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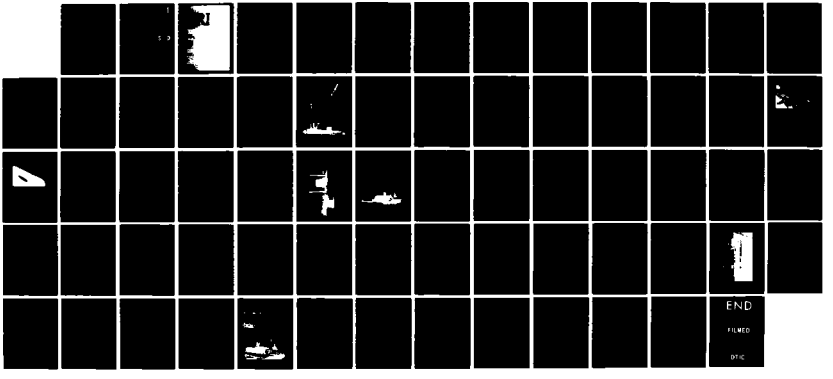

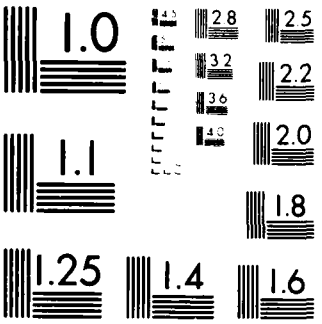

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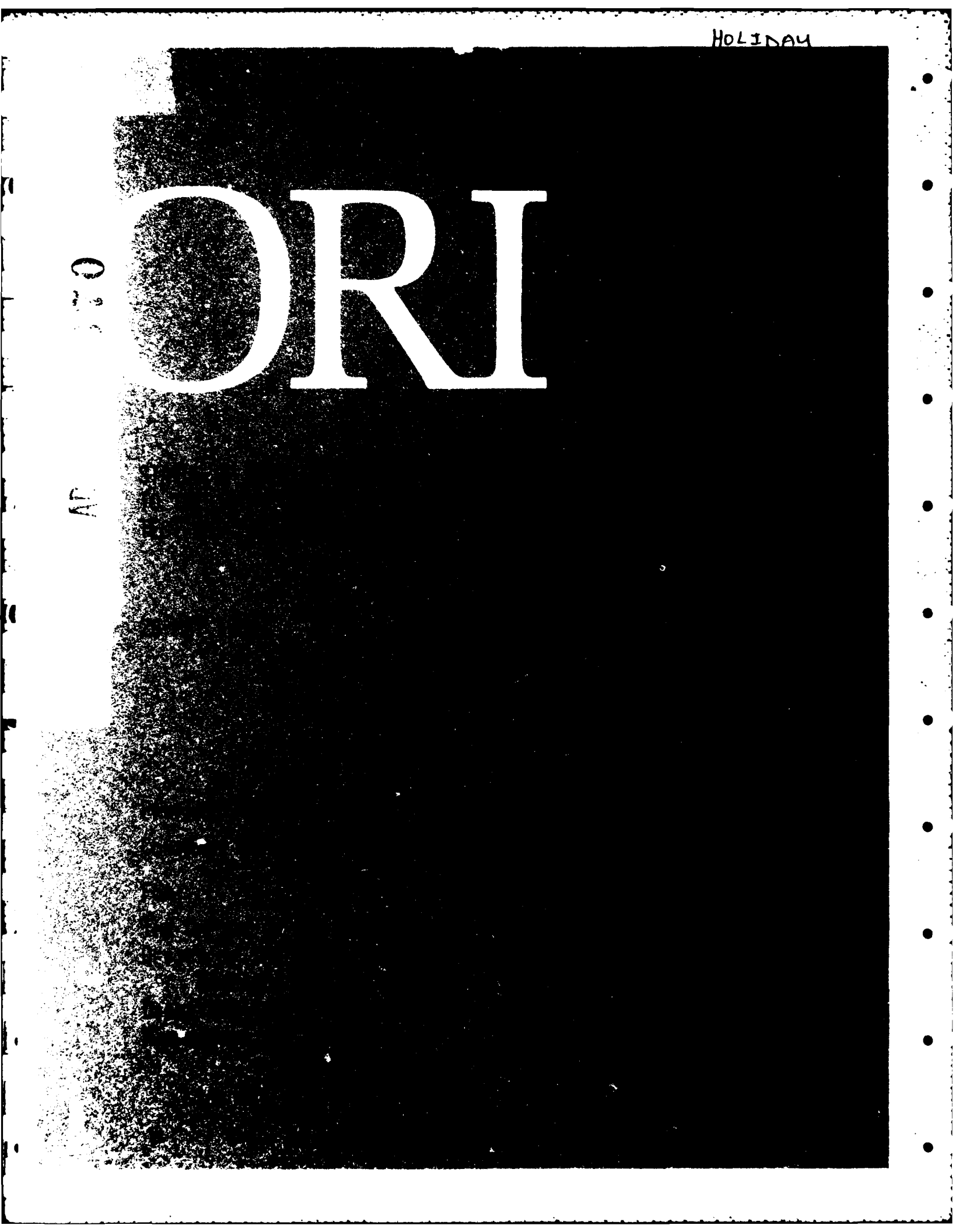

