted at Point Mugu and Coronado, California respectively. Based upon these tests, several modifications, structurally and procedurally, were recommended and incorporated for the LOTS tests.

The causeway became operational as scheduled in ample time for training and subsequent operations in support of Phase II. The timing of its introduction at Blue Beach, Ft. Story was related to the arrival time of the containership. Because of the limited experience of the naval personnel involved in its construction, additional time was allotted for construction and training to evaluate certain equipment and techniques prior to container operations.

Description. Basically the elevated causeway is composed of existing Navy assets augmented by commercial hardware.

- 3 x 15 causeway sections. A sufficient number of sections (90 ft x 21 ft) is required to place the pierhead (seawardmost section) in water depths of 10 to 20 ft. Five sections were needed as a roadway during the LOTS test. (See Figure 3.7.) Each section is modified with a type of spudwell which houses the piling that provides the elevating capability. The four sections which composed the pierhead had internal spudwells which allowed adjoining pierhead sections to meet without side-by-side gaps. Excessive lengths of piles were then cut off close to the deck and capped for traffic clearance. Those sections connecting the pierhead to the beach had external spudwells. This allowed for two-way traffic without having to cut off the excess piling. An extra causeway section to support truck-trailer turntable operations was placed seaward of the pierhead and it also was equipped with external spudwells.

FIGURE 3.6 ELEVATED CAUSEWAY

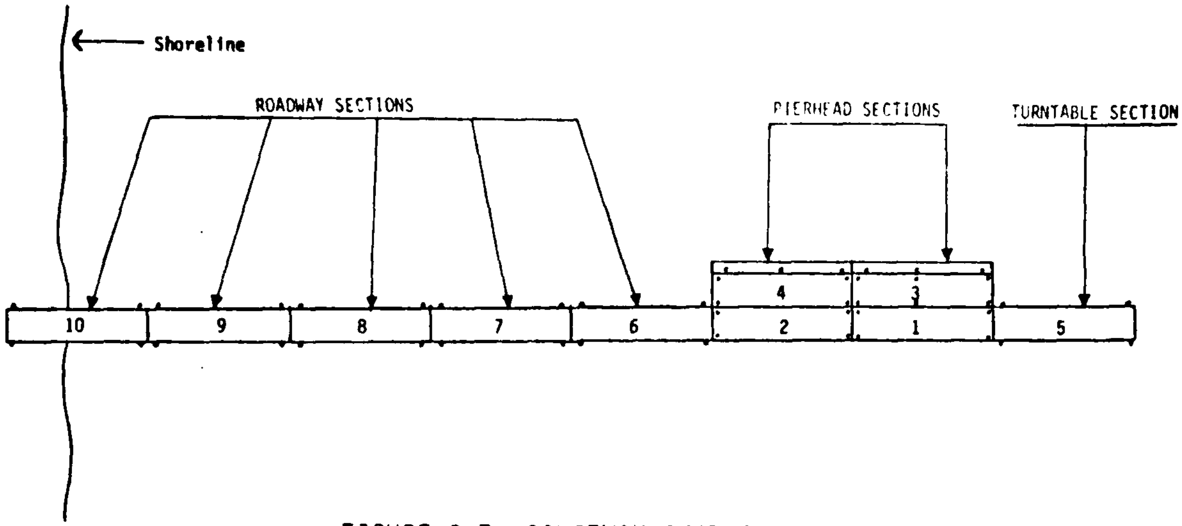

FIGURE 3.7 CAUSEWAY SECTIONS ARRAY

- Side connectors. These are installed to make a stable pierhead section into a continuous platform 42 ft wide. They are connected during transit to the beaching site, disconnected during elevation, then reconnected after the sections are in their final elevated position.

- Beach ramp. A 30-ft steel beach transition ramp is installed to the existing end-connector of the shoremost section of causeway.

- Fender system. Two fender units each 7 ft by 90 ft are basically comprised of a 1 x 15 pontoon string modified to include three internal spudwells. Pilings, which pass through these internal spudwells also pass through external spudwells on the pierhead causeway sections, thus adding to the stability of the pierhead. The pontoon strings are secured to the pilings only to preclude horizontal motion. Both fenders are permitted to float with the tide and sea surface. A series of foam-filled, commercial ship fenders are strung on the outboard side of the pontoon string.

- Turntable[2]. The turntable, which is 48 ft in length, is

[2]Civil Engineering Laboratory, Container Off-Loading and Transfer System (COTS) -- Advanced Development Tests of Elevated Causeway System - Volume V-Container Handling Operations, June 1977, CEL Technical Report R852-V.

capable of rotating a balanced load of approximately 80,000 lb. It rotates on 12 air bearing casters which are positioned 30 degrees apart on the perimeter of a 16-ft diameter circle on the base of the structure. The total weight of the turntable is 36,000 lb. An air compressor capable of providing 250-cfm at 100 psi is required for the turntable.

- Crane. A leased P&H 9125 truck-mounted 140-ton capacity crane was used on the causeway for container operations. A 50-ton capacity crane was used on the causeway during its installation for positioning piles.

- Elevating System. This includes the hydraulic jacks and lines, power unit, gimbals, pipecaps, piling, pile driver and miscellaneous hardware.

Elevated Causeway Installation. Ten sections of causeway, configured as noted in Figure 3.7, were moved to Blue Beach on 11 July 1977. Previously established installation procedures were followed to allow for on-site evaluation of selected installation techniques. Evaluating these procedures significantly delayed the overall installation time in order to determine the most satisfactory technique. The total time required to actually beach, erect, elevate, and become operational was approximately 110 hr. This was spread over a 16-day period.

The initial beaching attempt was made less than 1 hr before low tide (1144 on 11 July). More than 5 hr were spent in getting the causeway beached at its proper position due to a misunderstanding between the Army and the Navy as to the desired location at the end of 31st Street (extended). Two warping tugs and two LCM6 causeway tender boats were assisted by two TD-25 bulldozers.

The beach causeway was initially secured to the bulldozers while piles were driven into the four external spudwells at the connecting ends of sections 6 and 7. A combination of showers and darkness forced the termination of the first day's activities.

The next day (12 July) was spent in setting and driving piles into the roadway section of the causeway (sections No. 6, 7, 8, 9, and 10). Some delays were experienced when bolts became loose on the pile driver. This happened on a recurring basis and resulted in stopping operations periodically for routine checks on the pile driver.

At about 1300 on 13 July, sections No. 7 through 10 were elevated while piles were driven on sections at the pierhead. When the sections were raised to their required height, holes were cut into the pilings and retaining lock pins inserted. Eight jacks were used to lift the four sections.

As a matter of course, piles on the roadway sections were driven until the hammer striking rate (refusal rate) exceeded 60 hits per ft. On the pierhead and turntable bearing sections, 70 to over 90 hits per ft were required. Sufficient lengths of pile had been allowed on all positions except the seaward end of section No. 5. At that position both pilings required additional lengths to be added until the required hammer striking rate was attained. At that point, 120 ft of piles had been driven below the ocean floor.

The lengths of piles used are depicted in Figure 3.8. A total of 48 piles were used for the causeway. An additional pontoon section was subsequently positioned seaward of section No. 3, but was not elevated. It served as a camel and provided protection to the landing craft and section No. 5. Pile driving data collected on a sampling basis are contained in Table 3.5.

TABLE 3.5

ILLUSTRATIVE PILE DRIVING RATES

Number of Samples	Average Time To Drive	Hammer Striking Rate At Finish	Average Depth Under Ocean Floor
28*	11.36 min.	90.39/ft	13.7 ft

*Not included in this sample were the two pilings that required extensions.

All pilings were in place by 24 July after the center piles were driven in section No. 3. This section was to support the crane and was the only one elevated on six pilings.

On 26 July, the Navy 50-ton crane and all other installation equipment was removed from the causeway. The container crane, a leased P&H 9125, was positioned on section No. 3 where its counterweights were attached with the assistance of a USMC 30-ton Drott crane. From this time through to the start of Phase II, the Navy and Marine Corps accomplished familiarization and training with the elevated causeway.

Operations. Phase II operations at the elevated causeway began 11 August. During the next nine days of both Phases II and III, approximately 793 container transfers were made by the crane to and from landing craft. Operational techniques generally remained the same during that period.

Lighterage, when called alongside, usually had to rendezvous with a tender boat for the transfer of line handlers. These personnel subsequently were transferred back to the tender boat after the lighter had been loaded or discharged. Mooring times, which constituted approximately 20 percent of the elevated causeway-lighter average turnaround time, were due primarily to tidal currents and difficulties in passing lines. A 2-knot prevailing current frequently moved the lighterage into or away from the fenders. There were some reported incidents of minor lighterage damage. Lines had to be passed from the elevated causeway to the lighters (at times poorly thrown) since all mooring bitts were on the elevated causeway.

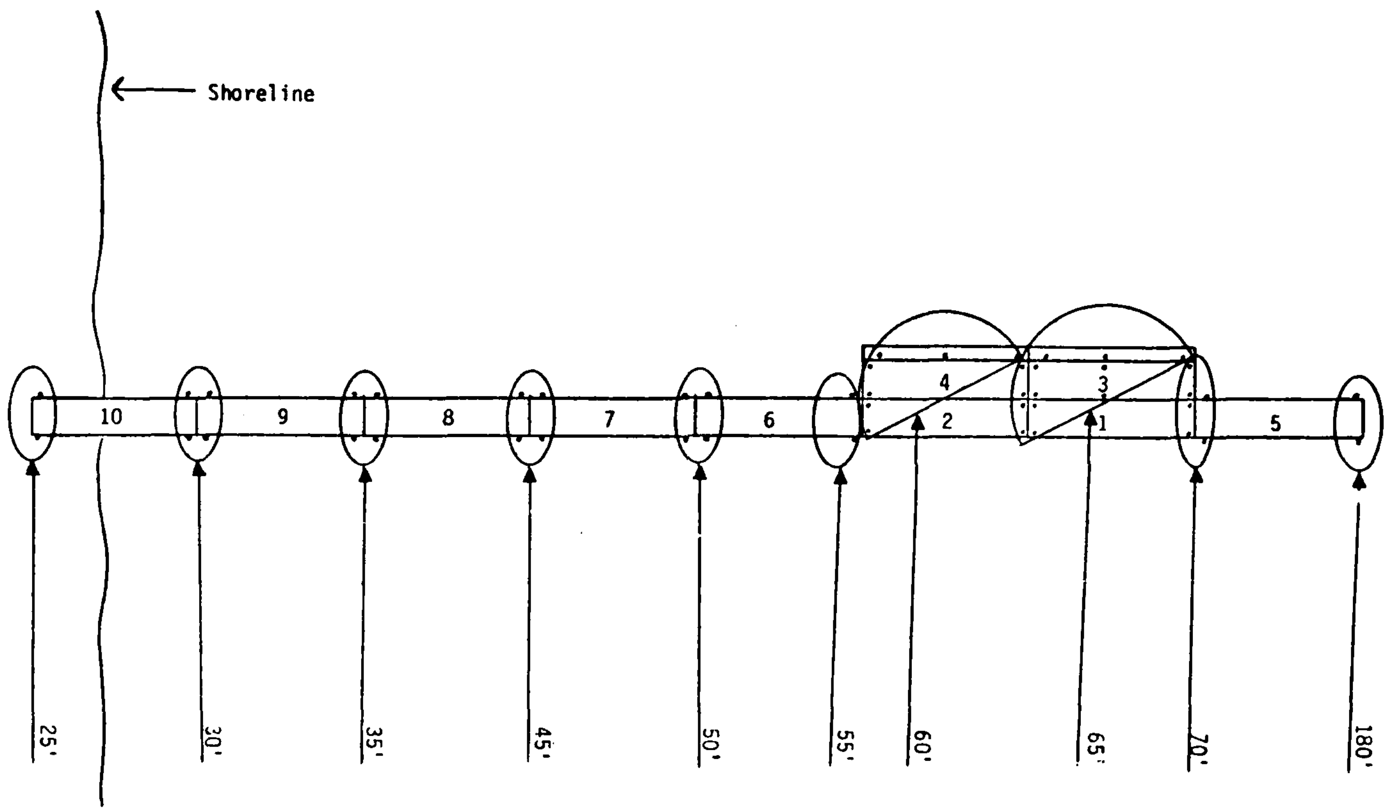

FIGURE 3.8 LENGTHS OF PILING ACTUALLY USED

With regard to night operations, the lighterage operators complained that they were blinded by the elevated causeway's night lights early in the test. Modifications to the lighting were made so that it was not directly beamed at approaching craft. Lighting on the causeway itself also caused problems. Truck guides were blinded by oncoming headlights. Subsequently, trucks operated with only blackout lights at night. Reflective paint strips were also painted on the outer edges of the roadway to serve as lane markers.

As a rule, trucks were staged on the roadway sections of the elevated causeway. Usually one truck per section was allowed with not more than four trucks at a time in the queue. Trucks were either discharged before or loaded after going to the turntable, depending upon whether off-load or retrograde operations were under way. Traffic patterns for loading trucks were as noted in Figure 3.9. Truck discharging (retrograde operations) had an opposite traffic pattern. Two-way traffic on the roadway sections did not cause any problems.

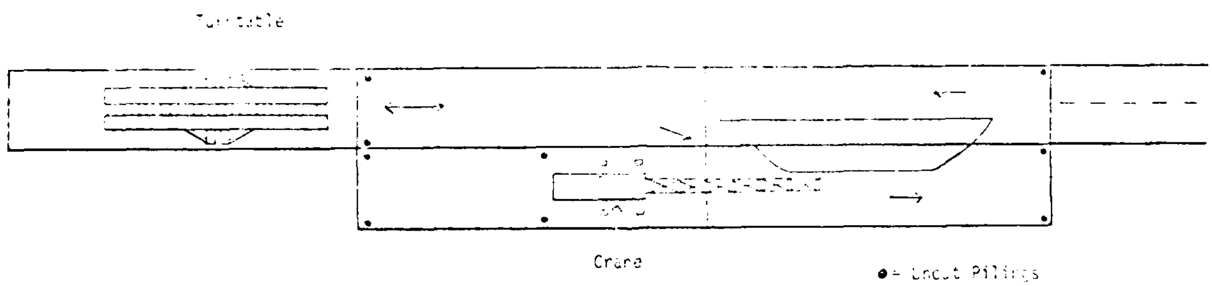

FIGURE 3.9 TRAFFIC PATTERN TO LOAD TRUCKS

The leased 140-ton capacity crane had some minor mechanical problems during the test period. However, there was a technical representative on the beach throughout this period and the effect on deadline times was not significant.

Results. The elevated causeway generally operated in concert with the Marine Corps LACH. Both shared the available lighters and truck assets, although as noted previously, approximately 25 percent more containers went to the elevated causeway than to the LACH site.

During the five days of Phase II the elevated causeway off-loaded 308 containers and retrograded 214. However, this was not representative of its maximum potential since the elevated causeway had waiting periods in which it could have been either off-loading from or retrograding to lighters. On two separate shifts, a night one and a day one, elevated causeway operations peaked when 67 containers were off-loaded. During retrograde the shift peak was 62 containers transferred, which happened on a day shift. The lowest points were 41 off-loaded in one shift and 28 retrograded in another. Operations were halted early during the night shift on 15 August when retrograde objectives were met. Figure 3.10 illustrates the productivity by shift.

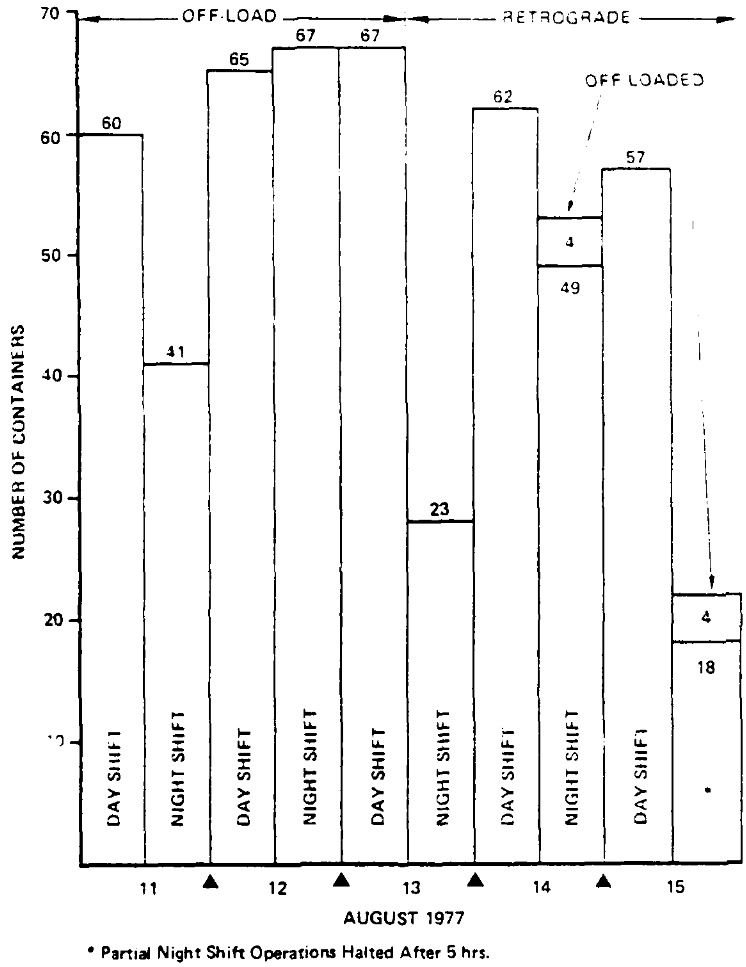

FIGURE 3.10. ELEVATED CAUSEWAY PRODUCTIVITY BY DAY AND NIGHT SHIFT FOR PHASE II

On the average the elevated causeway transferred about 56 containers per shift, a factor more dependent upon the number of lighters dispatched to it rather than a representation of its capabilities. On the average LCUs were alongside for about 24 minutes. There was about a 20 min wait on average between lighters, 92 percent of which were LCUs and - except for one causeway ferry - the remainder were LCM8s.

