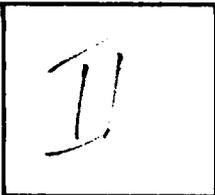


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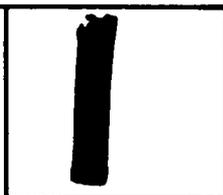
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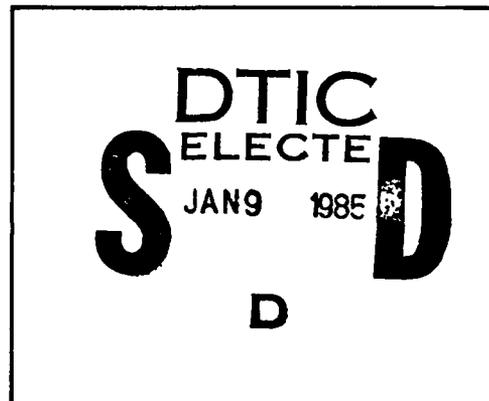
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**ORI** 1400 SPRING ST.  
Silver Spring, Maryland 20910

CONTAINER THROUGHPUT RESULTS OF  
OPERATIONS ASSOCIATED WITH  
SOLID SHIELD 79

6 JULY 1979

PREPARED FOR:  
COMMANDING GENERAL  
FLEET MARINE FORCE, ATLANTIC  
NORFOLK, VIRGINIA

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM	
1 REPORT NUMBER CR-TR 1520	2 GOVT ACCESSION NO.	3 RECIPIENT'S CATALOG NUMBER	
4 TITLE (and Subtitle) CONTAINER THROUGHPUT RESULTS OF OPERATIONS ASSOCIATED WITH SOLID SHIELD 79		5 TYPE OF REPORT & PERIOD COVERED	
		6 PERFORMING ORG REPORT NUMBER	
7 AUTHOR G. HOLIDAY, A. GREEN, R. BIHR		8 CONTRACT OR GRANT NUMBER N00014-79-C-0502	
9 PERFORMING ORGANIZATION NAME AND ADDRESS ORI, Inc. <del>1400 Spring Street</del> <del>Silver Spring, MD 20910</del> <i>Rockville, MD</i>		10 PROGRAM ELEMENT PROJECT TASK AREA & WORK UNIT NUMBERS	
11 CONTROLLING OFFICE NAME AND ADDRESS Strategic Mobility Sect., Force Embarkation, FMFLANT, Camp Elmore Norfolk, VA 23511		12 REPORT DATE 6 July 1979	
		13 NUMBER OF PAGES	
14 MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) Project Officer, R&D Planning Analysis & Support Division, Office of Naval Research 800 North Quincy St., Arlington, VA 22217 Attn: Mr. Ben L. Friedman, Code 232		15 SECURITY CLASS (of this report) UNCLASSIFIED	
		15a DECLASSIFICATION/DOWNGRADING SCHEDULE	
16 DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution limited			
17 DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)			
18 SUPPLEMENTARY NOTES Contracting Officer's Technical Representative - Lt. Col. Fred Fish			
19 KEY WORDS (Continue on reverse side if necessary and identify by block number) Amphibious Assault                      Cargo                      Crane Amphibious Logistic System          Causeway                  Discharge AFOE    Containerization        Elevated Causeway Beach and Port Co.                      Containership            Foreign Flag Vessel Breakbulk                                  COTS                      LACH                      (Over)			
20 ABSTRACT (Continue on reverse side if necessary and identify by block number) This report, sponsored by the Commanding General, Fleet Marine Force, Atlantic, analyzes the throughput results of container operations associated with SOLID SHIELD 79. The report analyzes data collected, evaluates equipment and procedures used, determines planning factors, and extrapolates results to determine the capabilities of a Landing Support Battalion (LS Bn.) to support a notional Marine Amphibious Force (MAF) across a beach into a marshaling area.			

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## EXECUTIVE SUMMARY

This report, sponsored by the Commanding General, Fleet Marine Force, Atlantic, analyzes the throughput results of container operations associated with SOLID SHIELD 79. The report analyzes data collected, evaluates equipment and procedures used, determines planning factors, and extrapolates results to determine the capabilities of a Landing Support Battalion (LS Bn.) to support a notional Marine Amphibious Force (MAF) across a beach into a marshaling area.

The ship used was a small, foreign flag, container vessel that was operationally hampered in sea states approaching marginal conditions. Sufficient fair weather and seas were experienced, however, so that periodically good container flow was attained across the beach.

The primary container handling system at the beach was an elevated causeway with a crane mounted on it. A lightweight amphibious container handler (LACH), used intermittently for demonstrations and as a reserve container handling capability, was stationed on the beach as a back-up for the elevated causeway. Extrapolating results, it was determined that the elevated causeway had a capability to handle about 190 containers per day and the LACH about 100 containers per day. Based upon a notional requirement for transferring 700 containers per day, two causeways and six LACHs would be required or, as an alternative, one causeway and eight LACHs would be needed.

The report recommended that the Commandant of the Marine Corps sponsor a study to do a systems analysis of throughput units and their resources. It also recommends that a planning factor for breakbulk cargo be determined through test and evaluation procedures and that certain doctrinal areas be reviewed to encompass some of the special requirements for container operations.

Some limitations in the evaluation were that no transshipment requirements were attempted, at no point was there any container unstuffing or retrograde documentation attempted, no dump operations were conducted, and no concurrent breakbulk handling was accomplished. Management and accountability were excellent but it was thought that with a more demanding throughput load a minicomputer would have been required to keep pace with documentation and transshipment requirements.

## I. INTRODUCTION

### 1. SCOPE OF OPERATIONS

During the period 12-18 May 1979 concurrent with the exercise SOLID SHIELD 79, units from the Marine Corps, Navy, and Army conducted a joint cargo throughput exercise at Camp Lejeune, N.C.<sup>1</sup> The exercise primarily involved containers off-loaded from a foreign flag container-feeder (intercoastal) vessel (see Figure 1.1); in addition, a limited amount of breakbulk cargo was also discharged by the Army during the joint terminal operations phase of the scenario. The exercise was accomplished in four phases:

- Site preparation and equipment staging (Phase I),
- Marine Corp-Navy container throughput operations (Phase II),
- Army container and breakbulk LOTS terminal operations (jointly supported) (Phase III), and
- Wrap-up and redeployment (Phase IV).

Marine Corps activity involved only container movement. The major participant was 2D Landing Support Bn.<sup>2</sup>, 2D Force Service Support Group. The exercise did not require the participation of the full battalion; in fact, elements of two of the landing support companies and part of the beach and port company had other separate commitments.

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<sup>1</sup>SOLID SHIELD 79 was essentially a joint command exercise (CPX). The scenario used for cargo throughput operations was unrelated to the main exercise; however, the command structure and timing of the annual exercise provided a convenient vehicle for the organization and conduct of a joint logistic field operation.

<sup>2</sup>The 2D Landing Support Bn. was organized from H&S Bn., Division Support Group, 2D Marine Division. Although the organization did not formally take place until 1 May 1979, the new battalion was given authority to prepare for container throughput planning and operations in advance of this date.

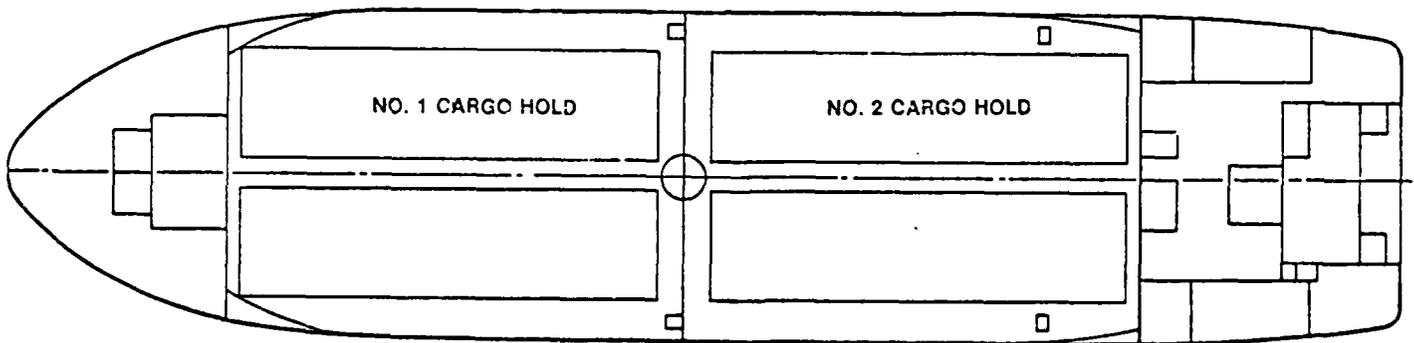
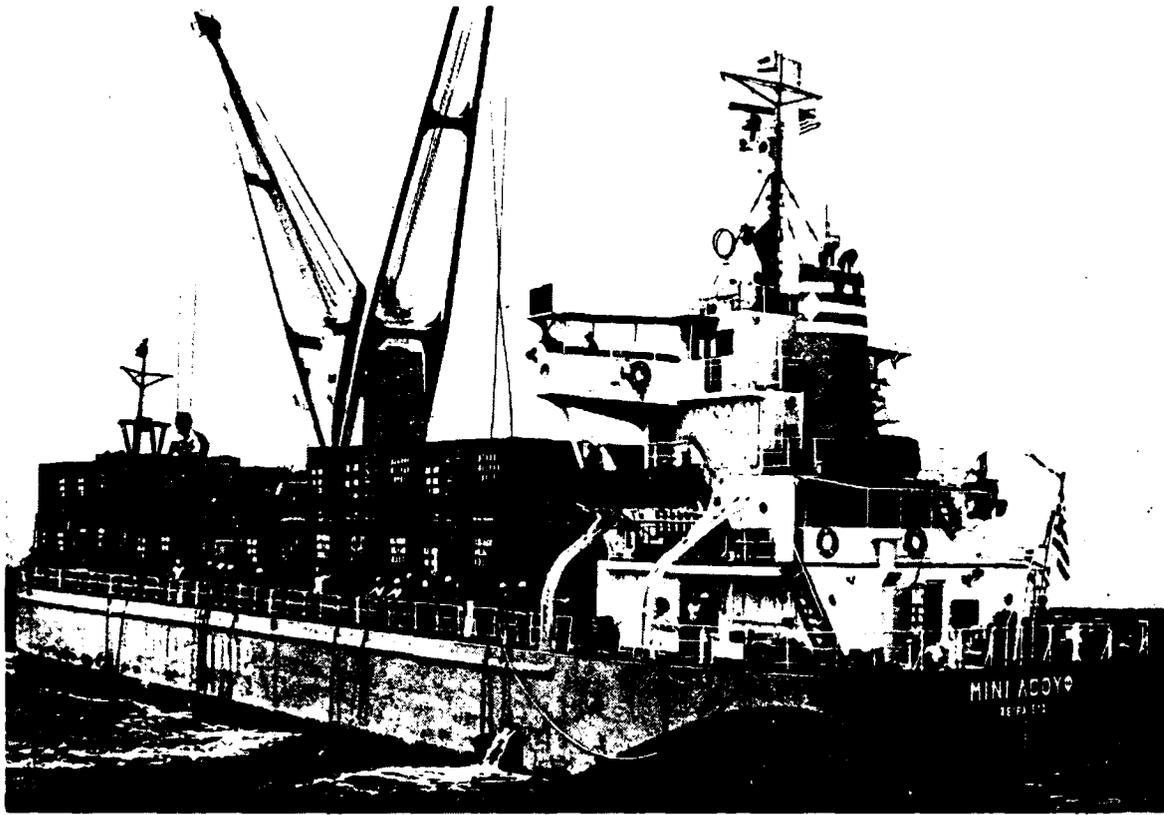


FIGURE 1.1. EL MINI LOAF. The foreign flag (Greek) vessel used for container throughput operations held 99 20-ft containers (Milvans) and had a crane capacity of 15 STons.



Phase I operations (not part of this evaluation) were essentially accomplished on an administrative schedule (8 April - 10 May). Most of this activity involved installation of the elevated causeway by the Naval Beach Group TWO. Installation required approximately 165 operating hours.

Three days (Phase II) were allocated for Navy-Marine Corps container off-load and retrograde operations. This was followed by an overnight turnkey operation in which an Army terminal service battalion took over ship, lighter, beach, and marshaling yard operations. There were then three days (Phase III) of Army LOTS operations with the 2D Landing Support Bn. assuming a consignee role but retaining responsibility for some exercise support. Other missions were performed by 2D Landing Support Bn., which were not part of the evaluation. The Army terminal service units conducted breakbulk training in addition to container operations. Neither the Army breakbulk operations nor container operations are part of this evaluation, except where equipment operations provided insights on techniques or some additional times for comparing equipment performance.

Approximately 20 officers and 375 enlisted Marine Corps personnel were directly involved in throughput support or in other capacities, e.g. troop messing, road repair, traffic control, medical, etc.

## 2. PURPOSE

The purpose of this evaluation is to assess the current capabilities of the 2D Landing Support Battalion to conduct container operations, review the procedures necessary for the management and accountability of a surface-supported container throughput system, and determine the limitations of the system to meet expected Marine Amphibious Force (MAF) container throughput requirements during an amphibious post-assault environment. In addition, this report also examines the procedures and requirements for transition to an Army-supported LOTS operation, at least insofar as they were demonstrated in the throughput operations.

## 3. OBJECTIVES

### 3.1 Report Objectives

The objectives of this report with respect to SOLID SHIELD 79 planning and operations are as follows:

- Evaluate the adequacy of the beach and port company table of organization to support container operations in a LOTS-type environment, making such recommendations as may be appropriate to resolve manning level or skill level shortfalls.
- Evaluate the adequacy of the landing support battalion table of equipment to support LOTS-type operations and identify both qualitative and quantitative deficiencies.
- Determine Marine Corps peculiar equipment shortfalls to support LOTS-type/container operations.
- Determine the adequacy of the M52A2/M127 tractor-trailer for container transportation.

- Evaluate methods/techniques to support container operations in a beach or marshaling yard.
- Determine personnel/equipment/level of training required to support one elevated causeway LOTS operation.
- Determine throughput planning factors utilizing one lightweight amphibious container handler (LACH).
- Evaluate procedures for transfer of Marine Corps responsibility for beach operations to the U.S. Army under LOTS.

### 3.2 Analysis

Using the data and planning factors developed during the joint exercise, project both current and future capabilities to support Marine Amphibious Force (MAF) assault follow-on echelon (AFOE) and resupply discharge requirements.

## 4. BACKGROUND

### 4.1 Commercial Impetus

The commercial evolution from breakbulk cargo modes to intermodal systems has necessitated adjustments to traditional DoD cargo throughput procedures and equipment. These new systems, especially containerization (which has become the dominant mode), have provided the means to accelerate the movement of supplies, improve cargo protection, and facilitate management and accountability. Savings in manpower and shipment costs are realized. Transportation flexibility and resource turn around times, particularly for ships, raise the productivity of the system and reduce the operating costs. Such advantages, in turn, can be exploited in an expeditionary environment, provided an appropriate system structured with the right hardware is employed.

### 4.2 Service Mission Areas

The Services have overlapping areas of interest in the off-shore discharge of merchant vessels and the conduct of LOTS operations. Service responsibilities have been jointly agreed upon and published<sup>2</sup>. LOTS nearly always is a common-user ocean terminal operation which by DoD Directive is under the management of the Army. However, the Navy in certain circumstances also has a LOTS responsibility, as well as the ship-to-shore responsibility for support of the Marine Corps in an amphibious assault, the assault follow-on echelon (AFOE), and during Force resupply. The most obvious distinction between Army and Navy ship-to-shore type operations is reflected in the degree of threat or hostility<sup>3</sup>.

<sup>2</sup>Army Regulation No. 55-176, OPNAV, Instruction 4620.6A, and Air Force Regulation No. 75-4, Transportation and Travel, Logistics-Over-the-Shore Operations In Overseas Areas, 8 September 1970.

<sup>3</sup>A secondary reason for a functional overlap is that each Service is responsible for the provision of its own combat logistic support.

LOTS is defined<sup>4</sup> as, "the loading and unloading of ships without the benefit of fixed port facilities in friendly or non-hostile territory and in time of war during phases of theater development in which there is no opposition by the enemy". On the other hand, an amphibious assault operation may be opposed or may be conducted in a high threat environment. Consequently, procedural, deployment, installation, and equipment requirements may differ as a function of the threat or lack thereof. Ultimately an amphibious operation would evolve into a LOTS operation, as was assumed and played in this exercise.

#### 4.3 Hardware Development and Testing

For approximately 10 years various Service programs have been addressing solutions for the hardware systems needed to employ containers in an over-the-beach role in order to capitalize on the evolution of commercial transportation advances. The major military problem, discharge of a non-self-sustaining (NSS) containership, has largely paced overall container system development. Ship discharge methods as well as better shoreside transfer methods, however are just now coming into being. They are based upon developments from field experiments primarily accomplished in the 1970 and 1972 timeframe involving tests such as the Off-Shore Discharge of Containership (OSDOC) exercises. By 1977 the Army had established an off-the-shelf hardware capability for its LOTS role and had procured sufficient assets for an operational test and evaluation of its container handling capabilities. The Navy and Marine Corps at that time were able to field a largely experimental container throughput system to support operations from a large containership to a nearby logistic support area.

In order to evaluate these initial capabilities which had been projected to be available in the 1977 timeframe, OSD agreed to sponsor a joint Logistics-Over-the-Shore (LOTS) test program. The test primarily looked at the Army system and Army equipment. However, the Navy's elevated causeway which had been under development for several years, the Marine Corps' newly developed lightweight amphibious container handler (LACH), a newly procured Drott 30-ton crane, and a modified M127 trailer pulled by an M52 tractor were assembled to form the basis of a Marine Corps-Navy shoreside container handling system. Management of the Marine Corps effort was accomplished by a Marine Support Element which drew the nucleus of its capability from the Beach and Port Operations Company but also drew from 2D Force Service Support Group (FSSG) for additional management and planning support. Marine Corps participation, while effective in accomplishing the container-supported throughput mission, was essentially an interim approach to a system requirement.

#### 4.4 Transportation System Requirements

Marine Corps assault forces have two fundamental logistic problems. The first relates to the necessity to support attacking units in the early stages of an assault; a problem for which doctrine, policy, procedures, and

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<sup>4</sup>Joint Chiefs of Staff, Dictionary of Military and Associated Terms, JCS Pub. 1, dated 3 September 1974.

system orientation have been well engineered and well tested. The second problem, which has not received any significant field evaluation, was addressed during SOLID SHIELD 79; that is, the throughput of assault follow-on-echelon (AFOE) and resupply cargo. This latter area has a two-fold problem, the physical handling of containerized and barge cargo in an expeditionary environment and the organized transition to the DoD system for the rapid throughput of cargo

Procedures governing the transportation of cargo for both peacetime and contingencies have been adopted by DoD and are published in DoD regulation 4500-32R, Military Standard Transportation and Movement Procedures (MILSTAMP). These procedures regulate the movement of cargo through the civilian transportation system to military consignees and are routinely employed by Marine Corps Base units, as well as other DoD transportation facilities and organizations. Because of the nature of amphibious warfare and movements preparation, Marine Corps units have been geared almost entirely toward the different requirements needed to support an amphibious operation and working with amphibious ships or merchant ships under emergency conditions. Thus, routine movement procedures generally do not apply and are waived. Consequently, landing support battalions and force service support groups are not normally tasked and do not train in the establishment and operation of a transportation network to mesh with the MILSTAMP system. It is important to note first, that MILSTAMP procedures cater to transportation systems that have been engineered for operations in a high volume/high productivity mode and second, to recognize that cargo management does not begin when it arrives at the beach but that specific consignees are addressed, movements monitored, and tracer actions will be initiated.

Consequently, landing support battalion not only had to plan for the physically more difficult handling of containers but also learn to adjust to the MILSTAMP system. With the anonymity that typifies containerized cargo, familiarization with MILSTAMP cargo documentation for identification and response to tracer and reporting procedures is important for rapid throughput to the appropriate consignees. As noted, these were areas not exposed previously to Marine Corps field units.

#### 4.5 1979 Exercise Differences

For container throughput operations in this year's field exercise basically the same equipment as the 1977 LOTS Main test, was used except that standard M127 trailers were employed instead of those fitted with container corner guides. One trailer experimentally was fitted with container locking pins (but no corner guides) for special evaluation by the Marine Corps Development and Education Command (MCDEC). (See Figure 1.2.)

The major difference in this year's field test was the employment at Camp LeJeune of the newly organized 2D Landing Support Bn. which provided the nucleus command and control elements for shoreside operations. However, two operationally significant procedural changes also were adopted. These included the use of Marines in Navy lighters to act as tagline handlers and some limited use of MILSTAMP documentation. Another significant departure from the 1977 LOTS test was that in the former exercise nearly all of the

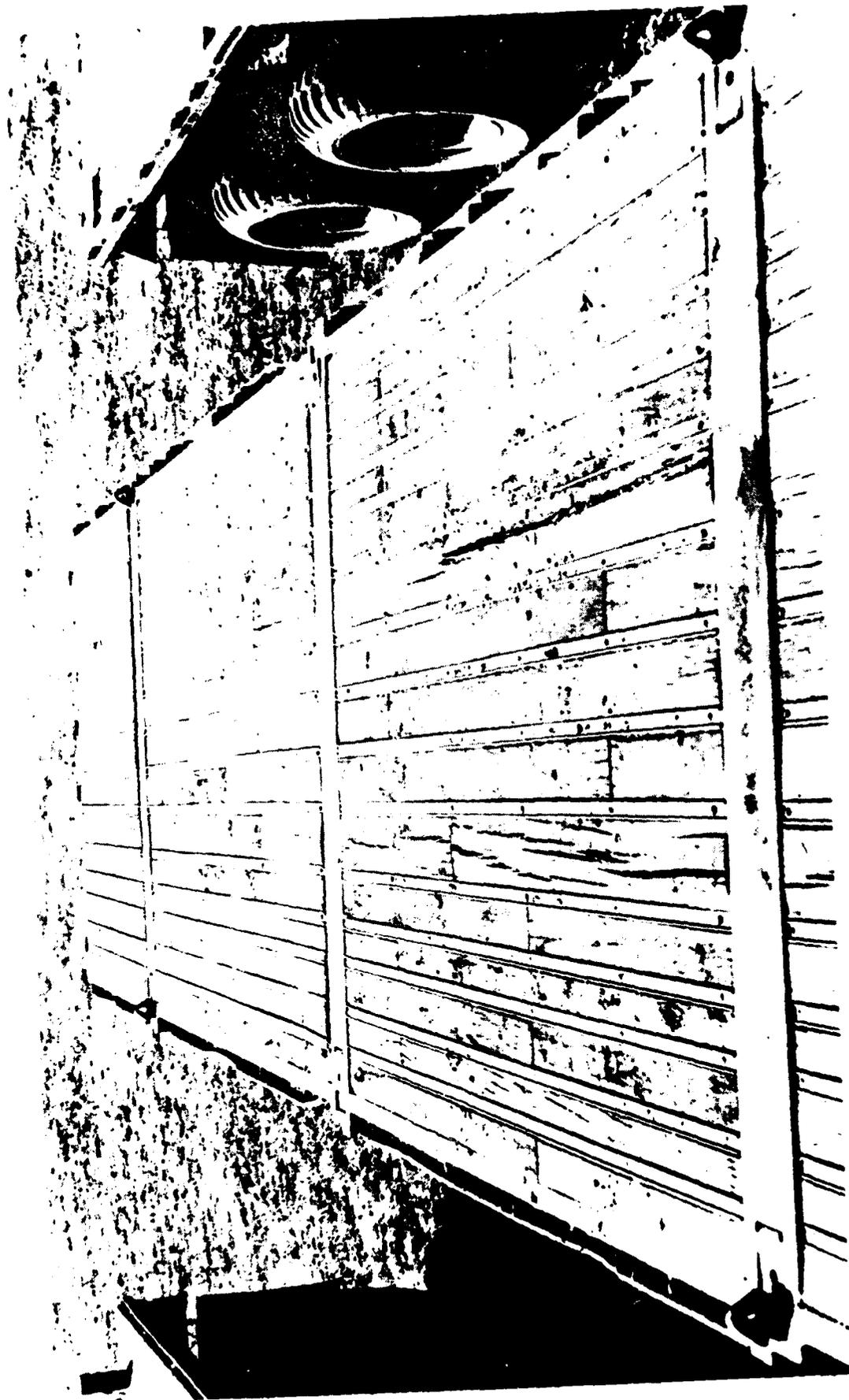


FIGURE 1.2. LOCKING PINS TESTED. Procedures for the use of International Standardization Organization (ISO) locking pins were evaluated by MCDEC as a means to expedite the securing of a load on a field trailer. The results could apply to future trailer buys.

containers had cargo, but in this year's field exercise only 21 of some 280 containers were loaded. These loads weighed about 13 STons, as opposed to about 1 1/4 STons per empty container.

The 2D Landing Support Bn. used elements of its Beach and Port Company for shoreside control; a detachment from a Landing Support Company to act as tagline handlers in the lighters; the battalion command section to oversee the entire operation; a detachment from Supply Battalion to operate the marshaling area; and various supporting units from 2D FSSG for maintenance, medical engineering, motor transport, and miscellaneous support requirements. One Marine Corps Base element, a detachment from the Traffic Management Office (TMO), was added to provide on-station receipt and retrograde documentation support of containers and assist with container limited technical inspections (LTIs). No supply or warehousing activity was attempted nor was any inland transshipment play attempted. Basically the exercise was limited to container movement from ship to a rearward marshaling yard, management, and accountability. The scenario for the exercise envisioned operations just prior to the introduction of Army LOTS forces and included a transition into Army terminal operations.

## II CONDUCT OF THE TEST

### 1. SECTION SUMMARY

This section describes the organization, concept of operations, management and accountability procedures, major events, and results observed at each node. The elevated causeway had priority for surfline operations over the LACH and consequently handled 88 percent of the containers. No major problems were encountered on the shoreside of the throughput exercise but the small ship was found to be very sensitive to sea state and wave action, especially during retrograde periods. The level of throughput from the ship did not stress ship to shore capability or shoreside activity. The most containers transferred (ship to marshaling yard) in a single 24 hr period was 91. The most transfers in a 1 hr period at the beach was 12, nine of which were at the elevated causeway and the other three at the LACH site. Cargo management by 2D Landing Support Bn. was accomplished using a manual system. Altogether the battalion moved 248 containers in the 3-day period.

### 2. AFOE/RESUPPLY OPERATIONS

#### 2.1 General

The 2D Force Service Support Group had overall responsibility to the Commanding General, Fleet Marine Force, Atlantic (CG, FMFLANT) for the conduct of container throughput operations associated with SOLID SHIELD 79. Consequently, the 2D Force Service Support Group Headquarters, which was a participant in the CPX, also had supervision over the container throughput operation but was not a participant in any container related events being conducted by 2D Landing Support Bn. and Naval Beach Group (NBG) TWO.

Operations began at 0600 12 May and were conducted on a 12 hr per shift, round-the-clock basis for three days. Stand-down periods from 0600-0800 and 1800-2000 were observed daily to accomplish crew relief, refuel equipment, perform operator maintenance, and complete whatever other preparation or adjustments were necessary prior to initiating each shift's throughput.

Site preparation was accomplished several days before the formal start of the exercise. Navy construction of the elevated causeway required approximately 65 hr of actual operation, which was accomplished intermittently over about a 2-week period immediately preceding the exercise. Marine Corps beach preparation, the installation of mo-mat roadway sections, was accomplished in about a week in advance. Figure 2.1 shows the general layout of the beach area, including the area where Army breakbulk operations were conducted (no mo-mat was used at that site). In the marshaling area, where necessary, a roadway was bladed or improved for tractor-trailer operations but no mo-mat was used.

Four exercise artificialities did impact significantly upon operations. These were:

- The unusually long distance (7.8 mi) from the beach to the marshaling area. (The intercoastal waterway separated the beach from the marshaling area. Crossing it at the closest installed bridge still meant a long detour.)
- The heavy commercial and pleasure boat traffic on the intercoastal waterway caused the bridge to be opened numerous times and often for prolonged periods.
- The large number of weekend bathers caused heavy pedestrian and private motor vehicle traffic within the exercise area.
- The unsuitability of the vessel (MINI LOAF) for off-shore operations resulted in an exceptionally low and sporadic discharge rate to the beach.

Other exercise artificialities impacted also upon the findings and conclusions. These are identified and discussed in the analysis section.