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STATUS OF SERVICE PROGRAMS SUBSEQUENT TO THE JOINT LOGISTICS-OVER-THE-SHORE (LOTS) TEST AND EVALUATION PROGRAM

29 MAY 1980

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FOR:
The Office of the Secretary of Defense
Office of the Under Secretary of Defense,
Research and Engineering
Director, Test and Evaluation
Washington, D. C. 20301

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EXECUTIVE SUMMARY

This is the final report under the Joint Logistics-Over-the-Shore (LOTS) Test and Evaluation Program. The program evolved from a test feasibility and definition phase in 1975 to a pretest phase in 1976, a main test design and execution phase in 1977, and a test results and analysis phase in 1978. This final report was largely compiled in 1979 but held in abeyance pending completion of Navy floating crane tests.

The report concludes that the Military Services have retracted considerably from original goals and objectives for attainment of a container handling capability. The Army has slipped by two years its conversion schedule of breakbulk companies to container capable ones. The Navy has nearly completed its research and development of cranes for a ship-TCDF but has slipped procurements until FY83. The report concludes that it will be from five to seven years before ship-TCDFs will be available for Amphibious Forces. No committments have been made by the Army for cranes/ship-TCDFs, presumably pending successful operational testing. The report also finds that the Navy has not fully identified funding for development and testing of a RO/RO platform.

Finally, the report recommends that LOTS program requirements be placed under ASD, PA&E in order that certain policy guidance, procedures, doctrines and program emphasis for OSD can be accomplished.

I. INTRODUCTION

BACKGROUND

Upon completion of the 1977 Joint Logistics-Over-The-Shore (LOTS) Test and Evaluation Program, several critical deficiencies were uncovered which required additional Service attention. The program's final report[1] included the following major developmental conclusions:

- There was no bulk POL capability sufficient to support a corps size force from off-shore vessels nor adequate storage and distribution in a LOTS environment.

- There was no adequate means for discharging RO/RO vessels short of reallocating key container system equipment.

- LOTS operations are vulnerable to sea and weather conditions, lack sufficient redundancy in system elements, and involve a high degree of uncertainty in continuity of operation.

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[1]ORI, Inc., The Joint Logistics-Over-The-Shore (LOTS) Test and Evaluation Program Report, Volume II - Analysis of Test Results, 5 January 1979, ORI TR No. 1412.

- DOD had no assured nor responsive means for obtaining specialized merchant shipping to meet the Department's deployment requirements of LOTS heavy and outsized equipment in a non-mobilization contingency situation.

- Training, procedural changes, equipment improvement, further system definitions, trade-offs, and some additional testing were needed by each of the Services.

PURPOSE

The purpose of this report is to assess the progress of the Services in developing procedures and equipment to correct deficiencies and shortfalls uncovered in the Joint LOTS Test and Evaluation Program. The report is intended to provide and overview of the status of key system developments in DOD for the conduct of LOTS or LOTS-type operations and the capabilities of the U.S. to support such an operation.

PROGRAM ACCOMPLISHMENTS

At the onset of the Joint LOTS Test and Evaluation Program in 1974, the Army had already determined its concept for organization, designated the test unit for conversion, and had an equipment delivery schedule to meet a 1977 full operational test. The Army approach was to utilize off-the-shelf commercial hardware for use in a LOTS environment, since the mission of the terminal units modified for container operations is to operate in existing port facilities as well as the LOTS requirement. The operational efficiency of such equipment in a LOTS environment was subject to question.

In accordance with the Joint LOTS Test and Evaluation Program test definition[2], a series of preliminary tests were conducted employing major U.S. flag vessel types. These tests examined the deployability and timely establishment ashore of major items of LOTS equipment. Besides ship loading and discharge tests, training and timing for container throughput

[2]ORI, Inc., Feasibility and Definition of a Joint Logistics-Over-The-Shore (LOTS) Operational Test, dated 30 April 1975, ORI TR No. 913.

operations were conducted.[3] The pretest program provided a considerable number of "firsts" in the deployment area including:

- LCM8 deployment and off-shore discharge from a CHALLENGER-class vessel;
- Deployment and off-shore discharge of 140- and 300-ton capacity cranes on conventional breakbulk, heavy-lift breakbulk, and LASH vessels;
- Discharge of barge cargo using an off-shore floating transfer platform;
- Deployment of military lighters, cranes, and sideloaders on a LASH vessel using an LCM8 liftbeam;
- Discharge of LASH and SEABEE vessels in a LOTS environment using military crews;
- Use of a cantilever liftframe on a LASH ship's barge crane for loading and off-shore discharge of military equipment;
- Deployment and off-shore discharge of a DeLong barge (with a 300-ton crane mounted on it) aboard a SEABEE vessel;
- Deployment and discharge of LCUs, LACV-30, 3X15 causeway sections, and LARC-LX from a SEABEE in a LOTS environment; and
- Field employment of a mobile automated remote processing facility for cargo management.