Tractor-trailers spent about 22-27 min on the elevated causeway. Within this period about 3-4 min were spent in the load/unload position. In addition to the vehicles in queue or in the load/unload position, there were frequently several vehicles in queue in a holding area ashore at the end of the elevated causeway.

Lightweight Amphibious Container Handler (LACH)

Background. The LACH is a two-wheeled, straddle lift, hydraulically operated container handling device that can be propelled by a dozer or wheeled tractor. It was intended for use on the beach and in unimproved areas and was propelled during the main test by a Marine Corps Terex 8320 crawler tractor. The tractor had its blade removed in order to hook up the LACH. (See Figure 3.11.)

Only one LACH, a development test model, was employed in the LOTS main test. USMC table of equipment (T/E) and maintenance support requirements have not yet been implemented. The production model used in the test was built at a cost of $40,500 (excludes cost of the tractor needed for propulsion). A Terex 8230 crawler tractor was used but another tractor could have been used. Table 3.6 provides the basic characteristics and personnel requirements.

TABLE 3.6

LACH BASIC CHARACTERISTICS AND PERSONNEL REQUIREMENTS

Vehicle Data	
LACH:	
Weight	40,000 lb
Dimensions:	
Travel Mode	35 ft (L) x 8 ft (W) x 10 ft (H)
Operating Mode	35 ft (L) x 13 ft 2 in (W) x 19 ft (H)
Terex 8230 Crawler Tractor:	
Weight	54,520 lb
Dimensions	225 in. x 134 in. x 144 in.
Operating Personnel Requirements	
LACH:	
	1 Hydraulic Lift Operator
	1 Spreader Frame Operator, or
	2 Spreader Bar Hook Operators
Terex 8230 Crawler Tractor:	
	1 Operator

FIGURE 3.11 LACH OFF-LOADS AN LCU DURING PHASE II OPERATIONS

The LACH was not involved in any LOTS pretests. The Marine Corps conducted developmental testing during the two-week period prior to the main test at the Naval Amphibious Base, Little Creek, Virginia. The LACH and Terex were not transported by the commercial shipping in the main test, but could have been. Both were administratively landed at the beach by LCU. The LACH was operationally ready, requiring no set-up time when it arrived on the beach; thus, no data were available on making it ready for operations.

Concept of Off-Load Operations. The LACH was used to enter lighterage (Navy LCUs, LCM8s, and causeway ferries) grounded out at the beach, lift the container, and carry it ashore. If there was a queue of loaded lighters waiting for discharge, the LACH deposited the containers on the beach. If there were no other landing craft waiting to be unloaded, the LACH loaded containers directly from the lighter to tractor-trailers. This approach was used to free lighters for rapid return to the ship. Once the beach was clear, the LACH shuttled containers from the beach drop point to the tractor-trailer loading site. There the container was loaded by the LACH for transport to the logistic support area (LSA). The reverse procedure was used during retrograde except that for the most part containers were off-loaded directly from tractor-trailers to the lighters. Figure 3.12 depicts the LACH operating area. Points are identified as follows: (1) tractor-trailer holding area, (2) LACH-tractor-trailer load/unloading, (3) beach temporary holding area for containers, (4) and (5) lighterage-LACH discharging/loading points.

Results. During Phase II the LACH was used for about nine shifts, until beach operations were terminated. (See Figure 3.13.) In that interval the LACH off-loaded 158 containers from 52 and retrograded 139 containers onto 33 lighters. The most shift period transfers occurred during retrograde when on the last day the LACH retrograded a total of 49 containers; 12 were loaded onto one causeway ferry, 29 containers on eight LCUs, and eight containers on eight LCM8s. The second highest shift period occurred during off-load when 43 containers were off-loaded from 18 landing craft, including 11 LCUs and seven LCM8s. The fewest number transferred on a shift was 20, when an Army frontloader was also used for retrograding and drained off part of the LACH's workload. Figure 3.14 illustrates the transfers made during Phase II by the LACH, including the fact that the LACH had a rather lengthy distance to travel for loading tractor-trailers.

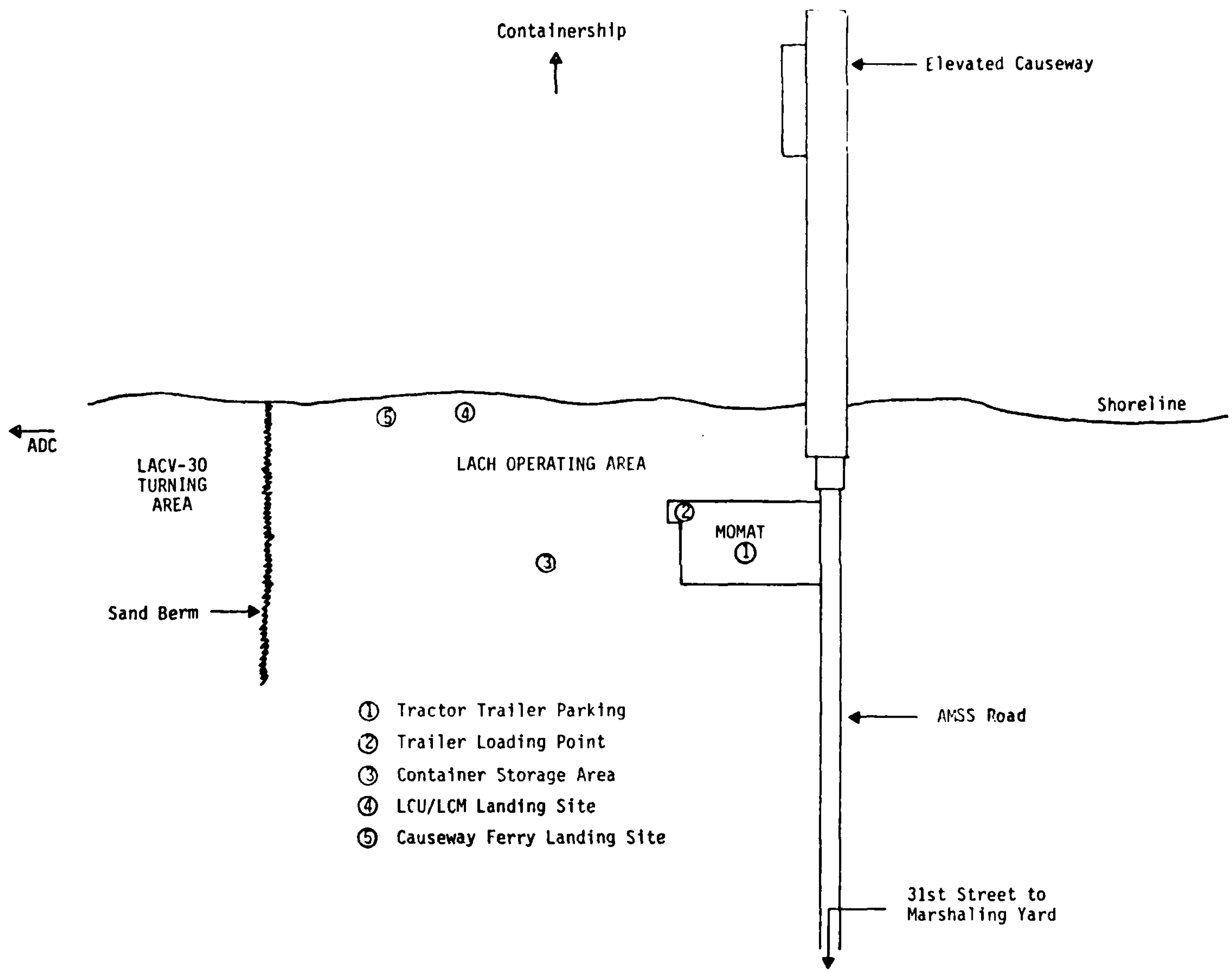

FIGURE 3.12 LACH OPERATING AREA

FIGURE 3.13 LACH LOADS CONTAINER ON A MILVAN CHASSIS ON BLUE BEACH DURING PHASE II

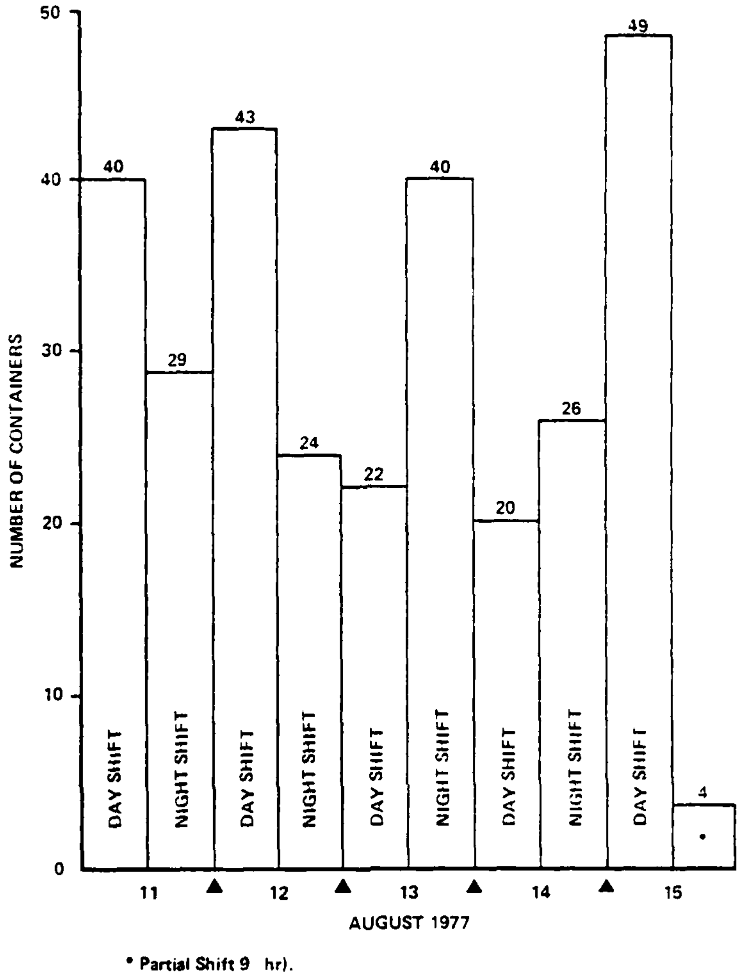

FIGURE 3.14. LACH PRODUCTIVITY BY DAY AND NIGHT SHIFT FOR PHASE II

During off-load operations, LCUs spent on the average approximately 34 min being discharged on the beach; LCM8s about 12 min; and the causeway ferries about 191 min. In this same period, there was an average of about 36 min between lighters including some cases of overlaps and some extensive delays. During retrograde the time between lighters averaged about 27 min. An LCU being loaded by the LACH during that period spent about 36 min on the beach, an LCM8 about 11 min, and the causeway ferry about 5 hr.

Generally, the LACH averaged (for round-trip cycles) about 8 min per cycle between lighters and the beach temporary holding area; about 7 min when working between the holding area and loading tractor-trailers. If the cycle was direct from the lighter to truck the time was about 11 min. Slightly faster times were noted in the retrograde.

Not all of the containers made it off the beach. Near the end of the off-loading period some containers were still waiting on the beach as import cargo when export operations had already begun. These containers were simply exported from there, rather than being transported inland to the LSA and then exported.

LACH Non-Operating Time. The LACH was operating or involved in the movement of containers 2,225 min of the total 3,244 min of the Phase II off-load period, or 68.6 percent of the time. The LACH non-operating time tabulated from data collection forms is set forth in Table 3.7.

TABLE 3.7

LACH NON-OPERATING TIME PHASE II

	Minutes	Percent Total Time
LACH Repairs, prev. maint., refuel, etc.	412	12.7
Awaiting Lighters	434	13.4
Awaiting Trucks	76	2.3
Unknown, Misc.	97	3.0
TOTAL	1,019	31.4

The "awaiting lighters" time includes only those times that the LACH was operative and had no containers to move, either off lighters or off the beach. There was a total of 1,659 min when no lighters with containers were available at the beach, 51.1 percent of the time. However, during a major portion of this time the LACH was not available to off-load lighters due to requirements to move containers from the beach to trailers, maintenance, repairs, etc.

PHASE II, M-52 TRACTOR/M-127 TRAILER OPERATIONS

Background

The M-52 road tractor and M-127 flatbed trailer are standard Marine Corps T/E assets and were not designed for container hauling. However, they were used by the Marine Support Element during the LOTS test to evaluate the suitability of the equipment as an interim container transporter until vehicles designed for such use are available to the Marine Corps. Pertinent vehicle specifications are listed in Table 3.8.

TABLE 3.8

M-52 TRACTOR/M-127 TRAILER SPECIFICATIONS

M-52 Tractor	
Weight	24,[illegible] lb
Dimensions	[illegible] in. x 97 in. x [illegible] in.
M-127 [illegible]	
Weight	13,[illegible] lb
Dimensions	[illegible] in. x [illegible] in. x [illegible] in.
Rated Payload	
Off-road	12 short tons
On [illegible]	12 short tons
Highway (max)	18 short tons

Eleven M-127 trailers received minor modifications, the addition of a container loading guide and container locking devices (see Figure 3.15), to facilitate the loading of containers and to secure them while moving on the road. Only 20-ft containers were transported in Phase II. The M-127 trailer, rated at 18 tons on the highway, cannot handle 35 or 40-ft containers weighing up to 34 tons.

Tractor-Trailer Employment

The M-52/M-127 tractor-trailers were utilized during off-load operations to transport containers from the LACH site on the beach and from the crane on the elevated causeway. The containers were transported a distance of about 1.2 miles to the LSA (formerly the marshaling yard) for off-loading by a Drott crane and frontloader.

A turntable at the seaward end of the causeway was used to turn tractor-trailers around, avoiding the need for additional pier sections or the slow alternative of backing approximately 720 ft from the crane to beach. The tractor-trailer units were turned around empty immediately prior to spotting alongside the crane for loading. The causeway was wide enough to provide for two-way traffic. Empty vehicles were spaced one unit per causeway section while awaiting their turn for loading. A parking area on the beach provided additional staging space and a loading area for the LACH, as previously discussed.

A summary of tractor-trailer operations during Phase II is given in Table 3.9.

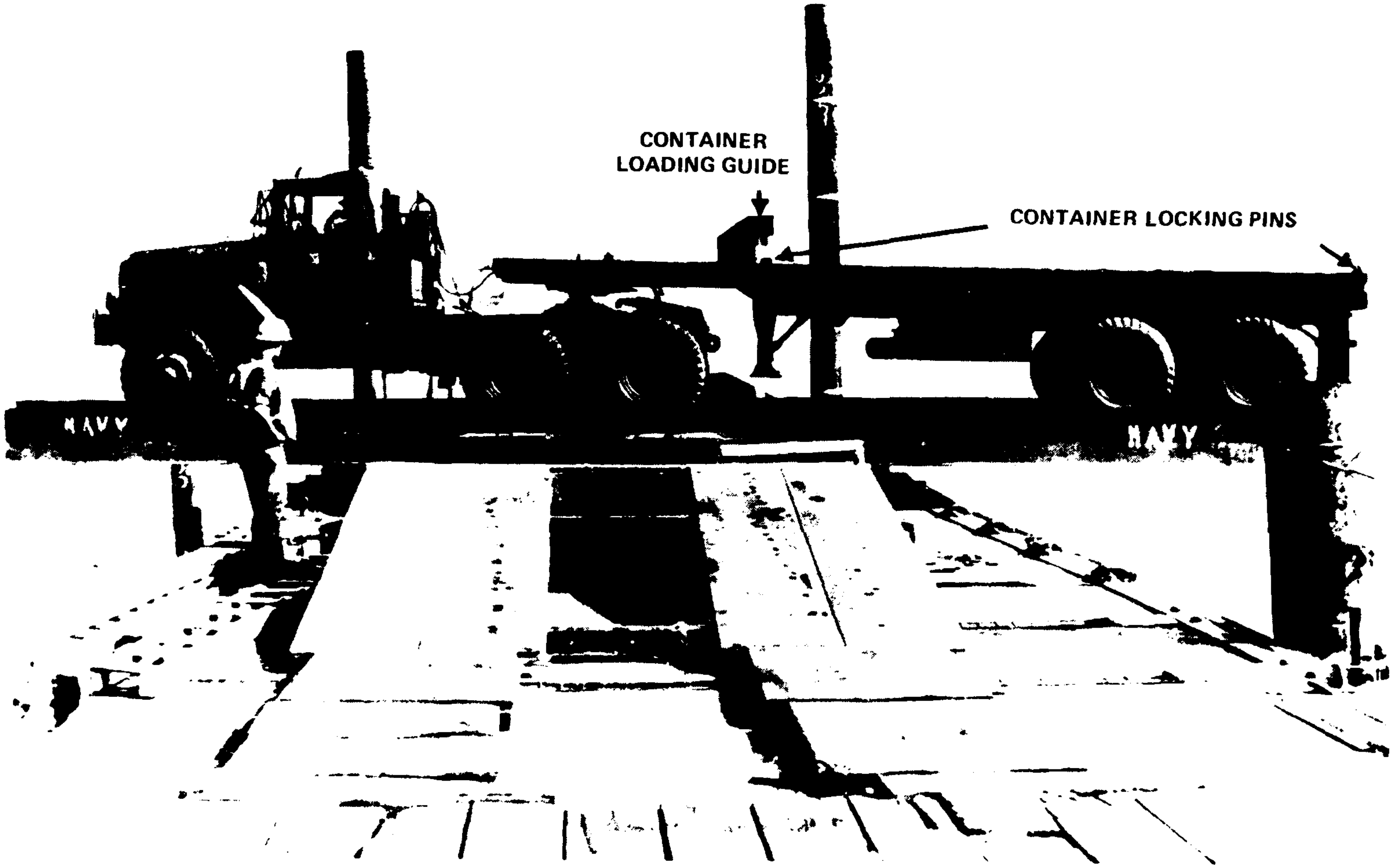

FIGURE 3.15 MARINE CORPS CONTAINER TRANSPORTER. An M-52 tractor and modified M-127 semi-trailer are turned by air cushion turntable on the elevated causeway. Arrows indicate the Marine Corps modifications made to the trailer so that it could be used to transport 20-ft containers.