## 2.2 Organization and Command Relationships

2.2.1 Navy Organizations and Commands. The containerized cargo exercise scenario assumed a post D+15 time frame during which MAF resupply operations were being conducted. Although no amphibious ships were necessary for exercise play, one LPD, the USS SHREVEPORT, with COMSERVRON FOUR embarked took station off Onslow Beach in accordance with its exercise assignment. COMSERVRON FOUR was designated in the SOLID SHIELD 79 exercise as COMNAVFOR BLUE. As the senior Navy officer



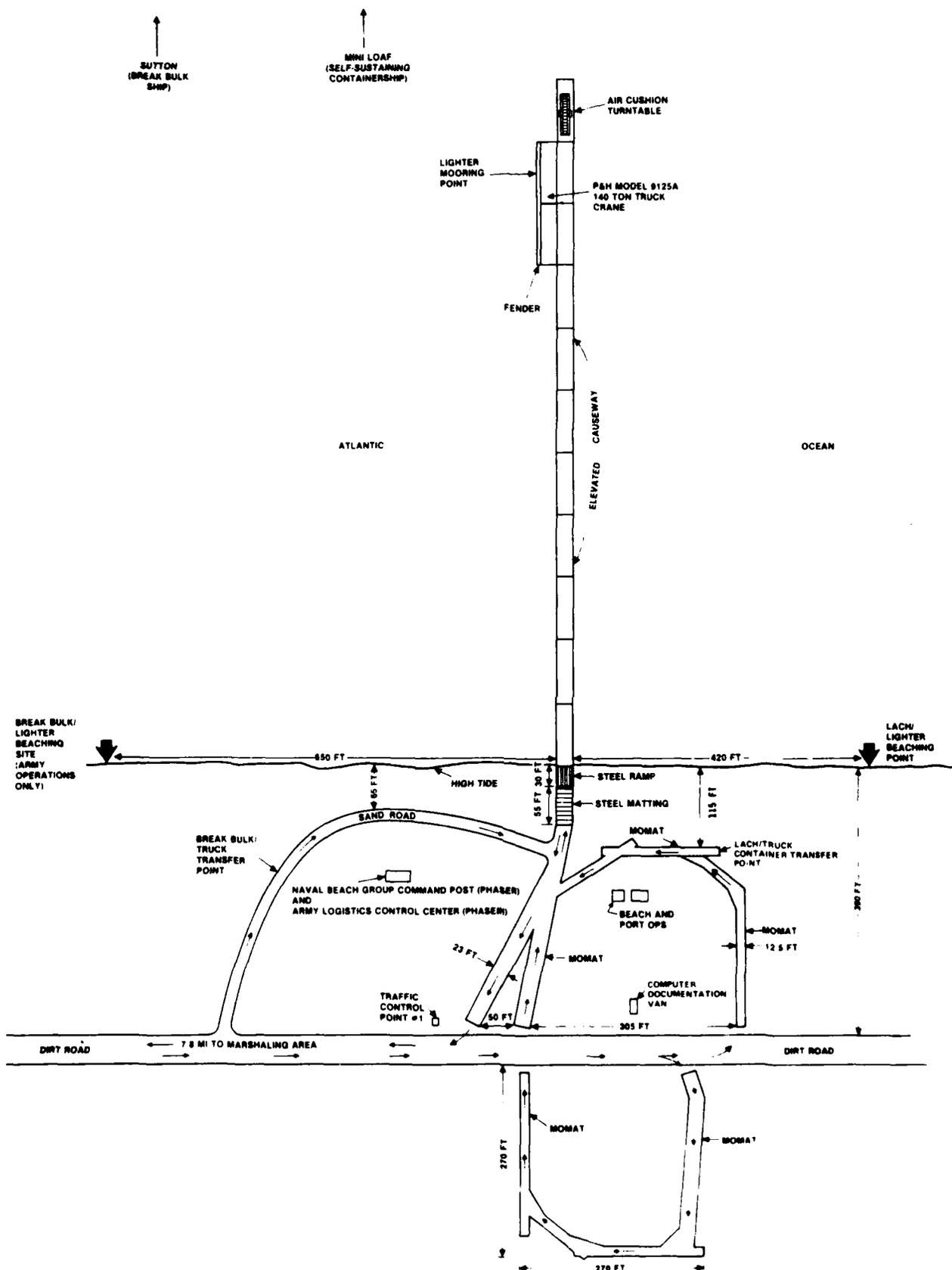


FIGURE 2.1. ORGANIZATION OF THE BEACH DURING CONTAINER THROUGHPUT OPERATIONS. Also shown above is the site used for Army breakbulk operations.

present, afloat (SOPA) he assumed overall command of operations afloat. These included some naval inshore warfare training for units not involved with container operations, as well as the Navy Cargo Handling and Port Group (NAVCHAPGRU) discharge operations from the MINI LOAF together with supporting lighter operations.

Naval Beach Group TWO was charged with two functions. In its normal role a naval beach group provides the command and staff elements for coordination and control of a beachmaster unit, amphibious construction battalion, and assault craft unit. In this instance, a NAVCHAPGRU detachment also was attached to Naval Beach Group TWO. In effect, the reinforced Naval Beach Group organization had all of the resources required to conduct a ship-to-shore operation. The second function assumed by Naval Beach Group TWO was that of a primary control ship (PCS); that is, the responsibility for coordinating and directing lighterage operations. Thus, in SOLID SHIELD 79 Naval Beach Group TWO was normally responsible for all operations seaward of the high water line.

Naval Beach Group TWO operationally reported to 2D Landing Support Bn. The working level relationships were established between Beachmaster Unit TWO of Naval Beach Group TWO and Beach and Port Company of 2D Landing Support Co. Beachmaster Unit TWO coordinated all lighter activities between the ship and shore.

2.2.2 Marine Corps Organizations and Commands. The 2D Landing Support Bn. provided the traditional Landing Force shore party effort. The battalion was task organized to support just the level of effort being attempted during SOLID SHIELD 79, as opposed to the much larger requirement of supporting a MAF. Figure 2-2 illustrates the task organization used in the test.

As stated in the battalion's operations order, the mission of 2D Landing Support Bn. was to provide the command and control element for the discharge, processing, and retrograding of containers. In fact, the battalion also provided a LACH capability, beach and shipside stevedore support, marshaling yard personnel and MHE resources, and various administrative and encampment services. It was, nevertheless, true that a significant share of the battalion's personnel were involved with the movement of containers in a command and control capacity. Table 2.1 lists the positions through which containers passed and the minimal manning requirements at each site. The movements management positions were at the Beach and Port Co. command post, traffic control point #1 (Beach and Port Co.), the logistic operations center (operated by the Headquarters, 2D Landing Support Bn.) and the marshaling yard control point (MCP) (operated by personnel from 2D Supply Bn.).

Personnel from the battalion who actually handled containers were stevedores from Company A (about two per landing craft per shift). The LACH crew (four personnel per shift), and the Drott 30-ton crane crews (three personnel per crane, three cranes per shift and one NCOIC). About four heavy equipment personnel were stationed at the beach per shift for forklift and dozer support. With supporting units the battalion altogether had a

total of about 20 officers and 375 enlisted personnel involved. Thus, 27 percent of the task organized force actually handled containers and 15 percent were directly involved in the management and accountability of containers. The remaining 58 percent were involved with functions such as medical, engineering, maintenance, traffic control, transportation (other than container transportation), billeting and messing, and routine administrative support.

TABLE 2.1  
MARINE CORPS MINIMAL MANNING LEVELS USED IN  
SOLID SHIELD 79 BY STATION PER SHIFT  
FOR CONTROL AND MOVEMENT OF CONTAINERS\*

<u>Station</u>	<u>Officers/Enlisted</u>	<u>Purpose</u>
Lighters	(2 per draft)	Stevedores
Elevated Causeway	0/4	Secure loads to trailers
Beach and Port CP	1/4**	Command and control
Landing Zone	0/3	Helicopter Support Team
LAC-	0/4	Stevedore and equipment operations
Lighter Beaching Site	0/3	heavy equipment support
Tractor-Trailers	0/15**	Container transportation
Traffic Control Point #1	0/3	Documentation
Marshaling Yard Control Point	0/7**	Documentation, guides
Cranes	0/10	Stevedores and equipment operations
Logistic Operations Center	1/8	Command and control

\* Support personnel (engineer, medical, maintenance, traffic control, messing, etc.) are not included. Not counted also are certain other positions such as floodlight units which were manned only in the day or at night but not both.

\*\* Includes CO and XO or, as the case may be, CIO.

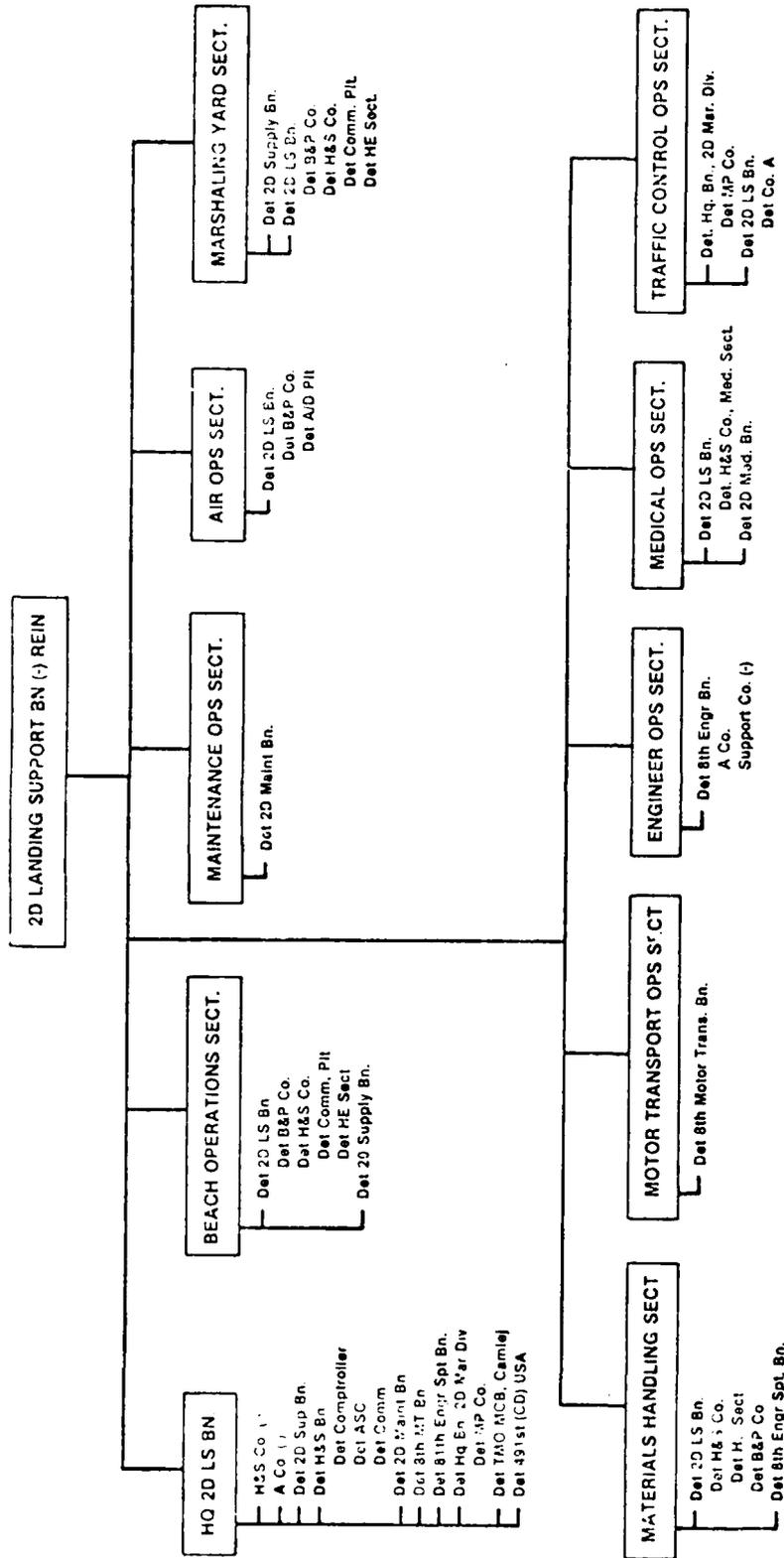


FIGURE 2.2. TASK ORGANIZATION OF 2D LANDING SUPPORT BN.

## 2.3 Concept of Operations

2.3.1 Scope. The concept of operations for 2D Landing Support Bn. was based primarily upon the transportation, control, and accountability of containers between the beach and a marshaling yard. Involvement with the distribution of container contents, the movements management of high priority or sensitive cargo, and the concurrent handling of breakbulk cargo were not factors addressed in the exercise.

2.3.2 Shoreside Operations. Beach and Port Company was tasked with the responsibility of managing shoreside operations. Originally the Navy intended to conduct an operational evaluation of the elevated causeway and requested tractor-trailer support. Consequently, as a matter of policy priority was given for supporting the flow of containers across the elevated causeway. The LACH was employed as a shoreside back-up in the event of a queue build-up or disruption of throughput capability on the elevated causeway. Operation of the elevated causeway was the responsibility of NAVCHAPGRU, who reported to NBG TWO. Beach and Port Company augmented with personnel from H&S Company heavy equipment section, operated the LACH. On the causeway, the securing of containers to trailers was accomplished by assistant drivers from the 8th MT Bn. detachment prior to the vehicle's departure off the causeway. Otherwise no Marine Corps personnel were involved with causeway operations.

2.3.3 Land Transport Operations. Land transportation of the containers was to be provided by M52A2 tractors and standard M127 trailers provided by a detachment from 8th Motor Transport Bn. Altogether, 20 tractors and 30 trailers were to be available. It was planned that only 10 tractor-trailer units would be on the road at a time, two units would be stationed for back-up support in the marshaling yard, and 3 units would be staged for back-up support at the elevated causeway. The 15 remaining trailers were to be available at either site as needed. During each beach-to-marshaling-yard-and-return cycle vehicles hauling were required to stop at a field motor pool enroute for a maintenance inspection.

2.3.4 Marshaling Yard Operations. In the marshaling yard two Drott 30-ton cranes were planned to off-load/load tractor-trailer units. Four sites were to be used for storage and storage assignments were to be made at marshaling yard control point. Cranes and tractor-trailers would both proceed to the assigned storage locations where the container was to be off-loaded or loaded, depending upon the container class of supply indicator.

2.3.5 System Management. Control was built into the system by the reporting of container and tractor-trailer identification numbers. A specific container number in the system first surfaced with the ship's cargo manifest, which was held by the LOC; thus, cargo and consignees could be immediately identified and routing planned, as required. Container reporting began with NAVCHAPGRU providing periodic off-load reports to NBG TWO. However, no reports were passed to Beach and Port Co. unless special handling was required. Once a container had departed to the elevated causeway or LACH site, it had to pass traffic control point (TCP) #1, where its container and vehicle trailer numbers were to be recorded and the driver was then to be dispatched to the marshaling area. TCP #1 then was supposed to report the arrival to the LOC.

Military police at key intersections were to direct the vehicles along the route. At the marshaling yard the vehicle was to be halted, further directions passed regarding storage locations, a guide assigned to direct the driver, and then the container could be transported to its temporary storage site. The marshaling yard was then to report the arrival and storage assignment to the LOC. The assignment of storage locations was to be based upon class of supply instead of consignee. Management was accomplished by the marshaling yard control point (MCP).

The LOC was expected to maintain a log and status boards of intransit containers. If transshipments were required, the LOC would have received disposition instructions from 2D FSSG. According to the scenario, 2D FSSG would have been located many miles inland. Cargo movement would have been eventually directed inland by 2D FSSG following an arrival report from 2D Landing Support Bn. In addition, line haul resources would also have been provided by 2D FSSG.

Primarily movement control and documentation were to be keyed upon the use of a container trip ticket designed by the battalion especially for the exercise. The trip ticket required the container number, times in and out of TCP #1 and the marshaling yard, trailer number, marshaling yard site locations, and remarks when appropriate. The trip ticket remained with the container and was eventually retained at the marshaling yard. A reverse process was planned for retrograde.

Paralleling the manual documentation process was an automated documentation system operated during the Marine Corps-Navy phase by the Army's 491st Cargo Documentation Detachment of the 7th Transportation Group. This system is described in Annex A. Briefly, shipping manifests and transportation control and movements documents (TCMDs) were prepared in advance by the Army using cargo and consignee information furnished by 2D FSSG. A van-mounted ADP central processing facility was set up on the beach and two remote video work stations were tied in from TCP #1 and the MCP. For forward movement cargoes, TCMDs were issued from the TCP and retrieved at the MCP. Work-station operators, using their remote terminals updated the computer central files for each container movement into or out of their check-points, furnishing date, time and container location. Periodically, the processing facility produced listings by containers. With the continuing update system, any work station as well as the central processor could, upon request, produce up-to-date locator information.

#### 2.4 Test Cargo

The test cargo consisted of about 280 containers (milvans), some of which were missing doors and had other defects. While a number were not suitable for actual shipment, they could be used satisfactorily for training. The number of containers available was about three times the capacity of the ship, so about 200 were left in the marshaling area as cargo that "had been landed" and part as cargo that was ready for retrograde.

When the ship arrived it did not have a maximum load. Consequently, a retrograde exercise was conducted before the exercise until it had 98 containers aboard. Of these, 21 were loaded with C-rations being shipped from Yorktown to

Camp Lejeune. The loaded containers averaged about 12.7 STons each, including tare weight plus about 11.4 average STons of cargo. The loaded containers were deck stowed with empty containers stacked on top of them.

## 2.5 Summary of Operations

Marine Corps-Navy throughput results are summarized in Figure 2-3. Operations began the first day at a rapid pace. The deck stowed, empty containers were the first off-loaded. With calm seas and the first 36 containers all empty (so the two cranes could work independently), the ship discharged at a rate averaging about 6.5 containers per hour. At about that time a queue of loaded lighters was building at the elevated causeway so two LCM8s and an LCU were diverted to the LACH discharge site.

By then the ship had reached the containers having C-rations in them. These containers each required both cranes per lift, effectively reducing discharge productivity by 50 percent. Over the next 4.4 hr the ship off-loaded 23 containers, of which 21 had C-rations in them. Until that point, the beach had averaged a transfer rate of seven containers per hour, peaking at a rate of nine per hour, with the change over to loaded containers, the rate of handling at the beach dropped back to about four per hour.

During the first night shift the ship was slowed by the necessity to open hatches, as well as experiencing other delays. Consequently, only 32 containers or about three per hour were handled on the beach and all of these were accomplished by the elevated causeway. After 24 hr the elevated causeway had transferred 83 containers and the LACH 8.

On the second day the LACH finished the first ship off-load period by discharging the last eight containers. In the meantime, retrograde operations were initiated which created an unexpected surge requirement for tractor-trailers. As a result, the elevated causeway, which initiated the first retrograde period, experienced some delays during the transition from off-load to retrograde.

Retrograde at the ship progressed much more slowly than the off-load. Attachment of the spreader bar by a ship crane to a container in a lighter alongside was influenced by different vessel motions. Thus, control of the hook-up process was largely a matter of chance, mostly determined by swell and wave activity as opposed to crane operator skill.

During the second day of activity, 71 transfers were made; eight of which were LACH off-loads and seven retrogrades while the remainder (56) were elevated causeway retrogrades. Because the ship was having difficulties backloading and sufficient loaded lighters were in queue, the second night shift at the beach handled only 13 containers. In addition, thunderstorm activity forced an operational shut down.

On the final day of Marine Corps-Navy throughput operations there were almost as many transfers (86) as the first day (91). The number backloaded aboard the ship was terminated at 75 for ship stability reasons and the second off-loading period began at noon. By 0600 the next day the ship had been almost

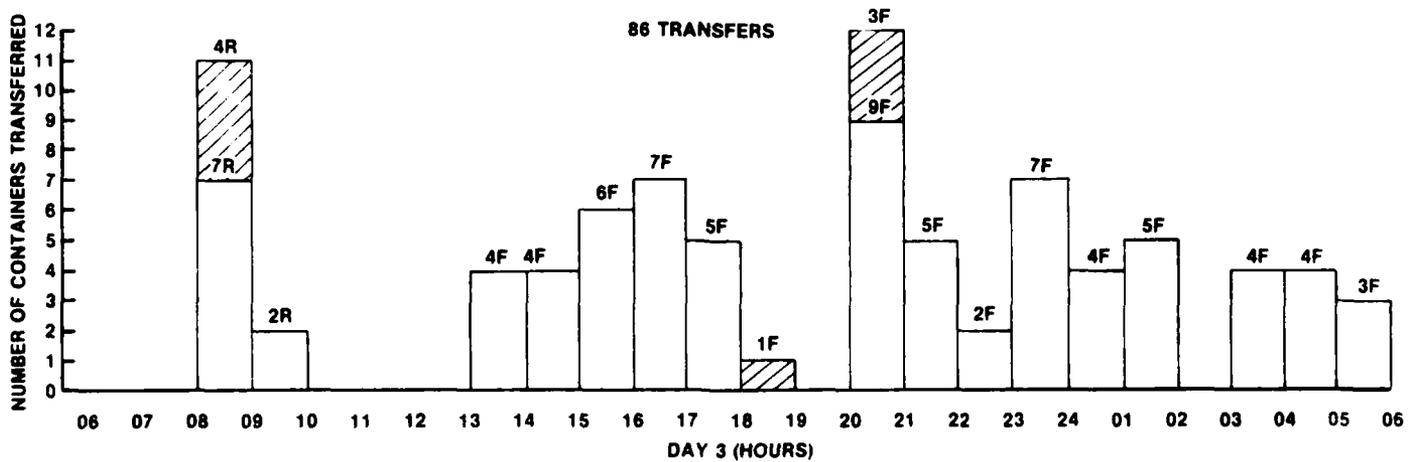
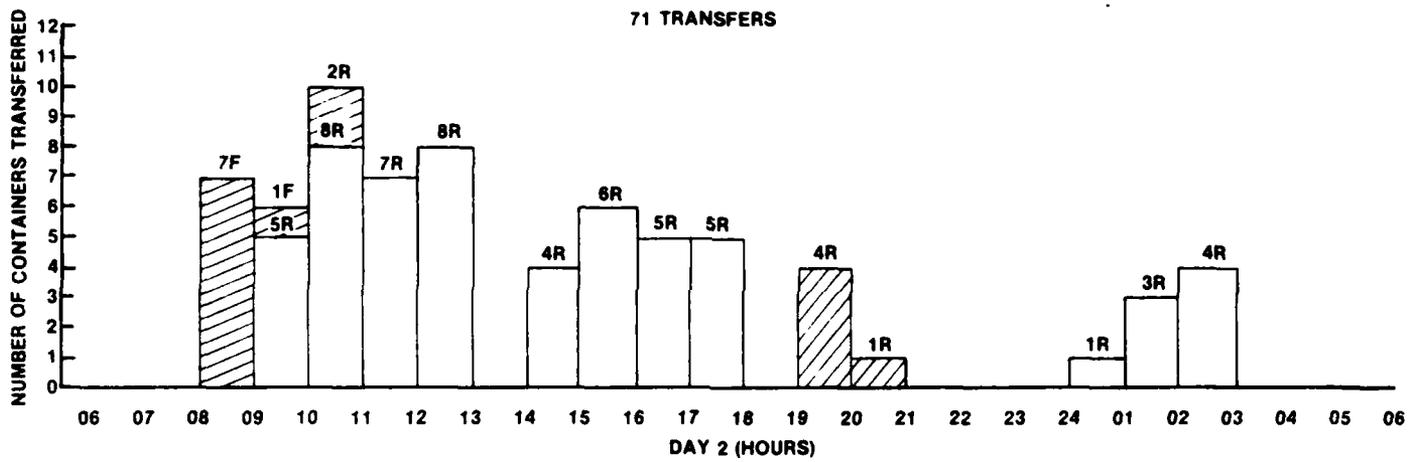
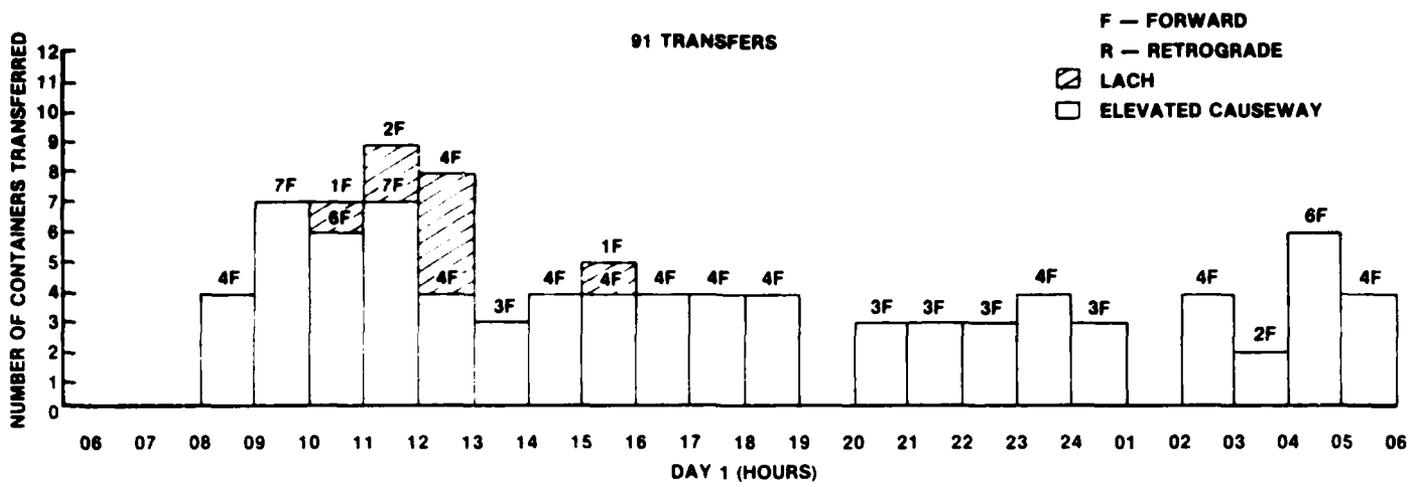


FIGURE 2.3. SUMMARY OF BEACH TRANSFER OPERATIONS DURING PHASE II.



completely off-loaded again. The peak Marine Corps-Navy off-load period at the beach during the exercise occurred during the night shift when nine containers were off-loaded at the elevated causeway and three at the LACH site. Of the 86 transfers 13 were retrograded and 73 were off-loaded on the final day.

Overall, in the Marine Corps-Navy segment of the exercise 248 container transits between the ship and marshaling yard were made. Of these 30 percent were retrograde and required 40 percent of the time. The elevated causeway accounted for 87 percent of all container transfers. The LACH had a good deal of idle time. Neither of the facilities was taxed by its workload.

In the paragraphs which follow operational details at each major link and node are discussed. The analyses of these events are discussed in the section which follows.

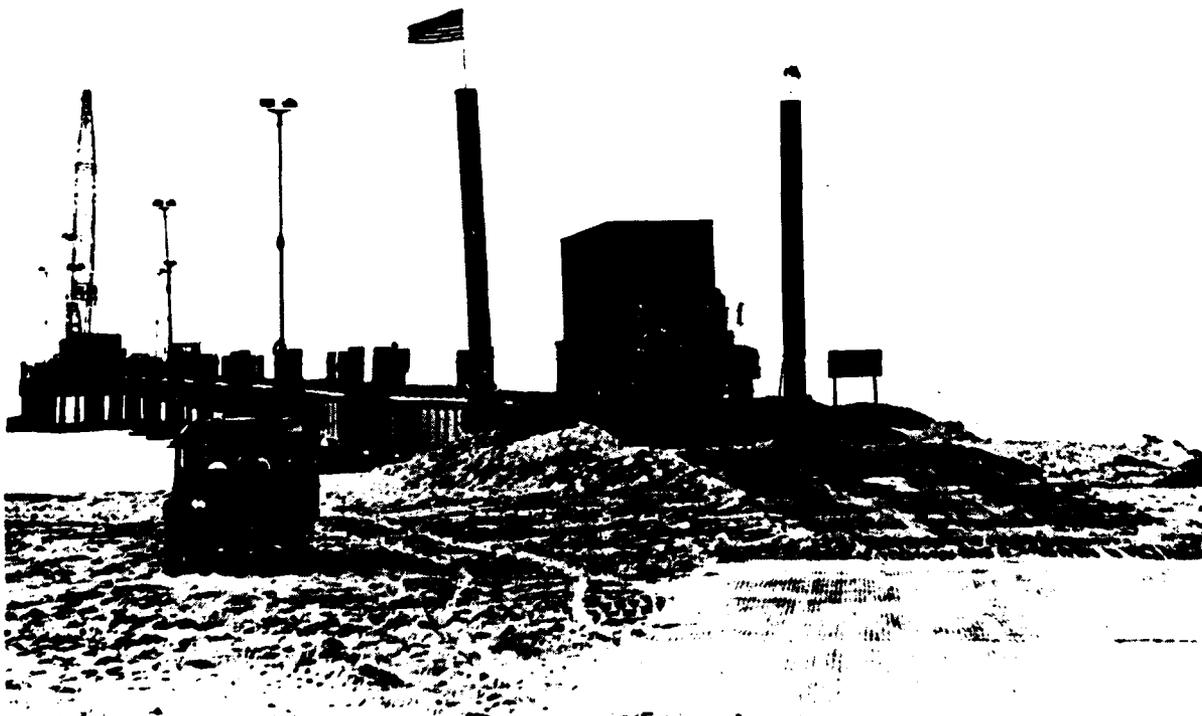


FIGURE 2.4. THE ELEVATED CAUSEWAY HANDLED 86 PERCENT OF THE 248 CONTAINER TRANSFERS MADE DURING THE THREE DAYS OF PHASE II.