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[3]See Annex for bibliography of Joint LOTS Test and Evaluation Program Reports which discuss the pretests and deployment results.

Main test operations in 1977 also provided a number of first time efforts and a considerable amount of data was gathered on all aspects of a throughput system. Prior testing emphasis had been on crane operations and capabilities but the LOTS main test examined deployment and establishment of beach facilities in a time-constrained scenairo, cargo and system operational management, interfaces of equipment at major container transfer points, equipment performance, and timing of cargo handling throughout the system. Among the "firsts" contributed by the main test were:

- Ship-to-shore containership operation solely supported by military units;
- Hatch-to-hatch movement and operation of a crawler crane and hatch bridging kit (crane-on-deck subsystem);
- Operational test of the lightweight amphibious container handler (LACH) on the beach and in staging areas; and
- Around-the-clock military container discharge and retrograde operations.

SUBSEQUENT PROGRAM OBJECTIVES

Following the LOTS main test several programs were initiated by the Services to improve their capabilities. The Army initiated an effort to develop an interim bulk POL system capable of sustaining a corps size (100,000-man) force. The Navy, under its Container Off-loading and Transfer System (COTS) Program initiated an engineering analysis of crane stresses for crane operations on a floating barge, development of an improved causeway lighterage system, and testing of a motion compensation device for cranes working in sea state 3 (SS 3) conditions. The Marine Corps, as part of its Field Logistic System (FLS), has a major testing program and buy in progress for tractor-trailers, LACHs, and ancillary support equipment. The Marine Corps still will rely on a breakbulk system for support of its assault echelon deployed in Navy amphibious ships.

The major emphasis of the Navy COTS program is the development of a self-deployable temporary container discharge facility (TCDF), but it also is the lead Service for development of a means for the off-shore discharge of Roll-on/Roll-off (RO/RO) ships. The Navy also has been developing a means for the discharge of large tankers off-shore. This latter system will be evaluated by the Army for a future buy to replace the interim system.

The Army following the LOTS test did not initiate any new major LOTS equipment developments. The Army has requested an option for LACH purchases for testing purposes. A major drawback for the Army with the existing LACH model is that it cannot accommodate containers larger than 20 ft. Additionally, equipment for the conversion of breakbulk terminal service companies into container-capable ones have been delayed approximately two years because of funding priorities within the Army. The Army did modify one major element of its container handling system as a result of observations of the Navy's elevated causeway. The air cushion turntable, used for rotating tractor-trailer units at the end of the causeway, has been added to the Army's shoreside DeLong pier to expedite vehicle positioning.

SCOPE

This report, an overview of key systems and equipment in DoD for LOTS or LOTS-type operations, will provide an update on the status of related developmental programs and the broad capabilities of the U.S. to support an operation requiring LOTS. Although LOTS support could be an essential link for resupply of the Rapid Deployment Force (RDF) and the report recommends a closer alignment between LOTS programs and the RDF, RDF operations are not analyzed here. Similarly, rationale for delay of LOTS system procurements also are not analyzed.

II. STATUS OF SERVICE PROGRAMS

GENERAL

The momentum behind program developments at the time of the LOTS main test has dissipated considerably without full attainment of original program objectives, as discussed below. The significance of having a container-supported distribution system--that is, the potential for a 250-400 percentincrease in cargo handling capability with one-fourth less man-power[1/]--may have been obscured. The requirements for a LOTS-type capability has not been emphasized because LOTS operations are normally not needed during peacetime. Also, the requirement has not been covered in plans submitted for JCS approval.

Subsequent to the early days of the Vietnam build-up, when extensive LOTS operations were employed, ports have been used exclusively to discharge deployment and resupply ships. Since the mid-1950's, due mainly to economic factors, breakbulk shipments--which are slower but less difficult to handle in a LOTS environment--have been replaced by cargo packed in 20-40 ft containers.

1/ ORI, Inc. The Joint Logistics-Over-The-Shore (LOTS) Test and Evaluation Program Report, Vol. II - Analysis of Test Results, ORI TR, 5 January 1980.

Currently, for DOD overseas shipments, containers constitute approximately 74 percent of the cargo shipped[2].