TABLE 3.9

USMC TRUCK OPERATIONS

Date	Number of [illegible] Shift 1	Number of [illegible] Shift 2	[illegible] Shift 1	[illegible]	[illegible]	[illegible]	[illegible] Shift 1	[illegible]
11 [illegible]	12	[illegible]	[illegible]	66	93	[illegible]		
12	[illegible]	13	107	[illegible]	1	[illegible]		
13	1	11	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
14	[illegible]	11	[illegible]	74	1	[illegible]	[illegible]	[illegible]
15	[illegible]	11	98	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]								
[illegible]								

Tractor-trailers made a beach-to-LSA-and-return cycle in approximately an hour or less, including queue time. About 70 percent of this time was spent at the beach in queue or loading, about 20 percent in going to and from the beach, and about 12 percent of the time at the LSA in queue or unloading.

PHASE II, LOGISTIC SUPPORT AREA (LSA)

General

Marine Corps LSA operations, as conducted by the Marine Support Element (MSE), differed significantly in concept and purpose from Army marshaling yard operations. An Army marshaling yard functions as an area for the temporary off-beach storage of breakbulk and containers for later transport to multiple consignees and for returning retrograde shipments. Containers are normally stripped by General Service Support Activities for further distribution to operational units.

A Marine Corps LSA, by contrast, is a supply point from which units draw their requirements. Container stripping normally would be performed in the LSA, which would initially be established near the beach, and later displaced inland. In this test the LSA was established in Phase II at the same geographical site as the marshaling yard used in Phase I (see Figure 3.16).

Concept of Operations

The concept of operations as originally envisioned required supplementing the existing hard surface roads in the LSA area (see Figure 3.16) with MOMAT roads in order to permit trucks to position themselves parallel to each of the five rows planned for container stowage. The concept called for two Drott cranes, which have a 30-ton lifting capacity at about 10 ft, to be operating and the third to serve as a maintenance back-up. When a tractor-trailer with container arrived at its designated off-load position in one of the five lanes, a crane would then move to a position alongside and off-load the container directly to its designated stowage spot (see Figure 3.17).

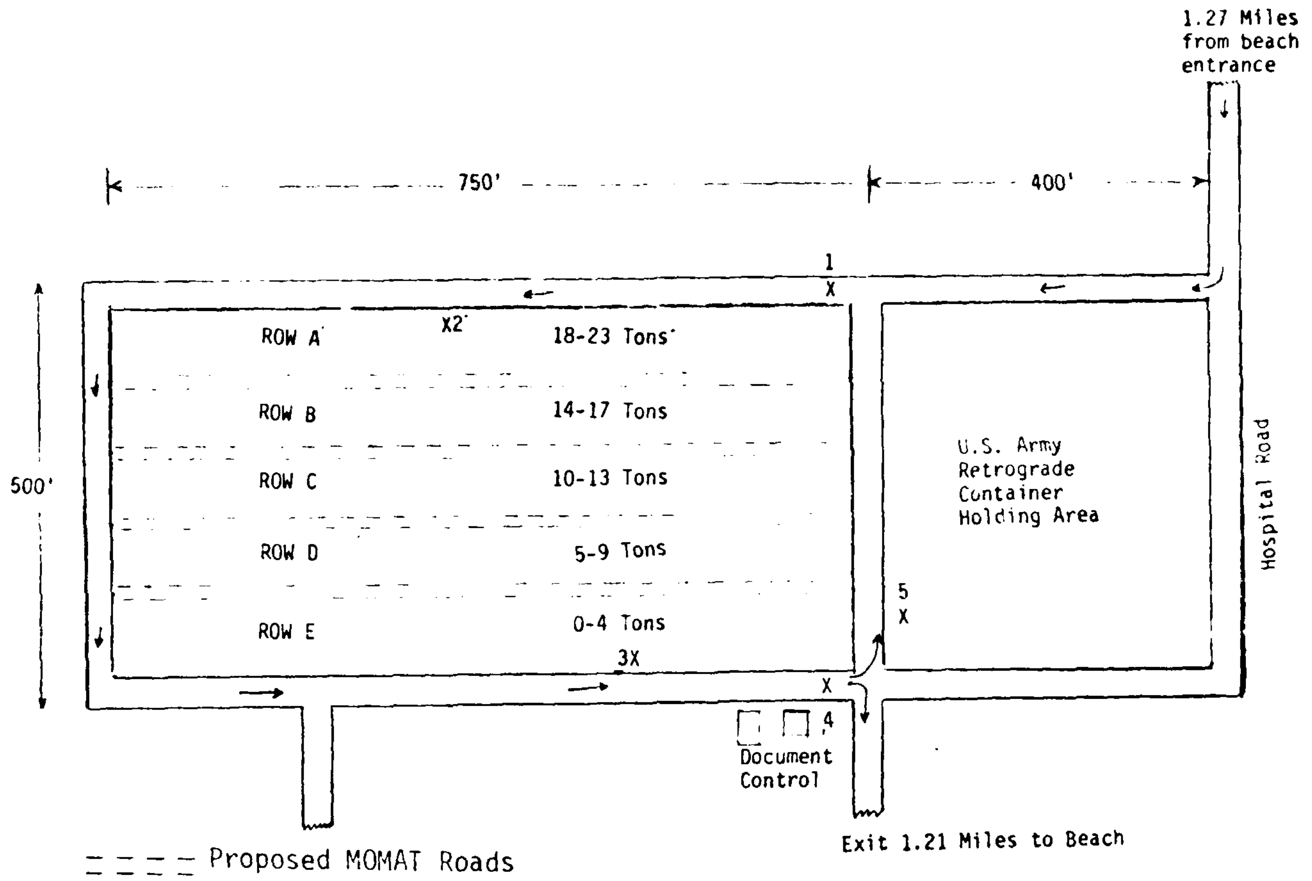

FIGURE 3.16 USMC LOGISTIC SUPPORT AREA

FIGUPE 3.17 DROTT CRANE

Operation of the LSA

The Drott crane-LSA concept was only partially tested. The MOMAT roads planned for the LSA in Phase II were not laid down because of a shortage of MOMAT and possible interference with Army marshaling yard operations conducted on the same site in later phases. As a result, direct off-loading to stowage spots by the crane was accomplished only along one row adjacent to a hard surface road (discussed in further detail below). Containers for the other four rows were off-loaded by the crane and set upon the ground. These containers were then transported and placed in their stowage position by frontloaders operated by the Army, an artificiality for Phase II.

Not all containers were stowed in the LSA. Tractor-trailers with containers designated for Marine Corps use reported to the LSA from the beach, received initial documentation control processing at point 1 (see Figure 3.16) and were given instructions to unload at points 2 or 3. "Reporting out" documentation control occurred at point 4. Tractor-trailers with containers destined for the Army were routed direct from point 1 to point 4 where they received Marine Corps documentation control and routing to point 5 for Army unloading instructions.

The five container rows were established two containers wide, one high, and back-to-back with doors exposed to provide for stripping. Container rows were segregated by weights for the LOTS operation to facilitate retrograde requirements, where in practice they would have been segregated by commodity. The containers in each row were normally stacked within a few inches of each other, with approximately 60 ft between rows. If the containers had been positioned 4 ft apart in each row, a minimum of 50 ft between rows would have been necessary to allow for LACH and stripping operations. The LSA would then have had a storage capacity of 124 containers per row for a total of 620 containers.

Doctrine and SOPs for USMC container operations are still being developed. Several LSA internal operations and considerations, such as a security yard, breakbulk, and container stripping were not included in the test. Additionally, 40-ft container handling was not conducted, since the Marine Corps currently envisions only the use of 20-ft containers in LOTS-type operations. The task organization and numbers of personnel required for an appropriately sized shore party or Logistic Support Element (LSE) are also to be developed.

Documentation Control

Manual documentation control records were maintained on container stowage and shipments to the Army, including the use of status plotting boards at the documentation control point.

Throughput Operations

The LSA received 469 containers for forward movement, of which approximately 102 containers were passed through to the Army, and 367 containers were subsequently retrograded.

30-Ton Drott Crane Employment in the LSA

Background. The MC 2500 CRUZ Crane (Drott), 30-ton lifting capacity, is standard T/E equipment for a variety of Marine Corps units. The Drott crane was designed as a replacement for several existing types of Marine Corps cranes and multiple MHE requirements. It was not designed to handle 8 x 8 ft x 20 ft containers. However, since the Drott crane does have a 30-ton lift capability and was the only available item of Marine Corps equipment capable of handling containers besides the untested LACH, the cranes were assigned for use in the LSA during Phase II. Table 3.10 lists the crane's basic characteristics.

TABLE 3.10

MC 2500 CRUZ CRANE (DROTT) BASIC
CHARACTERISTICS AND PERSONNEL REQUIREMENTS

Crane Data		Personnel Requirements
Maximum Capacity	30 short tons (at 10 ft)	1 Crane Operator
Weight	72,000 lb	2 Tag Line Handlers
Width	9 ft 7 in.	1 Crane Director
Height*	12 ft 6 in.	
Length*	44 ft 1 in.	
* With boom in horizontal position.		

The Drott crane was not included in any pretest operations. Since the crane is relatively new in the Marine Corps inventory, maintenance requirements and percent operational availability are unknown. The crane was administratively introduced across the beach by an LCU. It has yet to be deployment tested on commercial shipping.

Throughput Operations. The capability of the Drott crane to independently handle the throughput rates generated during Phase II was not fully tested. However, the crane was used alone as well as in conjunction with Army frontloaders, providing some useful data on the crane's capabilities and limitations.

Drott Crane Operating Cycles. The Drott crane operated in an unassisted mode by removing containers from a trailer on a hard surface road and placing the container directly in a stowage position immediately adjacent to the road. The cycle time commenced with a container on a trailer in position for off-loading alongside the crane. Other elements in the cycle are the crane lifting the container off the trailer and depositing it in its stow position, the crane raising its jacks, backing a short distance, and jacking back up to a level position to be ready to off-load the next container adjacent to the last (end to end). This type of operation required about 5 min per container.

During LSA operations some limitations were noted with use of the Drott crane as a container handling vehicle. The LSA had limited lighting and without instrument lights in the crane it was not possible for the operator to see:

- The leveling bubble to properly level the crane on its jacks.
- The boom angle indicator for establishing proper boom angle for lift and setdown.
- The weightmaster dial, for correlating the weight being lifted with boom angles and safety limits.

In addition, the Drott crane had difficulty handling some heavy containers. With the crane configured for the test with a container lifting frame, its capacity at the required operating reach was about 42,000 lbs. Containers weighing up to 21 short tons were within this capacity and were handled safely. However, there were 104 20-ft containers in the "heavy" (21 - 23.5 ton) category, more than half of which exceeded the 44,800 lb maximum for type 1C containers. When attempting to lift some heavy containers, the crane was observed tilting and lifting off its jacks.

The original Drott crane jack pads provided insufficient bearing surface for operations in sandy areas such as were found in the LSA. Expander pads, providing approximately four times the bearing surface, were strapped to the original pads for this test. However, the expanded pads had a tendency to hang at an angle, presumably due to faulty operator technique, dig into the sand, and slow or stop the vehicle when it was displacing to another location.

Finally, the Drott crane cannot safely move with a loaded container from a truck off-loading site to a stowage location. This limits its employment as a container handler to the method described above.

PHASE II, SUMMARY

Phase II involved only containerized cargo handling, although some LASH and SEABEE barge operations were conducted prior to the start of Phase II. (Barge operations are discussed in a separate section later in this volume.) No 40-ft containers were handled, no breakbulk operations were conducted, and no deployment testing was done on the LACH or the 30-ton capacity Drott crane. Neither the LACH nor the Drott crane at that time had been loaded aboard merchant vessels. Causeway sections during the pretests were loaded aboard the LASH and conventional breakbulk ships (and, following the main test, aboard the SEABEE also).

Marine Corps personnel (about 30) spent approximately six days in preparing the beach for operations. This involved laying a 23,000 sq ft Momat pad for the tractor-trailer staging area at the end of the causeway and laying an AMSS roadway from the end of the causeway to the end of 31st Street. Additional AMSS applications were also made in support of the Army on Red Beach and in the marshaling yard/LSA.

While shoreside preparations were under way, the Navy was installing the elevated causeway. The amphibious construction battalion erected the causeway for the first time. About 110 hr over a two-week period were needed to complete the effort.

During Phase II the COD discharged 225 containers and retrograded 195 for a total of 420 container transfers in about 9.4 shifts. An average day shift transferred about 52 containers and an average night shift about 36 containers, approximately 18 percent less. The barge-TCDF discharged 233 containers and retrograded 183. An average day shift transferred 50 containers while an average night shift transferred 34, about 20 percent less. Altogether 458 containers were off-loaded at the ship and 378 retrograded for a total of 836 transfers.

LCUs constituted 79.1 percent of the Phase II lighter transits between the ship and shore nodes, carrying 81.8 percent of the containers. This provided an average LCU load of 3.8 containers per transit.

At the elevated causeway 96 percent of the lighters were LCUs, while 58 percent of the lighters worked by the LACH were LCUs. Of all containers off-loaded, 66 percent went to the elevated causeway and the remainder to the LACH site. During retrograde operations 57 percent of the containers came from the elevated causeway, 37 percent from the LACH site, and 6 percent from a frontloader-causeway ferry trial on the beach.

In the off-load period four causeway ferry transits were made carrying 11-14 containers per trip. During retrograde five transits were made, four from the LACH site and one from an adjacent site served by a borrowed front-loader. The four LACH originated causeway ferries had an average load of 13.5 containers each while the fifth causeway ferry (loaded by frontloader) had 24.

The elevated causeway off-loaded 308 containers and retrograded 214, for a total of 522 transfers during Phase II. Day shifts averaged about 62 containers per shift while night shifts averaged about 42 per shift. However, it should be noted that such productivity was restrained by the number of containers being dispatched to the elevated causeway, rather than being representative of its expected productivity. On the average, there was about a 20 min wait between lighters and the LCUs spent an average of about 24 min at the elevated causeway.

The LACH during Phase II off-loaded 158 containers and retrograded 139 containers, for a total of 297 transfers. The LACH worked in calm surf and had no problem wading out to lighters when necessary nor in moving around in the loose sand. An average lighter-to-tractor-trailer and return cycle took about 11 min.

The M-52 tractor and a modified version of the M-127 semi-trailer were used as the primary means for container hauling. Containers were loaded on the after end of the trailer in order to accommodate the LACH. Including queue time, a tractor-trailer cycle required approximately an hour per container.

Marine Corps LSA operations were conducted using manual accounti ‹, methods, a Drott crane, and borrowed Army frontloader support. The plan to use two Drott cranes was scrapped due to a shortage of soil surfacing materials needed for tractor-trailers to drive into the container storage area to the spot where each container was to be stored. Instead, on one side where there was a hard surface road, the concept was partially tested. Frontloaders were used for handling and storing the others. The LSA received 469 containers (some from the Army) and retrograded 367.

IV. PHASE III - JOINT OPERATIONS

PHASE III, BACKGROUND

Phase III operations were built around a "best case basis" from the standpoint of ship availability for deployment. The Navy and Marine Corps were already in position. The Army with all equipment and shipping needed was able to "deploy" its barge-TCDF and establish its improved beach capability, a jacked-up DeLong pier. To support these deployments it was assumed that mobilization had taken place and the special shipping needed, specifically a SEABEE ship, was available. In actuality, a SEABEE ship had been planned for the test but its arrival could not be adjusted to meet the test schedule. However, SEABEE barges had been leased, were loaded with cargo, and were included in the test to expand cargo handling requirements, gain experience with handling barges, and provide additional data for the Services. The deployment aspects of using a SEABEE ship were explored and reported subsequent to the test.[1]

Phase III operations were unique from the standpoint of distributing the workload between Navy and Army facilities. One crane on an Army jacked-up DeLong pier was designated to receive all containers from the two shipside cranes, that is, the barge-TCDF and the COD. Once the DeLong pier workload was saturated and it was apparent that the crane could not keep up, then the Navy's elevated causeway was to be activated. The DeLong pier facility then would be used as a back-up in a similar type attempt to saturate the elevated causeway. With this approach the upper limits of shoreside container transfer productivity for each system could be examined.

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[1] The largest item of LOTS equipment, the Army's barge TCDF, weighing approximately 656 long tons, was successfully loaded and discharged while the ship was at anchor in Hampton Roads, Va. The test also included other major end items. See ORI, Inc., SEABEE Pretest Results of the Joint Logistics-Over-the-Shore (LOTS) Test and Evaluation Program, ORI Technical Report No. 1267, 7 December 1977.

PHASE III, OPERATIONS

Organization for Operations

The operating units employed in Phases I and II were brought together in a coordinated effort under mission orders from the Joint Task Force Commander, the Commanding Officer of the 7th Transportation Group, and were under the operational direction of the Commanding Officer of the 24th Transportation Bn. In the case of the Navy units and Marine Corps MSE, these directions were passed through Naval Beach Group TWO and the Marine Corps Tactical Operations Sections.

Concept of Operations

Aboard ship, Army personnel manned the barge-TCDF and the Navy manned the COD. Both crews coordinated efforts when required. Lighterage during off-loading primarily involved LCUs with LCM8s for back-up when an LCU was not immediately available. Technically lighterage was under joint control but in reality Army lighters essentially worked between the TCDF and the jacked-up DeLong while Navy lighters worked between the COD and the elevated causeway.