### 3. SHIP AND SHIP-TO-SHORE OPERATIONS

#### 3.1 Characteristics

The vessel made available through MSC charter for support of this exercise was the SS EL MINI LOAF, an inter-island/coastal container and breakbulk carrier of foreign registry. The vessel is 215 feet long with a 50 foot beam, 16 ft. navigational draft, displacing 2,972 deadweight long tons, a cruising speed of 8 kts and a crew of 10 personnel. A photograph of the ship with an LCU alongside is shown in Figure 2.4. The EL MINI LOAF is equipped with two cranes operating from a single central kingpost, each crane being of 15-ton capacity. The vessel has a capacity of 100 20-ft containers, including double deck loading on the hatch covers. The holds are not equipped with container cell guides.

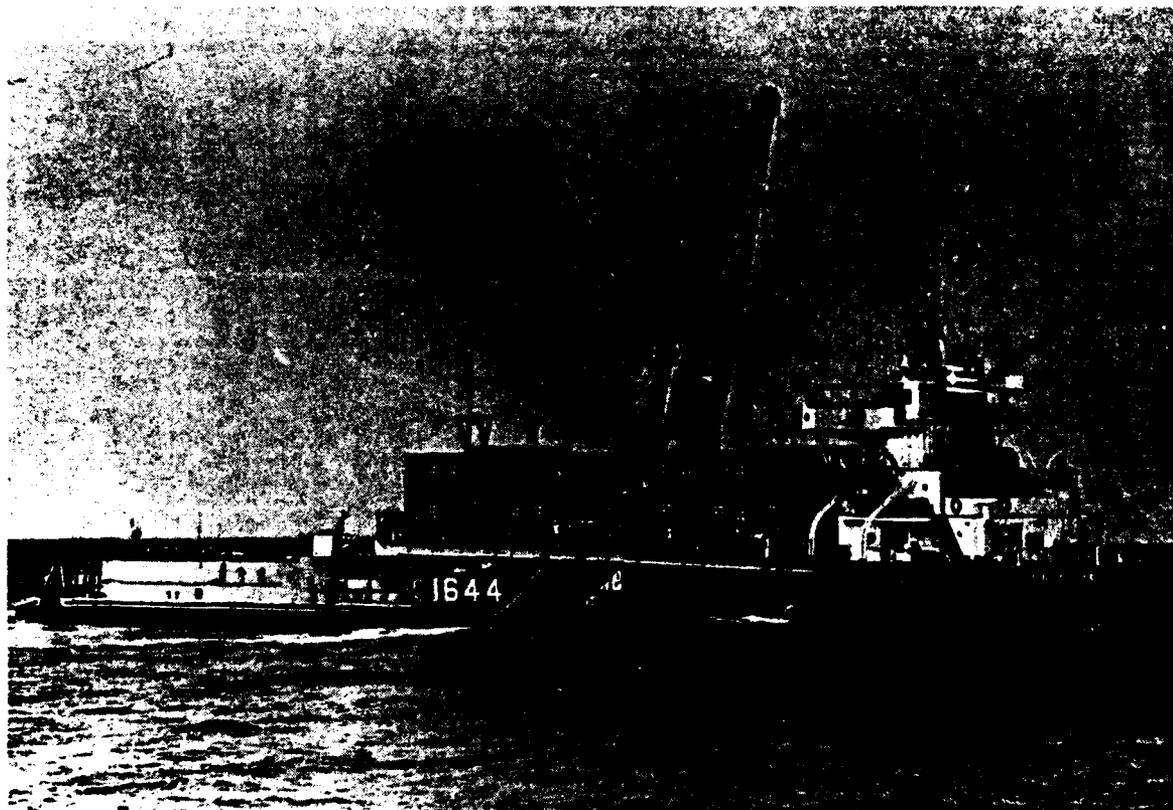


FIGURE 2.4. THE MINI LOAF IN RELATION TO AN LCU.

### 3.2 Exercise Preparations

The charter commenced 6 May with the vessel's arrival at CHEATHAM Annex, Virginia. From 6-8 May NAVCHAPGRU personnel gained familiarity with the ship and on-loaded 76 pre-staged milvans. EL MINI LOAF sailed on 8 May arriving off Onslow Beach in time to commence the backloading of additional containers on 10 May. At that time 22 additional containers were positioned on board during the period 10-11 May. Accordingly, at exercise commencement at 0600, 12 May, MINI LOAF had a load of 98 containers.<sup>1</sup> The 21 loaded containers, containing C-rations, were included among those comprising the deck load. On a decision of the master of the vessel, off-loading of the loaded containers was to be accomplished with the booms operating in tandem, because the weight of the loaded container (about 13 tons) approached the individual crane working load limit. It was anticipated that working in an open roadstead would add dynamic stresses not encountered at a protected pierside operation.

### 3.3 Exercise Operations at the Ship

From commencement of the exercise at 0600 12 May until about 0610 13 May, some 99 containers were transferred to the beach. Weather during this first day of operations was moderate, with the maximum wind about 25 kts and a medium seaway estimated by NAVCHAPGRU personnel as 4-7 ft which produced rolling of a maximum of 10° to the MINI LOAF.

However, there was heavy rain experienced during the early morning hours of 14 May. Nevertheless, 96 containers were loaded as of about 1330 4 May. Operations at MINI LOAF were limited to one side (leeward side) for some 7 hrs. during daylight hours and about 3 hr. at nighttime due to weather influences. During the backload period, an outage of about 7 hr. was experienced on one crane. Operations on the other crane were lost for a period of about 1 hr. due to severe weather (25 kts winds, 6 ft waves, and rolls up to 7°).

On 14 May forward movement commenced upon completion of reload about 1330. As of about 0530 on 15 May, 75 containers were discharged. One container was left on board to provide a placement guide for Army personnel to use during the next phase. Two containers did not make it to the beach before the transition and were backloaded by the Army.

### 3.4 Lighterage

During the Navy-Marine Corps phase, 4 LCM-8s and 5 LCUs constituted the active lighterage fleet. During stand-down periods, LCM8s were "married" to LCUs for crew support. Refueling was accomplished by the SHREVEPORT. There

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<sup>1</sup> As noted above, MINI LOAF was loaded with 98 containers. The 99th container was in a lighter at the start and was landed ashore as part of the forward movement.

were no significant breakdowns noted, in the sense that all lighters were involved each day. However, some minor outages occurred as, for example, a steering problem which delayed one boat for about an hour at the elevated causeway.

Altogether, lighters transported 250 containers (including the two which did not get off-loaded at the beach). LCUs carried the bulk of the effort but often were not loaded to the maximum at the ship because of pendulation of the load due to ship movement and the added motion of the lighter. Lighter succession times at the elevated causeway are discussed in the section which follows. Table 2.2 provides a summary of the loads carried by lighters during the Marine Corps-Navy phase.

Table 2.2

SUMMARY OF LIGHTER OPERATIONS  
DURING AFOE-RESUPPLY PHASE

	No. Transits Made to:		No. Contnrs. Carried to:		Average Loads
	Elevated Causeway	LACH	Elevated Causeway	LACH	
LCU	46	7	172	25	3.72
LCMB	27	4	45	6	1.65

#### 4. ELEVATED CAUSEWAY

##### 4.1 Background

The elevated causeway that was used during the SOLID SHIELD test is shown in Figure 2.5. It consisted of 13 3x15 causeway sections. The most seaward causeway section supported the air cushion turntable which provided a means of turning trucks around. Immediately inboard of the turntable section the pierhead was two causeway sections wide and two causeway sections long. Two fender units each comprised of a 1x15 pontoon section were attached to the pierhead. A series of foam-filled, commercial ship fenders were strung on the outboard side of the pontoon fenders. A P&H 140-ton truck crane model 9125A was mounted on the pierhead section to transfer containers between lighters and tractor-trailer units. The pierhead section was connected to the shore by an eight causeway section roadway. A 30-ft steel ramp provided a transition between the causeway and the shore.



FIGURE 2.5. THE ELEVATED CAUSEWAY PREPARED FOR OPERATIONS AT ONSLOW BEACH

The dimensions of the elevated causeway components are given in Table 2.3.

TABLE 2.3  
DIMENSIONS OF THE ELEVATED CAUSEWAY COMPONENTS

<u>COMPONENT</u>	<u>DIMENSIONS</u>
Causeway Section (3x15)	21 ft x 90 ft
Turntable	48 ft in length 16 ft diameter base
Pontoon Fender (1x15)	7 ft x 90 ft
Ramp	21 ft x 30 ft

Lighting for the elevated causeway was provided by a newly designed and constructed system which provided improved lighting over that used in the previous LOTS test. The light poles which fitted into the causeway pilings during the test withstood high winds and rain storms. Observers rated the lighting system highly and thought it facilitated night operations on the causeway. Another item installed on the causeway for this test and not available during the LOTS test was a safety net which circumscribed the causeway pierhead except from the mooring area.

#### 4.2 Concept of Operations for the Elevated Causeway

The P&H 140-ton truck crane positioned on the pierhead section transferred containers between lighters and tractor-trailers. When a lighter was called alongside the elevated causeway, mooring lines were passed from the causeway to the lighter. Tidal currents sometimes made the mooring process more difficult, frequently moving the lighter into or away from the fender. Only one lighter moored at the causeway at a time. After the transfer of containers was completed at the causeway, the lighter retracted and was then succeeded by a new one. During the lighter succession process the crane on the causeway was idle (delayed) once its container transfer cycle was completed.

Tractor-trailers going on the causeway were initially queued on a mo-mat road that ran across the beach to the elevated causeway. Just prior to driving onto the causeway, the drivers were issued hard hats and life jackets. These were collected when the tractor-trailers departed the causeway. Once on the causeway drivers of the tractor-trailers were directed by Navy signalmen. The tractor-trailer drove up the left side of the causeway to a second queue near the pierhead. Two to four tractor-trailers were usually in the second queue.

For forward container movement an empty tractor-trailer departed the causeway pierhead queue shortly after the preceding tractor-trailer went on the turntable. Once the preceding unit was rotated, it then drove off the turntable and waited on the pierhead until the tractor-trailer being loaded had cleared the crane's loading point. (See Figure 2.6.) The empty tractor-trailer unit then moved into the load position. After being loaded, it cleared the crane and proceeded to a designated point on the causeway to the trailer. Tractor-trailers proceeded off the causeway on the left side. After a tractor-trailer departed the causeway, a new tractor-trailer in the beach queue was sent onto the causeway.



FIGURE 2.6. VEHICLE EXCHANGE ON THE ELEVATED CAUSEWAY  
(CRANE AT RIGHT IS NOT SHOWN)

For retrograde container movement procedures were nearly the same. Loaded tractor-trailers remained in the causeway pierhead queue until the tractor-trailer under the crane was off-loaded and had cleared the crane's off-load position. Then a tractor-trailer unit from the causeway queue proceeded to the off-load position at the crane. Containers were unlashd while the trailer was in the queue. After being off-loaded the tractor-trailer drove to the turntable where it was rotated so it could drive off the causeway. Tractor-trailers drove on and departed the causeway on their left side.

#### 4.3 Problem Areas

At the beginning of shift two on the second day (13 May) the crane boom on the causeway was lowered for routine maintenance. It was discovered that the cable on the hook block was not correctly threaded and the hook block had been damaged. The damaged hook block was replaced in about 1 hr and operations continued.

The turntable experienced a failure which halted operations on the causeway for a period of about 1 hr also during the second day. The problem was with the air compressor. This equipment casualty was resolved by replacing the compressor with another one.

#### 4.4 Exercise Results for the Elevated Causeway

The elevated causeway was the primary system used to transfer containers between lighters and tractor-trailers at the beach. The elevated causeway off-loaded 152 containers and retrograded 65 containers during the three days of Phase II. This is an average rate of 72.3 container transfers per day with a one day peak reached of 91 containers. By comparison, the one day peak for the elevated causeway during the 1977 LOTS test was 132 containers. In both cases, the elevated causeway lacked sufficient lighters to keep it busy.

A total of 46 LCUs came alongside the elevated causeway averaging 3.74 container transfers each. A total of 26 LCM8s came alongside the elevated causeway accounting for an average of 1.67 container transfers each. The number of lighters that came alongside the elevated causeway and the number of containers transferred for each shift are given in Table 2.4.

TABLE 2.4  
NUMBER OF LIGHTERS ALONGSIDE  
THE ELEVATED CAUSEWAY AND  
AVERAGE NUMBER OF CONTAINERS  
PER LIGHTER.

DAY	SHIFT	NUMBER OF LCUS	AVERAGE NUMBER OF CONTAINERS PER LCU	NUMBER OF LCM8S	AVERAGE NUMBER OF CONTAINERS PER LCM8
1	1	11	3.45	8	1.62
1	2	4	4.00	8	2.00
2	1	11	3.72	3	1.67
2	2	2	4.00	1	2
3	1	7	3.71	7	1.29
3	2	11	3.91	-	--
TOTAL		46	3.74	26	1.67



## 5. LACH OPERATIONS

### 5.1 Background

The lightweight amphibious container handler (LACH) is a rubber tired, hydraulically operated and maneuvered (during the pick-up and removal of 8 x 8 x 20 containers) device that is propelled by an engineer tractor/dozer. As envisioned in the Marine Corps Letter of Adoption and Procurement,<sup>1</sup> the LACH will normally be used whenever the primary discharge system for containers (the Navy elevated causeway) is inoperative or when the input to the beach exceeds the capacity of the elevated causeway. (See Figure 2.7.)

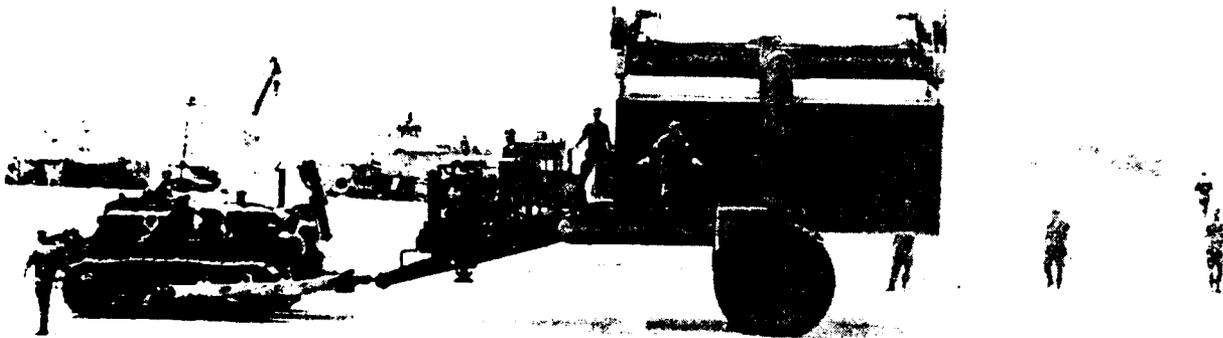


FIGURE 2.7. THE LACH WITH A LOAD AT ONSLOW BEACH

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<sup>1</sup> Deputy Chief of Staff for Installations and Logistics, Headquarters, Marine Corps, Letter of Adoption and Procurement 22-78 for Lightweight Amphibious Container Handler (LACH), 9 June 1978.

The LACH was first used in the LOTS main test. In that test also it was used as a back-up for the elevated causeway. During the LOTS test the LACH off-loaded 158 containers and retrograded 139. The most containers it transferred in a single shift was 49. The cycle time for lighter to trailer times (and return) was about 11 minutes.

The unit cost of the LACH has been estimated at \$98,000. The initial provisioning level for the Marine Corps has been set at 56, of which 14 are specified for mobilization. The initial item delivery is currently scheduled for the first quarter of 1983. At the present time 14 are to be added to the landing support battalion table of equipment. The LACH will be supported for maintenance and operation by the existing tables of organization. No military occupational specialty changes are believed required. The LACH characteristics are contained in Table 2.5.

TABLE 2.5  
LACH BASIC CHARACTERISTICS AND PERSONNEL REQUIREMENTS

Vehicle Data	
<u>LACH:</u>	
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 0 in (W) x 19 ft (H)
<u>Terex 3230 Crawler Tractor:</u>	
Weight:	54,520 lb
Dimensions:	225 in x 134 in x 144 in
Operating Personnel Characteristics	
<u>LACH:</u>	
	1 Hydraulic Lift Operator
	1 Spreader Frame Operator, or
	2 Spreader Bar Hook Operators
<u>Terex 3230 Crawler Tractor:</u>	
	1 Operator

## 5.2 LACH Preparations

The LACH was moved from the Marine Corps Development and Education Command (MCDEC), Quantico, VA. about 2 weeks prior to the test. Approximately 2 routine working days were spent by the MCDEC personnel assembling and instructing on the assembly of the LACH. Little opportunity was available for training and practice by heavy equipment and Beach and Port Company personnel before the exercise began. Some of this limited training, however, was accomplished on the beach.

## 5.3 LACH Concept of Operations

The LACH was used to enter LCUs and LCM8s grounded out at a lighter beaching site, straddle and lift the container, then carry it ashore. If there was a queue of loaded lighters or more containers on the same lighter, the LACH deposited the container at a temporary storage site on the beach and off-loaded the remaining containers until the lighter(s) had cleared the beach. Then it would commence loading tractor trailers. This procedure was used in order to return lighters to the ship and in order to keep the ship cranes working. During retrograde containers were loaded directly from tractor-trailers onto the lighters. (See Figures 2.8 and 2.9)

## 5.4 LACH Operations

The LACH did serve as a back-up option for the elevated causeway and also for visitor demonstrations. Because the container flow from the beach was slow and the causeway was able to keep pace, only 31 containers were transferred (20 off-loaded, 11 retrograded) at the LACH site. Table 2.6 provides all of the times recorded for the LACH.

Problems observed with the LACH seemed to relate to the ISO locking pins disengaging from the container corner fittings. The LACH used two locking bars (one at each end) instead of a spreader bar to lift the containers. A stevedore on each end manually engages each locking pin with a corner fitting. It was noted that on several occasions there were problems in disengaging the locking pins which delayed the cycles. The cause was not apparent and there were too few cycles to determine the frequency of occurrence.

Table 2.7 is a summary of the LACH times for each element of its operation during Phase II. Some of the more extreme values contained in Table 2.6 have not been included in the mean calculations. Some of the times recorded do not truly characterize LACH operations; operational factors are discussed in the section on analysis.

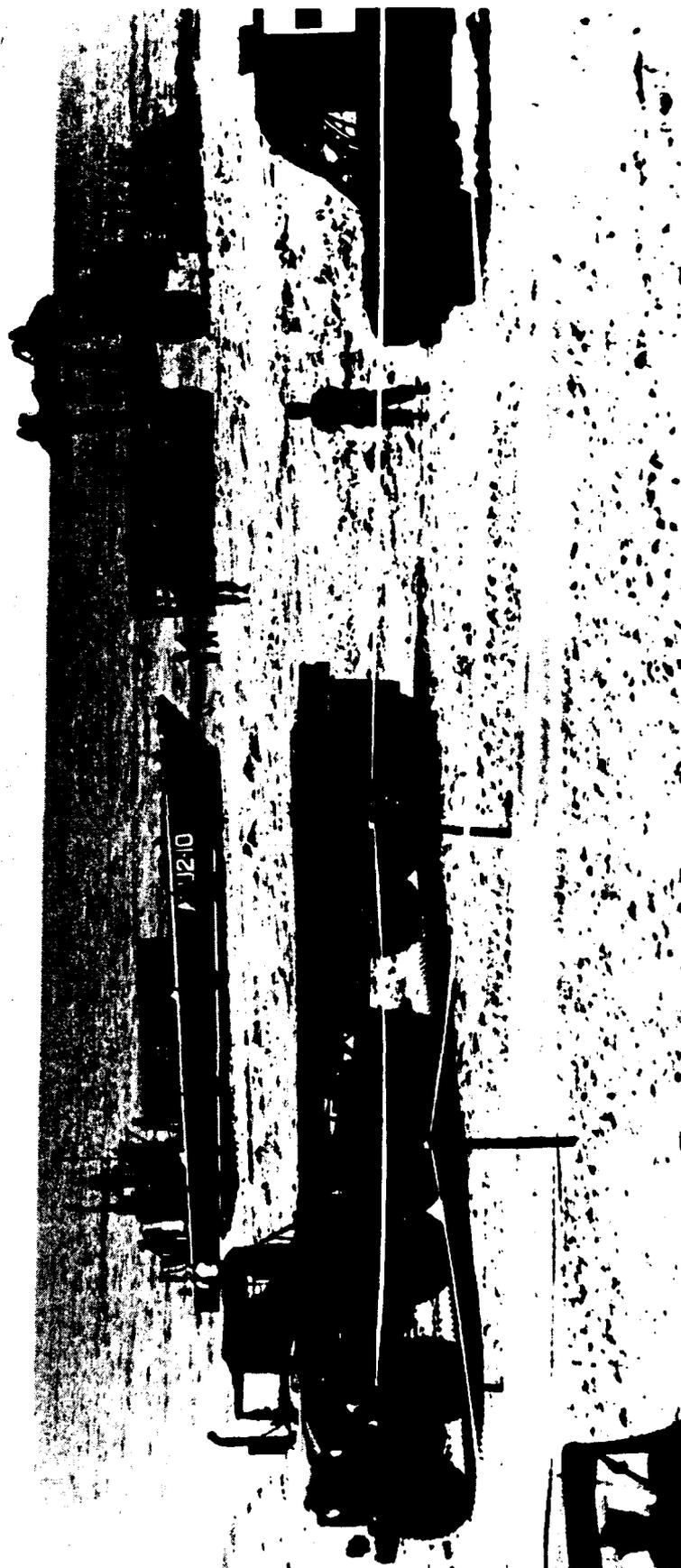


FIGURE 2.8. THE LACH OFF-LOADED THE FIRST CONTAINER TO A TEMPORARY STORAGE LOCATION ON THE BEACH.

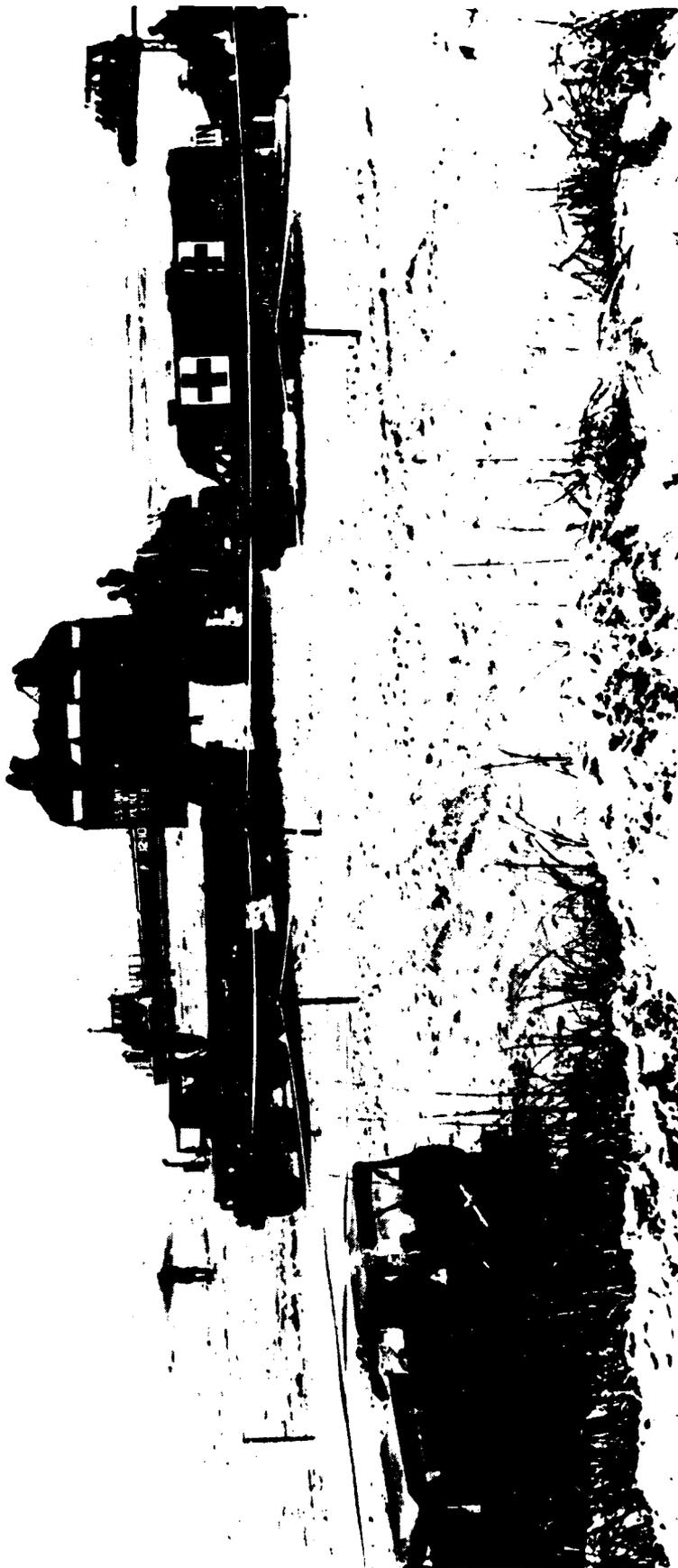


FIGURE 2.9 . THE LACH LOADED THE LAST CONTAINER FROM A LIGHTER DIRECTLY ONTO A TRAILER.

TABLE 2.6  
LACH OPERATIONAL TIMES DURING PHASE II

Day	Shift	Lighters				Forward or Retrograde	Container ID	LACH Cycles		
		ID	Time to Approach Beach (Min)	Time on Beach (Min)	Time to Clear Beach (Min)			Vehicle to Vehicle (Min)	Vehicle to Storage (Min)	Storage to Vehicle (Min)
1	1	2-10	1.4	11.2	2.1	Fwd	3622	N/A	6.8	11.2
						Fwd	6716	N/A	9.5	1.38
1	1	2-13	2.6	24.8	2.6	Fwd	4961	15.58	N/A	N/A
		2-13				Fwd	4003	19.58	N/A	N/A
1	1	1654	3.2	26.3	3.6	Fwd	6273	N/A	7.4	11.7
		1654				Fwd	8125	N/A	9.5	7.1
		1654				Fwd	6619	11.3	N/A	N/A
1	1	2-15	7.6	13.6	6.1	Fwd	8445	17.0	N/A	N/A
2	1	1644	15.4	69.5	2.8	Fwd	3731	N/A	11.2	6.0
		1644				Fwd	9081	N/A	11.2	7.9
		1644				Fwd	6089	N/A	18.7	6.7
		1644				Fwd	9207	N/A	10.1	6.6
2	1	1643	3.2	46.0	3.8	Fwd	7226	N/A	16.0	8.6
		1543				Fwd	4850	N/A	8.3	12.5
		1643				Fwd	4069	N/A	13.2	7.1
		1643				Fwd	3771	9.08	N/A	N/A
2	1	1654	2.0	28.0	3.7	Retro	8981	N/A	6.6	7.2
		1654				Retro	9070	N/A	6.4	14.9
2	2	1643	3.1	43.7	3.8	Retro	6212	N/A	5.8	13.6
		1643				Retro	8590	N/A	5.9	11.3
		1643				Retro	9373	N/A	5.6	11.0
		1643				Retro	7372	N/A	6.7	8.9
2	2	2-16	2.7	21.0	1.1	Retro	6452	15.6	N/A	N/A
3	1	1654	-	-	-	Retro	7135	-	N/A	N/A
		1654				Retro	3666	13.2	N/A	N/A
		1654				Retro	7238	13.3	N/A	N/A
		1654				Retro	8019	17.2	N/A	N/A
3	2	1644	-	-	-	Fwd	7751	16.2	N/A	N/A
		1644				Fwd	6826	40.0	N/A	N/A
		1644				Fwd	7135	8.1	N/A	N/A
		1644				Fwd	8899	-	N/A	N/A

Containers are transferred from lighters to tractor-trailers during forward operations, and containers are transferred from tractor-trailers to lighters during retrograde operations.