Meanwhile, in the U.S. ship construction industry no breakbulk ships have been built since 1968 and none are currently planned. On the other hand, ships, particularly container and RO/RO ships, are increasing in number each year. The objective of the Maritime Administration and the Omnibus Maritime Bill is to increase the U.S. share of import-export ocean shipping business from the present 5 to about 40 percent of the U.S. market. Thus, the push is for more modern and economically competitive, dry cargo vessels.

For wartime or emergency conditions DOD must be prepared to better accommodate the new merchant vessels in areas where port facilities are not available or denied. In such cases, off-shore anchorage operations would be required. Therefore, LOTS capable units and equipment are needed to discharge and retrograde these vessels, the lighters to transport the cargo, line haul vehicles to move the cargo, and the ships needed to deploy all of the LOTS elements must either be in the DOD inventory or readily accessible for employment. These conditions do not now exist.

TCDF PROGRAM

Army Barge-TCDF

During the Joint LOTS Test and Evaluation Program two methods of container discharge were used, the crane-on-deck, discussed below, and the temporary container discharge facility (TCDF). Only one type of TCDF has been tested, the Army's barge-TCDF, a 300-ton lifting capacity truck crane mounted on a Delong barge. The barge alone is 150 ft long, 60 ft wide and 10 ft high. The barge with the crane mounted on it weighs 656 LTons and has the same dimensions as the barge itself, except the height is increased to 28.5 ft. near the block and to the body of the crane to [illegible]vide ship motion

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2/ MTMC briefing information provided by MTMC public affairs office. LCol. H. T. Dittamo, 21 February 1989.

compensation. In addition, the Navy is also testing a sensing device to compensate for lighterage motion due to sea swell activity so containers can be lowered at the proper instant into loading craft. (See Figure 1.)

With these R&D initiatives the Navy expects to field a TCDF that is deployable and capable of operating in conditions up through SS 3. This system is projected for development testing aboard a ship beginning in FY80. Preliminary land tests began during FY79 and afloat tests of sea state effects to a crane-on-barge were just completed using an Army DeLong and a Navy ringmounted crane (see Figure 1). Appendix A describes the program and summarizes the major results. The next phase will involve an instrumented crane on an LSD (dock landing ship). Developmental and operational testing with military crews is expected to be completed in the November-January timeframe.

Ship-TCDF Procurement and Service Availability

Although testing will have been completed in the next 6 to 8 months, as currently projected, it will be almost four years from now before the first ship-TCDF will be available for Service use. Navy procurement funds will not be available until FY 83 and delivery could require an additional 12 to 18 months. Thus, with an optimistic delivery for two cranes to be procurred in FY 83 for the first ship-TCDF, delivery might be made as early as October 1983. Then a period of assembly and crew training will be required which could take as much as 12 months more. Thus, the first ship-TCDF should be ready for operations by about October 1984, almost 4½ years from the date of this report. On the other hand, a pessimistic crane delivery time of 18 months could slip the readiness date of the first ship-TCDF to five years from the date of this report.

Four more cranes are scheduled for FY procurement (the second and third ship-TCDFs) and the last two cranes are to be procurred in FY 85. Thus, it will be seven years from now before DOD has a four ship-TCDF capability.