Shoreside, the Army, which had been given 72 hr to install the jacked-up DeLong pier, manned a 140-ton crane and provided the yard tractors and trailers needed to clear containers from the pier. The Navy continued to man the elevated causeway, while the Marine Corps provided the tractors and trailers necessary to clear containers from it. The marshaling yard was organized and manned by the Army for the receipt and temporary storage of containers. The MSE established a small dump area to act as an inland customer for containerized shipments. The Army's Remote Processing Facility was fully operational for the first time and was prepared to perform all planned documentation functions.

By the afternoon of the second day (17 August), the TCDF had off-loaded all containers in its area of responsibility and began retrograding that evening. The COD still had approximately 75 left to discharge at that time so it was left to continue off-loading operations. The night of 17 August brought in windy and stormy weather prohibiting much activity for either crane.

During the day shift of 18 August, the COD finished its off-loading and began retrograding. The TCDF, which had been intermittently retrograding since the previous afternoon, received some containers in LCM8s from the DeLong pier, but most were in amphibians loaded at the amphibian discharge point. TCDF retrograde operations were halted briefly that afternoon to conduct a test requested by the Army of the retrograde and off-load of two 40-ft. containers from the ship's centerline.

Ashore, elevated causeway operations were periodically halted (on 18 August) for demonstrations but some retrograding was accomplished. The DeLong pier, however, spent the day off-loading containers, vehicles, and palletized cargo from one SEABEE and three LASH barges.

Full retrograde operations were resumed during the night shift of 18 August and continued until retrograde objectives had been met. By 1800 hours, operations were secured and Phase III was terminated.

PHASE III, CONTAINERSHIP OPERATIONS

General

Operations commenced at 0600 on 16 August under fair weather conditions. As noted previously, the Army operated the TCDF and the Navy operated the COD. Each Service provided stevedores for their own ship unloading system. The first container was off-loaded at the COD at 0749. There was some confusion at both sites getting cargo handlers organized and lighters alongside. Operations were plagued by periodic thunderstorm activity from late afternoon of the second day (17 August) through the end of Phase III. Usually winds and lightning caused the cessation of operations, although some accompanying wave action did adversely affect the TCDF during this period.

Crane-on-Deck

The first lighter alongside was an Army 1466-class LCU which was loaded by the Navy with six containers in 35 min. (from mooring to cast-off time). After that an Army 1671-class LCU was loaded and then only Navy lighters were used.

During Phase II, the COD off-loaded through 4½ shifts and retrograded for 2½ shifts. In that interval the COD off-loaded 212 containers into 62 lighters and retrograded 133 containers from 63 lighters. This produced a total of 345 transfers in approximately seven shifts for an average of about 50 per shift. The peak number transferred in any one shift was 96 and for a 24-hr period it was 147 containers. Figure 4.1 illustrates the COD's productivity during Phase III.

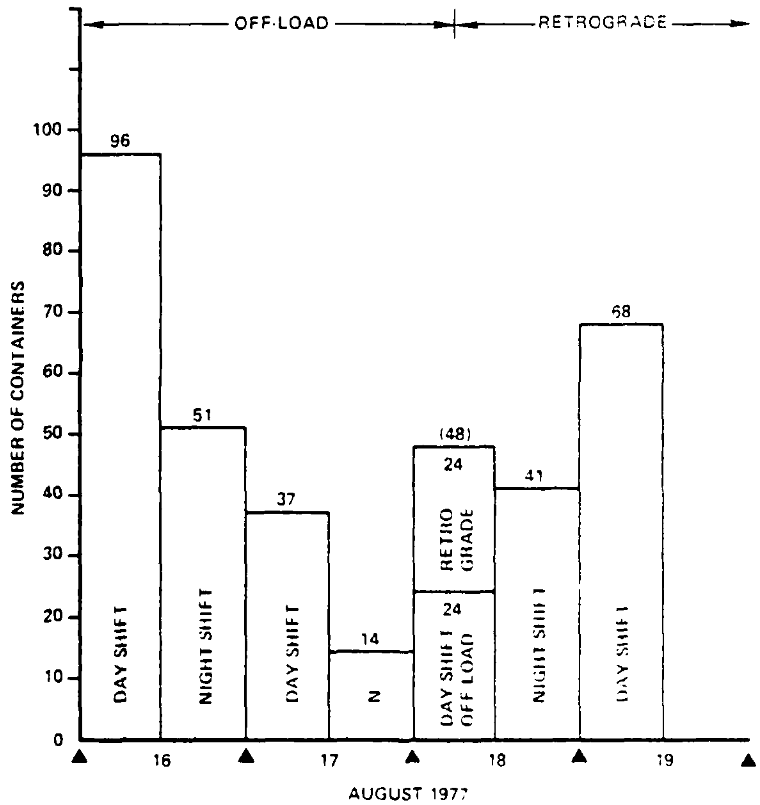

FIGURE 4.1. COD CONTAINER PRODUCTIVITY BY DAY AND NIGHT SHIFT FOR PHASE III

Although there was an adequate quantity of lighters, lighter delays were still experienced. Usually these delays were on the order of about 11 min. and were mostly experienced at night. But, a total of 65 min. solely was attributable to lighter delays on the night shift of the first day. In one instance the COD crew left two containers in a cell and proceeded to close the hatch rather than be further delayed operationally for lack of lighters.

During discharge operations the crane-on-deck loaded 62 lighters. Most of these were LCUs, which spent about 29 min. on average alongside being loaded with about four containers each. (See Figure 4.2.) The remainder of the lighters were LCM8s, which spent an average of about 7 min. being loaded with only one container; and a causeway ferry, which spent 139 min. alongside while being loaded with 13 containers. Lighter succession (the time between the departure of a loaded lighter until the next lighter is in position) was comparable on average between LCUs and LCM8s, both averaging about 5 min., with the LCM8 slightly faster. Lighter succession and time alongside calculations disallowed factors such as hatch openings, lunch breaks, crane relocations, and shift changes, but did include management and operationally related considerations that affected the interaction between the COD and lighters. (Volume II discusses and analyzes these calculations further).

During retrograde the COD received 63 lighters. This time twice as many LCM8s were used as LCUs and no causeway ferries were involved. LCM8s spent on the average about 8 min. alongside and normally carried only one container, while LCUs each spent about 40 min. having four containers off-loaded. Succession times averaged about $2\frac{1}{2}$ min. for LCM8s and about 6 min. for LCUs. (Calculations again followed prior guidelines.)

COD Relocations. Only one crane relocation was required during the off-load period and one during the retrograde period. Both were done at night. Including about 21 min. to move the instrument van, the first relocation required about 140 min. Some difficulty was experienced with releasing the sling from the first span moved and hooking up the second span, which contributed about a 7 min. delay. The longest time spent, however, was unlashing and lashing the crane. This required about 35 min. The actual movement of the crane from one hatch to the next only required about 5 min.

For unknown reasons complete data on the crane's relocation during retrograde were not captured. Data were collected on the relocation of two span sections and the rigging change from spreader bar to slings. This data totaled about 39 min. and was comparable to data collected on the first Phase III relocation.

COD Hatch Cover Handling. The Navy used a crew of about 12 to handle hatch covers, but sometimes this dropped to as few as six. During Phase III data collection, there was one instance recorded involving two hatches (close one and open the second) and eight instances of single hatch operations (an opening or a closing of only one hatch). As before, hatch openings were measured from the time a 20-ft. spreader bar (or sling) change was initiated to the time the 20-ft. spreader bar (or sling) was placed back on the crane.

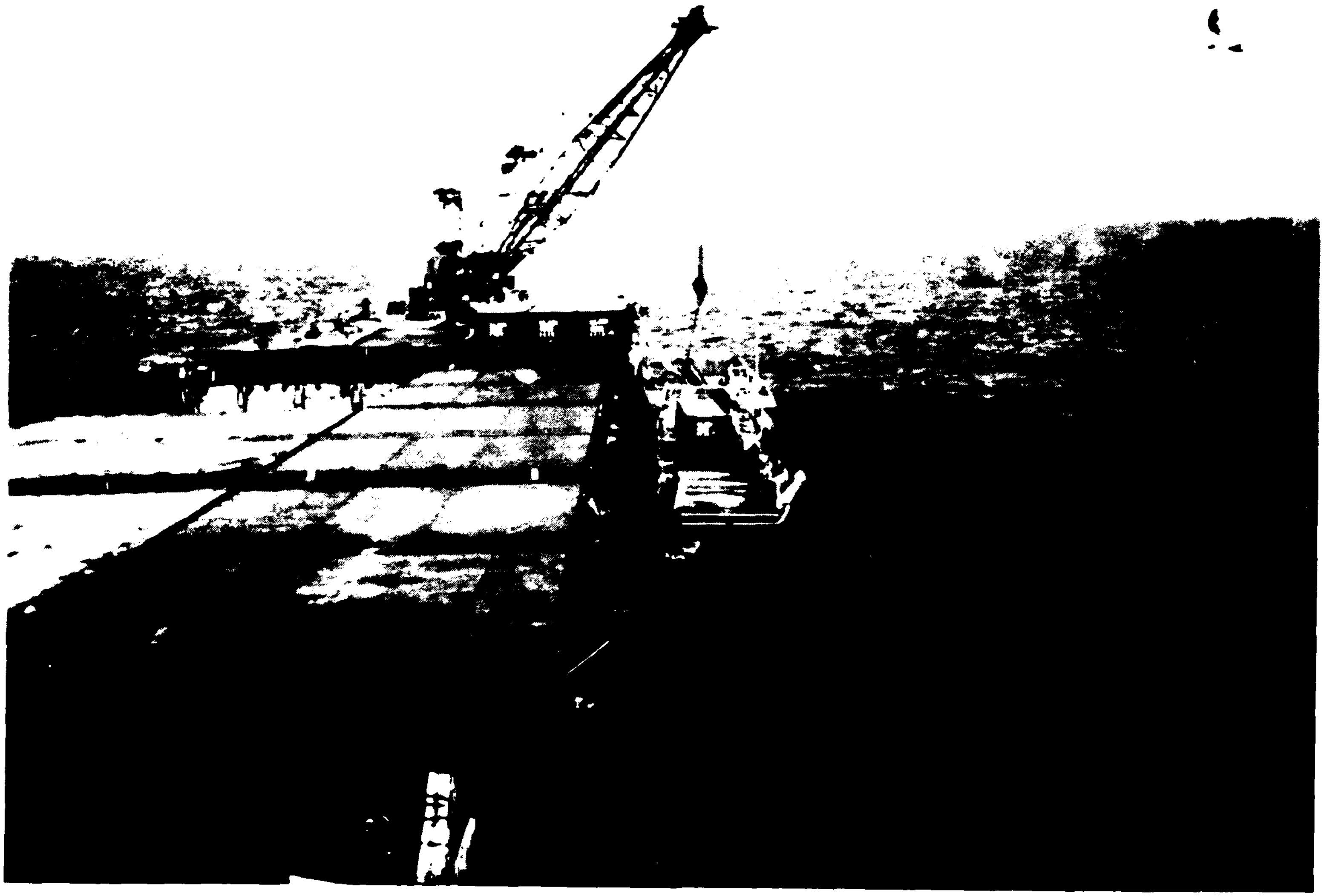

FIGURE 4.2. THE COD DISCHARGES A CONTAINER INTO A NAVY LCU

The two-hatch operation was accomplished in only 28 min. This operation involved closing one of the hatches in hold No. 5 and opening a hatch to hold No. 7. The longest element of this cycle, the hatch cover lift-to-land portion of closing No. 5, required about 11 min.

Single hatch opening/closing times varied considerably, from 10-29 min. The average time for this event was about 20 min. Altogether about 175 min. were spent during Phase III on single hatch operations. The busiest day for hatch openings was the first day, which also was the most productive one with respect to the number of COD container transfers. On that day, five hatches were opened or closed, the average time per hatch on that day was 15 min.

Crane Refueling and Maintenance. Except for the last day, maintenance and refueling of the crane were accomplished during the first 1-1½ hr of each shift. On the last day maintenance was delayed until about 0900 and completed shortly before 1200. Usually about 30 min. of each maintenance period was involved with refueling activity. Almost 2 hr. were lost during Phase III due to mechanical failures, specifically nearly an hour each on the need to recalibrate boom instrumentation and repair a broken hydraulic hose. More containers might have been retrograded on the last shift but operations were halted at 2145 hours due to a worn cable.

Weather. The COD lost approximately 8 hr due to the thunderstorm activity in Phase III. Usually such weather activity was preceeded by high winds, followed by lightening nearby, and heavy rains. The winds, for example, were strong enough to blow the containers into the side of an LCU. These factors were not considered safe conditions for personnel and equipment in which to work. However, sea state was not given as a reason to halt operations and, while it may have been choppy, did not appear to exceed estimates of a sea state two condition.

Barge-Temporary Container Discharge Facility (TCDF)

Phase III Operations. Army personnel achieved their off-loading objective before noon of the third shift and began retrograding earlier than had been anticipated. Retrograde operations were plagued primarily with winds and thunderstorm activity so that hourly productivity never reached the peak that off-loading did. To assist in mooring and handling taglines the causeway ferry was left moored to the barge-TCDF (see Figure 4.3).

During Phase III the barge-TCDF off-loaded 234 containers into 66 lighters and retrograded 154 containers from 80 lighters over the 4-day period. The most productive shift for a containership crane to this point in the test was accomplished by the barge-TCDF on the first shift when 118 containers were transferred between the hours 0749 to 1750. The following night shift produced another 56 containers discharged, for a 24-hour total of 175. This was the highest daily total to that point for any crane in the test. Off-loading was completed in about 2.5 shifts, for an average discharge rate of about 83 containers per shift.

Shortly after retrograde operations began, thunderstorm activity commenced and productivity was degraded over the next 3.7 shifts until retrograde operations were terminated. This produced an average shift productivity rate of about 42 containers each.

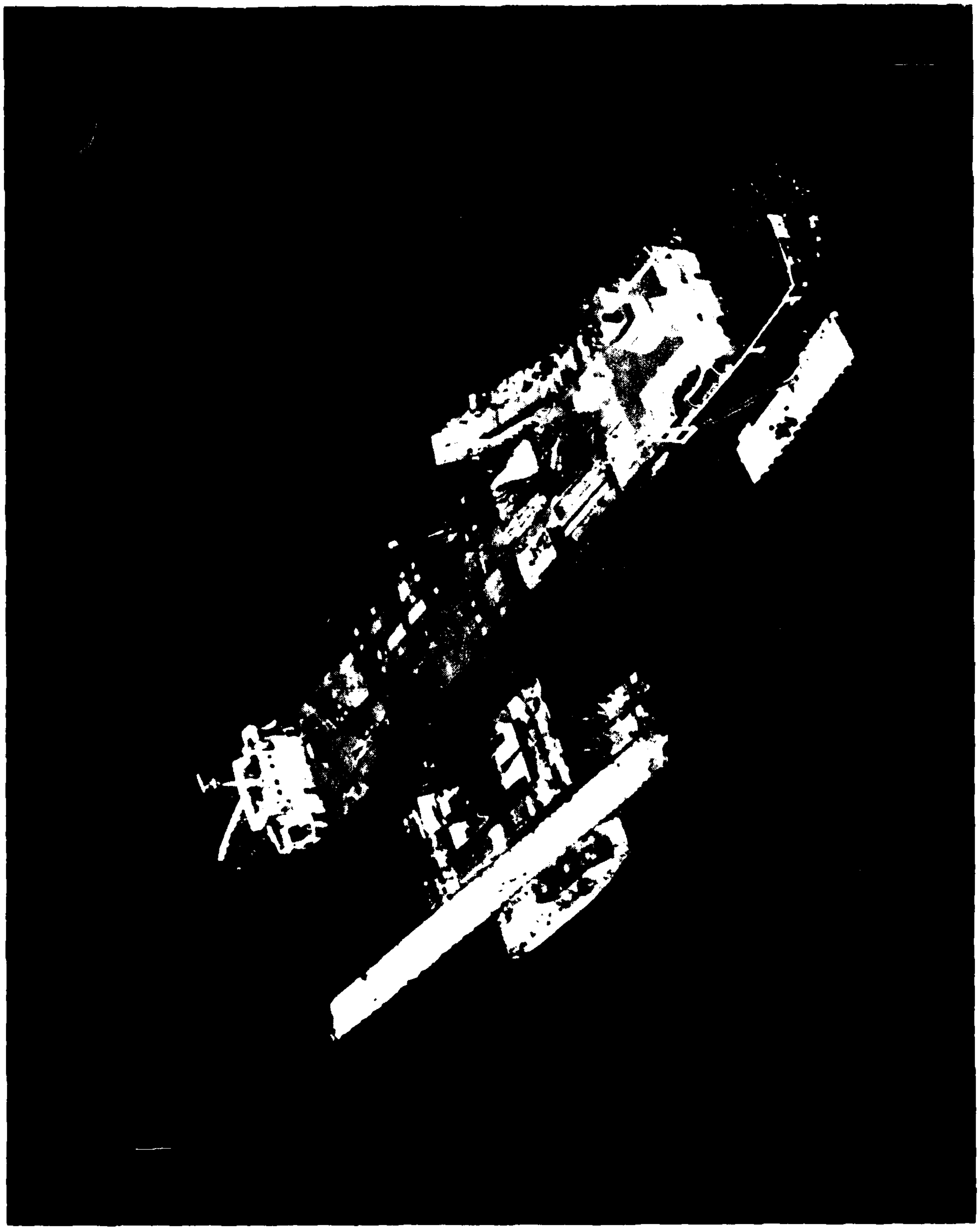

FIGURE 4.3. THE BARGE-TCDF OFF-LOADS CONTAINERS FROM HOLD NO. 3

As in the case of the COD the predominant lighter used during off-loading was the LCU; in fact, 59 of the 63 lighter transits were LCUs and the remaining four were LCM8s. During retrograde no LCUs were used; 41 of the 80 total transits required were LCM8s, 23 were LACV-30s, and 16 were LARC-LXs. LCUs averaged about 20 min. alongside the TCDF being loaded with an average of about 3.8 containers each and their succession times averaged about 2½ min. each. LCM8s during off-loading averaged about 2½ min. alongside being loaded with one container each and the average succession rate was also about 2½ min. each.