TABLE 2.7  
SUMMARY OF LACH OPERATIONS

LACH Operational Element	Time (In Minutes)		
	Fastest	Slowest	Average
Lighter to Vehicle (Fwd)	8.1	40.0*	14.3
Vehicle to Lighter (Retro)	13.2	17.2	14.8
Vehicle to Store	5.6	18.7	9.4
Store to Vehicle	1.4*	14.9	9.0
*Not considered in calculating the average.			

The LACH/tractor-trailer container transfer point was located about 225 ft from the LACH/lighter beaching site. This distance could have been decreased by placing the tractor-trailer transfer point closer to the site where lighters beached. As it turned out, a similar layout was used during the 1977 LOTS test when cycles that were longer than necessary also were experienced. During this year's exercise, the long turn-around distance was due to the lighter beaching site being shifted after the matting for LACH-trailer loading had been installed. The relocation was deemed necessary when it was decided that the lighter beaching site was too close to the elevated causeway.

## 6. TRACTOR-TRAILER OPERATIONS

### 6.1 Background

Transportation of containers off the elevated causeway and from the LACH site was provided by M127A2 semi-trailers pulled by M52 tractors. The Marine Corps does not yet have a true container transporter but does have a program for the acquisition of one which would be part of the Tactical Vehicle Fleet (TVF). According to the Marine Corps Required Operational Capability (ROC) document, a heavy prime mover will be used to tow either the 22.5-ton capacity trailer for 20-ft containers or the 30-ft long semi-trailer with a 65-ton capacity. At the present time there is no ROC prepared to obtain a dedicated 40-ft container transporter.

Commandant of the Marine Corps, Required Operational Capability (ROC) No. Log 1.36 for the Tactical Vehicle Fleet (TVF), Ser RDD-24-mrc, dtd 16 Jan 79.

Experience in the 1977 LOTS test indicated that this combination of tractor-trailer units could be used but the positioning of the load directly over the rear axles was not a good procedure. The vehicles used in that test were modified with container guides, and the locking pins. Without prior testing with the LACH it was thought that the containers had to be loaded all the way aft on the trailer. The only modification to the trailers in SOLID SHIELD 79 was the painting of two horizontal stripes to indicate where the container should be landed. Table 2.8 provides the basic characteristics for the tractor-trailer unit.

TABLE 2.8

M-52 TRACTOR/M-127 TRAILER SPECIFICATIONS

M-52 TRACTOR	
Weight	24,700 lb
Dimensions	257.5 in. x 97 in. x 103.13 in
M-127 Flatbed Trailer	
Weight	13,500 lb
Dimensions	344.25 in. x 55.75 in. x 59.5 in.
Rated Payload	
Off-road	12 short tons
On highway	12 short tons
Highway (max)	18 short tons

6.2 Concept of Operations

As originally intended, 20 tractor and 30 trailers plus support vehicles (wreckers and refuelers) were to be committed to the exercise. The assets were to be distributed as follows:

- Five tractors were to be held in reserve;
- Fifteen tractors and thirty trailers were to be staged at the beach initially with the first two tractor-trailers returning to the marshaling yard to remain there and provide on-site crane clearance support;
- Ten tractors and trailers were to continuously operate between the beach and marshaling yard; and



- Three tractors and trailers were to remain at the beach and shuttle empty/loaded trailers from the beach working areas to a staging lot nearby for subsequent movement to the marshaling yard when tractors were available.

This plan was altered prior to the start of the exercise. Instead of the above, it was decided that 10 tractor-trailers were to be used to make the cycles, with 2-3 spares, prepositioned at the marshaling yard and beach. The remainders were to be used for augmentation when required. First echelon maintenance was required every 24 hr. In addition, once every trip each vehicle was required to make a maintenance inspection stop at a field motor pool located adjacent to the marshaling yard. The securing of containers to trailers was to be accomplished by a 4-man team positioned on the causeway. At the LACH site the vehicle operator was responsible for securing the load.

### 6.3 Tractor-Trailer Results

During the Marine Corps-Navy phase (Phase II) the M52/M127 units transported 248 containers over the 7.8 mile route between the beach and the marshaling yard. The route traveled consisted of about 2.5 miles of unimproved road (about half of which was packed sand and clay and the other half was wash-board condition gravel) and 5.3 miles of pavement. The average speed was about 17 mph varying from an observed 45 mph on pavement to about 7 mph on the unimproved section. The marshaling yard itself was a bladed dirt road that offered good support for the M52/M127. None of the Marine Corps vehicles were ever reported stuck. Table 2.9 is a summation of tractor-trailer operations for the period 12-14 May.

TABLE 2.9  
SUMMARY OF TRACTOR-TRAILER OPERATIONS

SHIFT AND DAY	AVERAGE CONTAINER TRANSIT TIMES (IN MIN.)				NUMBER TRAILERS USED	TOTAL NUMBER TRANSITS MADE*
	FORWARD MOVEMENT		RETROGRADE MOVEMENT			
	TCP #1 TO MCP	TCP #1 TO TCP #1	MCP TO TCP #1	MCP TO MCP		
Day Shift, Day One	29.1	147.2	-	-	13	59
Night Shift, Day One	23.6	252.3	-	-	15	32
Day Shift, Day Two	29.9	60.0**	23.0	118.0	26	30
Night Shift, Day Two	-	-	56.3	None	4	4
Day Shift, Day Three	34.3	128.8	-	-	16	26
Night Shift, Day Three	32.2	135.7	-	-	23	47

\*Three containers retrograded to the beach on the last day and loaded by the Army are not counted so that system totals agree.

\*\*Partial cycles. Eight vehicles went directly from forward to retrograde operations. Thus, this average only includes times from TCP #1 to subsequent departures from the MCP after the vehicles had entered the retrograde cycle.

Vehicle operations were hampered by a large volume of civilian traffic in the adjacent area through which the tractor-trailers had to travel. In addition, the inland waterway on weekends (days one and two of the exercise) experienced heavy traffic also, delaying operational vehicles. Consequently, exercise traffic was sometimes as much as 20 percent slower.

A check was made to determine if vehicles hauling loaded containers were any slower than the ones carrying empty ones. The overall times for the loaded containers was about 1.8 min faster on the average, a negative correlation. However, more than half of the loaded containers were carried after 1700 when the beach traffic was much lighter than when the empties were carried.

The fastest beach to marshaling yard trip was 16 min. Several were recorded at 17 and 18 min. The slowest beach to marshaling yard trip was 76 min (no explanation) and on the last night shift four units required from 50-69 min (also no explanations are available).

Checks were made to determine the fastest and slowest complete cycles. That is, the time required to depart from one point (TCP #1 or the MCP) and return through the same point on the next cycle. The fastest cycle was 82 min, recorded twice, once during the first day shift and once during retrograde on the second day. The slowest cycle was 340 min, assuming the vehicle was not pulled out of the circuit. During the same 6-hr period (the first night), cycles were averaging 265 min for the 15 units employed. No explanation can be made for these slow turn-around times.

A check was also made of the times required for the four-man team on the elevated causeway to secure the containers to the trailers. (See Figure 2.10.) On the average about 6 min was required. One vehicle for various reasons spent over half an hour being secured. The fastest time was 29 secs (for the Marine Corps test vehicle that had ISO locking pins).

A shortage of vehicles several times delayed operations at the elevated causeway and the LACH site. Surge operations at both sites used up the available queue. This situation is discussed further in the analysis sections which follow.

## 7. MARSHALING YARD OPERATIONS

### 7.1 Background

A marshaling yard is an interface between inbound cargo and retrograde; it is the juncture between sea lines of communication and land lines of communication. The marshaling yard organizes and accounts for containers, offering them for movement and injecting them into the theater transportation system. Accomplishing the necessary documentation for accounting, retrograde and the inland movement is an important aspect of the marshaling yard. Security is a major responsibility. Inspections and minor repairs are also functions. Normally, containers are marshaled by destination, forwarding mode, special handling, priority and commodity.



FIGURE 2.10. CONTAINERS WERE CHAINED TO THE TRAILER BED  
IN AN AVERAGE OF 6 MIN.

A marshaling area is not a supply dump and issues are not generally made from a marshaling yard. Doctrinally, the Marine Corps does not have provision for the employment of a marshaling yard and it is unknown if the Marine Corps ever operated a marshaling yard. However, as a MAF moves inland, it is conceivable that a marshaling yard type function would be needed until such time as an Army terminal service unit (LOTS force) arrives. This was the way the scenario was played in the container operations associated with SOLID SHIELD 79. Among the responsibilities of a marshaling yard/beach organization would be the conduct of retrograde operations.

The marshaling yard was established at a TLZ bluebird. No improvements in the way of soil stabilization measures were attempted, although some dozer blading of a dirt road through the yard was accomplished.

## 7.2 Concept of Operations

Marshaling yard operations were controlled from the marshaling control point (MCP), a tent at the entrance/exit to the marshaling yard. A detachment from 2D Supply Bn. was assigned responsibility for marshaling yard operations. The MCP was to collect the container trip ticket and make an arrival entry in its logbook. The container was to be inspected and a guide assigned to the driver so that the container would be correctly stored in a predetermined site. For retrograde operations a reverse procedure was to be used.

Three commodity storage sites were planned: class III, class V, and all other supply classes. In actuality, a fourth site was designated for the storage of the containers actually having loads, class I. Within each of these areas rows and container slots were to be assigned for reference. Containers were to be stored side by side within the rows.

Equipment to handle containers was limited to two 30-ton Drott cranes belonging to 2D Landing Support Bn. (Subsequently, a third located at the beach was reassigned.) The cranes would be positioned to meet a tractor-trailer at the location where the container was to be stored or picked up. Two cargo handlers per crane were also to be provided from 2D Landing Support Bn. to work with the cranes.

## 7.3 Results of Marshaling Yard Operations

During the exercise numerous spontaneous checks were made on locations and container identifications (some were almost unreadable--usually painted over--or had missing ID plates). No errors were found.

Equipment operations varied. In handling loaded containers the tractor-trailer halted alongside the crane; the crane would latch a spreader bar onto the container; the container would be lifted and the crane's boom swing 90° and the container lowered; the crane would unlatch; and, finally, the crane would raise its outriggers, back up approximately one container slot, and reset its outriggers for the next lift. When handling empty containers, however, the crane would move two or three container slots and fill the slots before displacing again. By and large, there was not much repositioning of cranes from one storage area (class of supply to another). Figure 2.11 shows a crane off-loading a container in the marshaling yards. In the background at right is the end-to-end procedure used by the Army to store containers while the Marine Corps side-by-side method is shown in the foreground at left.

Cranes and tractor-trailer times were taken. Crane relocation time, that is, from set-up after one lift until set up and ready to operate at the next container slot, averaged 1.2 min. Boom cycle intervals, that is, from the start of boom movement until return to the starting position, averaged 3.7 min. Thus, total crane cycle time (a relocation plus a boom cycle) averaged about 4.9 min. A tractor-trailer either being off-loaded or loaded averaged about 2.9 min alongside the crane (loading was only slightly faster with respect to the tractor-trailer's time alongside). The average interval between tractor-

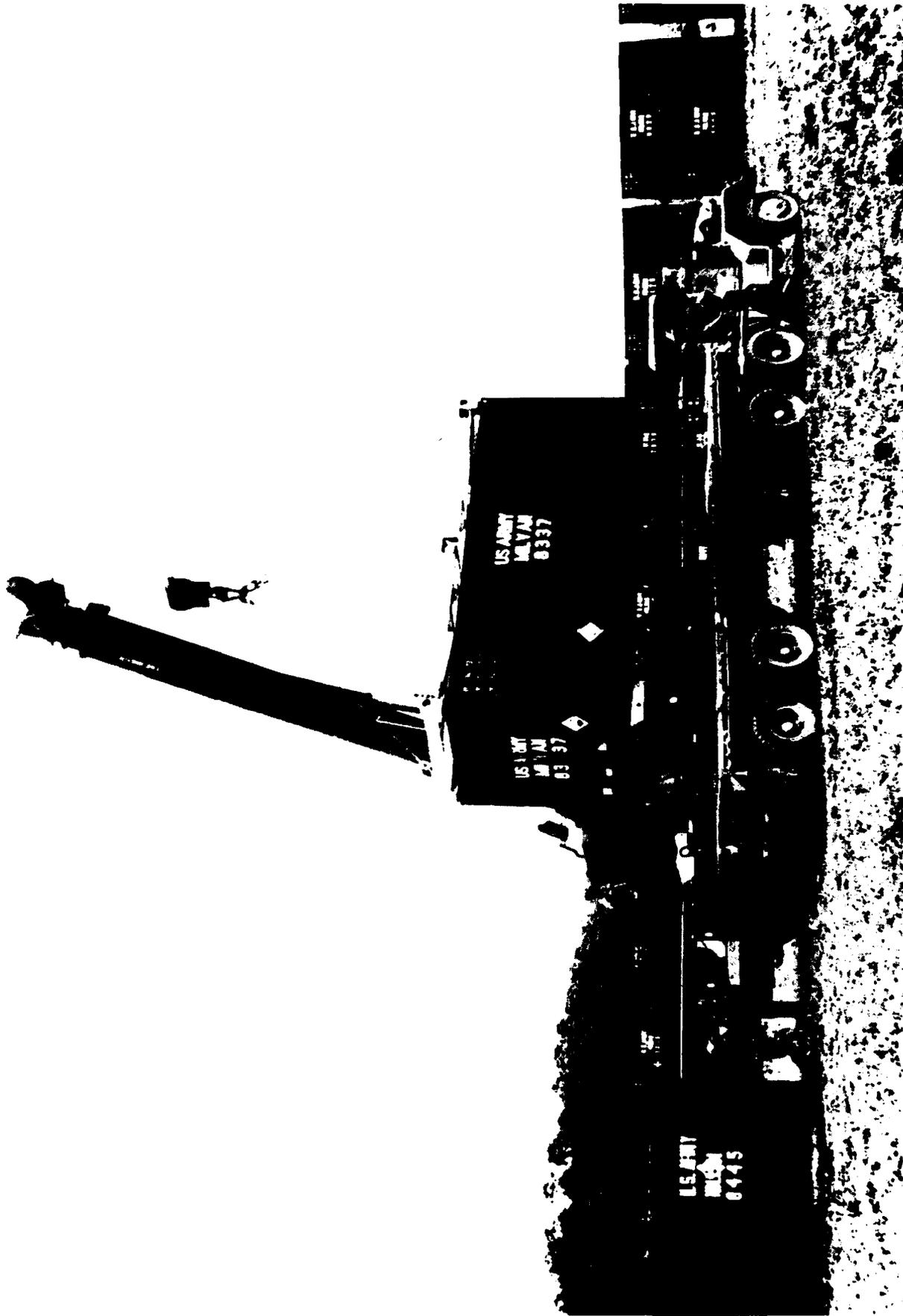


FIGURE 2.11. THE DROTT CRANE OFF-LOADS A CONTAINER IN THE MARSHALING YARD

trailers (exclusive of the lengthy weather delays, casualties at the beach, stand-down periods, etc.) was 5.8 min. Further discussion on crane times is contained in the analysis section.

## 8. TRANSITION TO ARMY LOTS OPERATIONS

### 8.1 Background

Historically, the turnover of beach operations from the Navy and Marine Corps to an Army terminal unit has had little, if any, recent precedent. In Vietnam the Services largely continued to support their own enclaves through ports which were developed as in-country operations expanded. Consequently, there appears to be few guidelines and LOTS transition of planning has been accomplished on a case-by-case basis.

In a tactical situation for combat units there are relieving procedures and specific steps to be followed. The issue to be investigated in this scenario was whether similar procedures also were necessary or applicable in a logistics operation. One of the major problem areas related to the continued sustained throughput flow to inland LSAs and compatibility of documentation and management procedures.

### 8.2 Transition Planning

Early in the planning, COMNAVFORBLUE attempted to establish some precedent. At a meeting called by COMNAVFORBLUE with representatives of the Army 7th Transportation Group it was pointed out that some guidance was provided in a joint transportation regulation.<sup>1</sup> The joint regulation states that "the Navy will provide appropriate Navy force, as may be available, for support of LOTS operations conducted by the Army." Other provisions with respect to command relationships in specific situations also could be prescribed by the chiefs of the Services.

It was agreed that basically the Army would assume responsibility for the Marine Corps-Navy activities and would use certain of the major items of equipment, such as the elevated causeway, beach matting, some communications gear, and some of the tentage. The Marine Corps would provide augmentation with tractor-trailer units, LACH operators, and liaison personnel. Some Navy lighterage would be left for augmentation of Army LCUs and LCMs. Part of this arrangement was exercise peculiar in the sense that it relieved some of the movement requirements deploying from Ft. Eustis, Virginia. COMNAVFORBLUE would be phased out of the scenario.

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<sup>1</sup> Army Regulation No. 55-176, OPNAV Instruction 4620.6A, Transportation and Travel - Logistics Over-the-Shore Operation in Overseas Areas, dated 8 September 1970.

### 8.3 Transition Steps

While the Marine Corps-Navy ship-to-shore operations were taking place, the Army was establishing its garrison support. Also the Army's 491st Cargo Documentation Det. was in operation throughout Phase II, keeping pace with the location and status of containers being handled by the Navy and Marine Corps.

The night prior to take over of the beach by the Army a joint meeting was held with the CO and key representatives of the 10th Transportation Bn. (Terminal Service). Information was exchanged on several communications frequencies to be used and what assistance would be available where. Most of the information passed, however, related to exercise peculiar details, such as visitors expected.

In addition, Army tractor operators were convoyed through the beach area to get familiarized with traffic patterns and road conditions.

### 8.4 Transition

When the transition took place, the ship had been emptied again, except for one container left in place to indicate stowage positioning and two containers in lighters which did not get off-loaded at the beach. The Army began by initiating retrograde operations. Three Marine Corps tractor-trailers had been loaded near the end of the night shift and were routed to the elevated causeway to start the effort.

During the transition process, no problems were observed or reported. The transition appeared to be not different than if a new shift were starting.

## 9. ARMY OPERATIONS

### 9.1 Organization

The LOTS force employed by the Army consisted of a battalion headquarters section and elements of: a container company operating the elevated causeway and marshaling yard, a breakbulk company operating the MINI LOAF's cranes; a medium boat company, operating LCM8s; a heavy boat company, operating LCUs; and a cargo documentation detachment, providing the documentation and accounting support needed. In addition, the Army also brought the MV FRANK SUTTON, a small breakbulk training vessel, partially loaded with breakbulk cargo for training one of its breakbulk handling companies.

The beach container handling facilities remained the same as during Phase II. The breakbulk operation was accomplished to the north of the elevated causeway. (See Figure 2.12).

### 9.2 Army Throughput

9.2.1 Breakbulk Operations. The only improvements that were made by the Army to the breakbulk beach was the blading of some of the loose top sand so that 5-ton trucks could negotiate the beach easier. The loading of the 5-ton trucks was limited to 2-3 pallets per vehicle. The palletized cargo was transported to the marshaling yard and stored adjacent to the containers.

9.2.2 LACH Operations. The Army made one adjustment to container operations. A frontloader operated by a soldier, was paired with a LACH, operated by a team from 2D Landing Support Bn. The frontloader is able to load trailers very rapidly but can not off-load lighters. The LACH, therefore, was used to off-load containers from lighters and store them on the beach. The frontloader would then transport the container to the trailer loading site and load it. (See Figure 2.13.) Table 2.10 provides the characteristics of the Clark frontloader which was used by the Army.

TABLE 2.10  
CLARK FRONTLOADER 475B 50K MODEL BASIC CHARACTERISTICS

<u>VEHICLE DATA</u>	<u>WITH TOP-RIGGLER</u>	<u>WITHOUT TOP-RIGGLER</u>
Length	40 ft 0 in	37 ft 3 in
Width	13 ft 0 in	13 ft 0 in
Height	16 ft 5 in	16 ft 5 in
Weight**	77,55 STONS	75,94 STONS

\* Transfer length extends from 20 to 40 ft containers

\*\* For performance to 100% removable counterweight, can handle these weights.





FIGURE 2.12. ARMY BREAKBULK OPERATIONS WERE CONDUCTED ADJACENT TO THE ELEVATED CAUSEWAY

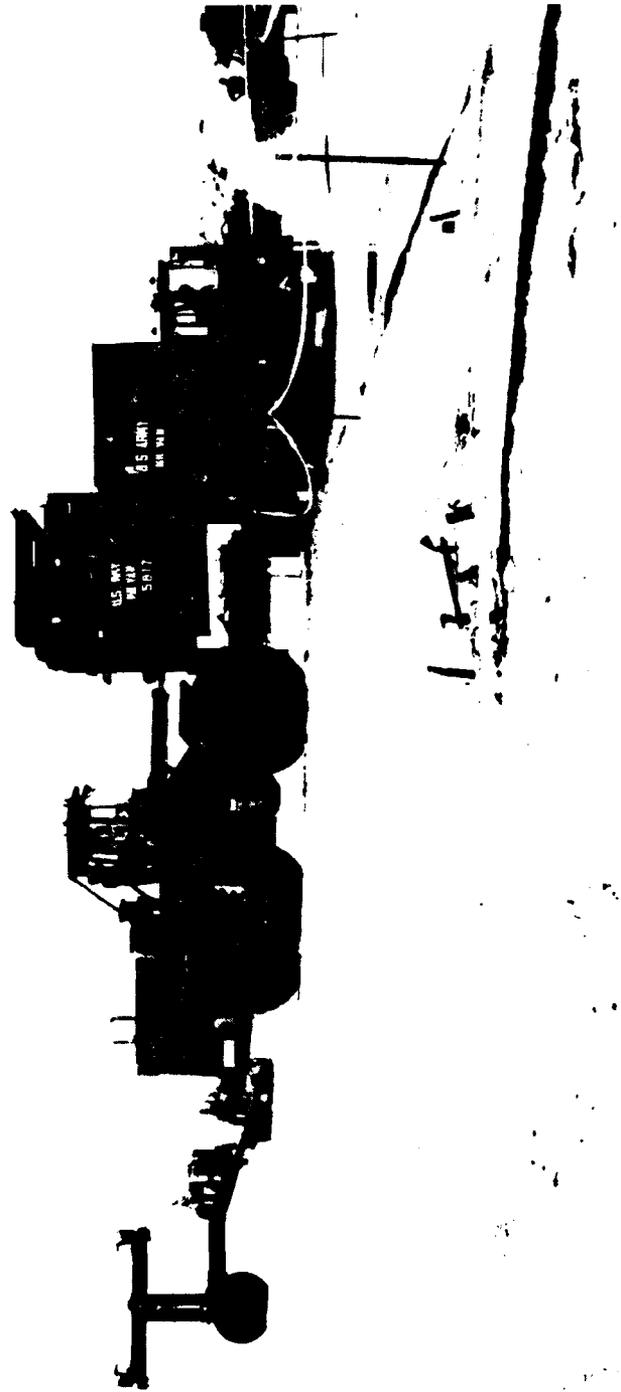


FIGURE 2.13. THE LACH AND FRONTLOADER WERE PAIRED FOR BEACH OPERATIONS

Another reason for use of a frontloader is that during Phase III the Army used Ottawa yard tractors and the XM872 34-ton dual purpose trailer transporters which are capable of hauling two 20 ft or one 40 ft container. Since the LACH straddles the trailer during loading and off-loading, it would not have been able to load containers to the center position which is used when only one container is carried to the 34-ton trailer.

This tandem operation provided times of about 6.6 min for the LACH to retrograde a container from the beach onto a lighter and return. For the discharge of a container from a lighter to a storage position on the beach and return to its starting position required about 5.8 min. The frontloader then required about 3.2 min to transfer containers (no significant differences noted between forward and retrograde operations). Thus, the operation required about 9-10 min for the two vehicles to clear a container from the beach.

It should be noted that there was no frequency of operation so that a steady rhythmic working arrangement could be developed. This might have improved cycle times. Even within the cycles there were some disruptions which also inhibited operations.

9.2.3 Elevated Causeway Operations. Elements of the Army's 119th Transportation (Terminal Service) (container) Company did not have opportunity to train on the elevated causeway prior to the exercise. Consequently, the first few container cycles were somewhat rough but shortly after the unit settled into a smooth operation. Army operations were observed for a period of about three days, during which time mostly retrograde was being conducted.

During the period observed, the Army's container company had a number of cycles under 2 min, the fastest being 1.7 min for a complete cycle (from start movement of boom to return to starting position). Overall, Army crane cycles during retrograde (See Figure 2.14) averaged almost 4 min and for forward movement about 4.3 min. Tractor-trailers were in the loading position during retrograde on the average of 7.1 min, and during forward movement about 5.6 min. This is longer than that for Marine Corps vehicles because sometimes two containers were off-loaded or retrograded per vehicle and partially because the vehicle had to wait for a lighter.

During Phase III Army lighter succession times were comparable to those of the Navy's, generally. However, the Army did try faster methods to clear the mooring position. These included having the LCU head toward the beach after casting off, make a U-turn, and then head toward sea. Some time was saved using this procedure, but it was only used once and the technique depends largely upon excellent sea conditions.

9.2.4 Marshaling Yard Operations. The Army used an end-to-end storage procedure for containers in the marshaling yard, with two rows back-to-back and stacked two high. In this fashion, frontloaders had access to all containers by not having to move more than one.



FIGURE 2.14. ARMY RETROGRADE OPERATIONS AT THE ELEVATED CAUSEWAY

Rain softened the marshaling yard somewhat and in one depression a frontloader got stuck. It was pulled out by a dozer which then, reportedly, got stuck and was pulled out by the frontloader. Two Army tractor-trailers, which were not designed for off-road operations, also got stuck on a marshaling yard road.

Two frontloaders were used in the marshaling yard. Tractor-trailers were positioned along the road surrounding the marshaling yard. The frontloader would then off-load the trailers and store the container at a specified spot. Frontloader cycle times were on the average of 3.6 min each.

### III. ANALYSIS

#### 1. SECTION SUMMARY

This section analyzes the major elements of the throughput system used in the container operations associated with SOLID SHIELD 79. The scenario exercised was a good one in the sense that operations are rarely conducted in this area and little recent experience has been gathered. MILSTAMP procedures need to be incorporated in the Landing Support Bn. and further training is needed in transportation system functions, if transportation management is to be a battalion mission. Some limitations in the unit's evaluation were that no transshipment operations were attempted and at no point was there any container unstuffing or retrograde documentation attempted. Breakbulk operations and bulk POL management would also have added considerably to the battalion's workload. Ship operations determined the daily container throughput level. The MINI LOAF was too sea state sensitive and not capable of providing sufficient stress on shore-side systems.

Based upon data extrapolations, it was determined that an elevated causeway as used in this exercise and with calm seas could handle about 190 container transfers a day. A LACH was found to have a capability of about 100 containers per day. The notional requirement for a MAF is about 454 containers off-loaded per day during AFOE operations and could be more than 700 containers off-loaded/retrograded per day during resupply operations. Thus, two elevated causeways and at least four LACHs on the beach would be required plus maintenance back-up. The lack of a breakbulk planning factor is a serious deficiency in determining a beach and port company's or a landing support company's capability to support beach clearance.

Transition to Army LOTS operations went smoothly, assisted by the advance implacement of an automated remote processing facility and the fact that 2D Landing Support Bn. had already established a LOTS-type system. The exchange of equipment appears to be a matter to be taken on a case-by-case basis.

#### 2. SCENARIO RELATED ANALYSIS

The scenario time frame selected for the test and evaluation period was well chosen. For all intents and purposes resupply operations appear to be a relatively simple procedure after dealing with the complexities and risks of an

assault ship-to-shore operation. However, this exercise revealed that there were some gaps between the planning and the procedures needed to execute a large scale surface resupply operation.

A resupply operation will involve a wide variety of items to include numerous specific requests generated by field customers as well automatically generated items. A ship's cargo may have several distribution points (consignees) once the cargo has been landed across the beach. In fact, several ships may be off-shore and distribution might also include another Service or Allied units. A resupply operation must include provision for retrograde of empty containers and containers with repairables for return to CONUS. Retrograde may be concurrent with discharge. In addition breakbulk operations will continue to some degree and bulk POL discharge operations will also contribute to the landing support battalion burden.