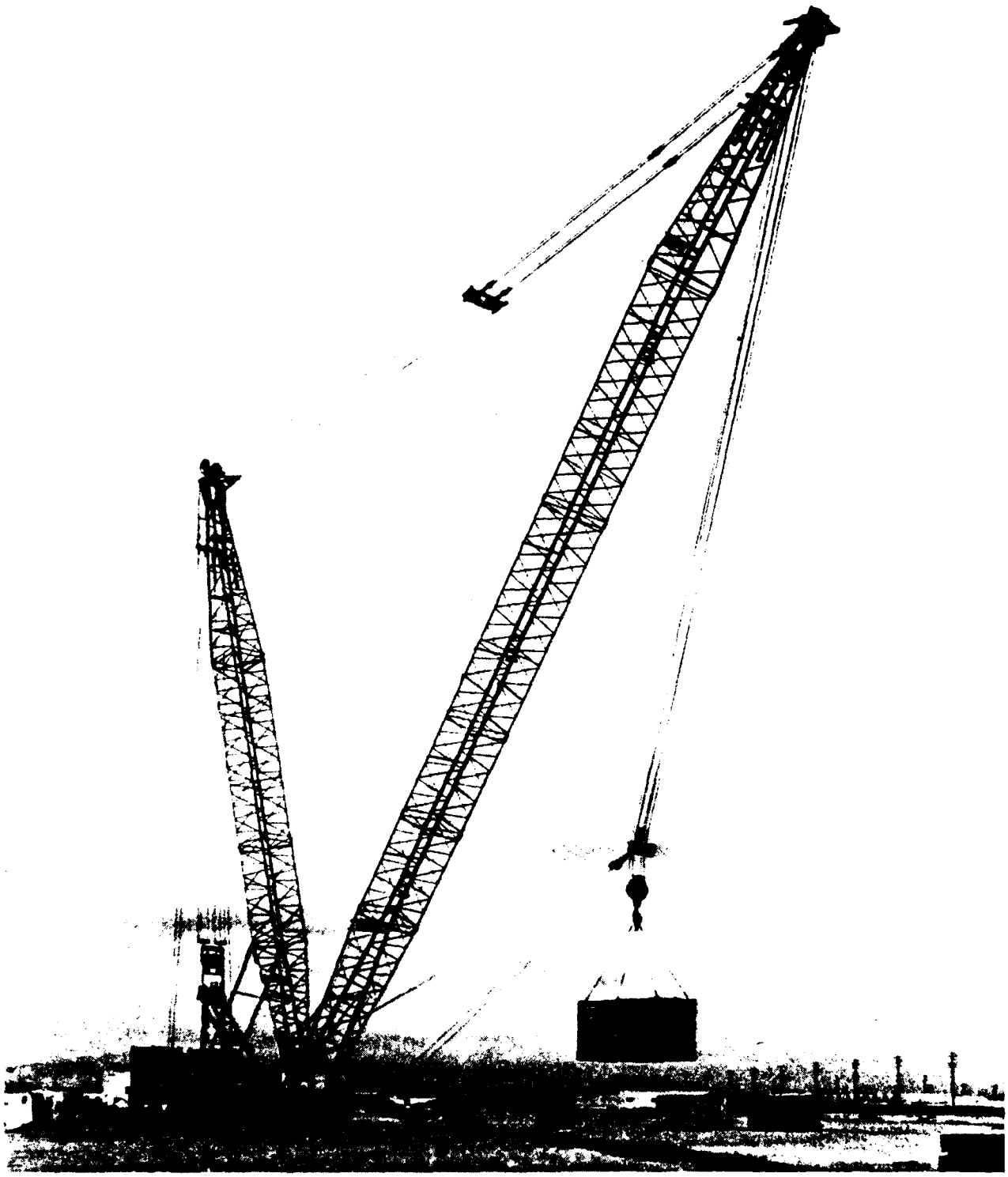

FIGURE 1. NAVY RING-MOUNTED CRANE LIFTS A CONTAINER USING THE RIDER BLOCK TAGLINE SYSTEM TO HELP CONTROL PENDULATION. THE SYSTEM WAS USED IN BOTH LAND AND AFLOAT TESTS TO ESTABLISH BASELINE OPERATIONAL DATA ON THE CRANE.

Two major problems are associated with the Army barge-TCDF: sea state sensitivity and deployment limitations. The Joint LOTS test revealed that during sea state 2 (SS 2), as conditions approached SS 3, boom pendulation became so great operations were forced to halt. The exact time and wave heights and frequency when operations were forced to halt could not be identified due, in part, to generally calm conditions and during stormy weather to an instrument failure for recording sea states. The effects of dynamic dynamic forces on crane components under these conditions were not measured.

The second major problem, deployment, was investigated during the Joint LOTS Test and Evaluation Program. Available options are towing the barge--at a rate of 4 to 5 kts and assuming high risk of loss in heavy seas--or secondly, loading aboard a SEABEE ship. A test load aboard the SEABEE ship was largely successful in that the barge-TCDF was lifted out of the water to the main deck level and then hoisted by the SEABEE's barge transporters (trolley devices used to haul barges forward). This was the largest military deployment load known to have been tested.

The drawback to SEABEE employment is the paucity of SEABEE vessels; there are only three and all are privately owned. Only by exercising wartime powers can the President requisition these vessels. This critically limits barge-TCDF employment under conditions less than a national emergency. The fact that there are only three vessels (and two are normally overseas concurrently) degrades the availability of sufficient SEABEEs to support more than a one containership discharge capability. Two or more containerships discharging simultaneously would be required to support a corps-size force. Thus, the barge-TCDF has serious deployment limitations which impacts on the Army LOTS capability and the capability to sustain a large force.

SHIP-TCDF DEVELOPMENT

First tested in the Off-Shore Discharge of Containership (OSDOC) II test of 1973, the ship-TCDF is a Navy-sponsored project. The current program calls for installing ring-mounted crawler cranes of about 200- to 300-ton lifting capacity on the deck of a tanker or other ship such as a Roll-on/Roll-of (RO/RO) vessel without on-deck boom and mast obstructions. The cranes will also be fitted with a Rider Tagline Block, a device attached

The total procurement of 8 cranes is based on Navy requirements to support a Marine Amphibious Force (approximately 50,000 personnel). No Navy procurement is being made for Army support. The Army could, of course, request options to the Navy contract for their own procurements which theoretically could mean even later deliveries. This is a decision and procurement effort the Army has yet to resolve. JCS also could direct the Navy to provide ship-TCDF support for Army operations, but this would be at the expense of Amphibious Force requirements.