In the retrograde portion of Phase III LCM8s averaged almost 13 min. each alongside the barge-TCDF retrograding an average of 1.93 containers each transit. The LCM8 succession time averaged 2 min. per event. The LACV-30s also were alongside an average of almost 13 min. each retrograding an average of 1.96 containers each, and their succession times averaged almost 3½ min. per trip. The third type of lighter used, the LARC-LX, averaged 13½ min. alongside, retrograding an average of two 20-ft. containers. The LARC-LX succession times averaged nearly 5 min. (Calculations above were made following the same procedures described previously.) Figure 4.4 illustrates Phase III barge-TCDF productivity.

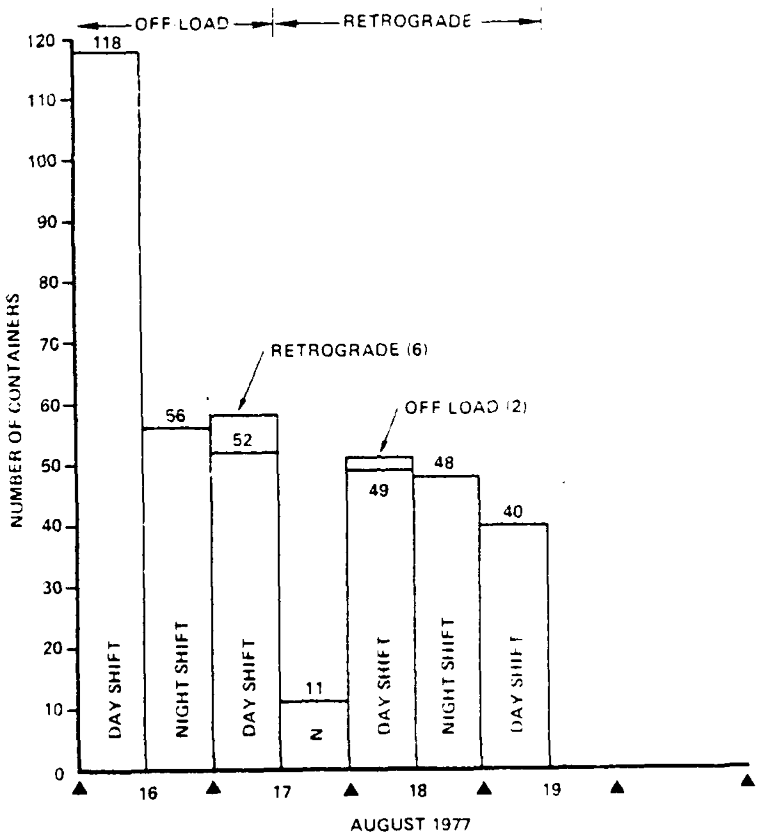

FIGURE 4.4. BARGE-TCDF CONTAINER PRODUCTIVITY BY DAY AND NIGHT SHIFT FOR PHASE III

Barge-TCDF Relocations. During the first day of Phase III barge-TCDF relocations required more than three hours, most of which were done at night. As before, two types of moves were made: first, along one side of the ship in order to work different holds and, second, around one end of the ship in order to work the opposite side. Available data show that approximately 1.3 hr was spent shifting around the bow of the ship. The other moves required periods of 34, 39, and 41 min. from the time movement preparations were initiated until the last line was made fast and the crane was again ready for operations.

In the move to the opposite side of the ship the Army was assisted by Navy craft. Two LCM6 warping tugs and a 3x14 causeway warping tug were used. The LCM6s each took an end of the barge-TCDF in tow. One LCM6 was tied athwartship for lateral control and the other LCM6 pushed at the other end. The 3x14 causeway warping tug attached itself amidship on the barge-TCDF, bow-on for additional lateral pushing and pulling power.

For hatch to hatch moves the LCM6 warping tugs provided the needed propulsion. A causeway ferry was used on the outboard side of the barge-TCDF for mooring lighters. The ferry was moved along the ship with the barge-TCDF but not when the TCDF was relocated to the opposite side of the ship. Ship personnel on at least one occasion assisted in securing the TCDF by using the ship's anchoring winches to apply tension on a forward mooring line.

Barge-TCDF Hatch Cover Handling. Most of the hatch cover openings and closings on which data were collected took place 16 August. Two 2-hatch operations (close one hatch and open a second) and nine single-hatch operations (open or close a hatch) took place that day. Data were collected on three other occurrences and more were known to have taken place.

On 16 August five of the single-hatch operations and one 2-hatch operation took place during the night shift. The night shift 2-hatch operation took 29 min. but the day time 2-hatch operation took only 14 min., for an average of only 21.5 min. The single-hatch operations varied from 8-28 min., averaging about 15 min., for operations on 16 August. On the other days this operation required more on the order of 22-23 min. per event.

Crane Refueling and Maintenance. Crane maintenance and refueling generally were accomplished within the first hour of each shift. On one occasion maintenance was postponed about three hours presumably to take advantage of good weather. When it became more difficult to attach the lifting device to containers, a break was called and maintenance conducted until the weather began improving.

Unscheduled maintenance was required 16 August on two occasions for oil checks, costing about 30 min. On 18 August about an hour was lost due to a need for a new hydraulic line. No other failures were reported.

Weather. Weather appeared to affect the TCDF more than the COP. Wave action reportedly caused the TCDF to lose some control in placing a power unit on the floating causeway tied alongside and the unit was accidentally immersed in the water (no tag line handlers were used). During one period of choppy sea activity the TCDF switched from its spreader bar to the Navy's chain sling for about 3 hrs. The sling was considered slower under calmer conditions than a spreader bar, but operations at this point were able to continue. It was also noted that the TCDF was forced to briefly halt operations when a submarine passed nearby and the wake caused excessive boom pendulation. The barge-TCDF lost approximately $8\frac{1}{2}$ hrs. of operation due to bad weather in Phase III. The sea state during most of these periods was judged to be not more than between one and two.

PHASE III, LIGHTER OPERATIONS

During Phase III off-loading, LCUs and LCM8s provided the bulk of lighterage support. The predominant lighter used in retrograde operations was the LCM8 but LCUs were included also, as well as LARC-LXs and LACV-30s. Shoreside off-loading was accomplished at a DeLong Pier and at the elevated causeway. Primarily Army lighters worked between the TCDF and the DeLong while Navy lighters worked between the COD and the elevated causeway. Although the 24th Transportation Bn. had operational control of all lighters, the Navy and the Army units operated their own communications circuits. Since Phase III used the combined assets of both Services, there was no shortage of lighters and few delays for lack of lighterage. Primarily, management of lighters was done by exception. When no lighters were available, a lighter would be called via radio.

Table 4.1 lists the number of lighters and types available for Phase III. As noted above, LCUs were predominately used in the off-load operations while LCM8s provided the bulk of the effort in the retrograde period. LCUs for the most part had calm seas to work in while the LCM8s worked during a period characterized by thunderstorm activity and frequent 15-20 kt. winds.

The one causeway ferry used was loaded at night by the COD and discharged at the elevated causeway the same night. It carried 13 containers, required 2 hr 19 min. alongside at the COD, spent 70 min. underway (including 8 min. to moor at the elevated causeway), and 1 hr 44 min. to be off-loaded.

Table 4.2 provides more detailed information on lighter employment in Phase III. It should be noted that the lighters loaded at the ship by the COD near the end of the off-load period did not make it to the beach. Instead they were retrograded back without any shoreside handling at all.

TABLE 4.1

LIGHTERS USED IN PHASE III

	ARMY	NAVY
[illegible]	8	0
[illegible]	1	12
[illegible]	10	11
[illegible]	3	6
[illegible]	2	0
[illegible] Ferry	0	1
[illegible]	[illegible]	[illegible]

TABLE 4.2

SUMMARY OF PHASE III LIGHTER OPERATIONS

SHIPSIDE

LIGHTER TYPES	OFF-LOAD OPERATIONS: NO. TRANSITS COD	OFF-LOAD OPERATIONS: NO. TRANSITS TCDF	OFF-LOAD OPERATIONS: NO. CONTAINERS COD	OFF-LOAD OPERATIONS: NO. CONTAINERS TCDF	RETROGRADE OPERATIONS: NO. TRANSITS COD	RETROGRADE OPERATIONS: NO. TRANSITS TCDF	RETROGRADE OPERATIONS: NO. CONTAINERS COD	RETROGRADE OPERATIONS: NO. CONTAINERS TCDF
LCU	48	59	186	222	21	0	89	0
LCM8	13	4	13	4	42	41	44	79
LARC LX	0	2*	0	2*	0	16*	0	30*
LACV-30	0	0	0	0	0	23	0	45
C/W Ferry	1	0	13	0	0	0	0	0
TOTALS	62	65*	212	228*	63	80	133	154

*40-ft. Containers included.

SHORESIDE*

LIGHTER TYPES	OFF-LOAD OPERATIONS: NO. TRANSITS JUD	OFF-LOAD OPERATIONS: NO. TRANSITS El. C/W	OFF-LOAD OPERATIONS: NO. CONTAINERS JUD	OFF-LOAD OPERATIONS: NO. CONTAINERS El. C/W	RETROGRADE OPERATIONS: NO. TRANSITS JUD	RETROGRADE OPERATIONS: NO. TRANSITS El. C/W	RETROGRADE OPERATIONS: NO. TRANSITS ADP	RETROGRADE OPERATIONS: NO. CONTAINERS JUD	RETROGRADE OPERATIONS: NO. CONTAINERS El. C/W	RETROGRADE OPERATIONS: NO. CONTAINERS ADP
LCU	59	40	219	155	0	15	0	0	63	0
LCM8	4	13	4	13	51	31	0	92	31	0
LARC LX	0	0	0	0	0	0	11	0	0	22
LACV-30	0	0	0	0	0	0	20	0	0	39
C/W Ferry	0	1	0	1[illegible]	0	0	0	0	0	0
TOTALS	63	54	223	[illegible]	51	46	31	92	94	61

* Excludes Minimal Land Beach Crane Activity.

Also the above totals do not reflect the 16 containers handled by the jacked-up DeLong (JUD) pier which were off-loaded from two LASH barges and a SEABEE barge on 18 August, the third day of Phase III.

The size of loads varied mostly with the LCM8s. During off-loading both the TCDF and COD loaded only one container per craft. During retrograde the DeLong pier usually loaded two containers per craft. On the other hand, LARC-LXs were consistently loaded with two containers each except, obviously, when carrying a 40-ft container. During retrograde, LCUs on the average carried 4.2 containers per transit but during off-loading had an average of 3.88 containers per transit from the COD and 3.76 from the TCDF. The LACV-30 averaged 1.96 containers per transit during retrograde.

PHASE III, SHORESIDE TRANSFER

DeLong Pier

Background. The use of a jacked-up DeLong (JUD) pier for shoreside unloading of containers in a LOTS operation was not an innovation for this test. OSDOC II at Green Beach, Ft. Story, briefly and successfully used a DeLong A section (80 ft x 300 ft x 13 ft) with a floating causeway shore connection. Unfortunately, during that test a storm caused the separation of the poorly connected causeway and DeLong.[2]

In a LOTS pretest[3] a DeLong B section (60 ft x 150 ft x 10 ft), which was specially modified to support 140-ton crane operations, was grounded near the high water mark (also at Green Beach, Ft. Story) and jacked-up. The DeLong's ramps (shore connection span), which extended to the near shore, were used for entry onto and exit off the facility. Unfortunately, the pier did not extend far enough seaward for continuous operations sinc LCUs and LCM8s could not always approach and moor alongside the pier. As a result, the crane lacked the reach needed to off-load the lighters during low water conditions. Since DeLong pier unloading was sporadic and over too short a period of time, an operational window based upon tides could not be defined at that time for that beach.

For the main test, as a result of the foregoing problem, it was determined that at least two DeLong B sections end-to-end would be needed to reach sufficient water depth at low tide and alleviate the landing craft approach problem. At that extended distance from the beach it was thought that the unloading process would be continuous. A third DeLong B section placed alongside the seaward end and slightly further out was planned as a pierhead so that trucks would have more turnaround space and to prevent operational interference

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[2] Joint OSDOC II Plans and Operations Group, Joint Army-Navy Test Directorate, Test Evaluation of Off-Shore Discharge of Containership II, (OSDOC II), Vol. II, Ft. Story, Va., 1973.

[3] See ORI TR 1168, Heavy-Lift Breakbulk Ship Pretest Results of the Joint Logistics-Over-The-Shore (LOTS) Test and Evaluation Program, dated 25 July 77.

with the crane. The only DeLong pier resources available in the Hampton Roads area for the test were a B section and an A section, along with ramp and piling. Accordingly, the A section was substituted for two of the B sections and the extra width of the A DeLong section was blocked off. The B section, specially modified to support 140-ton crane-container operations and with the crane positioned on it, formed the pierhead. (See Figure 4.5.)

Pier Installation. The DeLong pier components (in lieu of deployment by a SEABEE vessel) were pre-positioned at the test site but out of the way of other activities. Installation of the DeLong was time-constrained to fit the LOTS scenario for an improved beach operation. On 9 August the DeLong A section was positioned off Red Beach (at 1515) and after 3 hr of trying to beach the section (slowed by an underwater obstacle), four LCM8s warped the pier section into place and elevating by jacking was begun. Next the B section was brought in alongside the A section and placed with its outward end approximately 340 ft from the high waterline, a distance far enough seaward so that operations could continue through low tide. The 79 ft short connection span of the DeLong was pulled off the A section, a sand ramp was constructed at the end of the DeLong ramps, and M-19 airfield matting was placed over the sand to support traffic on and off the pier. The ramp ended on a hard surface (MOMAT/AMSS), beach road network. Because there was some doubt whether the ramps would support the 140-ton crane, the crane was prepositioned on the DeLong before deployment. Installation of the DeLong pier at the beach was done on a intermittent basis, although well within the 72-hr scenario parameter. No data were available on preparations that would be needed following ocean deployment or prolonged storage.

Operations. Operations at the DeLong pier began on the first day of Phase III, August 16. It had been planned that the pier would be the only beach facility to operate until such time as a large queue of loaded lighters started to build. When it was apparent that the JUD was being saturated, the elevated causeway was to be activated to absorb the difference. The first lighter, an LCU, did not begin its approach to the JUD until about 0750. The beach remained inactive but was ready before then.

When the first LCU arrived at the JUD it required nearly 15 minutes to moor due to a strong cross-current. At the fast pace at which the ship was being discharged by the COD and TCDF, two LCUs were loaded shipside during the time it took the first LCU at the JUD to moor. By the time the JUD had off-loaded its second container from the first LCU, the ship had reported that 14 containers were enroute to the beach. Then, because the second LCU at the JUD required 15 minutes to moor due again to the strong cross-currents, two more LCUs were loaded shipside. However, it was still too early to determine whether random difficulties were holding operations back, or whether the JUD facility was too slow, or a combination of these two factors.

Within 1¼ hr following the arrival of the first LCU at the beach, it became apparent that saturation had been reached. Four LCUs were in queue off-shore, a fifth LCU was making its second attempt at mooring, and two more LCUs were rapidly being loaded at the ship. Operations at the elevated causeway

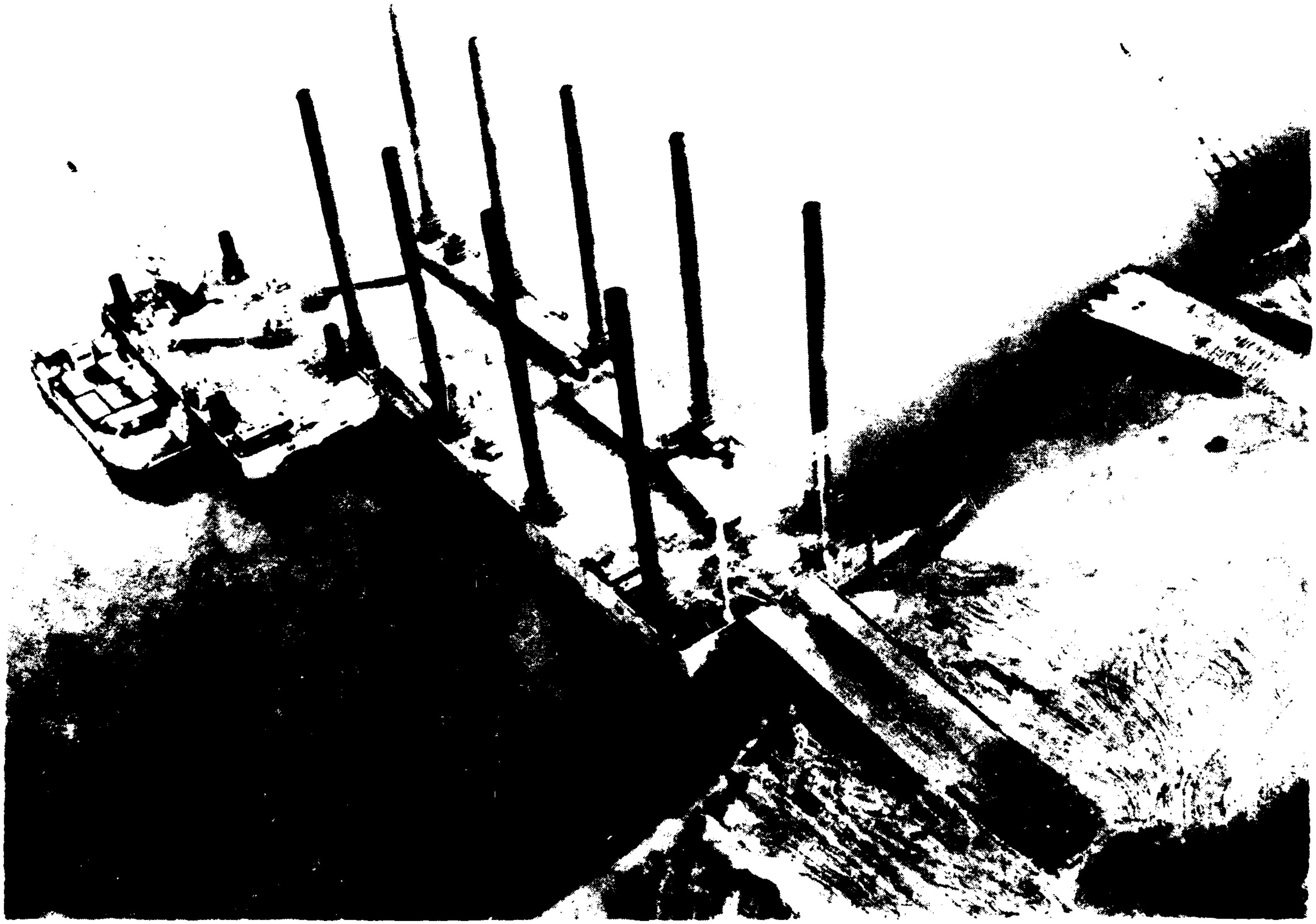

FIGURE 4.5. JACKED-UP DELONG PIER. THE DELONG PIER IS SHOWN TRANSFERRING MILVANS FROM AN LCU TO YARD TRACTOR TRAILERS.

were then initiated. The off-shore lighter queue build-up slowed but continued to increase into the afternoon, despite the introduction of the elevated causeway. A greater number of LCUs (Army and Navy), personnel at the ship had become more experienced, and improved management had accelerated the throughput flow from the ship to shore. The beach then became the bottleneck, but the quantity of lighters available at the time was still sufficient to absorb the output of the ship cranes. Hatch openings and required crane moves then slowed the ship off-load rate so that by crew change time that evening, the queue at shoreside was greatly reduced. In addition, the beach continued to operate while the ship discharge systems were inactive for crew change and maintenance.