## 2.1 Use of MILSTAMP Procedures

Because training in the past has almost exclusively concentrated on assault support and because shore party type support has organizationally been limited until recently to the company level, the planning for resupply operational support appears to have suffered somewhat. In terms of internal organization and management, response times, and control, 2D Landing Support Bn. performed exceptionally well. However, there appeared to be insufficient time following the battalion organization (12 days earlier) to familiarize concerned personnel with MILSTAMP procedures and at the same time implement a system for using the MILSTAMP documentation, tracing, and reporting procedures. Nevertheless, as a first step copies of the TCMDs were pulled from the vans as they passed through the beach and ship's manifests were employed. This is one area where further battalion and, in fact, FSSG organization need to continue development and training.

Lest the importance of MILSTAMP capabilities and requirements be slighted, it should be noted that there are two sound reasons for its broader use and system familiarity, especially by units managing transportation functions. First, by DoD regulation resupply will be accomplished, managed, and supported from shipper to the amphibious objective areas entirely under the MILSTAMP system. MILSTAMP focuses the requirements of commercial supplier, commercial land shipper, MTMC planner, port managers, stevedores, customs officials, MSC planners and operators, and commercial ship operators into a single informational system. This is necessary to efficiently allocate resources, and to properly control and expedite cargo planning and movement. The second reason for greater implementation of MILSTAMP is that the basic document, the TCMD, provides the means for the control and tracing of shipments (via transportation control numbers), once the item has been shipped. This capability is needed in the resupply phase.

A third reason for implementing MILSTAMP is that through automation and electronic processing of data contained in the TCMD, cargo can be identified, routed, and documentation processed with fewer personnel in far less time. This type of system is not only within the state of the art but has also been developed by the Army for DoD use. This type of system would have reduced delays 2-3 min at the beach for the

tractor-trailer units and the need for three personnel manning TCP #1. At the same time the LOC would have had immediately available reports of container arrivals and all shipment TCNs. While vehicles were enroute, the final destination of the containers could have been planned and, conceivably, the need eliminated for a large marshaling area and the equipment to support it. To date Marine Corps concept and developmental guidance have not been developed and published regarding procedures for using the MILSTAMP system. Annex B provides background about the system and suggests procedures for use in the field.

## 2.2 Scenario Limitations

There are four fundamental problem areas associated with containerization and the operational capabilities of a landing support battalion. These are:

- The transfer and transportation of containers in an expeditionary environment. This is largely a hardware function and the ship discharge program, as well as the LACH, elevated causeway, and Drott crane (except for handling 40-ft containers) are items which provide support in varying degrees of success. Some of these items were evaluated in SOLID SHIELD 79 and the results are noted herein. Others were tested in the LOTS 1977 joint test or related pretests.
- Documentation and movements management. This was evaluated and the results have been noted.
- System synchronization and system management. This was partially evaluated but key elements such as long haul requirements, tracing activity, and multiple ship and multiple off-load requirements were not included.
- Container unstuffing and retrograde documentation. The items were not part of the exercise and no data are available. Procedures have not been fully established by the Marine Corps for stripping cargo of various types. Neither does any consideration appear to have been given for the requirement of field units to prepare appropriate documentation for the retrograde and management of the large volume of empty containers. Possibly a container control element may be necessary in either a landing support battalion or in headquarters of the force service support group.

## 2.3 Other Cargo Requirements

In addition to the foregoing considerations, the exercise did not include other logistic support requirements for the beach such as bulk POL and breakbulk cargo. Bulk POL is not an organic handling responsibility within the landing support battalion but it would have been another management requirement that would have helped stress the span of control for the battalion staff.



Consequently, some allowance needs to be made in assessing the workload and staffing of the headquarters section to encompass these responsibilities. Breakbulk cargo poses a more significant problem.

With respect to the requirement for handling breakbulk cargo, it should be noted that not all resupply is containerizable. Thus, there will be a breakbulk requirement also during the resupply period. Following several source checks in the Marine Corps, it was found that there are no accepted data available as to capabilities and limitations of a landing support company or any other task organized shore party type unit to handle breakbulk cargo.

Based upon equipment and personnel resources, for example, a planning factor for an Army Terminal service company is 1,000 short tons of cargo per day. This factor has been tested and found to be reasonably valid. By contrast, the landing support company is manned and generally equipped differently. It has a surge requirement for handling a large volume of unit equipment and at least 15 days of supply in amphibious ships during the assault and general unloading phases of an operation. In the AFOE additional breakbulk cargo also must be handled.

Ship handling equipment has been upgraded, especially since 1970 with the arrival of the CHARLESTON-class LKAs and the new LHAs. The LPDs, of which there are a significant number, also transport and could generate a relatively large volume of breakbulk cargo. Equipment within the landing support company has undergone some changes but it is unknown whether the landing support company can meet its off-loading objectives in the time-frame required. Thus, some means of measured upgrading of beach capabilities might be necessary, if available.

### 3. ANALYSIS OF OFF-SHORE OPERATIONS

#### 3.1 Ship Performance Results

At the MINI LOAF there were some 52 hr of net productive time realized in the discharge of some 174 containers (32 hrs) and the onload of 75 retrograde containers (20 hrs). The 8 hr of delay (out of a total of 60 productive hours allocated) were distributed between rigging/unrigging (2 hr), weather (3 1/2 hr), awaiting retrograde containers (1 1/2 hr), and hold inaccessibility (1 hr). This performance translates into rates of 5.41 containers per hour for off-loading and 3.75 containers per hour for retrograde.

Aboard the ship some 2 hr of productive time was lost due to the necessity to tandem rig and unrig the two cranes incident to handling the loaded containers. An additional hour was lost due to the presence of toxic fumes in one hold which prevented personnel entry.

The tandem crane discharge rate for the 22 loaded containers, neglecting rig and unrig times, was computed by NAVCHAPGRU to be about 4 containers per hour. Retrograde commenced at MINI LOAF with arrival of the first lighter about 0940, 13 May. The weather continued moderate with maximum winds about 25 knots and seas at MINI LOAF running about 4-5 ft. This greatly inhibited operations. (see Figure 3.1).

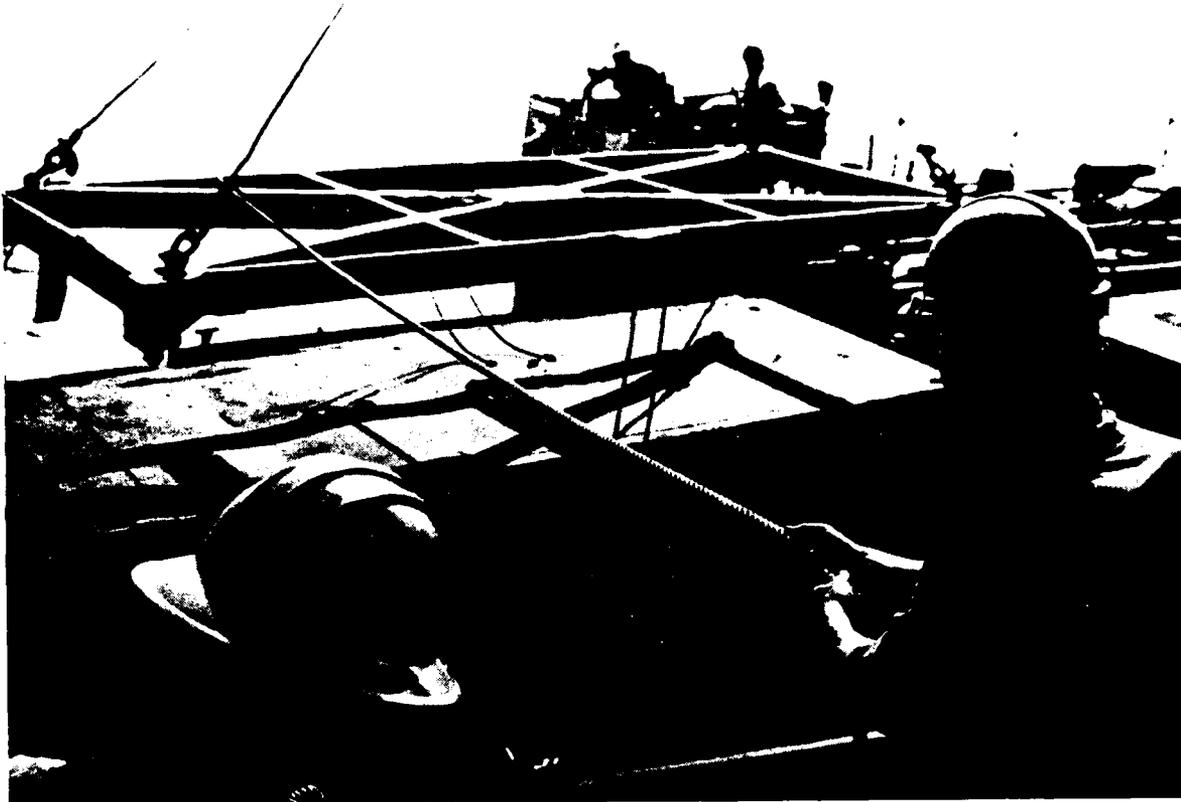


FIGURE 3.1. PENDULATION OF BOTH THE SHIP AND LIGHTER DURING MODERATE SEA STATES MADE LATCHING THE SPREADER TO A CONTAINER VERY DIFFICULT DURING RETROGRADE. THIS BOTTLENECK, IN TURN, BACKED-UP BEACH OPERATIONS.

Some additional statistics of ship component equipment and component activity performance are of interest. These are based on limited on-board observations during offload operations 14 May<sup>2</sup> all values are mean times:

- Lighter time alongside (first line over to last line cast off). -24.98 mins
- Boom cycle time (a measure of the time a boom commences movement from a nominal start position until boom returns to the same position upon completion of the lift). - 5.42 mins
- Lighter mooring time (time from commencement of approach until moored and ready for lifts). - 5.55 min

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<sup>2</sup>Observer access to MINI LOAF understandably was severely curtailed due to the small size of the ship and the difficult logistic support problems involved.

- Lighter clearing time (time from commencement of cast-off until spot cleared for next approach). - 1.82 mins
- Hatch cover removal (time from removal of spreader bar from crane hook preparatory to hoisting hatch cover sections until spreader has reattached to crane hook). -45.7 mins

### 3.2 Comment and Evaluation

The problem of unloading in the stream is the most pervasive problem in any over-the-shore operation. In this instance the throughput capabilities of the vessel provided were so low as not to establish any significant test of other sub-systems. The main problem, of course, was the small size and, hence, limited capability and capacity of MINI LOAF. The ship's unsuitability was manifested in several ways:

- The limited deck space and excessive movement constituted a hazardous working environment.
- The ship's extreme tenderness in a seaway resulted in significant lost time. Boom pendulation resulted in many lifts being slowed, halted or started. The ship exhibited rolls of up to 10° and yaws of up to 70° in a moderate sea. Under flat sea conditions, the wake of departing lighters caused the ship to yaw significantly.

There were other problems reported by NAVCHAPGRU personnel. These included:

- Inadequate lighting for night operations,
- Insufficient chocks, bitts and cleats for lighter mooring,
- Lack of window wipers on the crane cab window,
- Communication and signaling problems between crane operators and deck supervisors due, at least in part, to line of vision obstructions,
- Spreader bar distortion caused by ship unsteadiness,
- Inadequate personnel support facilities aboard the ship, and
- Unavailability of technical manuals in English.

As mentioned earlier, lighterage performance, although not consistent was not a major factor in determining overall throughput of the LOTS systems configuration used in SOLID SHIELD 79. In addition, it must be mentioned that

achievement of good throughput rates per se reportedly were not an objective for the participating Navy elements - emphasis was on training, elevated causeway technical and engineering evaluation, and other goals. Accordingly, cargo discharge, cargo loading and throughput rates measured in this exercise, for any subsystem except perhaps the unique ship sub-system employed, had to be extrapolated to obtain capability rates.

### 3.3 Analysis of Lighter Operations

There were numerous lighterage delays - no lighter available at a lift point at the ship or the causeway when a container lift could have been made. Lighter mechanical problems could have been contributory, but the chief courses seemed to be problems at other modes resulting in loaded or unloaded lighter queuing and, at least in part, inadequate lighter management (out of position, excessive maneuvering several abort approaches, etc.) Nevertheless, as will be noted later, performance of the lighterage was not as significant a factor in determining average throughput rates in this exercise as ship discharge rates. Lighter performance was not targeted for in-depth analysis.

Delays were noted in lighter succession due to lighters being out of position to promptly commence approach. Lighter succession rates at the causeway might be improved in other ways:

By changing mooring and clearing procedures so that either multiple moorings are employed or that, when wind and surf conditions permit, lighters clear toward the beach. This latter technique was employed occasionally by Army lighters and it greatly expedited the time for succeeding lighters to approach and moor. In addition, lighterage management and control procedures could be modified to better synchronize with crane cycles, thereby improving timing.

Lighter succession rate at the ship was timed for only a portion of the third day, during forward movement. In general, during short periods of continuing operations, and with lighter queues at shipside, the average time between one lighter clearing and the succeeding lighter mooring was some 9 min.

In comparison with the 1977 LOTS tests at Fort Story, lighter succession time in SOLID SHIELD was about 40 percent greater (i.e., poorer). This was due possibly to the lesser demand for lighterage in SOLID SHIELD and may have been due also to the limited rehearsal time for tightening up lighter approach and clearing techniques. Additionally, it should be noted that a strong cross current at Beach, coupled with greater wave and swell action, made mooring and clearing more difficult during SOLID SHIELD than during the earlier LOTS test.

## 4. ELEVATED CAUSEWAY ANALYSIS

### 4.1 Minor Operational Delays

The elevated causeway was not stressed by the sustained flow of containers. On the first shift and just prior to the off-loading of the heavy

containers (which required a boom marriage at the ship), it did appear that a queue was building at the causeway. Delays were first experienced at the elevated causeway. Containers were secured to the trailer using chains while the vehicles were still in the crane's load position. This caused the crane to halt unnecessarily before it could complete its next cycle. Accordingly, the Navy directed that the vehicle be moved out of the crane loading position before securing the container to the trailer. This did improve crane productivity.

On two other occasions during this first shift tractor-trailers caused delays totaling about 18 min when the causeway's surge efforts used up the on-site tractor-trailer queue. Additional resources were added once this information was known at the logistic operations center. A discussion with the motor transport officer revealed that the number of working vehicles had been based upon the elevated causeway's average discharge rate instead of surge requirements (see discussion on tractor-trailer operations).

#### 4.2 Lighter Succession

As previously suggested, the single major delay for the elevated causeway was the lack of lighters caused by a low throughput level. However, delays were noted in lighter successions at the elevated causeway even when loaded lighters were available. The average succession time (see Table 3.1) for an LCU during off-load and retrograde operations was 21.0 min and 21.8 min respectively. The average time to off-load an LCU was 19.2 min and the average time to retrograde an LCU was 15.6 min. The elevated causeway spent more time waiting for LCUs to succeed other lighters than it spent in actually transferring containers between LCUs and tractor-trailers.

Table 3.1 shows a similar pattern for LCM8s at the causeway. The average succession time for an LCM8 during off-load and retrograde operations was 16.2 minutes and 20.4 minutes respectively. The average time to off-load an LCM8 was 10.8 min and the average time to retrograde an LCM8 was 5.2 min. As with the LCUs, the elevated causeway spent more time waiting for LCM8s to succeed other lighters than it spent in transferring containers between LCUs and tractor-trailers.

During the surge period at the beginning of the test the average lighter succession time was 9.0 min. The reduced succession time is still 47 percent of the time required to off-load an LCU. The lighter succession delays would be eliminated or reduced in several ways:

- Tighten control procedures so that loaded lighters are immediately accessible to the causeway when an empty lighter is clear.
- Change mooring and clearing procedures so that either multiple moorings are used or that (as was done on occasion by Army lighters) lighters clearing the causeway pull slightly forward toward the beach, turn the bow parallel to the beach until clear and head out to sea (when weather and surf permit).

TABLE 3.1  
LIGHTER CYCLES AT THE ELEVATED CAUSEWAY  
(Average Time In Minutes/Number of Data Points)<sup>1</sup>

<u>DAY</u>	<u>SHIFT</u>	<u>LIGHTER APPROACH AND MOORING<sup>2</sup></u>	<u>LIGHTER MOORING<sup>3</sup></u>	<u>LIGHTER ALONGSIDE</u>	<u>LIGHTER CLEARING</u>	<u>LIGHTER SUCCESSION<sup>4</sup></u>
			<u>LCU</u>	<u>OFF-LOAD</u>		
1 <sup>1</sup>	1	9.5/11	4.8/11	2.0/1/11	3.1/8	14.6/9
1	2	10.2/1	2.7/4	17.8/4	1.9/4	2.4/3
3	1	6.3/4	2.9/4	17.5/3	3.0/3	9.9/3
3	2	-	2.0/11	19.2/12	1.3/12	32.6/11
AVERAGE		8.9/16	3.3/30	19.2/30	2.1/27	21.0/16
			<u>LCMB</u>	<u>OFF-LOAD</u>		
1	1	4.6/8	2.3/8	12.1/8	2.0/6	13.0/8
1	2	18.7/1	1.7/7	13.7/8	1.7/6	15.8/6
3	1	6.0/6	2.0/6	5.4/6	2.5/4	21.7/5
AVERAGE		6.1/15	2.0/21	10.8/22	2.0/16	16.2/19
			<u>LCU</u>	<u>RETROGRADE</u>		
2	1	13.7/11	6.8/11	15.0/11	3.1/8	25.3/10
2	2	16.5/2	7.0/2	19.2/2	1.4/2	14.6/1
3	1	3.2/1	5.2/1	14.0/1	3.8/2	7.6/2
AVERAGE		13.7/14	6.8/14	15.6/14	2.9/12	21.8/13
			<u>LCMB</u>	<u>RETROGRADE</u>		
2	1	5.3/3	1.9/3	6.0/3	2.1/3	22.3/3
3	1	6.2/1	1.8/1	2.8/1	2.2/1	13.5/1
AVERAGE		5.9/4	1.9/4	5.2/4	2.1/4	20.4/4

<sup>1</sup>Normal delays are included in the above averages but extremely long delays are not.

<sup>2</sup>Time from when the lighter is approaching and approximately 500 yds off the elevated causeway until the lighter is moored alongside the elevated causeway.

<sup>3</sup>Time from when the first line is received aboard the lighter until the lighter is moored alongside the elevated causeway.

<sup>4</sup>Time from when a lighter begins cast-off from the elevated causeway until the next lighter is moored alongside the causeway.

Day one starts at 0600 on 12 May 1973.

- Redesign the elevated causeway pierhead so that lighters can be moored port and starboard to the causeway.

#### 4.3 Crane Cycle Time

Figures 3.2 and 3.3 give the elevated causeway off-loading cycle distributions for the day and night shifts of day one. The average cycle time for the day shift was 5.2 min as compared to 5.3 min for the night shift. The small difference in average times is considered insignificant.

The cycle time distributions for day two, the beginning of retrograde operations, are given in Figures 3.4 and 3.5. The minimum average cycle time of 2.8 min for the Marine Corps - Navy phase occurred during shift one of day two. The average cycle time for shift two was 4.3 min. The increase in cycle times for shift two is considered insignificant because of the small sample during the shift.

Figures 3.6 and 3.7 give the off-loading cycle times for day 3 operations and night operations. Figure 3.8 gives the retrograde cycle times for day three. The average retrograde cycle time for shift one of day three was 5.3 min based on a sample of six. During shift one of day three the minimum off-load cycle time of 3.5 min was achieved and for shift two the average was 4.6 min. This was about a 12 percent improvement over the first day.

Figures 3.9 and 3.10 summarize the off-load and the retrograde cycle times at the elevated causeway. The average off-load cycle time was 4.8 min and the average retrograde cycle time was 3.3 min. On the average it required 0.8 min longer to attach the spreader bar to a container in a lighter for forward movement than it required to attach the spreader to a container on a tractor-trailer for retrograde movement. This is because the lighter is moving and the tractor-trailer is stationary. Also, landing a container on tractor-trailer for forward movement takes 0.4 min longer than landing a container on a lighter for retrograde movement. Landing a container on a tractor-trailer takes longer because the tractor-trailer presents a smaller landing area and requires more exact placement of the container. Placement of the container accounts for most of the difference between forward and retrograde container cycles.

#### 4.4 Effects of Weighted Containers on Causeway Crane

During shift one of day one 21 containers loaded with C-rations were off-loaded from lighters at the elevated causeway. The average cycle time for off-loading the loaded containers was 5.2 min compared to 5.1 min for the empty containers off-loaded during the same shift. The weight of the containers transferred did not significantly affect the transfer time.

#### 4.5 Operational Summary

In summary, the average time to off-load a container was 4.8 min and the average time to retrograde a container was 3.3 min. A 12 percent improvement in cycle time was noted as crane experience increased. The best average lighter succession time occurred during shift one of day one (a 4-hr surge period) when it was 9.0 min. During surge periods crane cycles were sometimes under 2 min

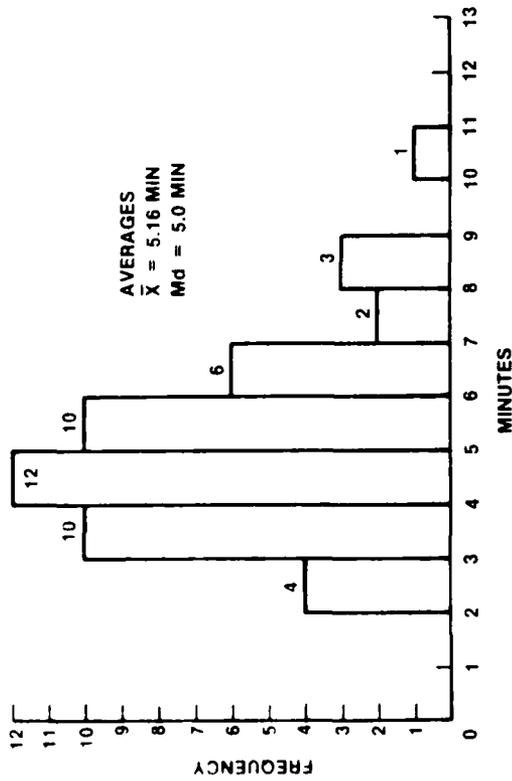


Figure 3.2 Elevated Causeway Off-Loading Cycle Distributions for Day 1 day operations. (Excludes cycles greater than 12 min)

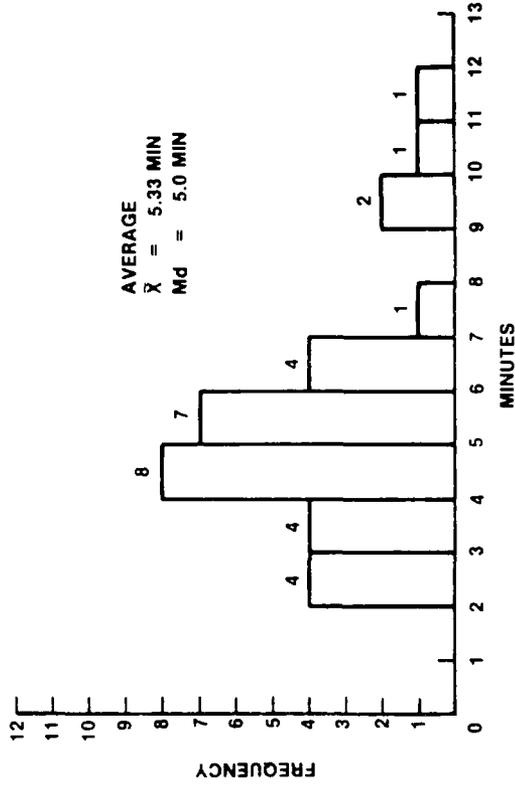


Figure 3.3 Elevated causeway off-loaded cycle distributions for day 1 - night operations. (Excludes cycles greater than 12 min)

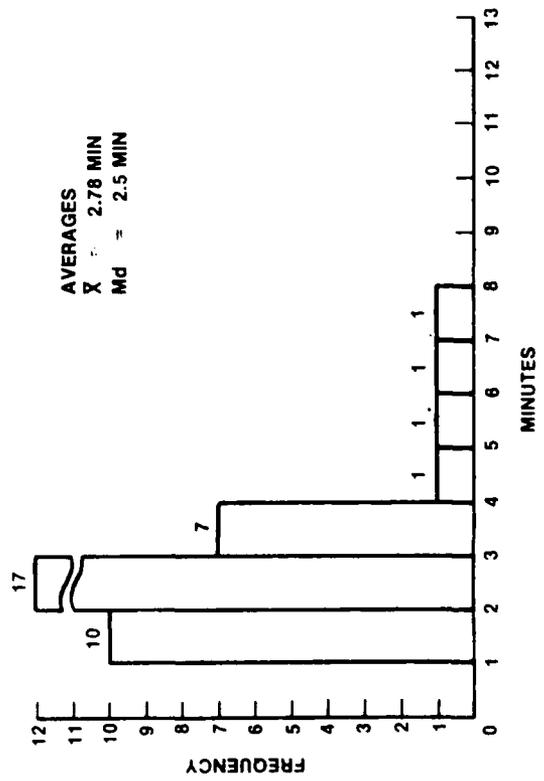


Figure 3.4 Elevated causeway retrograde cycle distributions for Day 2 - day operations. (Excludes cycles greater than 12 min)

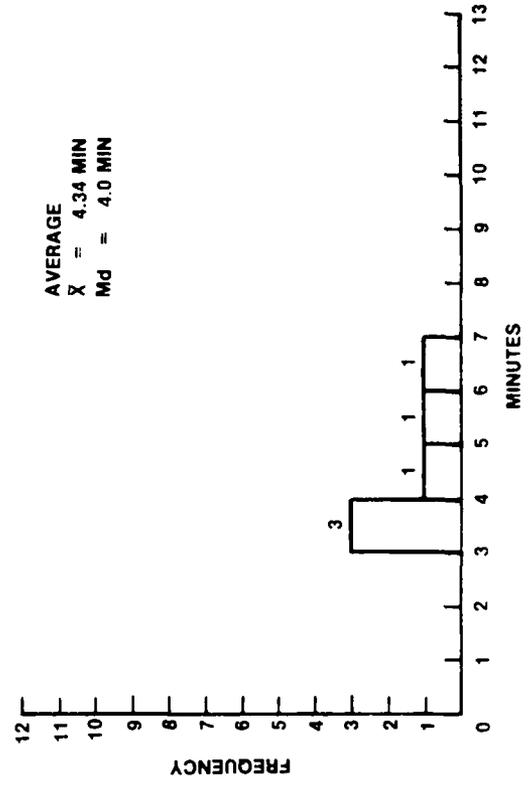


Figure 3.5 Elevated causeway retrograde cycle distributions for Day 2 - night operations. (Excludes cycles greater than 12 min)



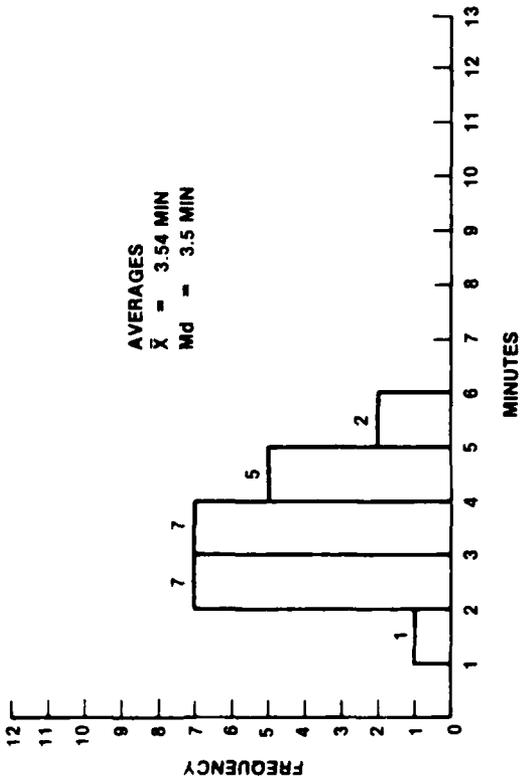


Figure 3.6 Elevated Causeway off-loading cycle distributions for Day 3 - day operations (Excludes cycles greater than 12 min)