Ship-TCDF Readiness, Maintenance, Control

Container surface movements to LOTS/amphibious objective area sites and ship-TCDF operations may never be required beyond those conducted in training exercises or possibly for disaster relief. However, it is a wartime capability that must always be available and useable. In that respect, it is somewhat analogous to a fire plug...nothing else can effectively provide the pipeline interface and the volume needed. Container systems and containerships will continue being the dominant mode for dry cargo shipping and continue being port dependent. In turn, ports with their dependence upon a few highly productive cranes will continue being more vulnerable than ever to political denial, sabotage, strike actions, enemy destruction, channel blockage, and other facility denial tactics. A TCDF capability can eliminate channelization through ports.

Thus, a system must be developed to maintain, manage, and crew the ship-TCDFs so that when required surface resupply operations can be supported. Several broad options have been suggested, such as:

- Active fleet ownership and maintenance of all components,

- MSC retention of cranes and a suitable number of vessels retained under lease,

- NDRF acquisition of cranes and appropriate vessels as part of the Ready Reserve Fleet (RRF),

- Some combination of the above.

Each of the above options have a different impact on Service funding, operations and maintenance requirements, responsiveness for emergency support, crewing and training, and overall management. Critical assets such as ship-TCDFs are required by all the Services. Perhaps recognizing this type of potential situation and the need for standardization in 1971, the ASD MRA&L (then I&L) ordered the Services to establish a "Steering Group for DoD Container-Supported Distribution Systems Development." The group was reorganized by MRA&L to be headed by a representative from that office, Mr. Paul Hyman. Its purpose was to develop equipment and systems where commonality and standardization are of joint concern.

The JCSG also was charged by ASD, MRA&L to determine termination of the development phase and recommend action required to incorporate containerization systems) into mobility forces.[2/] MRA&L and the Group have not resolved the issues cited above nor attempted to provide any guidance nor proposed doctrine. There are no immediate plans to delve into these matters before the JCSG expires as a regular meeting body. At present the JCSG believes its reason for existence has been served and its regular quarterly meetings are no longer required. Thus, a move for JCSG deactivation is anticipated within the next two months (summer, 1980). Such deactivation is probably appropriate. ASD, MRA&L and the JSCG were unable to prevent the slippage in R&D funding and procurement of Navy programs such as the ship-TCDF and RO/RO platform or conversion delays (discussed later) of Army breakbulk companies into container-configured units.

2/ DOD Inst. 4500.41 Enclosure (2) details the actions the Container Systems Standardization/Coordination Group was to accomplish for JCSG action, including the task cited above.

In the Joint Logistics Review Board (JLRB) report of 1970,[3] it was recommended that the DoD develop a LOTS capability. Shortly thereafter, policy and instructions were forthcoming in DoD to implement containerization. About 15 years from the JLRB report, the first ship-TCDF may be available and the RO/RO ship program presently is barely moving.

RO/RO SHIP PLATFORM

Two methods are possible for discharge of a RO/RO ship in a LOTS environment. First a TCDF could be used; this would be an unloading process slower than for containers, since individual hook-ups would be more time-consuming for vehicles. Second, a platform device could be used so vehicles could be driven off the ship onto lighters, such as a causeway ferry which could accommodate several vehicles at a time. The latter is the preferred option since it probably would be faster and would not draw TCDF resources away from container operations.

The Navy has had a program on-going in this area since about 1975. Because there have been far fewer RO/RO vessels than containerships, the priority for Navy efforts has been toward containership-related requirements. Nevertheless, the RO/RO ship off-shore discharge program has been continued, although at a slow pace. Meanwhile, the Army is counting heavily on RO/RO ships for deployment of its mechanized divisions. Several thousand large vehicles also would have to be deployed to establish a line haul capacity for resupply.[4]

Currently, the RO/RO platform is slated for design validation tests in FY 82 and has the funding available but more work is needed. For the engineering tests beyond this phase, Navy funding projections are

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3/ Joint Logistics Review Board, Monography 7, Containerization, 31 August 1970. See recommendation CN-7, pg. 83.

4/ ORI, Inc., Persion Gulf Logistics-Over-The-Shore (LOTS) Support and Throughput Requirements (U), ORI TR-1640, 28 December 1979.

uncertain. Developmental tests and operational tests would be 6-12 months after design tests have been completed. Given a higher priority and additional funding, this program and its procurements also could have a much earlier availability.

CRANE-ON-DECK

The crane-on-deck (COD) method of ship discharge was successfully tested during the Joint LOTS 1977 test. A 200-ton capacity crane mounted on two portable large I-beams was used on the non-self-sustaining containership CV STAG HOUND. During the test the crane off-loaded and retrograded 47 percent of the containers. The COD moved from hatch to hatch without difficulty and was not hindered by sea state conditions experienced in the test.

The major drawback to the COD is that at least two cranes would be required for each containership or more for some ship classes. This could mean as many as 60 or more cranes could be needed to keep a corps size force supplied 3,000 mi away. The cranes would need to be either purchased or leased; the unresolved issues here are the timely acquisition, uses, and overall availability of the cranes.