After the first 4 hr of JUD operations a change in operational procedures was made to rectify mooring delays at the JUD. While one lighter was being off-loaded at the JUD, a second lighter moored alongside the first. As soon as the last container had cleared the first lighter, the lighter cast-off from the JUD. At this time the second lighter cleared its lines from the first. As the first lighter backed off, clearing the slot alongside the JUD, the second lighter moved into the vacated position, often a distance of less than 50 ft. This shifting of positions was completed generally about the same time as or just after the JUD crane completed its loading cycle. Therefore, by using this procedure crane delays due to mooring were minimized.

The JUD worked fairly steadily until about midnight of the night shift and then the operational pace slowed as the cargo rate from the ship diminished. Before noon on the second day, 17 August, the TCDF had exhausted its share of the workload and the COD was within about 50 containers from completing its work. Consequently, the JUD facility began a token retrograde effort late that afternoon and evening.

During the day shift of 18 August, the JUD facility worked barge-type cargo. Two LASH barges and a SEABEE barge were discharged. The cargo included four containers in each of the LASH barges and eight containers in the SEABEE barge. Also included were two vehicles and some palletized cargo. (A description of barge operations follows this section.)

The majority of the containers retrograded across the JUD were accomplished the night of 18 August and during the day shift of 19 August. Only LCM8's were used as lighterage. When the retrograde operation was completed about mid-afternoon, the JUD facility was secured from all further test operations.

During Phase III the JUD facility off-loaded 239 containers from 66 lighters (including the LASH and SEABEE barges) and retrograded 92 containers using 51 lighters. A total of 331 containers were transferred over about seven shifts, in addition to the breakbulk and vehicular cargo. Figure 4.6 illustrates the DeLong pier facility's container productivity during Phase III.

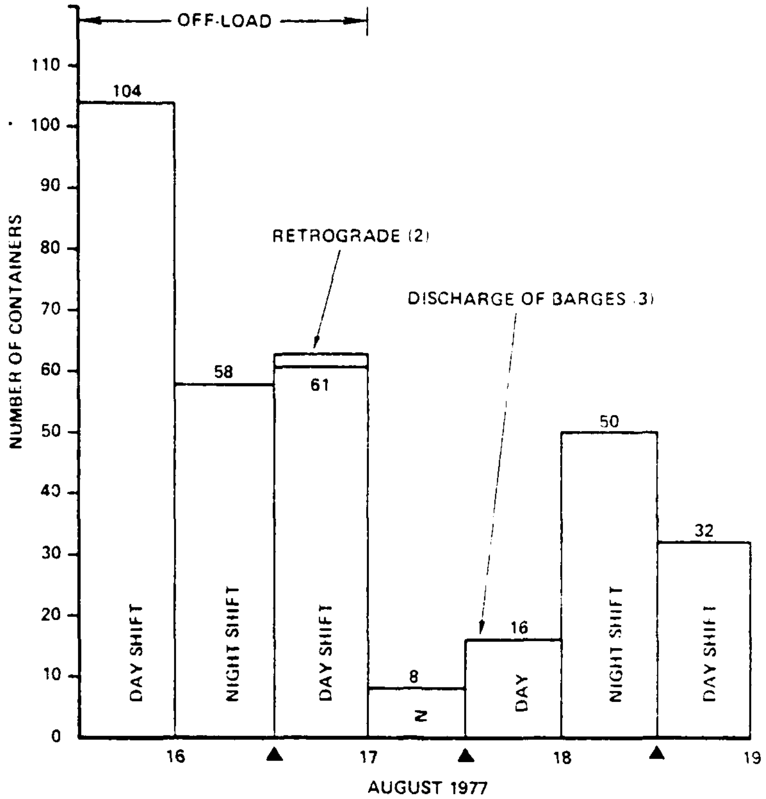

FIGURE 4.6. JUD CONTAINER PRODUCTIVITY BY DAY AND NIGHT SHIFT FOR PHASE III

In the off-loading period 59 LCUs transported most of the containers, carrying an average of 3.7 per transit. An LCU was alongside the JUD almost 20 min. on the average and the average rate of succession for LCUs at the JUD was about 9 min. Four LCM8s carried the remainder. They were tied up alongside almost 3 min. each off-loading one container and their average succession was about 2 min.

During the retrograde period 51 LCM8s transported 92 containers and were alongside the JUD about 9 min each, loading an average of 1.8 containers. Their succession times averaged nearly 5 min each.

Tractor-Trailer Operations. Tractor-trailers on the JUD had to operate in a relatively small area but no major problems or delays were encountered. One tractor-trailer was positioned on the JUD in the designated load position near the 140-ton crane, three tractor-trailers were queued on the A section, and generally about six were queued on the beach turnaround road near the ramp of the JUD. As soon as one loaded tractor-trailer cleared the load point, an empty one was already partially turned. The turn would then be completed and another vehicle operator would assist in backing the new one into position. (See Figures 4.7 and 4.8.) Tractor-trailer operations, when there was a steady stream of containers, average about 21 min. per vehicle from the time it appeared on the JUD until it departed with a load (one container). About 3.3 min. on average was spent in the load position.

FIGURE 4.7. VEHICLE TURNAROUND ON JUD. TRACTOR-TRAILERS DID A SHARP TURN AT THE END OF THE DELONG (ABOVE) WITHOUT BENEFIT OF A TURN-TABLE AND PULLED FORWARD ONCE THE LOADING POINT (BEHIND THE PILING) WAS CLEAR.

FIGURE 4.8. BACKING FOR A LOAD. WITH THE ASSISTANCE OF A GROUND GUIDE DRIVERS BACKED ONTO THE B SECTION UNDER THE CRANE'S BOOM. NO DELAYS RESULTED FROM THIS PROCEDURE.

Elevated Causeway

During Phase III the elevated causeway off-loaded 181 containers from 53 lighters and retrograded 94 containers using 46 lighters over the course of about five shifts. More containers could have been handled if they had been available. Also, the elevated causeway was used for about half a day for special demonstrations. The procedures for transferring containers did not change from those used in Phase II. Conditions during Phase III started out nearly ideal and remained so into late morning of 17 August.

The period of greatest elevated causeway activity was 16 August when 125 containers were off-loaded between the hours 0920 to 0613 of the next day. This was seven containers less than its most productive day (12 August) during Phase II. The elevated causeway started operations with a queue already developed from the back-up off the jacked-up DeLong pier. Even working this backlog, however, there was about 5 hr 9 min. of crane inactivity due solely to a lack of lighters. This involved 28 separate events which produced average delays of about 11 min. each, the longest lasting about 33 min. It was observed that even with a backlog of lighters the same type of delay, awaiting lighters, was experienced frequently.

Most of the lighters off-loaded in Phase III were LCUs, which carried an average of 3.9 containers each. LCUs were alongside the elevated causeway an average of about 24 min each and had an average succession time of about 6½ min. each. (See Figure 4.9.) LCM8s carried one container each, were alongside the elevated causeway an average of about 6 min. and had average succession times of about 4 min. each. One causeway ferry, carrying 13 containers, was off-loaded at the elevated causeway. The causeway ferry required about 5 min. to moor, one hr 44 min. to off-load, and about 15 min. to clear the mooring point.

During retrograde the elevated causeway loaded more LCM8s than LCUs (31 versus 15), but more containers were loaded into the LCUs (63 versus 31). LCM8s were alongside the elevated causeway an average of nearly 8 min receiving total loads of one container each and had an average succession time of about 4½ min. LCUs, with an average load of 4.2 containers, spent about 27 min. alongside and had succession times of about 11 min. on average. Figure 4.10 summarizes the elevated causeway's productivity.

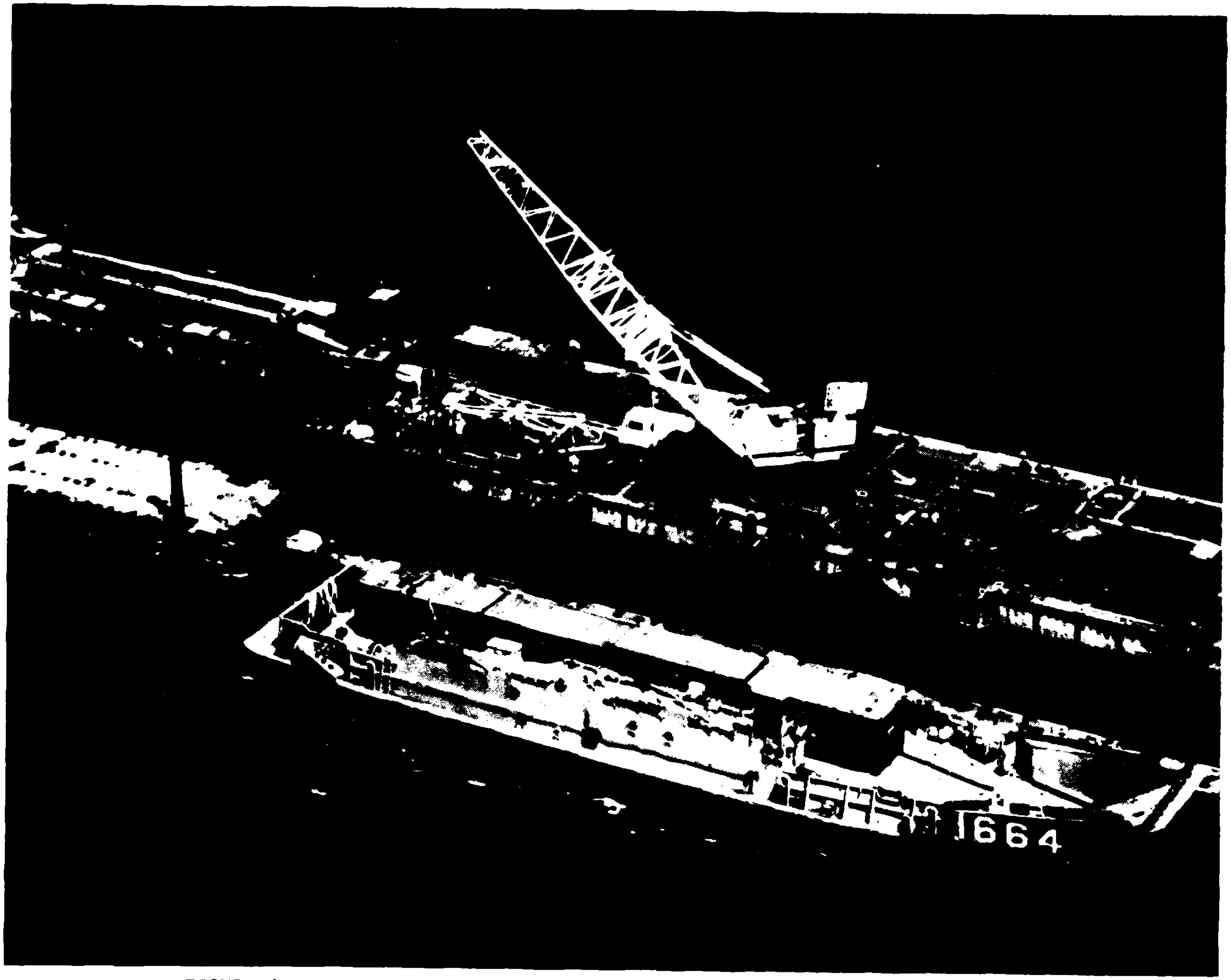

FIGURE 4.9. ELEVATED CAUSEWAY OPERATIONS. THE ELEVATED CAUSEWAY CRANE BEGINS OFF-LOADING A NAVY LCU. THE TRACTOR-TRAILER AT RIGHT PULLS INTO THE LOADING POSITION WHILE ANOTHER TRACTOR-TRAILER AT LEFT PULLS ONTO THE AIR CUSHION TURNTABLE.

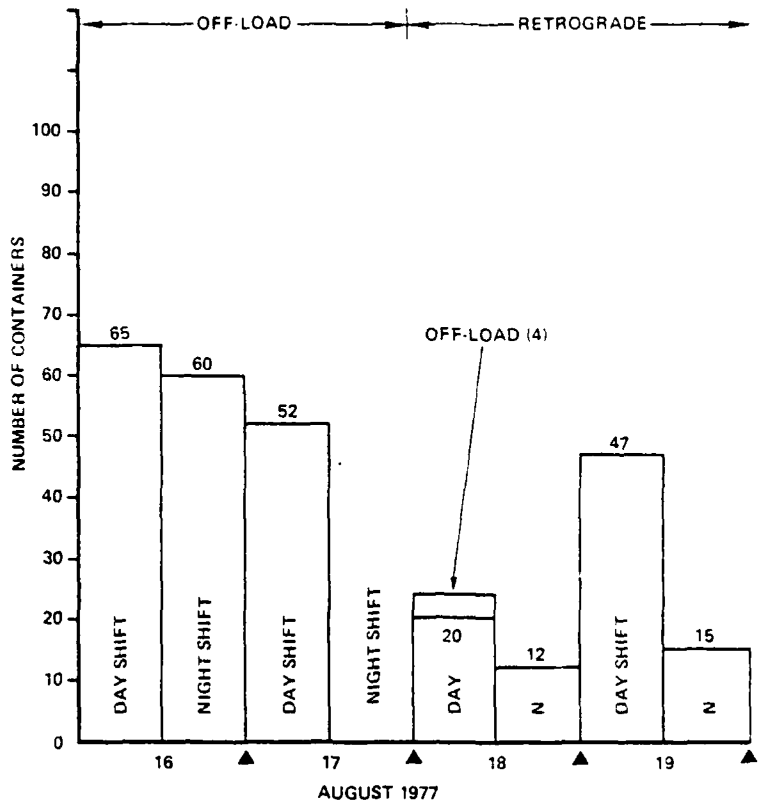

FIGURE 4.10. ELEVATED CAUSEWAY PRODUCTIVITY BY DAY AND NIGHT SHIFT FOR PHASE III

One exception to normal elevated causeway (and Navy) loading procedures was made on the last day. At that time three 1646-class Navy LCUs were loaded with five containers each. Otherwise, Navy LCUs were never loaded with more than four containers at any location.

Also during the final day of elevated causeway activity (19 August) the elevated causeway crane was used in a special test. The Army's LCU 1671 with two LARC-XVs embarked was brought alongside the elevated causeway. The two LARC-XVs were off-loaded from the LCU and placed in the water by the 140-ton crane on the elevated causeway. The test required about 41 min. In the test about 20 min was spent changing the crane's rigging for the lift, 10 min. was required for the first LARC-XV and 13 min was required for the second LARC-XV -- from attaching the sling and lifting to landing the vehicles in the water. The vehicle is 45 ft long, 14.5 ft wide, and when prepared for embarkation, is 11.5 ft high. It weighs 22.82 short tons.

Amphibian Discharge Point

While the DeLong pier facility was engaged in the discharge of the two LASH and one SEABEE barges, the amphibian discharge point (ADP) was activated on 18 August to maintain retrograde operations. Only two LARC-LXs and two LACV-30s were used.

The ADP retrograded a total of 61 containers, requiring 32 transits for the task. The LARC-LX average load was two containers per transit (10 transits were made, including two from an earlier shift) and the vehicle was in the ADP's loading position an average of about 14½ min. each time. The LACV-30 had an average load of 1.96 containers and spent an average time of about 15 min. in the loading position.

Jetty Crane

Two LARC-LXs were loaded by the jetty crane the afternoon of 18 August for a special lifting test of the barge-TCDF involving the two heaviest 40-ft containers. The two containers were retrograded to the barge-TCDF, lowered to and lifted from the centerline of the ship without problem. The LARC-LXs returned the 40-ft containers to the jetty crane where they were unloaded. The average time each LARC-LX was in the load and off-load position was 10 min.