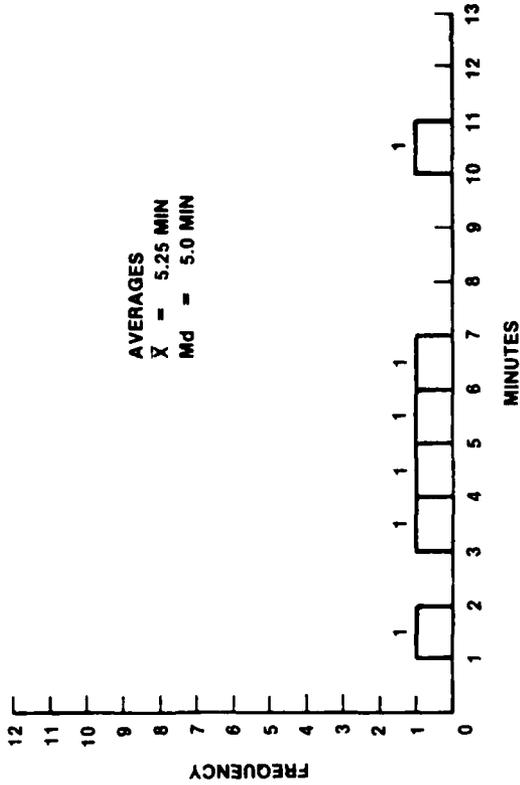


Figure 3.8 Elevated causeway retrograde cycle distributions for Day 3 - day operations (Excludes cycles greater than 12 min)

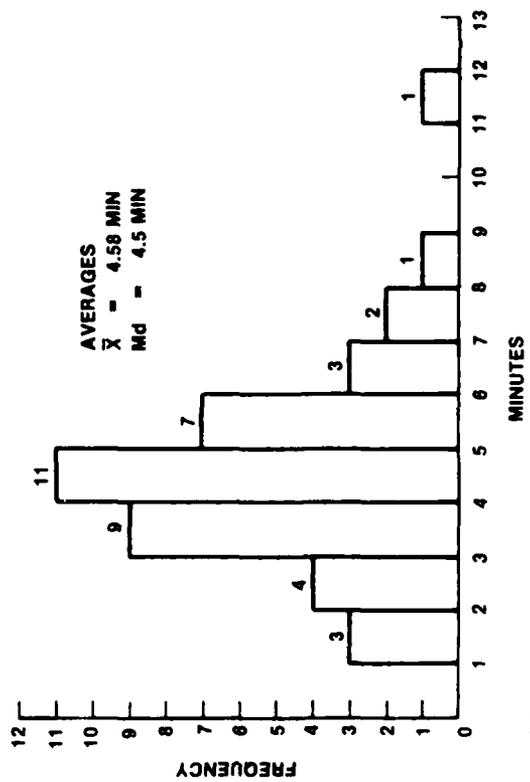


Figure 3.7 Elevated causeway off-loading cycle distributions for Day 3 - flight operations. (Excludes cycles greater than 12 min)

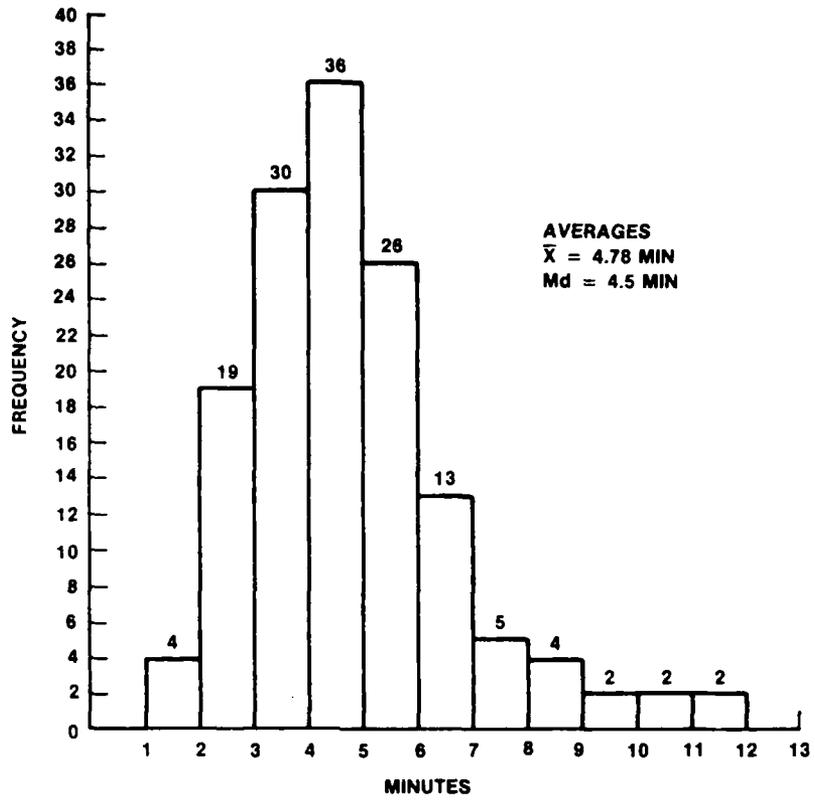


Figure 3.9 Elevated causeway off-loading cycle distributions (Excludes cycles greater than 12 min)

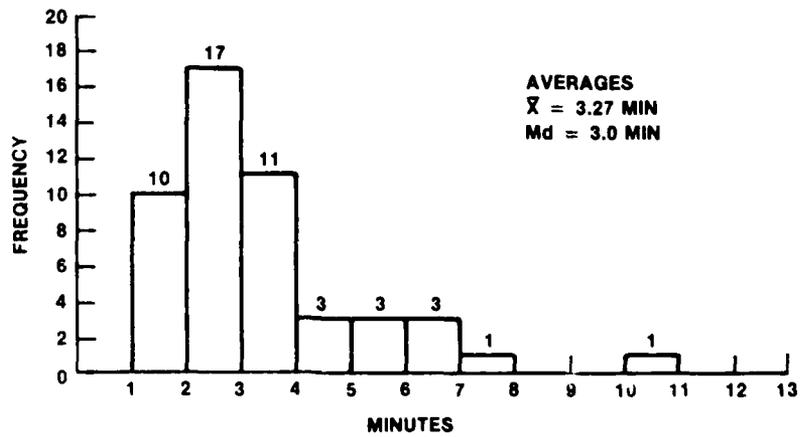


Figure 3.10 Elevated causeway retrograde cycle distributions (Excludes cycles greater than 12 min)

under 2 min each but a more realistic container handling surge rate during a 1-hr period would be 3.7 min for off-loading and for retrograde it would be 2.3 min. Faster times were possible during retrograde because the crane could attach the spreader bar to the container easier than when the container was in the lighter which was responding to sea swell activity. In general, elevated causeway productivity could be improved considerably (i.e., more ships could be served) if a faster method of handling lighter successions was derived.

## 5. LACH ANALYSIS

### 5.1 Analytic Methodology

Employment of the LACH was sporadic and tended to introduce a considerable amount of unrealistic data in the way of start, stop and wait activities. The crew and vehicle did not have the opportunity to establish a pattern and working rhythm from which the capabilities could be better evaluated. Demonstrations and waiting periods for visitors caused timed intervals to be skewed. Other disruptions also were experienced from routine delays, such as non-availability of tractor-trailer units and lighters, crew training, and some breakdowns. Consequently with a total sample size of only 31, some extrapolations were necessary.

The LACH cycle was broken into its component parts and the time required for each part was computed. Extremely long times were deleted from the calculation, and the average time for each component part of the cycle was found. The average times for each component were then summed and are contained in Table 3.2. For comparison the times for corresponding times found in the 1977 LOTS test are included.

TABLE 3.2  
AVERAGE TIME SEGMENTS FOR LACH OFF-LOADING CYCLES

TIME SEGMENT	LOTS MIN	SOLID SHIELD '79 MIN
Under Depart Lighter	3.5	3.2
Tractor to Trailer	2.0	1.5
Begin Positioning Container In Trailer To Land	3.0	2.3
Tractor Trailer and Return	2.5	2.0
TOTAL CYCLE	11.0	9.0

NOTE: See Appendix 2.

Two outliers were deleted from the LOTS data. The two outliers were included because of the small sample size.

## 5.2 LACH Cycle Times

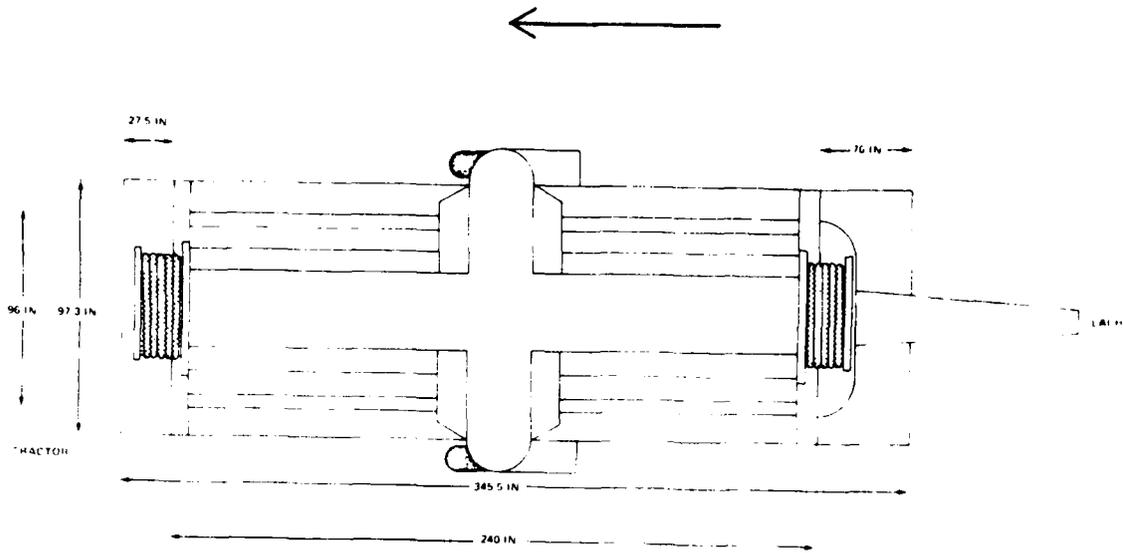
5.2.1 Direct to Vehicle Cycles. As may be noted from above, the average off-loading cycle time to transfer a container directly from a lighter to a trailer was 12 min for SOLID SHIELD and 11 min for the LOTS test. Besides the infrequency of operations, one factor contributing largely to this difference was the maneuvering of the LACH in placing the container on the trailer and backing away. The times to land the container on the trailer are similar even though in the LOTS test the LACH had to position containers on ISO locking pins. However, once the container had been landed, it was faster to clear the trailer in the LOTS test (the container was stowed on the after end of the trailer) than in the SOLID SHIELD exercise. In SOLID SHIELD the LACH had to maneuver to and from a position 6 ft further forward. Figure 3.11 illustrates the location of the container on the trailer and the relative clearances. Figure 3.12 is the load as it was actually positioned when the measurements were taken.

The necessity for positioning the load so far forward was to improve the vehicle's road stability. Locating the container above the fifth wheel helps distribute more of the load weight onto the tractor. This, in turn, improves control.

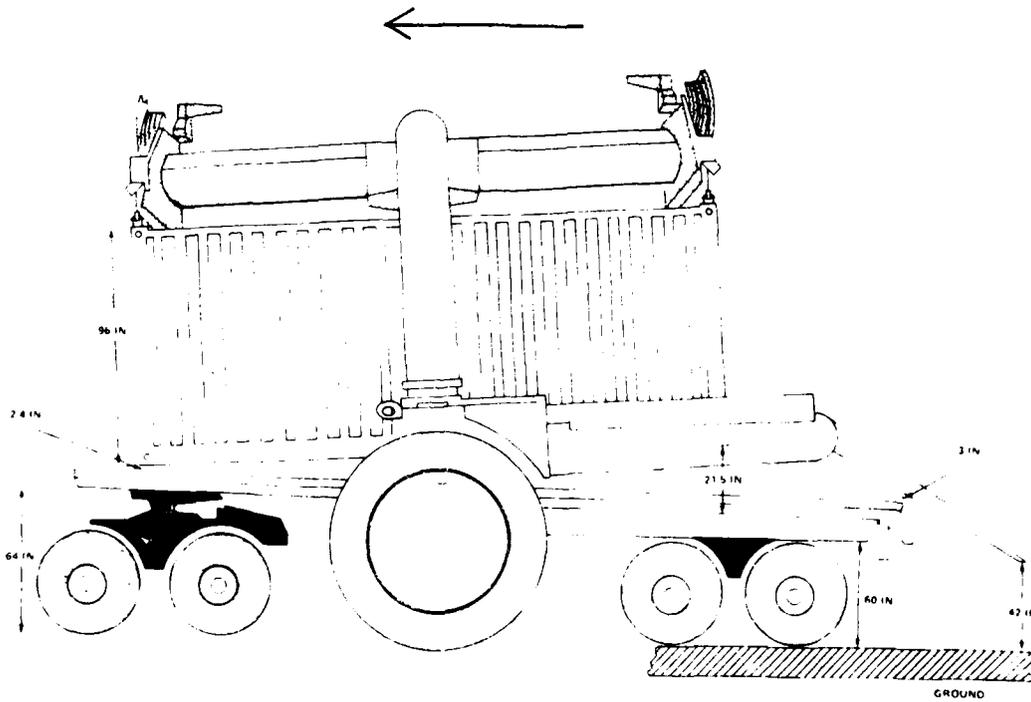
5.2.2 Lighter to Storage. In discharging lighters, normally all but the last container were stored on the beach to minimize the time the lighter spent at the beach. If no lighters were waiting the last container was taken directly to a tractor-trailer. The times for LACH off-loading cycles where the container was stored on the beach are given in Table 3.3. In computing these cycle times extreme values were deleted from the average. In both the LOTS and the SOLID SHIELD 79 tests for the LACH it required more time to store containers on the beach and later load the trailers than it did to load the trailers directly; however, it reduced the time a lighter was beached. The lighter was then free to return to the ship for more containers. In SOLID SHIELD 79 by storing containers on the beach, it increased the LACH cycle time from 12 min for direct to trailer loading to 17.6 min, a 47 percent increase in cycle time.

TABLE 3.3  
LACH AVERAGE OFF-LOADING CYCLE TIMES

<u>CYCLE TYPE</u>	<u>LOTS</u>	<u>SHIELD 79</u>
Lighter To Beach	8.0	9.7
Beach To Tractor-Trailer	7.0	7.9
Lighter To Tractor-Trailer	11.0	12.0



TOP VIEW



PROFILE VIEW

FIGURE 3.11 LACH AND CONTAINER LOADING CLEARANCES WITH RESPECT TO THE M127 TRAILER

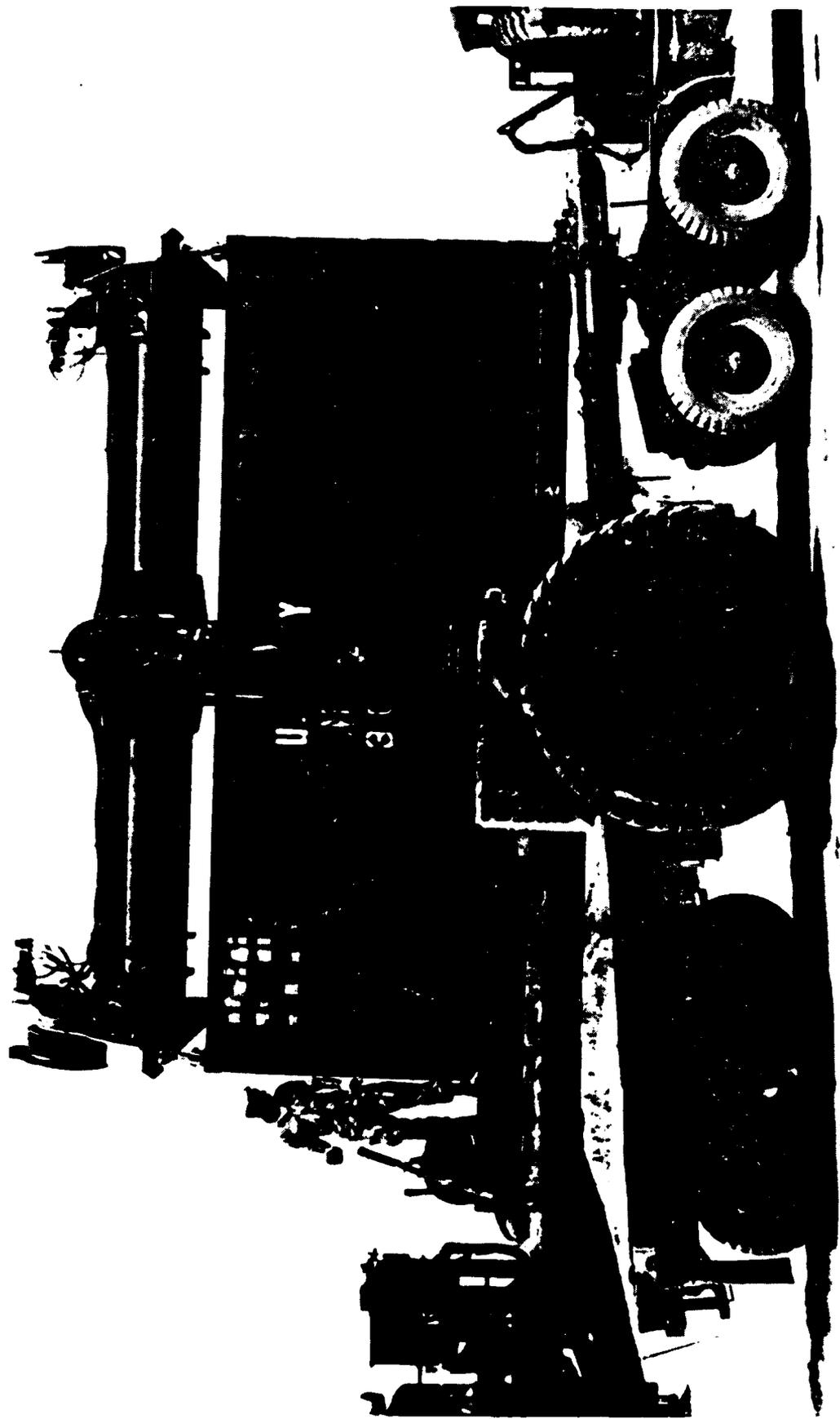


FIGURE 3.12 LACH LOADS A CONTAINER ON M127 TRAILER

5.2.3 Storage To Vehicle. In the Army operation, the frontloader was employed to transfer containers from the beach storage site to tractor-trailers (see Figure 3.13), requiring 3.2 min as compared to the LACH which required 7.9 min. The total time for a container to clear the beach using both a LACH and a frontloader would have required 12.9 min for transfer of a container from a lighter to a trailer. One frontloader could have supported three LACHs, since the frontloader had to wait 6.5 min per LACH-container cycle. Lighter turn-around time theoretically could be as little as 16 min, since one LACH could enter an LCU as soon as its predecessor cleared the LCU ramp. None of the LACHs would have to halt for the slower procedure of loading trailers.

### 5.3 Employment Analysis

During both the LOTS and SOLID SHIELD 79 tests only one LACH was available for operations and in both tests the distance from beached lighters to tractor-trailers was longer than need be. Also, the LACH was not supplied with a steady stream of containers to transfer from lighters to tractor-trailers. Under this set of circumstances it was acceptable to use the LACH for off-loading containers to a temporary storage location. Transfer to tractor-trailers was then made during the considerable periods in SOLID SHIELD 79 when no lighters were available.

The last container on a lighter was transferred directly to a tractor-trailer unless another lighter was ready to be off-loaded. This procedure, while requiring double handling of containers on the beach by the LACH, minimized the time to off-load the lighter. Where there are sufficient lighters, however, it would be more efficient for LACH operations to delay the lighter and load trailers directly.

5.3.1 One LACH for Off-Loading. Using a cycle time of 12 min to transfer a container directly from a lighter to a tractor-trailer, the LACH requires 48 min to complete the off-load of an LCU with four containers. At the end of 48 min the LACH is ready to off-load the next lighter. In using the direct lighter to trailer and return approach, the time from when the LACH first entered the LCU until it departs the lighter with the last container is 39.8 min. This is the minimum time the lighter must stay beached.

The cycle time to off-load from a lighter to a storage location on the beach is 9.7 min. The LACH can off-load an LCU with four containers to the beach and be ready to off-load the next lighter in 38.8 min. The time from when the LACH first enters the LCU until it departs with the last container is 32.9 min. Off-loading directly to the beach saves the lighter 6.9 min. The latter method is acceptable when there is a sporadic flow of containers to the LACH site. The LACH is able to transfer the containers to tractor-trailers during periods when no loaded lighters are waiting. As discussed, 7.9 min per container is required.

As noted above, double handling of containers is not an efficient procedure in terms of maximizing LACH handling capabilities. The double handling, in this case, increases the LACH worktime by 50 percent but decreases the beached LCU time by 17 percent. Thus, in some cases a decision may be required as to whether the LACH or the lighter should be given priority since one may have to wait/work longer on account of the other's priority.

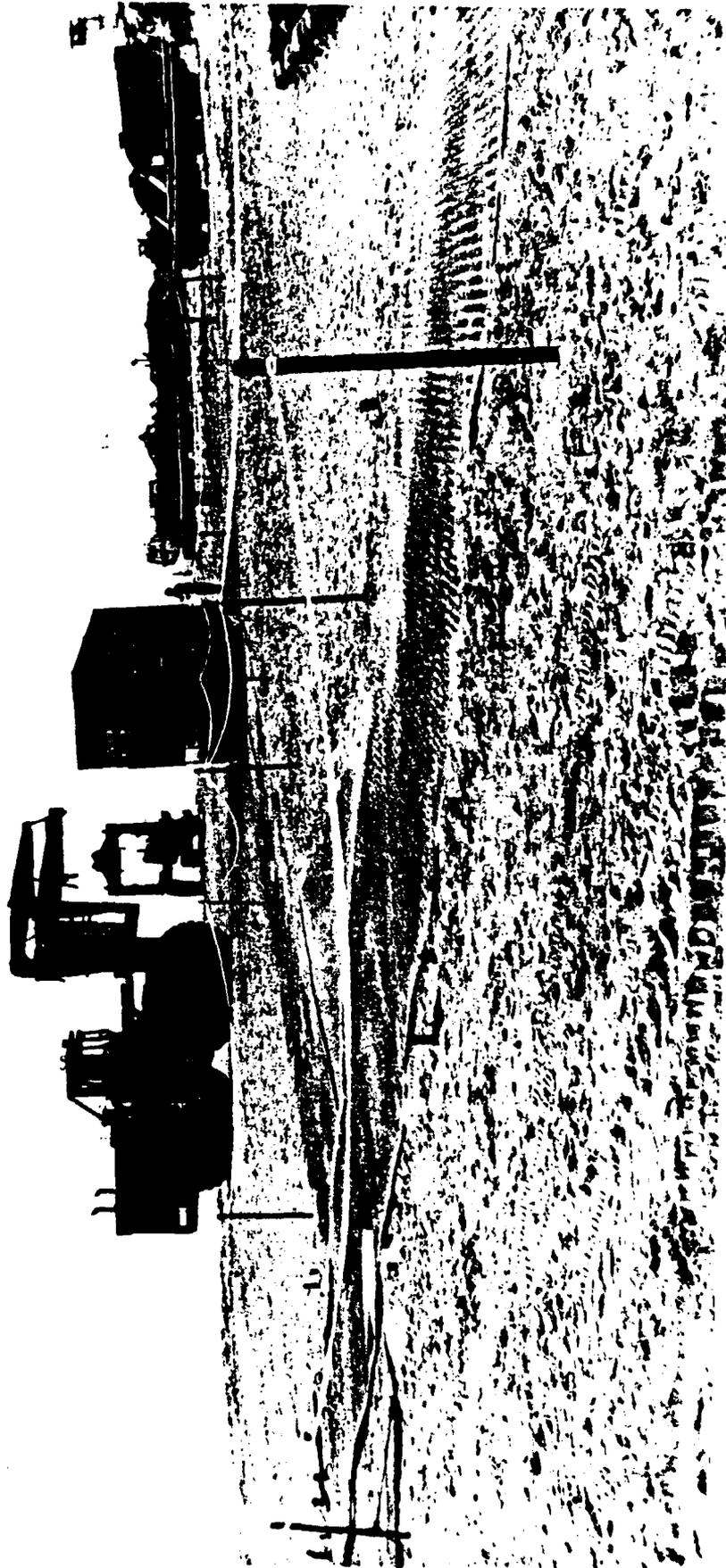


FIGURE 3.13 THREE LACHS AND ONE FRONTLOADER COULD HAVE REDUCED LIGHTER TURN AROUND TIME TO ABOUT 16 MIN



5.3.2 Two LACHs for Off-Loading. Two LACHs are considered in off-loading LCUs when there is a steady flow of LCUs to the beach. In one case, the two LACHs are both used to off-load containers from the lighter and transfer them directly to tractor-trailers. Again the 12 min cycle time is used. It requires 24 min before the next lighter can be off-loaded.

Also considered was a case using one LACH to off-load containers to the beach and the other LACH to load containers from the beach to tractor-trailers. One LACH requires 9.7 min to off-load a container from the lighter and deposit it on the beach and the other LACH requires 7.9 min to load the container from the beach to a tractor-trailer. Using this method it is 38.8 min before the LACH is ready to off-load the next lighter.

The cycle time for two LACHs loading directly to trailers is faster than the case where one LACH is only discharging and the other is only loading trailers. This is because of the double handling required for each container. An LCU can be off-loaded every 24 min instead of every 38.8 min. A time savings of 38 percent is gained loading directly to trailers.

5.3.3 More LACHs. Based upon the above times and calculations, a maximum of three LACHs could off-load an LCU without interfering with or delaying each other. This is a consequence of the fact that each LACH requires an average of almost 4 min on the LCU to discharge a container. A total cycle time of 12 min would mean that the fourth LACH would cause each LACH to wait 4 min before entering the boat. If there were a fourth LACH, it would be more efficiently used working an adjacent lighter by itself.

If the landing support battalions are to receive 14 LACHs each, some concept refinement and publication of their employment concepts would be helpful. In that regard simulation and modeling could help smooth operating procedures.

5.3.4 Summary. For one LACH and during periods of infrequent or sporadic container flow it is faster for the lighter to have the LACH deposit containers on the beach. For 2-3 LACHs working a steady container flow, it is more efficient to have the LACHs load directly to tractor-trailers. A maximum of three LACHs could be used per LCU without seriously interfering or delaying each other. Further concept refinement on the intended employment of LACHs appears desirable.

## 6. TRACTOR-TRAILER ANALYSIS

### 6.1 Possible Effects of Loaded Containers

Tractor-trailer operations did not appear to be fully taxed by hauling empty containers over the beach road. Since fully loaded ammunition containers would have averaged about 6-7 STons greater than the containers with cargo in the exercise, the maintenance effort could have been much more demanding. This, in turn, would have reduced the quantity of tractor-trailers available to clear the beach. Consequently, the reliability and dependability of these vehicles as container transporters is still subject to question. The SOLID SHIELD 79 test results should not be accepted as evidence of container transporter suitability over unimproved roads. The question is still unresolved.

### 6.2 Container Locking Devices and Guides

To secure a container to the bed of a trailer required four personnel per shift and 6 min per transit. The personnel used were assistant drivers but, nevertheless, their use did draw down on unit resources. By contrast, one trailer did have ISO locking pins in its bed and delayed the vehicle's driver approximately half a minute, as opposed to an average of 6 min. for those without the pins. The effects on crane cycle time could not be determined for lack of sufficient sample size. Presumably, more precise container positioning was required in loading the trailer with the locking pins, but the difference was not readily apparent in the exercise data.

Similarly, container guides might have facilitated loading. However, this type of device was not used on Marine Corps trailers. These devices used with the LACH might have expedited loading since container positioning was slow and difficult even without ISO locking pins. On Army trailers portable guides are used which can be adjusted as required for one or two container loads.

### 6.3 Resource Determination

The principal determinant to beach operations where cargo must pass through only two points, in this case the elevated causeway and the LACH, is to keep either or both facilities working steadily. Productive time can only be lost if the system is not kept in balance. Thus, sufficient vehicles serving the crane or the LACH must be maintained or the throughput chain will backup and likely not recover. Therefore, planning must consider not the average rate of an elevated causeway, but rather the surge capabilities. This factor could be 2-3 min. less than the planned average.

During SOLID SHIELD planning for tractor-trailer requirements reportedly was based upon a 6 min sustained crane cycle. Additional trailers were to be positioned nearby to absorb possible surges. This plan might have worked except that the time for movement along the causeway, rotation on the turntable, travel off the causeway, and trailer exchanges likely would have used up the quantity of shuttle vehicles planned (three) and the crane would have been delayed anyway. The crane's surge rate was nearly 1 1/2 to 2 times the planned sustained rate.

The 50 percent increase (from 10 to 15 vehicles) might also have satisfied the queue requirement except that local civilian traffic obstructed the beach thoroughfare, effectively slowing operational traffic. (Refugee traffic in a combat zone could be similar or worse.) Finally the draw bridge also contributed to the problem with periodic traffic flow interruptions. (Inaccuracies in local bridge records eliminated further analysis on time losses.)