The final report of the Joint LOTS main test results recommended the I-beam kits be stockpiled for ready availability (eliminating decision and construction time for an emergency deployment). OSD MRA&L was identified as the action and coordinating office. OSD MRA&L has taken no action on this matter.

Similarly, procedures and learning experiences should be recorded in the event COD operations are needed to supplement future TCDF operations. This responsibility rests with the Navy which intends to accomplish the project but has been involved with higher priority system developments. An initial draft manual has been prepared but further work is required.

TERMINAL SERVICE COMPANY CONVERSIONS

In 1976 the Army converted one of its breakbulk configured companies to a container-capable one, the 119th Transportation Company (Terminal Service). In the year following the LOTS test, a second company was planned for conversion and one each year thereafter until four companies were available. The second company has not yet been converted due to other funding priorities. As of this writing, the schedule calls for converting the second company, 368th Transportation Company (Terminal Service) in April 1981, the 155th Transportation Company (Terminal Service) in August 1982, and the 567th Transportation Company (Terminal Service) in August 1983. Equipment will be received by each unit subsequent to its conversion date. Thus, the Army's capability to sustain a large (corps-size or greater) force in a container-supported distribution mode will not be fully attained for another 3 to 4 years, allowing for equipping and training.

The LOTS main test established that one container company, even when also required to retrograde empty containers, had twice the productivity with 25 percent fewer personnel than a breakbulk company. Without a retrograde requirement(under surge conditions), productivity is on the order of 3.5 times that of a breakbulk company or more.

Meanwhile, conversion of the U.S. merchant dry cargo fleet is continuing from breakbulk to container and barge ships. No breakbulk ships are forecast for construction; however, the preponderance of Army cargo handling capability will remain breakbulk until at least the second container company is operationally ready. This may not be until 1982, since not only will there be delays until the equipment is received and readied (a long lead time is necessary for the cranes), but the company also requires training time with the equipment.

Despite trends in containerization, a breakbulk capability is still required to support military operations whether through a port or across a beach. Large quantities of outsized cargo, bulk items, vehicles, RO/RO and barge ship cargo will be shipped in the resupply and deployment phases. Bunkering material, dry cargo, drums, special weapons, lighterage, some major repair items, line haul vehicles, and follow-on units and their organic equipment would constitute primary examples of the breakbulk requirement. Currently, one active Army breakbulk company is scheduled for retention once the container units have been converted. The capabilities of this type unit in a LOTS environment are rated at about 1,000 STons of cargo per day. It is assumed that this capability would be sufficient during both the deployment and early resupply phases since no other terminal service capability exists except for an Army Reserve terminal service battalion.

BULK POL CAPABILITIES

General

Fuel is resupplied in a LOTS operation in drums from breakbulk ships and in bulk pumped from a tanker anchored off-shore via a pipeline to an inland distribution point. Drums are used early in the operation until such time as the off-shore pipehead/mooring system, pipeline, pumping, and storage facilities are established. In some cases truck refuelers also may be deployed for this purpose.

Fuel consumption varies subject to the ground force mix, supporting aviation requirements, terrain, operational intensity, and the like. However, notional planning estimates for peak requirements of a corps-size force at full build-up are on the order of 1 million gal. per day. Supporting Air Force tactical requirements have been estimated as being on the same order. A Marine Amphibious Force (MAF) (at approximately 50,000-man level, with air support) has a peak planning requirement also of about 1 million gal. daily.

Army POL Interim Developments

During planning for the LOTS test some Army bulk POL equipment was badly in need of rehabilitation and could not be reconstituted except at considerable expense. Also, the Army had not yet reorganized nor fully equipped its off-shore units. Subsequent to the test the Army ordered some stocks to be refurbished and others obtained from storage. The newly-reorganized company and the port construction company were then operationally tested in June and October, 1979. (See Figure 2.)