PHASE III, YARD TRACTOR-TRAILER TRANSPORTER OPERATIONS

In Phase III the basic difference from Phase I was in the use of the jacked-up DeLong pier with a 140-ton crane for transferring containers direct from lighters to trucks. Trucks turned around on the DeLong A section of the facility, then backed to a loading position on the B section. A marker line was painted on the deck to assist the driver in backing up at the correct angle to the crane. An NCO was also on hand to direct the trucks forward and to assist the drivers in the turning and backing maneuvers. This positioning, although involving a tight 225-degree turn which was followed by a backing maneuver, never slowed crane operations.

In general, the tractor-trailer operations were well organized and responsive to beach clearance requirements. A summary of Phase III tractor-trailer operations is set forth in Table 4.3.

TABLE 4.3

PHASE III YARD TRACTOR TRAILER OPERATIONS

	No. Units Used		Trips (under load)		Containers			
					Forward		Retrograde	
Date	Shift 1	Shift 2	Shift 1	Shift 2	Shift 1	Shift 2	Shift 1	Shift 2
16 Aug	23	28	167	115	167	115	0	0
17 Aug	28	8	155	8	120	0	35	8
18 Aug	19	21	79	64	18	0	61	64
19 Aug	22	6	84	15	0	0	84	15

PHASE III SUMMARY

The third phase was the only time afforded in the test for determining the upper limits of shore-side container handling facilities. Until this time the ship discharge cranes were the bottlenecks of the system. By directing their total output on all available landing craft first to the DeLong pier and then to the elevated causeway, maximum throughput handling rates could be attained.

At the close of the first 24-hr period the TCDF and COD had discharged 175 and 147 containers respectively for a total of 322. This was the largest number of containers off-loaded on any single day. On the beach the DeLong pier crane was saturated before mid-morning and landing craft were diverted to the elevated causeway. For awhile both shoreside facilities had queues to work. However, by the end of the second shift the queues had been worked off and before the third shift was midway, the TCDF had completed its off-loading objective. The COD completed off-loading the next day after several thunderstorm interruptions. During retrograde the TCDF loaded 154 containers and the COD loaded 133. Altogether during Phase III the two ship cranes transferred 609 containers.

The introduction and use of the jacked-up DeLong pier proved to be an adequate solution at Ft. Story's Red Beach for the handling of containers and barges. The facility enjoyed the benefit of the square footage equivalent to three B DeLong sections with parking on the A section for four tractor-trailers. No delays were recorded for lack of tractor-trailer service. In the most demanding workload day the JUD facility off-loaded 162 containers from 46 lighters directly onto waiting trailers. The predominant lighter used was the LCU which, when employed in a multiple mooring approach, minimized lighter succession time. On the average an LCU was alongside the JUD discharging its load of 3.7 containers in a period of less than 20 min.

The elevated causeway facility used the same procedures as it had during Phase II. It off-loaded a total of 181 containers from 53 lighters and retrograded 94 containers using 46 lighters. It was noted also that the elevated causeway still had a considerable number of delays while awaiting lighters. The elevated causeway crane also was used to off-load two LARC-XVs from an Army LCU into the water.

In general, the experience gained during the previous two phases began to show in faster times for nearly all activities, better coordination, and less confusion in the conduct of operations.

V. PHASE I(R) OPERATIONS

GENERAL

Phase I(R) was a repeat of Phase I, bare beach operations. Planning for the LOTS test had included extra weather days in the event that adverse weather necessitated a prolonged halt to operations. The general lack of bad weather permitted retrograde operations in Phase III and the opportunity to repeat Phase I for a period of one day. The Army, accordingly, manned all systems.

During this one full day of operations the Army off-loaded a total of 285 containers. The ship's container load was concentrated to minimize crane moves and the same crews used throughout the test were used again. Weather conditions for the most part were excellent, although the TCDF did experience some delays due to choppy water about 1000 and again about 2230.

PHASE I(R), CONTAINERSHIP OPERATIONS

The crane-on-deck was late getting started (see below) so it was never able to off-load the same number of containers as the TCDF. Near the end of Phase I(R) the TCDF was positioned to assist the crane-on-deck in off-loading one hold. However, rather than risk a collision of booms, the crane-on-deck was subsequently shut down. During both shifts the Commanding Officer of the 119th Terminal Service Co. (Container) directed operations from the containership. Figure 5.1 illustrates the productivity by shift of both cranes for Phase I(R).

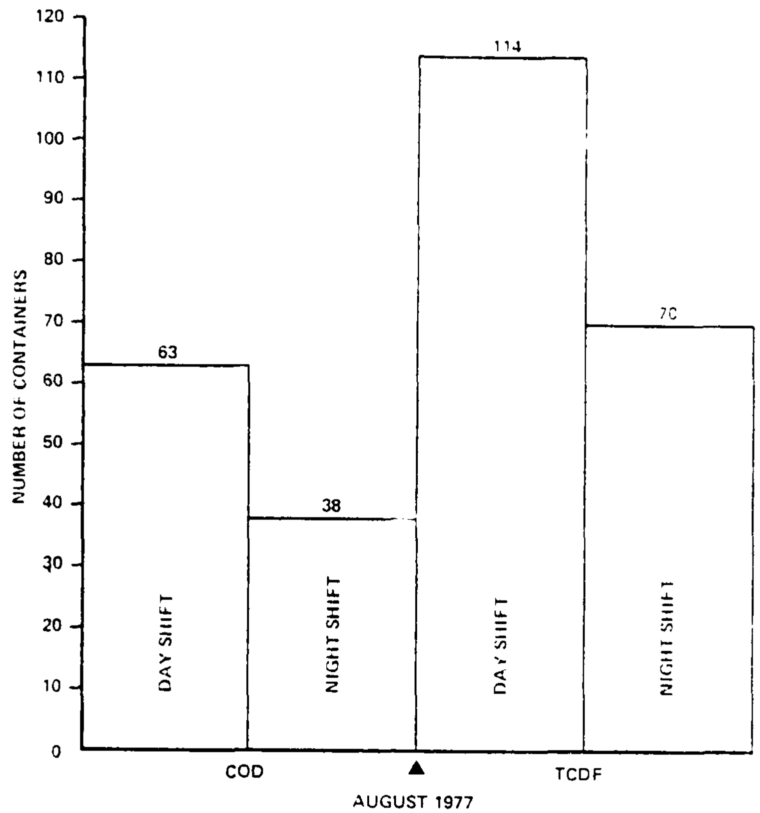

FIGURE 5.1. PHASE I(R) COD AND TCDF PRODUCTIVITY BY SHIFT (20 AUGUST)

Crane-On-Deck

The crane-on-deck was delayed more than 2½ hr due to a requirement to replace a worn boom cable. Shortly after that the COD engine overheated; it was discovered that a loose cap had permitted the engine's water to boil away so the problem was considered minor (a 20 min. delay). Finally, the COD was halted about 25 min. when a piece of metal, later discovered to be boom instrumentation installed for the test, fell from the boom tip. Altogether the COD after its late start was in operation about 18½ hr including the above delays and about ½ hr spent changing crews and some brief maintenance. Also in addition to the above delays, the COD experienced several "awaiting lighter" delays varying from 2 to 21 min. and totaling about 3/4 of an hour.

During Phase I(R) the COD off-loaded 101 containers into 38 lighters, most of which (16) were LCM8s. The LCM8s carried an average of 1.75 containers each transit (28 total). However, 12 LCUs carried most of the containers (59) discharged by the COD, for an average load of 4.92 containers each trip. LCM8s were alongside the COD loading on the average of about 12½ min. each and had succession times averaging about 1½ min. each. LCUs were alongside the COD about 33½ min. each and their average succession times were about 5 min. each.

Eight LARC-LXs and two LARC-XVs were also used at the COD. The LARC-LXs were alongside about 16½ min., loaded an average of 1.5 containers, and had succession times of about 2 min. LARC-LXs can carry only one container, their times alongside (only two) averaged about 14½ min., and their succession times were about 6 min.

Hatch Removal. Three instances of hatch cover removal were recorded Two of these were two-hatch operations (close one hatch and open the second) and one was a single-hatch operation (open or close a hatch). The times for the two-hatch operations were about 20 min. (day shift) and 37 min. (night shift). The night shift also had a single-hatch operation, requiring about 12 min.

Barge-TCDF

The barge-TCDF began about 0630 and terminated operations about 0530 the next day. In that interval the barge-TCDF off-loaded 184 containers. It was trouble somewhat by choppy water from about 0900-1130 and from about 2215-0130. During both of those periods it halted operations for about a half-hour the first time and about 2 hr the second time. In the latter period some maintenance was performed. Once the tidal current had swung the ship around so that the barge-TCDF was in the lee, operations were able to continue.

The barge-TCDF also had "awaiting lighter" delays totaling about 3/4 of an hour. These delays varied from about 2 to 12 min.

The TCDF used 86 lighters during the off-load. During the day shift mostly landing craft were used but during the night shift the emphasis swung to amphibians. The night shift began on a low tide, backing up the number of landing craft that were loaded and opening the way for a switch to amphibians. As in Phase I, the barge-TCDF did not use a causeway ferry alongside to assist lighters in mooring.

The TCDF loaded all five types of lighters available: LCUs, LCM8s, LACV-30s, LARC-LXs, and LARC-XVs. Fifteen LCU transits were made transporting a total of 73 containers (average load was 4.87): the time alongside for loading averaged about 20 min. each and succession times averaged less than 3½ min. Thirty LACV-30s carried 51 containers (average load of 1.70); they had an average of about 8 min. alongside and succession times of about 2½ min. Seventeen LCM8s carried 30 containers (average of 1.76), were alongside the TCDF an average of 7 min. and had succession times of about 1½ min. Seven LARC-LXs (11.7 container average load) and 17 LARC-XVs (one container each) carried the remaining containers with times of about 8 min. and 4 min. alongside, respectively, and average succession times of about 2 min. for both types.

Hatch Removal. The data collected for TCDF hatch cover removals show three instances of a single-hatch operation and one instance of a two-hatch operation. Times for the single-hatch operations were 14 and 21 min. for the day shift and 17 min. for the night shift. The day shift performed the only two-hatch operation, requiring only 20 min. The one single-hatch operation for the night shift had to be postponed approximately 2 hr due to choppy water. During that period the crane was inactive.

PHASE I(R), LIGHTER OPERATIONS

During Phase I(R) the priority for lighter operations went to landing craft (LCUs and LCM8s) instead of amphibians and during the night shift the priority was reversed. As noted above, this reversal may be attributable to the fact that at the end of the day shift landing craft were unable to get in to the jetty crane for discharge. While control of lighterage was still retained ashore by the 24th Transportation Bn., more detailed direction of individual craft (loading, in particular) was accomplished from aboard ship.

The day shift began with a low tide, so while operations were still getting organized and initial off-loading was taking place aboard ship, the jetty crane was inaccessable to LCUs and LCM8s. The first few craft loaded shipside were LCUs which have more difficulty beaching at low tide than LCM8s. Thus, no early attempts were made until LCM8s were loaded and this suggestion was relayed to lighter control ashore. After some minor difficulties in approaching the beach, the first LCM8 beached slightly before 0800. The first five lighters to beach were LCM8s and the first LCU beached shortly after 0900. Lighters at the jetty crane were able to beach to the left and right of the crane. In this fashion, landing craft approaches and retractions could be made without interference with one another.

Amphibian use was sporadic during the day. Only 14 were used to carry 27 containers, and no LARC-XVs were used at all. On the night shift 50 amphibians were used to carry 68 containers. This totaled 95 containers and represented about 1/3 of all containers off-loaded in Phase I(R). Except for two LARC-XVs at the jetty crane, all amphibian discharge at the beach was accomplished at the ADP.

The lighterage workhorse in Phase I(R) was the LCU, which made 27 transits carrying 132 containers (46 percent) for an average load of 4.89 containers per transit. The second most productive lighter was the LCM8, which made 33 transits carrying 58 containers (20 percent) for an average load of 1.76 containers per transit. Third was the LACV-30, which made 30 transits carrying 51 containers (18 percent) with an average load of 1.70 containers per transit. The LARC-LX made 15 transits carrying 25 containers (9 percent) with an average load of 1.67 per transit. Finally the LARC-XV made 19 transits carrying one container each time (7 percent of the total containers transported). Table 5.1 provides information on lighter employment.

PHASE I(R), SHORESIDE TRANSFER

Crane-on-Jetty

Beach operations for the day shift were helped somewhat by low tide which occurred about the time Phase I(R) began since lighter operations commenced working with an incoming tide. The first five lighters (LCM8s

TABLE 5.1

SUMMARY OF PHASE I(R) LIGHTER OPERATIONS

Lighter Types	Number of Transits From		Number of Containers Carried		Total Transits	Total Cntnrs
	COD	TCDF	COD	TCDF		
LCU	12	15	59	73	27	132
LCM8	16	17	28	30	33	58
LARC-LX	8	7	12	13	15	25
LACV-30	0	30	0	51	30	51
LARC-XV	2	17	2	17	19	19
TOTALS	38	86	101	184	124	285

SHORESIDE DISCHARGE

Lighter Types	Number of Transits To		Number of Containers Unloaded		Total Transits	Total Cntnrs
	Jetty	ADP	Jetty	ADP		
LCU	27	0	132	0	27	132
LCM8	33	0	58	0	33	58
LARC-LX	0	15	0	25	15	25
LACV-30	0	30	0	51	30	51
LARC-XV	2	17	2	17	19	19
TOTALS	60	62	192	93	124	285

carrying two containers each) initially had little difficulty getting over a sandbar and beaching at the 300-ton jetty crane. Approximately 3 hr after low tide, the first LCU without difficulty made an approach to the beach and grounded out close enough to the crane for discharge.

The jetty crane began off-loading at approximately 0800 and by 1800 it had off-loaded 114 containers from 17 LCUs and 19 LCM8s. This performance averaged 11.4 containers per hour but at one point it hit a peak of 18 containers in one hour. Overall the jetty crane discharged 192 containers from 60 lighters, which was the highest number of containers transferred by any crane in any 24 hr period of the test.

The jetty crane and the ADP crane were the only ones which could accommodate two lighters from a single working position. This eliminated any delays resulting from lighter succession. While one lighter was being off-loaded on the port side at the jetty crane, an empty lighter was retracting and subsequently being replaced by a loaded lighter to starboard. When the port side lighter had been off-loaded, it immediately raised its ramp and retracted so that a loaded one could take its place. As a result the crane was able to work continuously.

At the jetty crane 14 LCM8 successions overlapped other lighters being off-loaded. This overlap totaled 93 min. The average overlap period was about 6.6 min. per LCM8 for the day shift. There was only one LCM8 succession overlap of 40 min. on the night shift. There were nine instances where LCUs overlapped other lighters being off-loaded on the day shift. The LCU overlap periods totaled 111 min., for an average of about 12 min. per overlap. There was only one instance at night when an LCU overlapped another lighter; that was for 3 min.

Despite overlap periods on the day shift, the average succession time for LCM8s still averaged nearly 1½ min. and for LCUs about 7 min. At night these succession times were about 4 min. and 5½ min. for the LCM8 and LCU, respectively.

The time lighters spent beached for unloading varied between day and night operations. An LCM8 was beached at the jetty about 12½ min. during the day shift and about 7 min. during the night shift. An LCU was beached about 25½ min. during the day and at night about 24½ min. The longer periods beached during the day shift may be attributable to the fact that lighters had to wait for the crane during the day shift and at night the crane had to wait for lighters.

The night shift discharged 78 containers from 26 lighters. Operations did not begin until 2012, delayed because of low tide. The first two lighters were LARC-XVs which are not bothered by tides or sandbars. They were followed at 2036 hr by eight LCM8s and then at 2205 the first LCU beached. At that time seven other LCUs were loaded and waiting to go into the beach. Jetty crane operations were secured about 0400. Figure 5.2 illustrates jetty crane productivity in Phase I(R).

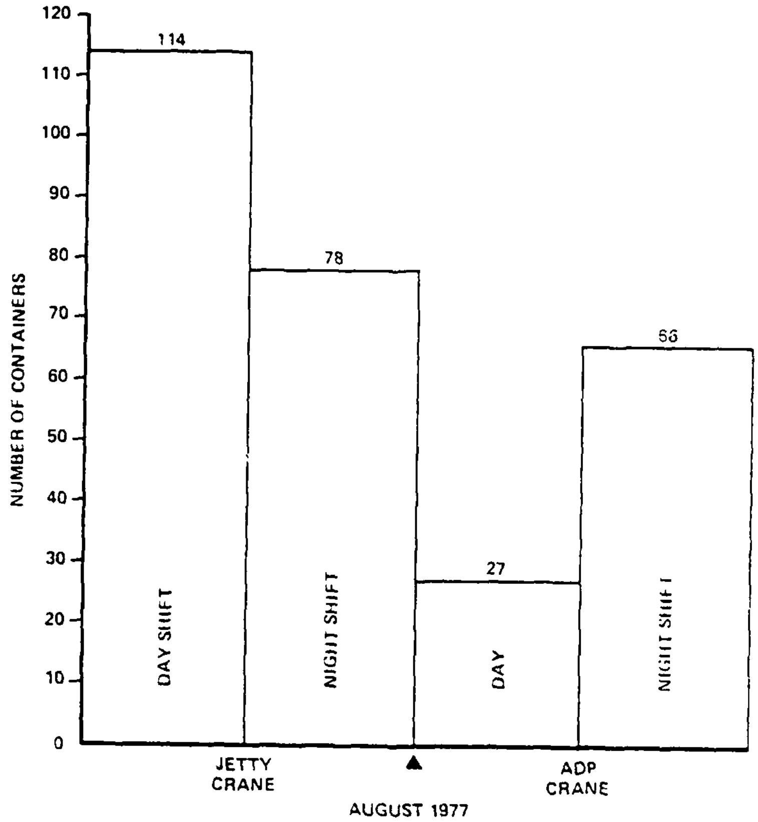

FIGURE 5.2. PHASE I(R) CRANE-ON-JETTY AND ADP CRANE PRODUCTIVITY BY SHIFT (20 AUGUST)

Amphibian Discharge Point

As noted, the amphibian discharge point (ADP) handled about 1/3 of the containers discharged in Phase I(R). Most of those containers (62 of the 93), were landed during the night shift. The predominant lighter off-loaded was the LACV-30, which made 30 transits carrying 51 containers.