To determine what the available tractor-trailer unit resources should be, two other factors apply besides meeting the surge rate. Through data analysis, modeling, and simulation, it has been found that a 15 percent increase in resource requirements will normally provide sufficient assets to satisfy a 95 percent working availability of a LOTS crane. There are minor speed fluctuations in the surge period which require queue support, otherwise the crane is delayed. However, a 95 percent availability is considered sufficient since for 100 percent availability the increase in resources requires considerably added costs. In addition, the crane usually is delayed for other reasons and realistically is not able to achieve 100 percent availability.

A common planning factor for the support of sustained operations is that 25 percent of all automotive type resources will be down for maintenance. Thus, there must be some built-in support to satisfy the requirement. In summary, once the surge requirement has been calculated and a 15 percent increase has been added to meet queuing requirements, the calculation finally must be divided by .75 to allow for maintenance.

#### 6.4 Sample Calculation

The following example illustrates the procedure for calculating resource requirements. When operations are moving at a sustained pace, tractor-trailers during the recent exercise spent an average of 40.9 min on the causeway. During surge operations the average time was on the order of about 19.8 min. Breaking these times down, the averages were on the order of:

	<u>Sustained Operations</u>	<u>Surge Operations</u>
Time for movement and queue on elevate causeway	27.2 min	8.6
Time in load position	4.8 min*	3.9*
Secure load and depart elevated causeway	8.9 min	7.3
TOTAL	40.9 min	19.8

\* Average crane cycle time was 5.2 min for sustained operations and 3.8 min for surge operations.

If there is an assumed 3 mile round trip to the marshaling yard, the average speed on an unimproved road would be about 10 mph, or require about 18 min. At the marshaling yard about 1-2 min was required for documentation

and about 1 min to arrive at a crane. The vehicle spent an average of 2.5 min in the crane's load position (the crane was still conducting its boom cycle when the tractor-trailer was underway). Thus, trip time from the elevated causeway to the marshaling yard and return would be about 23.5 min for this example.

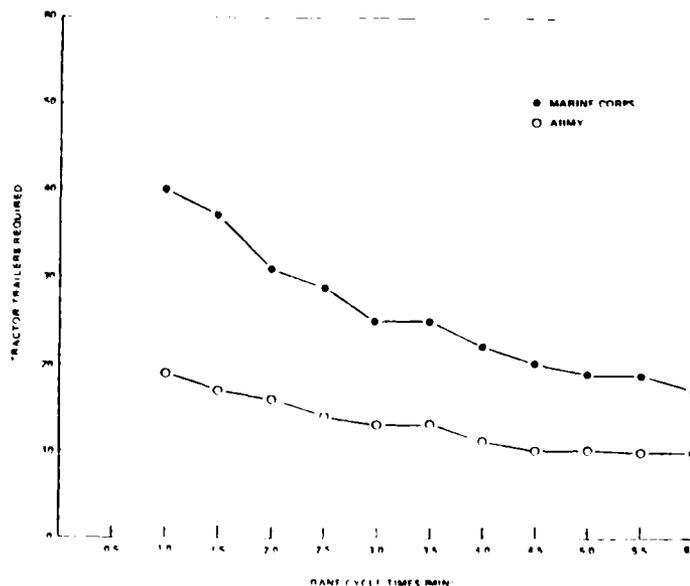
For a surge operation the vehicle's causeway time (19.8 min) would be added to the road time 23.5 min to obtain the overall cycle time for one vehicle (43.3 min). In that amount of time a crane off-loading at a rate of 3.8 min per container could discharge 11 containers, assuming lighter successions were not considered. To carry 11 containers would require three LCUs. During the exercise lighter succession times were as fast as 4.5 min for an LCM8 and 7.7 min for an LCU. Assuming an average lighter succession rate of 8.9 min and using only LCUs, the third lighter would almost be moored when the first tractor-trailer returned to the load position. Thus, to support this theoretical case, at least eight tractor-trailers would be needed to keep the crane working continuously.

Since some crane cycles are going to be faster than 3.8 min and some lighter successions are going to be faster than 8.9 min, a trailer queue is needed. Eight times .15 equals 1.2 which (rounded up) gives a total requirement for 10 vehicles to support queue and round trip times. To support this level of operations, maintenance must be taken into account so that 10 vehicles are always available. Ten is divided by .75, yielding a requirement for 14 vehicles (rounded up from 13.3) for a 3 mi round trip. To verify, 75 percent of 14 is 10.5.

#### 6.5 Exercise Requirement

Using the same procedures, the SOLID SHIELD exercise requirements were plotted for crane cycles varying the average handling times. The results are contained in Figure 3.14. For comparison Army tractor-trailers (which can carry two containers) are included in the figure. Distance traveled equals 15.6 mi per round trip. Lighter succession time was kept constant at min.

FIGURE 3.14  
Variability of  
Tractor-Trailer  
Requirements  
With Crane  
Cycle Times.



## 7. MARSHALING YARD OPERATIONS

### 7.1 Operational Concept

Technically the marshaling yard was not operated the way a marshaling yard would be. Normally, containers would be segregated by consignee and by special handling requirements (e.g. mail, classified cargo, etc.) Ammunition would likely be routed to a special storage area.

Since the exercise did not have any transshipment requirements, containers were segregated by class of supply. A representative number of Drott 30-ton cranes was used for the handling of the limited number of containers employed. Without a transshipment requirement the marshaling yard's workload was halved in terms of receipts and shipments. Since there was no requirement to deal with the contents of the boxes, the marshaling yard's problems were relatively simple, accounting for the receipt, storage, and shipment of about 80 containers per day. This was done quite well. No errors were found in numerous random checks.

### 7.2 Drott Crane

It should be remembered that the Drott crane handled mostly empty containers and 21 that approached the average DoD container shipment weight, 13 STons. No problems were noted. Ammunition, on the other hand, averages close to 19.5 STons and sometimes exceeds the normal 22.5 STon limit. Previously in the LOTS test the Drott crane was found to be severely strained handling containers on the heavy end of the container weight spectrum. Thus, the excellent Drott crane performance during the exercise should be viewed with some reservation. Assuming half of all resupply cargo may be ammunition, MHE for ammunition in the marshaling yard and in LSAs without LACHs could be difficult. It is also noted that the crane was not procured for container handling but it can serve in this role until, or if, a more capable substitute is found. (See Figure 3.15). A change in storing procedures (from side-by-side rows to end-to-end container rows) should be considered to facilitate random removal of heavy containers by the Drott crane.

### 7.3 Frontloader

The Army's frontloader operated in the marshaling area with difficulty and with good speed. It requires fewer personnel than a Drott crane (two versus three) and its cycle times were less (3.6 min. versus 4.9 min. for the 30-ton crane). In addition, both the frontloader and Drott crane can stack containers too high to save space but only the frontloader can transport containers from point to point.

## 8. PLANNING FACTORS

### 8.1 General

Based upon the data extrapolated from exercise results, factors were derived for throughput planning. Subsequent verifications, of course, are advisable because the influences of exercise artificialities are difficult



FIGURE 3.15. DROTT CRANE IN OPERATION. BECAUSE THE DROTT CRANE HANDLED MOSTLY EMPTY CONTAINERS AND A FEW LOADED ONES, ITS SUSTAINED PERFORMANCE COULD NOT BE FULLY EVALUATED.

to screen out. First, a full system was not exercised in the sense that transshipments from the marshaling yard were not made. Secondly, empty containers were used which did not stress vehicles or equipment. Third, there was no continuous flow nor any significant surges to stress or determine what the upper capabilities of the beach to respond to a greater demand might be. Thus, equipment capabilities can be assessed but reliability and maintainability can not be judged. In terms of control and accountability, management limitations would be speculative.

The best indications from test results are that with one elevated causeway and one LACH in good weather conditions, 290 containers per day could be transferred (off-loaded, retrograded, or some combination of the two). This is assuming a steady flow of lighters to both sites, 9 min lighter succession times at the elevated causeway, no major or catastrophic maintenance delays, and relatively experienced crews. In terms of breakbulk tonnage this throughput level would equate to about 3,770 STons per day. It also should be noted that currently there are no Marine Corps or Navy back up equipment items to the LACH or the crane on the elevated causeway.

## 8.2 Methodology and Planning Factors

To determine these factors average times were taken from the preceding analysis and a composite transfer rate was determined (off-load rate plus retrograde rate, divided by two). The rates are contained in Table 3-4, including those of the LOTS test for comparison. Two 10 hr shifts per day were used. It is understood that these high rates would not be achieved the first few days because of the complexities of organizing and integrating a full system. Also, later surge periods could increase these levels. Over a long term period these are expected to be the averages.

TABLE 3.4  
CYCLE TIMES USED TO DEVELOP PLANNING FACTORS

	CONTAINER OPERATIONS		
	Forward	Retrograde	Composite
LACH (SOLID SHIELD 79)	12 min	12 min	12 min
LACH (LOTS Test)	10.5 min	--	10.5 min
E1. Causeway (SOLID SHIELD 79)*	7.1 min	5.6 min	6.4 min
E1. Causeway (LOTS Test)	5.7 min	6.0 min	6.2 min

\* Includes lighter succession times, 9.0 min, every four containers

Based upon the cycle times contained above for one elevated causeway and one LACH, the daily container throughput planning factors are contained in Table 3.5. For comparison, the LOTS test results are also included.

TABLE 3.5  
PLANNING FACTORS DERIVED

	CONTAINERS PER DAY	
	SOLID SHIELD 79	LOTS TEST
LACH	100	115
Elevated Causeway	<u>190</u>	<u>195</u>
TOTAL	290	310

### 8.3 Breakbulk Operations

In contrast to the container operation which has a LACH with a projected capability for handling approximately 100 containers per day and the elevated causeway which also has a projected capability of about 190 containers per day, there has been no quantification of breakbulk throughput. To meet an off-load requirement of, say, 350 containers per day, another LACH or elevated causeway would be added. However, for breakbulk operations there has been no procedure adopted for tasking personnel or equipment to meet the beach off-load requirement.

Amphibious ships carry considerable quantities of breakbulk cargo and unit equipment that has to be off-loaded in short order. The AFOE will follow with additional breakbulk cargo and it will be followed by resupply echelons. Amphibious ships can discharge breakbulk cargo at the rate of several hundred tons an hour. The capability of the beach to receive and control this loose cargo *should be questioned and evaluated*. The consequence could be that the beach may be blocked and lighterage tied up when container operations are to be initiated.

## 9. CONTAINER HANDLING REQUIREMENTS

### 9.1 Notional Requirements

For planning purposes Headquarters, Marine Corps (Code LPP) has projected notional lift planning requirements for a MAF which are contained in Table 3-6. Generally, for the period D+5 to D+15 the beach will be required to off-load an average of 454 containers per day. Upon arrival of the resupply echelon after D+15 the beach will be required to handle containers at a rate of 341 per day. However, it will also be necessary to initiate the retrograde of all of the containers previously off-loaded that will then be empty. Hence, the handling requirement will rise by more than double the 341 containers inbound. This will be necessary to keep the commercial container system in balance.

### 9.2 Beach Requirement

To meet the maximum requirement (680 containers, including 340 off-loaded and 340 or more retrograded) the beach should have at least two elevated causeways (380 container capacity) plus four LACHs (400 container capacity). A trade-off would be one elevated causeway and six LACHs (total of 790 container capacity) to off-load the resupply requirement and support retrograde operations.



TABLE 3.6

## NOTIONAL MAF LIFT REQUIREMENT

CONTAINERIZATION OF MAI MATERIAL										
Supply Class	Percent Containerizable	Prescribed Load and Floating Dump #S/Ton>	AI		AFOI		FIE		RESO FLY	
			Short Tons	8x8x20 Containers	Short Tons	8x8x20 Containers	Short Tons	8x8x20 Containers	Short Tons	8x8x20 Containers
I	100	500	1290	121	9100	848	310	29	5600	522
II	100	300	850	96	3905	441	145	17	2600	294
III(P)	100	(100)	(1291)	66	(547)	28	(241)	13	(1089)	55
IV	85	100	269	15	1497	78	64	4	1100	57
V	100	9710	3591	186	52,700	2703	9450	485	38,850	1993
VI	100	-	120	13	658	68	22	3	400	42
VII	20	280	60	18	220	55	90	25	61	-
VIII	100	-	100	10	387	38	13	2	250	25
IX	100	200	683	65	3000	281	158	16	100	23
		11,090	6,963	590	71,467	4,540	10,252	594	52,425	3,414
(% not cont.)			288		1,144		371		2,694	
Vehicles			32,100		25,100		3,600			
UE			2,950		5,900		2,950			
PLFD			42,301							
			11,090							
			53,391		103,611		17,173			

\*Class V on Pallets; Other Classes in Falcon, Quadcon, or on Pallets.

NOTE. The 8x8x20 container equivalents relate containers to cargo and do not indicate that the Assault Echelon (AE) or Fly In Echelon (FIE) employ (Handle) 8x8x20 containers.

this calculation does not include maintenance back ups for the LACHs but does permit some additional allowance for retrograde of containers originally off-loaded during AFOE operations. Operationally at least two LACHs need to be set aside or back ups for each elevated causeway. Inland LACHs may be required to support Drott cranes in handling the heavier containers. This inland requirement, if any, will also depend upon who and where the consignees are and could not be determined from this test. Table 3.7 summarizes beach requirements.

TABLE 3.7  
MAF BEACH REQUIREMENTS FOR CONTAINER OPERATIONS

	ELEVATED CAUSEWAYS	LACH		TOTAL
		OPERATIONAL ON BEACH	BACK UP SUPPORT OF EL C/Way	EL C/WAY/LACH
Case 1	2	4	2	2/6
Case 2	1	6	2	1/8

10. BEACH AND PORT COMPANY

While one of the requested elements of analysis was the organization and operation of the Beach and Port Co., in terms of the potential mission, there was little to note or observe. Beach and Port Co. maintained a small control element on the beach around the clock, which appeared adequate. Some stevedore effort was required with the LACH and in the marshaling yard with the cranes. This type of operation did not stress the company. Some additional accounting and coordinating would have been necessary if special containerized cargo had been landed. Another elevated causeway and additional LACH operations could have been managed without great difficulty. No breakbulk was handled so additional requirements in that area were not observed. Additional LACH support requirements would increase the stevedore workload slightly (from three to about 12-18 per shift) and additional Drott cranes (approximately six, depending upon marshaling yard organization and availability of LACHs to support ammunition handling) would require another 24-30 personnel altogether. In addition, Beach and Port Co. organization and operations have not been fully defined and a systems analysis approach appears needed.

According to the Table of Organization, the Beach and Port Co. does not have an over-the-beach mission, but instead it has a mission to direct designated port, railroad, and airhead operations when control of these functions has passed to the force service support groups. Organization of the landing support battalion with the incorporation of Beach and Port Co. into that organization has freed the landing support companies to accomplish helicopter support team missions. A re-examination of the missions and functions would appear to be in order.

#### 11. TRANSITION TO ARMY LOTS OPERATIONS

Basically 2D Landing Support Bn. was operating a LOTS system when the transition to Army operations took place. The transition was a success because the Army did not have to make any major adjustments to the LOTS operation underway. In addition, the early "arrival" of the cargo documentation detachment facilitated the turnover. Essentially the Army's remote processing facility was already in lock-step with Marine Corps activities when the Army assumed responsibility for the operation. The approach and procedures worked well and should be adopted.

The issue of which Service retains the elevated causeway, beach matting, and other facilities and equipment is likely to continue being taken on a case by case basis. Other considerations, such as deployment of the Army's LOTS package (DeLong piers, LCUs, and other large items) will impact heavily upon their capabilities to assume the LOTS mission. Similarly, the Amphibious Force may be required to conduct a retrograde of part or all of the Force for subsequent operations elsewhere.

#### 12. DOCTRINAL CHANGES/SHORTFALLS

##### 12.1 Stevedore Support in Lighters

During this operation 2D Landing Support Bn. at the request of the Navy provided tagline handlers in lighters. Large heavy containers require tag line handling guidance when being discharged to lighters and when spreader bars are attached during retrograde.

Historically, shore party support has been limited to the beach area. Also, ships' platoons were provided by the Landing Force because cargo operations were labor intensive and the ship lacked sufficient crew to meet the requirement. The ships' platoons ultimately became Landing Force replacements, thereby solving two problems. Since those days replacements are handled differently and ships are now equipment intensive. In addition, there is a Navy Cargo Handling and Port Group which has an off-shore cargo discharge responsibility. NAVCHAPGRU has a human resources shortfall and there is some question as to whether stevedore support in lighters, in fact, is their responsibility and how it should be accomplished. The procedures and agreements in this area should be reviewed and made known. It may be possible that landing support battalion by default could be burdened with this mission in the future.

## 12.2 Afloat Commander

During resupply operations there may well be no on-site Commander Amphibious Task Force (CATF). CATF probably will be elsewhere bringing in additional forces and equipment. Consequently, this raises the question as whether another Navy afloat command needs to be introduced to assume responsibilities over lighterage operations and the conduct of merchant ships discharge and retrograde operations. This issue is not doctrinally covered. The Army assumes responsibility for all terminal operations in a LOTS situation. The Navy in either case is charged with the protection of ocean shipping. Naval Beach Group rightfully assumed responsibility for the ship discharge and ship-to-shore operation, but it was required to report to COMNAVFORBLUE. COMNAVFORBLUE, in turn, chose at one point to interject himself into the operation. Naval Beach Group TWO, in effect, had two operational commanders, the Landing Force Commander and COMNAVFORBLUE, who was both SOPA and an exercise commander. There were no significant difficulties or problems surfaced but the fact that another Navy command can interpose himself into the ship-to-shore mission raises some doctrinal or at least procedural concerns with regard to how the Navy intends to support the resupply role and who is responsible for terminal operations until the Army arrives.

## 12.3 Retrograde Ship Loading

Clearly in the days of breakbulk operations there was little concern for retrograde operations because it was relatively small in quantity. With containerization retrograde is 50 percent of the ship-to-shore operation. Retrograde will likely take on increasing importance with the scarcity of materials and the increasing involvement of CONUS depot and maintenance facilities for logistic support. Qualified personnel to include container-ship loading expertise and appropriate documentation capabilities are matters that need to be addressed by the Navy and Marine Corps for over-the-shore resupply operations and a determination made as to who provides the officer responsible for the loading plan.

## 13. THROUGHPUT SUMMARY

There are a number of factors that influence the success of a container supported ship-to-shore operation. Figure 3.16 illustrates some of the more pronounced ones, both common and unique to each subsystem. Basically, the ship determines the rate at which cargo will be transported forward but to operate effectively and at its greatest efficiency each link and node must be geared to make the whole system operate at its maximum. One element of the system cannot be made to operate better at the expense of the remainder of the system. At a level of approximately 300 containers per day, there is a great deal of leverage gained over a breakbulk system -- on the order 3 $\frac{1}{2}$ -4 times that of a breakbulk system plus considerable relief in management and organization. But it is no better than the traditional ship-to-shore procedures if tractor-trailers are not always available in the quantities needed or lighter succession at the causeway falls off, or

# THROUGHPUT DETERMINATION FACTORS

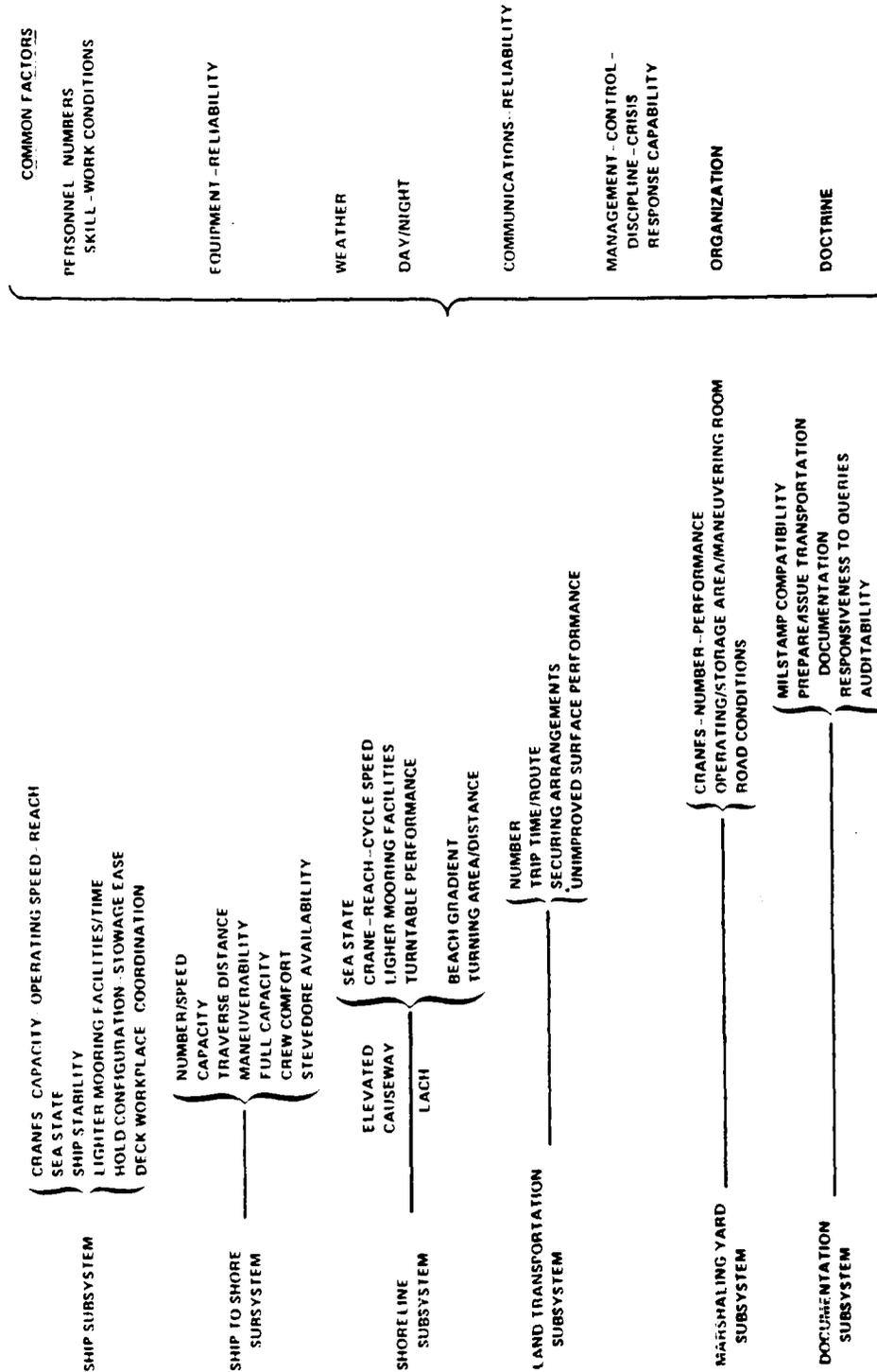


FIGURE 3.16. UNIQUE AND COMMON FACTORS ASSOCIATED WITH A THROUGHPUT SYSTEM

if personnel are not responsive to the means for saving time and moving containers faster, or if management is not thorough and aggressive. The equipment is available, albeit in limited quantities, but it is a significant improvement over breakbulk handling in terms of cargo protection, fewer personnel required, better management, and (most importantly) faster delivery.

SOLID SHIELD 79 provided some valuable insights with respect to organizing a throughput system, interface with the larger DoD transportation, system operations and management, and the physical handling and on-site management of containers. Some areas still need further development, evaluation, and training. These include:

- Transshipment to several LSAs/other field locations,
- Field tracer activities (by TCNs),
- Supply dump organization and container stripping,
- Retrograde from several field locations,
- Movement of mixed types of cargo (breakbulk, bulk POL, barge, and containerized cargo), and
- Cargo identification in containers.

With respect to a capability for the identification of cargo in containers or shipped by breakbulk, the capability to conduct tracer actions, and the requirement to document and retrograde containers and repairables, there is strong evidence to support the need for early computer support for landing support and transportation functions. In addition, procedures would appear to be desirable for field units to have a link between SASSY and MILSTAMP. For these reasons computer support, perhaps on the order of that used by the Army's cargo documentation detachment, should be investigated. There was not sufficient cargo activity generated to define what these requirements would be or fully picture the range that minicomputer support would help provide. However, it should not be construed that the ease and noteworthy success 2D Landing Support Bn. had with SOLID SHIELD 79 (80+ containers per day) would have satisfied the larger requirement of supporting a MAF (more than 700 containers per day plus breakbulk). Accordingly, a recommendation should be forwarded that this requirement be evaluated with these volume requirements in mind. One possible source for automated support might be the SDA FMF (Source Data Automation, Fleet Marine Force), which is a candidate for introduction into the FMF. The capability of this equipment for providing all throughput mission support could not be determined in this evaluation.

## IV CONCLUSIONS AND RECOMMENDATIONS

### 1. GENERAL

Incorporating container operations in the SOLID SHIELD 79 exercise was an important milestone. The operation was a noteworthy success from the standpoint of the significant and far-reaching lessons learned considering the limited resources that were available. It is important, for example, to note that large numbers of ships committed to the support of NATO are of the MINI LOAF size and capability. On the other hand, the North Sea presents a far more severe environment than that encountered off Onslow Beach during SOLID SHIELD. Consequently, the difficulties encountered in this year's exercise should be of considerable interest to logistic planners, to include NATO.

The conclusions and recommendations contained here stem from two sources. First, directly from the limited exercise results and, secondly, from those that can be extrapolated into the larger arena of a full MAF AFOE and resupply operations. The tone of the following conclusions is not meant as admissions nor as implications that there were few benefits derived. To the contrary, the 2D Landing Support Bn. was most successful in its efforts and numerous insights into operational improvements were gained which would not otherwise have been possible. These lessons learned are especially important in an area as new as containers-supported AFOE throughput operations.

### 2. CONCLUSIONS

2.1 The severely limited transfer rates generated in the stream coupled with exercise artificialities (e.g., empty containers, no transshipments) failed to stress the capabilities of Beach and Port Company or 2D Landing Support Bn. and equipment.

2.2 The general organization, procedures adopted, and manning levels used were excellent for the type and level of effort required in the exercise and would have succeeded had the throughput flow been greater.

2.3 Based upon cycle rates observed and had there been a steady flow of lighters, a discharge rate of 290 containers or about 3,800 STons of cargo per day could have been supported.

2.4 There was insufficient time to integrate MILSTAMP procedures and training into the system employed by 2D Landing Support Bn. and still needs to be done.

2.5 The concept and organization of marshaling yard type operations has not been developed for a Marine Corps field transportation system, although needed to sustain container operations until such time as an Army terminal service unit can assume the support mission.

2.6 Conclusions regarding the 30-ton Drott crane in the marshaling yard are:

- Based upon the type of employment used in SOLID SHIELD the Drott crane average cycle time was 4.9 min, which would equate to 240 containers per day, if there had been a steady flow of tractor-trailers.
- The 30-ton Drott crane was not stressed by the lightly loaded and empty containers used. For the loads handled, the crane performed well.
- The crane's utility in handling ammunition containers (average weight of 19.5 STons) was not observed.

2.7 To maintain a high level of throughput support a sufficient tractor-trailer queue must be available to support LACH and elevated causeway surge capabilities. This is necessary to avoid the loss of unused transfer time which can not be recouped.

2.8 Conclusions regarding M52A2 tractor and the M127 trailer:

- The M52A2/M127 was not stressed by the loads transported; thus, reservations are advised with respect to trailer capabilities when transporting containerized ammunition (up to 22.5 STons).
- Vehicle round trip times and personnel requirements could be reduced by incorporating ISO locking pins into the trailer bed of any future trailer buys.
- The utility of container guides with a LACH and in a beach environment needs evaluation. This also should be considered in future trailer buys.

2.9 Conclusions regarding the LACH are:

- Based upon data extrapolated from exercise results, the LACH could have transferred 100 containers per day. This is comparable to the 1977 LOTS test results of 115 containers per day.



- The LACH did not have the opportunity to establish a working pattern and rhythm, which partially obscured operational results.
- Delays were experienced with the ISO locking pins, suggesting modifications may be desirable.
- The LACH-trailer loading point needs to be established as close as possible to the lighters beaching site.

2.10 Conclusions regarding the elevated causeway are:

- Based upon data extrapolated from exercise results, the elevated causeway demonstrated a capability to transfer 190 containers per day. This is comparable to the 1977 LOTS test results of 195 containers per day.
- Productivity on the elevated causeway could be increased considerably by developing new techniques or modification of the pierhead to reduce lighter succession times.
- The capability for surge operations at the elevated causeway should be based upon an average crane cycle time of 3.8 min with an allowance of 9 min per LCU succession time and 4.5 min for LCM8s.