The ADP crane began operations about 0900 and worked on an infrequent basis during the morning. In about a 2 hr. period near noon 12 amphibians carrying 23 of the day shift's total of 27 containers landed and were off-loaded. The night shift began about 1930 and worked fairly steadily until about 2230 when barge-TCDF operations were halted by choppy water, thus shutting off the flow of cargo. Operations resumed again about 0150 and were continuous from then until 0600. The amphibian crane hit a peak of about 12 containers an hour during this phase.

Amphibians spent a relatively small amount of time at the ADP crane. The LACV-30 on average spent about 7 min. at the ADP crane being off-loaded, the LARC-LX about 8 min., and the LARC-XV about 3 min. Average loads were 1.67 containers per LACV-30, 1.67 containers per LARC-LX, and 1.00 containers per LARC-XV.

Average succession times during the day reflected the low level of amphibian activity at the ADP, something on the order of about 14½ min. for the LACV-30 and LARC-LX. At night succession times were 6½ min. for the LACV-30, about 8 min. for the LARC-LX, and about 3 min. for the LARC-XV. There were only three instances in which lighter arrivals overlapped: one for 18 min. and one for 3 min., which involved the LARC-LXs; and one for 3 min., which involved a LACV-30.

PHASE I(R), SUMMARY

Phase I(R) provided an opportunity for the Army to apply improvements in operating procedures learned in the earlier phases of the test. By exercising better control of lighters the ship discharge systems were able to operate at near maximum rates. Minimum delays were incurred in lighter succession time under the hook, bay cover removals, and the like. Of significance was the diversion of most of the throughput (81 percent) from the ship to the crane-on-jetty for about 8 hr of the day shift without appreciable queue buildup until low tide restricted operations. The ability of the crane-on-jetty to work one lighter while a second one was mooring/casting off had a noticeable affect in keeping the crane productive. The jetty crane transferred 192 containers in a 24 hr period, the highest 24 hr rate of any crane in the test and more containers could have been handled if they had been available.

Altogether the Army off-loaded 285 containers continuously in this 24 hr. period. More could have been transferred if they had been retrograded at the end of Phase III. The TCDF was troubled by choppy water on two occasions and had to temporarily halt off-loading while the COD contained. The COD was halted for about 2½ hr due to a cable replacement that delayed its start. The COD secured operations early to prevent interference with TCDF off-load operations. The COD off-loaded 101 containers while the barge-TCDF off-loaded 184.

LCUs transferred most of the containers to the shore, carrying 132 in 27 transits for an average load of 4.89 containers per transit. LCM8s carried 58 containers in 33 transits for an average load of 1.76 per transit. LACV-30s carried the most for an amphibian, 51 containers in 30 transits, for an average load of 1.70 per transit. LARC-LXs in 15 transits carried 25 containers, 1.67 per transit, and LARC-XVs made 19 transits with one container each.

VI. BARGE OPERATIONS

A total of two SEABEE and six LASH barges were divided equally between the Army and the Navy for off-loading at the jacked-up DeLong pier and elevated causeway. Nominal amounts of vehicular, container, and breakbulk cargo were off-loaded from these barges. None of the barges were loaded to capacity, mainly due to the lack of available cargo fill them. See Table 6.1 below

TABLE 6.1

BARGE CHARACTERISTICS

Type	Length	Width	Height	Draft	Capacity
LASH	61.5 ft	31.2 ft	12.0 ft	8.83 ft (max)	369 LTons
SEABEE	97.0 ft	35.0 ft	17.0 ft	10.6 ft (max)	834 LTons

Since neither of the parent ships were involved in the test, all of the barges were administratively introduced into the test. LCM6 pusher boats and warping tugs were used to move the barges from Little Creek to Ft. Story. Mooring techniques at both the elevated causeway and the jacked-up DeLong pier followed standard practices for lighterage. Barges were pushed alongside both discharge facilities expeditiously and without incident. (See Figure 6.1).

Discharge techniques also followed the methods used for other types of lighterage with one notable exception. Unlike landing craft or amphibians, the barge hatch covers required at least a partial removal prior to any cargo off-load. LASH barges have a three-piece hatch while SEABEE barges have an eight-piece hatch. (See Figure 6.2).

Each section required separate handling and were stowed either on the discharge facility or on other sections still on the barge during off-load.

Table 6.2 summarizes barge discharge operations. "Unknown" times relect the lack of clearly defined segments in the available data. (Additional data is being sought.)

Off-loading at both discharge facilities was conducted during a single day period. The elevated causeway operation was on 6 August and the JUD operation on 18 August. Figure 6.3 shows the interior of a barge being off-loaded at the JUD and Figure 6.4 shows a vehicle being discharged from the barge.

TABLE 6.2

SUMMARY OF BARGE OFF-LOAD STATISTICS

LIGHTER TYPE	ID NUMBER	DISCHARGE FACILITY	TIME ALONGSIDE	TIME FOR HATCH REMOVAL AND RETURN	CRANE DISCHARGE TIME	CRANE LIFTS	MISC DELAYS	CARGO
LASH	PL-1-0540	JUD	176 MIN	42 MIN	74 MIN	4	60 MIN	4-MILVANS
SEABEE	LY-126	JUD	193	81	68	8	44	8-MILVANS
LASH	PL-1-0364	JUD	82	39	24	4	19	4-MILVANS
LASH	PL-1-0584	JUD	237	38	160	31	39	2-VEHICLES 29-PALLETS
SEABEE	LY-040	EC	278	UNK	151	36	UNK	6-VEHICLES 60-PALLETS
LASH	PL-1-0597	EC	155	UNK	104	15	UNK	4-VEHICLES 21-PALLETS
LASH	PL-1-0530	EC	127	43	46	4	38	4-MILVANS
LASH	PL-1-0271	EC	116	UNK	48	12	UNK	21-PALLETS

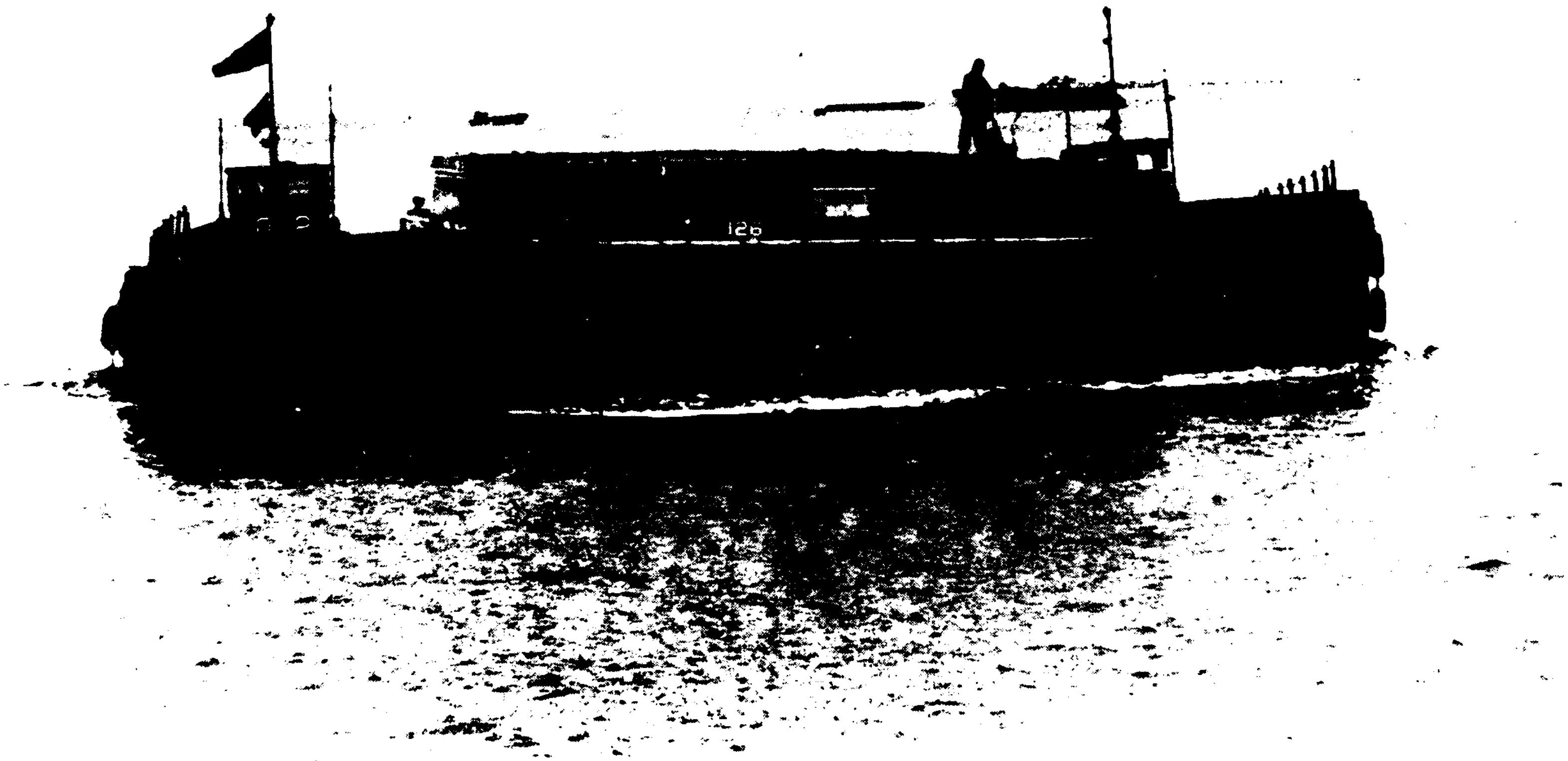

FIGURE 6.1. TWO LCM8s BRING A SEABEE BARGE INTO THE JACKED-UP DELONG PIER FOR UNLOADING

FIGURE 6.2. HATCH COVER IS REMOVED FROM A BARGE AT THE DELONG PIER

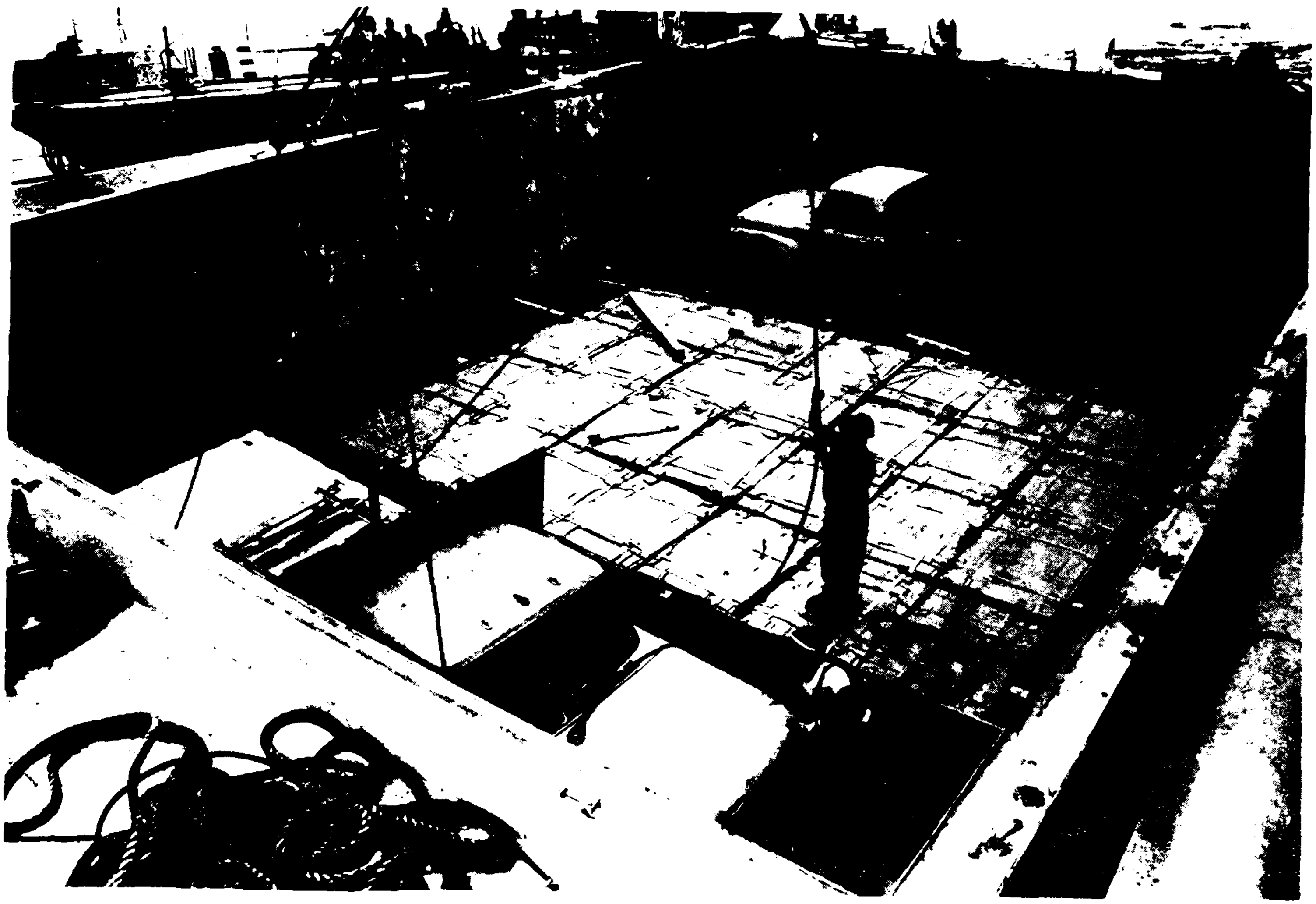

FIGURE 6.3. INTERIOR VIEW OF A LASH BARGE BEING OFF-LOADED AT THE DELONG PIER

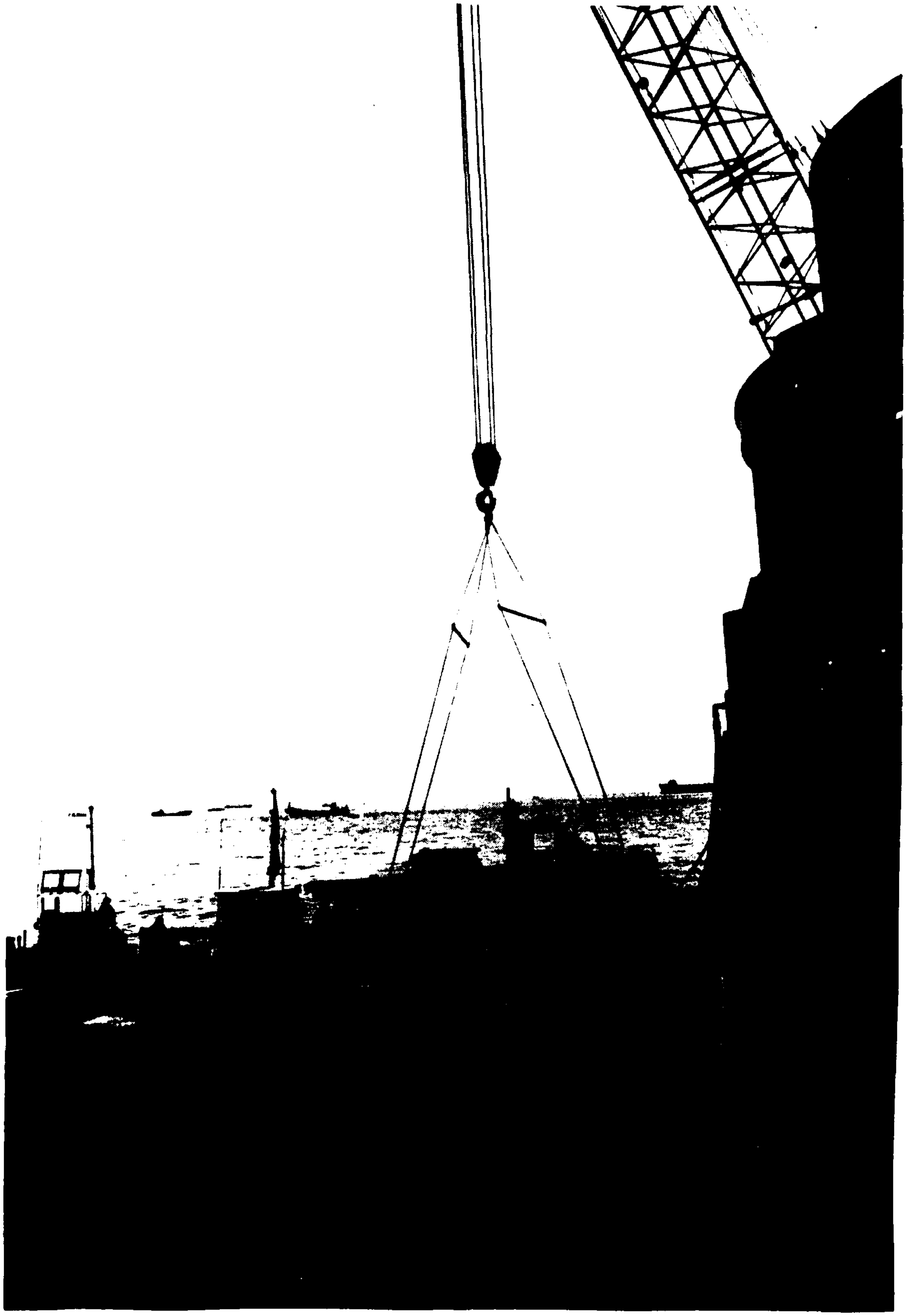

FIGURE 6.4. A VEHICLE IS REMOVED FROM
A LASH BARGE AT THE DELONG PIER

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