2.11 Conclusions regarding the adequacy of cargo management and accounting procedures are:

- A system is required for the effective production and utilization of MILSTAMP documentation.
- An evaluation effort beyond the scope of this report is needed to determine system requirements for an automated cargo documentation system. The SDA FMF should be evaluated as a candidate for this role.

2.12 Resolution of the requirement for stevedore support in Navy lighters is needed. The requirement is not central to container operations only but applies to all cargo modes.

2.13 There is no requirement, doctrinally or otherwise, for interposing a special Navy afloat command (i.e. COMNAVFOR BLUE) to assume responsibility during any throughput phase of resupply or terminal operations, to include ship discharge or lighterage operations.

2.14 In view of container (and barge) retrograde requirements responsibility needs to be determined, qualified Marine Corps or Navy personnel need to be provided, and more firm procedures adopted for the planning, management, and backloading of ships in the objective area. At present, responsibilities and procedures are undefined.

2.15 Based upon notional MAF requirements and if a DoD policy of maximum containerization is followed, a container transfer (off-load and/or retrograde) requirement of more than 700 containers per day (minimum of 340 inbound) can be anticipated.

2.16 Based upon daily container handling requirements and equipment transfer rates, a MAF would require a minimum of two elevated causeways and four LACHs on the beach plus back up support in the event of equipment or subsystem failures.

### 3. RECOMMENDATIONS

3.1 A recommendation be made to the Commandant of the Marine Corps that a system approach type analysis be conducted on the mission and capabilities of the landing support battalion from assault operations through to transition to an Army LOTS operation.

3.2 Additional testing be accomplished to determine planning factors for the breakbulk throughput handling capabilities available within the landing support battalion.

3.3 Procedures be adopted and training conducted in the use of MILSTAMP documentation.

3.4 The Commanding General, Marine Corps Development and Education Command be advised of the need to update the appropriate logistic field manuals, to include organization and operation of a marshaling yard, LACH operations, employment of an elevated causeway, transition to an Army supported LOTS operation, determination of tractor-trailer resource requirements, and cargo accountability.

3.5 A recommendation be forwarded to the Commandant of the Marine Corps that doctrine be reviewed with the Navy for guidance on the potential requirement for the provision of Marine Corps personnel in lighters as stevedores and responsibility for the management of ship backloading during retrograde operations.

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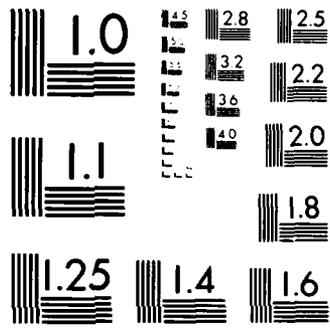
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## ANNEX A

### ARMY REMOTE PROCESSING FACILITY

#### 1. GENERAL

The 491st Cargo Documentation Detachment of the 7th Transportation Group, Fort Eustis provided on-site automated cargo documentation control and monitoring during all phases of the SOLID SHIELD tests. The system generates the same type information normally passed by the Military Traffic Management Command (MTMC) to its terminal units around the world. The information is used to plan discharge requirements, coordinate transportation, and route cargo, among other things.

#### 2. REMOTE PROCESSING FACILITY EQUIPMENT

The following components of ADP equipment were provided:

UTS-700 (militarized UNIVAC BC-7) with 64K central processor

Rigid disk drive with 10 megabyte cartridge disks

Magnetic Tape Drive (800/1600 BPI densities)

One 250 LPM Printer

3 video-work stations

Also provided in the configuration of equipment as deployed to Onslow Beach, but not used in the exercise, were a card reader, multiple "floppy" disk drives and an AUTODIN MODE 1 interconnection modem.

The UTS-700 is an exceptionally flexible, operator oriented system. For the purpose employed it is programmed in ESCORT, a UNIVAC proprietary "macro" instruction high level language. This language permits a high degree

of operator freedom in data base management and report generation. Also available, but not used by the 491st are compilers for RPG-II, BASIC and SCL (Systems Control Language). The UTS-700 basic core memory is 48K expandable to 128K. The main frame can accommodate up to 40 megabytes of rigid disk peripheral memory (4-10 MB disks), 2 magnetic tapes disks, 6 video terminals (work-stations), 2 line printers, 1 card punch and 1 card reader. As noted above, the configuration used in the exercise was considerably smaller in power and memory capacity

### 3. ONSLOW BEACH ORGANIZATION

As indicated in Figure A.1, the main frame equipment was van mounted, the van being positioned behind the first dune line proximate to the elevated causeway and the LACH operations areas. Prime power to the van was provided by an onboard 10 KW diesel generator alternating with a transportable 30 KW diesel generator made available by the Marine Corps. The UTS-700 van is a converted 20 foot reefer milvan, with the interior dimension reduced to 16 ft. to provide for a 4 foot generator porch. The van is wired for 220/110 volt power and is air conditioned. Video work-stations were located in the van (main console station), at the beach TCP #1 area and at the MCP in the marshaling yard. The TCP station was connected to the van with field wire. The MCP work-station was connected via a microwave path, using jeep mounted microwave equipment and 1.5 KW generators. The equipment could also be battery powered from the jeep batteries. In general, reliability of the system was excellent, most of the limited outage times experienced being due to the generator prime movers running out of fuel. A land line connection from the MCP work station to the van was laid, with the wire sunk to cross the inland waterway. This was initially satisfactory but later failed, probably due to water penetration. The UTS-700 equipment performance was superb with only a minor problem prior to the commencement of the exercise.

### 4. SOLID SHIELD 79 OPERATIONS

The 491st prepared the vessel manifest for the MINI LOAF onload of 76 containers at Cheatham Annex. This was done at Fort Eustis before relocation of the equipment to Onslow Beach. Upon backload of an additional 22 containers at Onslow Beach prior to the commencement of the exercise, the vessel manifest was amended to document the additional containers. The 2nd FSSG provided the 491st with consignee addresses for each class of cargo represented in the containers used in the exercise. The TCMDs were then outputted from the UTS-700 and positioned in multiple copies at the TCP. Each truck departing the beach stopped at the TCP and the driver received the TCMD package less one copy pulled for use of the work-station operator. The operator used this copy as a basis to update (date, time and container location) the central file from his terminal. Upon arrival at the MCP, the driver surrendered the TCMD package, retaining one copy. At the MCP one copy was pulled for use of the work-station operator for central file update. The remainder of the TCMP copies were filed in suspense and subsequently used for retrograde. Retrograde movement essentially involved a reverse procedure with both MCP and TCP work-stations providing prompt update information on line to the central files.

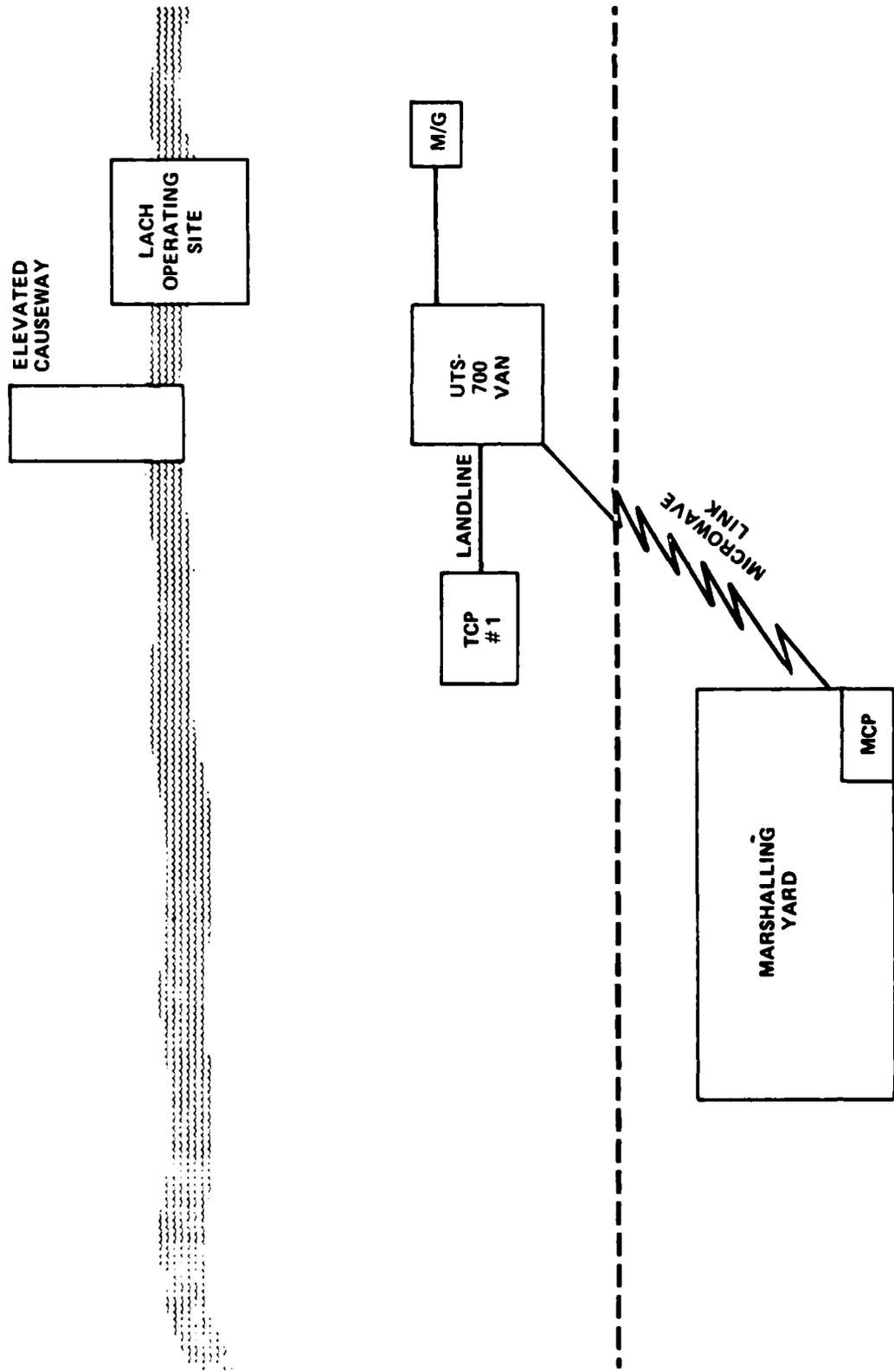


FIGURE A.1. ARMY REMOTE PROCESSING FACILITY LOCATION

## ANNEX B

### MILSTAMP CARGO DOCUMENTATION BACKGROUND AND PROCEDURES PROPOSED FOR MARINE CORPS FIELD USE

#### 1. BACKGROUND

##### 1.1 DoD Regulation

The movement of DoD sponsored cargo is normally governed by DoD Regulation 4500.32-R, Military Standard Transportation and Movement Procedures (MILSTAMP). MILSTAMP provides the basic policies and procedures and the Transportation Account Codes (TACs) necessary for DoD access and use of commercial air, ground, and sea systems. MILSTAMP regulates how the principal Defense transportation agents for the Government do business with the commercial world and how Defense shippers present and receive cargo.

##### 1.2 Military Mission Areas for Surface Transportation

Interface between DoD and commercial vendors is handled (for surface considerations herein) by the Military Traffic Management Command (MTMC) and Military Sealift Command (MSC). Basically, MSC is responsible for ship operations while MTMC is responsible for CONUS land traffic management and terminal operations. Terminal operations can be either in-port or across a beach; however, MTMC is directly responsible only for the port operations, while LOTS operations are the responsibility of the theater commander. LOTS operations for the Army are accomplished through a transportation terminal unit in command of watercraft and various terminal units. For the Navy, LOTS operations<sup>1</sup> are a task-organized responsibility of a group normally involving Naval Beach Group units, which provide lighterage and some shoreside support (but no cargo handling capability); and Navy Cargo Handling and Port Group, which provides the shipside cargo personnel

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<sup>1</sup>OPNAV Instruction 4620.6A, a Joint Services instruction, defines Navy responsibilities for LOTS operations but does not outline Navy unit missions or doctrine.



and some shoreside breakbulk capability as well as stevedores. The Army has container handling capabilities while the Navy has none except an elevated causeway with a 140-ton crane as part of its system equipage.

Army LOTS operating units are equipped to provide the same type interface services with commercial systems as would be found in a port operation. Navy-Marine Corps amphibious assault support operations are geared toward an entirely different support system involving highly selective call-up of individual items from specially designed and loaded ships. Once the beachhead is clear for general unloading, ship-to-shore operations in support of an amphibious assault take on the character of pushing cargo ashore from cargo carrying vessels into a supply dump organization as rapidly as possible. At this juncture the Marine Corps requirement for documentation and control of cargo is similar to the Army's and the value of employing MILSTAMP procedures is more evident.

### 1.3 MILSTAMP Background

MILSTAMP documentation originally became necessary with the establishment of the Defense Transportation System. Previously each of the Services had its own movement control policies, documentation procedures, and documentation forms. Very little uniformity existed, especially for coded information.

No requirement for use of MILSTAMP documentation exists for cargo moved in amphibious ships, which are off-loaded in an objective area. DoD does require MILSTAMP documentation for accountability, control, and billing of equipment and supplies destined overseas in conjunction with a complete or partial unit move if the cargo transits common user water terminals or moves in ships obtained by MSC. This is particularly important where commercial stevedores and civilian port activities become involved.

In today's supply systems numerous and expensive specialized items of varying priorities are requisitioned by a large number of consignees, including some generated through automated processes. Consequently, MILSTAMP procedures have become a prerequisite for identification, rapid handling, delivery, and management. With volume shipments and modes where multiple shipments are consolidated, as with containers, MILSTAMP is particularly necessary for simplified, expeditious handling and management.

## 2. MILSTAMP IN AN EXPEDITIONARY ENVIRONMENT

### 2.1 General

Two MILSTAMP documents, the ship's cargo manifest and the Transportation Control and Movement Document (TCMD), would be utilized in an expeditionary environment for cargo accountability and management. Both documents could have significant positive impacts upon cargo planning, control, and operations.

The ship's cargo manifest is the key document for planning in the objective area for the discharge and movement of each shipping unit to an appropriate destination (supply dumps, etc.). In a LOTS or LOTS-type environment the ship's cargo manifest normally would be electronically forwarded to an on-site Army computer. It also could be passed by courier or it simply could be delivered with the ship, if electronic means fail. The ship's cargo manifest is based upon input from the TCMD.

The TCMD provides the destination/consignee of the shipping unit (a pallet, container, etc.) and can, if desired, provide a detailed listing of the contents, as well as other pertinent shipping information. The TCMD arrives with the cargo and, in the case of the containerized cargo, each TCMD is located in a large envelope often attached to the inside of the right door. The TCMD can also be transceived by the CONUS port of embarkation (POE) so that TCMDs could be made up before the cargo arrives. The TCMD record is the key document for accountability of intransit cargo until delivery at the shipping destination. Once cargo is received by a Marine Corps supply unit, it is picked up under SASSY for storage and issue operations.

In the sections which follow the normal terminal operations processing of documentation is briefly described. This is followed by a more detailed discussion of the manifest, TCMD and transportation control number (TCN).

## 2.2 Normal Documentation Flow

MILSTAMP is administered by MTMC with the primary user being the Army's transportation commands. Although the system described below addresses Army procedures, Marine Corps requirements could similarly be satisfied except that a minicomputer is used (see Annex A) for preparation of documentation and reports. Also, data link communications equipment is used for sending and receiving.

2.2.1 Preparation. The CONUS POE transmits the ocean (ship's) cargo manifest to the Army's documentation element. Upon receipt of the manifest the data are edited for completeness and the manifest prepared in multiple copies for the Terminal Operations and Transportation Movement Officer (TMO).

The terminal operator uses the manifest to plan for the discharge of any hazardous or oversized cargo, general classes of cargo, and consignees. The manifest helps determine what size stevedore gangs and equipment are necessary to off-load the vessel.

The TMO reviews the cargo manifest and alerts the consignees of the cargo due to arrive. As a result, the cargo may be diverted, staged, or prioritized. This information is passed to the terminal operations office and the cargo documentation element.

2.2.2 Suspense File Readied. After receipt of the TMO's instructions changes are made to the consignee address file. The TCMDs are prepared and filed in suspense pending delivery of cargo.

2.2.3 Reports. Discharge tally data files are established and reports for control of cargo from the ship, shore, marshaling yard, and to the consignee prepared. These pre-printed reports will be used as back-up in the event the computer should fail or become inoperable. Normally manual discharge reports are prepared and submitted to the Remote Batch Terminal (RBT) operators for update on a near-real time basis. (In SOLID SHIELD 79 these forms were processed hourly with operational reports prepared every 3 hr.).

### 2.3 Ship's Cargo Manifest

The ship's cargo manifest (see Figure B.1 for an excerpt of one prepared at Norfolk) can be as detailed as necessary. Normally, the manifest will list each container by number only once with the container's own transportation control number, but having the same priority number as the highest priority item in the container and its required delivery date (RDD). Also given is the number of pieces in the container, cube, weight, DoD Activity Address Code (DODAAC) of the consignor and consignee. However, it is possible to request and receive a manifest with all TCNs and related shipping information of all cargo in each of the containers. This would, of course, produce a rather thick document, especially for a ship having a capacity of 1,700 twenty-foot equivalent units. Consequently, only the lead TCN is normally used.

A second informational item of importance is the commodity description, which is identified by MILSTAMP commodity code and may not be generically printed, unless specifically requested. Commodity codes are described in the basic MILSTAMP regulation and would be particularly helpful in dump or special storage operations (segregation of cargo by class of supply, etc.).

The ship's cargo manifest should be reviewed prior to arrival of the ship in the objective area (communications permitting) so that shoreside planning can be initiated. This permits early planning of the routing of containers by number to the appropriate dump/destination and determining unstuffing requirements or change in disposition instructions before actual ship discharge begins.

### 2.4 Transportation Control and Movement Document

If no ship's cargo manifest is received and TCMDs prepared before ship arrival or for some reason the ship has an incomplete manifest aboard, containers can still be off-loaded and cleared from the beach. A temporary holding area will be necessary so that vans can be opened and copies of the TCMD (packing list) obtained. Once the container's contents have been identified, the container can be resealed and routed to its appropriate destination.

Figure B.2 provides an example of the information found on a typical TCMD. The TCMD illustrated is for a container that was carried on the ship's cargo manifest shown in Figure B.1. It can be seen that a large number of items have been shipped in container number 16051 (block #2) under the lead TCN W25N145698V674MM2 (block #10). Each of the items shipped in the container has its own TCN (column #40) apart from the TCN for the container (block #10). Some pertinent shipping information (column Nos. 32-44), specifically, the DODAAC listing for customer identification (column #41, consignee), will require the MILSTAMP order. In other cases, such as the commodity code (column #35), a generic description will be printed, if requested, otherwise that code will also have to be referenced. Listed with the commodity code will be an alpha-numeric code to indicate any special handling requirements such as for heavy lifts, special chemicals, explosives, classified materials, etc.

The TCMD also provides space (blocks 25-27) for transshipment information to assist in the disposition and subsequent tracing of cargo movement. This can be used for dump location information and/or cargo status file updates.





## 2.5 Transportation Control Number (TCN)

The TCN, a 17-figure/letter code group assigned to a shipment unit, is the key through which a shipment is traced in the transportation system. The TCN, besides providing an identification, allows each shipment unit (box, vehicle, pallet, or container) to be separately controlled from origin to ultimate consignee. TCNs are specially constructed and assigned by the shipping authority. The shipment of milvans/seavans (military or commercial containers) is arranged for by the transportation officer (depot or installation) (ITO) who, in turn, receives TCNs from the Water Control Authority (WTCA). For the East Coast of the U.S. the WTCA is Eastern Area, Military Traffic Management Command (EA MTMC). Table B.1 provides the procedure followed for the assignment of a TCN to a container.

Container contents also would normally be assigned separate TCNs by the individual shippers and TCMDs provided for each shipping unit, since subsequent breakbulk delivery to the ultimate consignee listed on the container's TCMD may be required. Another example could be a resupply operation where multiple packs would be consolidated into a single container and later at some point in the delivery breakbulk unstuffing would be necessary for final distribution/delivery. Once a TCN is assigned to an item of resupply, the TCN is also separately forwarded via supply system channels to the consignee as a report of shipment.

For a quick mount-out a generic term, such as "unit impedimenta" of (coded) unit is often used and a single TCN given on the TCMDs. This procedure still allows for control in the eventualities when containers are misdirected or delayed in shipment. Special unit manifests (packing lists usually prepared in advance) could also accompany this quick reaction procedure for inclusion in the van (a copy retained by the deploying unit) and would be available for immediate use in the operations area.

## 3. SOLID SHIELD 79 CONTAINER DOCUMENTATION

During SOLID SHIELD 79 the Army had a means to create ships' cargo manifests, TCMDs, and reports on transactions at a shoreside logistic base. This was accomplished with the assistance of a remote processing facility (RPF) that employs a Sperry Univac UTS 700 minicomputer (described in Annex A). The system, belonging to the U.S. Army 491st Cargo Documentation Detachment, is programmed for providing documentation and management reports on cargo throughput operations. Thus, realistic MILSTAMP documentation was available during the test and the manifests were used. Control of the container's movement, however, was accomplished with a specially designed trip ticket. (See Part II of this report.)

## 4. PROPOSED CARGO, FLOW AND DOCUMENTATION PROCEDURES

### 4.1 Use of Ship's Cargo Manifest

Using the ships' cargo manifest, forward movement of containers can be determined before arrival of the ship. Decisions can be made as to whether containers would be dispatched to a tactical airfield, forward dump site, allied units, a particular logistic support area (LSA), or other destination. Considerations such as LSA displacement priorities or maintenance/supply priorities can be more readily accommodated once the container has reached the beach and can be individually managed.

Normally containers on the ship will be off-loaded without regard to priority or selectivity because containership cell and loading design do not permit access except to the topmost layers. However, once a container has been identified at the beach procedures can be adapted to expedite forward movement (direct shipment of ammunition from the waterline to forward dumps, for example). Most containers will have to be routed to nearby storage/unstuffing locations, a routing requirement that can be handled by cargo checkers.

#### 4.2 Cargo Checking

Cargo checkers should be located at the beach, at the entrance to the dump site(s), and at exit points. Intermediate points other than traffic control, would be largely situational requirements. In the event there is no on-site computer and preprinted advance manifests are not available, at some point the original TCMD must be extracted from the container. Otherwise, cargo tallying (inspection and recording of cargo quantity, condition, and identification markings) for containers is a relatively simple and fast matter. Specifically, it will involve recording the container number, landing craft (at beach) and/or chassis number, damage, storage location (as applicable), and the times for each container.

Normally cargo tallies constitute the basis for preparation of documents for further shipment, payment of commercial carriers and stevedore/port costs (when appropriate), adjustments of cargo shortages or overages, preparation of records on goods received, intransit storage and transshipments, and preparation of cargo manifests and stowage plans for retrograde shipments. For field operations the cargo checkers and their tallies will constitute a means of reporting initial arrivals, collecting copies of the TCMDs, identifying priority items, directing transshipments (cargo dump/units), tracing shipments, and providing the inputs for management reports. Accordingly, cargo checkers should be well trained and motivated.

#### 4.3 Documentation Management

4.3.1 TCMD Employment. Documentation of cargo in the objective area will be necessary to support cargo identification requirements, storage records, subsequent transshipments, retrograde, and initiation of vessel outturn reports. The TCMD can support all of these requirements. Conceivably, if unit issues were to be made from the container, the TCMD could be used initially to help establish, carry, or adjust tallies but that is not its intended purpose.

At the beach the container's arrival should be logged at the landing site, container number, landing craft number it arrived in, time of arrival and departure, and upon departure the vehicle chassis number. It may be desirable to relay this information immediately to the beach operations center; however, frequent (hourly) periodic reports will normally suffice. Conveniently to the beach (1-3 miles) the container should be pulled aside at a temporary holding area before entering the dump sites. There the TCMD would be extracted from the van's interior (except for two copies which are retained in the van), if no advance preprinted TCMDs were available.

A transshipment instruction is registered by the checker on the TCMD, two copies are pulled, and the remaining three copies of the TCMD returned to the driver. When the checker pulls two copies, one is immediately forwarded to the beach/dump operations center and one is kept for his use (which subsequently becomes a back-up record when submitted to the beach CP at the end of the shift). The van upon departure could either be dispatched to a forward LSA or a consignee, or possibly assigned to a particular marshaling/site or a particular dump, depending upon the operational phase.

At the destination — an ammo dump, for example — the storage assignment is made and noted on the TCMD copies, two of the remaining three copies are pulled, and the driver keeps the third TCMD copy. Two files are created at the dump. One file remains as the dump's permanent or master file while the second is used when the cargo is unstuffed. In a highly mobile situation the container might not be stripped immediately and the dump's second TCMD could be used to forward the van to the next LSA site... saving time on loading, documenting, and re-establishing the forward dump site. If there is a computer available, it is updated.

4.3.2 Tracing. Automated tracing of vans, cargo as manifested in the vans, cargo destined to a particular consignee, and breakbulk cargo can be queried and ascertained from information on the ship's cargo manifest or by the use of TCMDs. The fastest means for tracing, in view of the volume of containers anticipated (eventually, nearly 700 per day<sup>2</sup>), would be a minicomputer if queries are to be responsive and cargo and containers are not going to be lost.

4.3.3 Beach/Dump CPs. The beach will be required to initially manage the build-up of stockage levels, provide resupply of combat units, tranship, and manage the throughput of all cargo moving ashore. The types of reports due will relate to the following:

- Status of ship's unloading/retrograding
- Dump status
- Daily tonnage/containers off-loaded and retrograded
- Missing cargo (tracer action)
- Cargo disposition instructions
- Special situation reports

Nearly all of the above needed information can be extracted from or traced back to the TCMDs and ship's cargo manifests. The format for these reports are largely a matter of unit SOP. Ultimately, logistic activity at

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<sup>1</sup>See paragraph 9 "Container Handling Requirements" in Part III of this report.



the beach will diminish to transshipment to LSAs or an expeditionary airfield. Port improvements may continue and eventually operations will be either shifted to a nearby fixed port operated by the Army or Navy or the operation will evolve into a Logistics-Over-The-Shore (LOTS) operation conducted by the Army or Navy.

Table 1  
 ASSIGNMENT PROCEDURES FOR SEAVAN TCNs (MADE BY THE SHIPPING AUTHORITY)

<u>TCN Position</u>	<u>Card Column</u>	<u>Description</u>
1-6	30-35	DODAAC of shipping activity.
7-10	36-39	Last four positions of voyage number assigned at the time of booking with MSC. Do not change even if a different voyage is used for shipment. FOR MILVAN ONLY - If a voyage number is not available at the time of shipment clearance and movement must commence to avoid delay, WTCAs will use code series 0001 through 0999 to establish TCN control.
11	40	Enter "V".
12-14	41-43	Serial number assigned by WTCA.
15-16	44-45	<p>SEAVAN origin and destination service codes. Show origin service code in cc 44 and destination service code in cc 45. Show code MM for TGBL SEAVAN shipments. The service codes identify the extent of the service paid for by MSC under the terms of its container agreement with the ocean carriers. The same code is used for both origin (cc 44) and destination service (cc 45) as follows:</p> <p>K - SEAVAN service begins/terminates at the ocean carrier's loading terminal.</p> <p>L - SEAVAN service begins/terminates at a point, other than the ocean carrier's loading/discharge terminal, within a 10-mile radius of the city limits of the foreign loading/discharge port, except when the commercial zone or 10-mile radius is divided into subareas or zones as defined in the MSC Container Agreement and Rate Guide.</p> <p>1-9 - SEAVAN service begins/terminates at a point, other than the ocean carrier's discharge terminal, in one of the subareas (zones) within the commercial zone of the CONUS discharge port or 10-mile radius of the city limits of the foreign loading/discharge port as specified in the MSC Container Agreement and Rate Guide. Codes 1-9 are assigned by MSC and published in Container Agreement and Rate Guide.</p> <p>M - SEAVAN service begins/terminates at a point other than covered by codes K, L, or 1-9. Code M will be shown for MMTS TGBL shipments.</p>

Table 1  
(CONT)

<u>TCN Position</u>	<u>Card Column</u>	<u>Description</u>
17	46	Type of SEAVAN as follows: 2 - Dry cargo. 3 - Platform or flatbed. 4 - Open top. 5 - Refrigerated. 6 - Top filling. 7 - Insulated. 8 - Open frame or rack. 9 - Tank type. X - Special or experimental.

**END**

**FILMED**

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