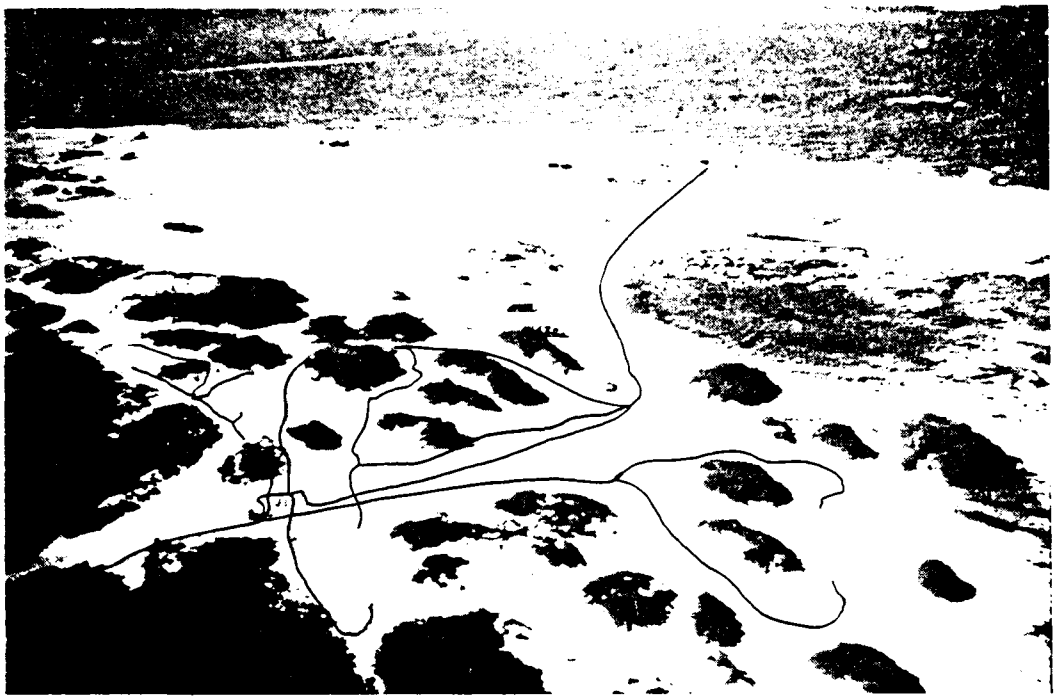

FIGURE 2. POL SYSTEM COMPONENTS WERE TESTED BY THE ARMY IN 1979.

Although the entire tactical marine terminal (TMT) system was not tested, component assembly was sufficient to train personnel and to satisfactorily demonstrate the system's capabilities. The major equipment consists of a multi-leg tanker mooring system, water craft, anchors for floating hose, 6-inch submerged pipeline, and forty-two 50,000 gal. bags (2.1 million gal.) for storage. The bags require approximately 160 acres for full installation. The Army has abourt 5 mi of hose, which comes in sections mounted on large reels (approximately 10x10x10 ft). The system has a 600 GPM pumping capacity and multiple pipelines can be installed for pumping more than one POL product. Altogether there are about 550 STons of equipment to be deployed. The system requires about 72 hr for installation. Figure 3 illustrates the concept for system operations.

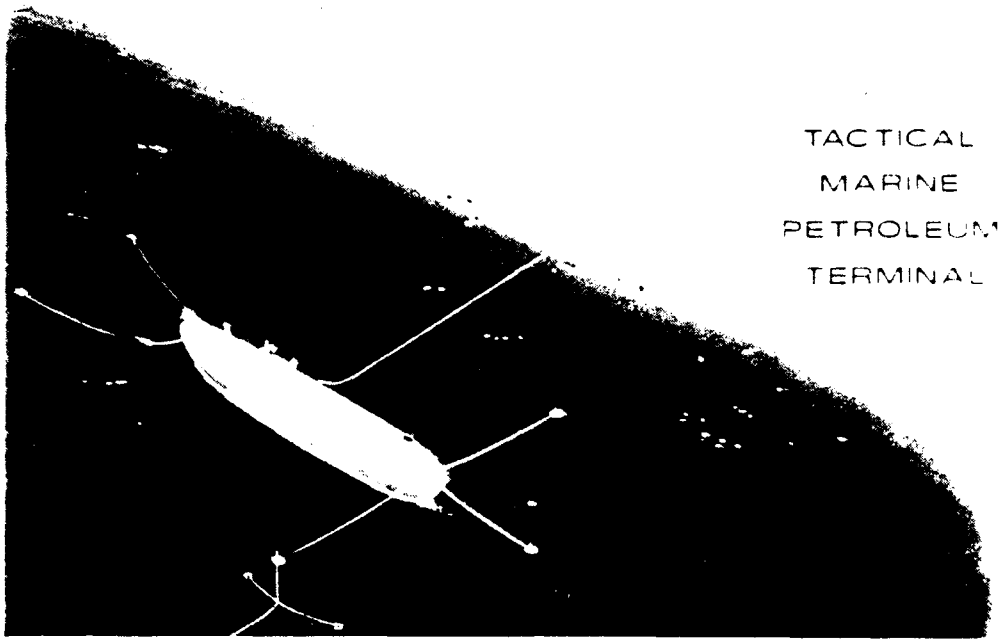

FIGURE 3. CONCEPT ILLUSTRATION OF ARMY LOTS POL OPERATIONS.

For additional storage the Army has type classified a bulk fuel tank assembly, but no equipment has been purchased. A hasty bulk storage reservoir would be installed until such time as more and better storage equipment becomes available. This type of reservoir essentially is a football field size hole dug to a depth of approximately 11-13 ft. It would be lined to contain the fuel and help reduce contamination. This assembly provides storage for about 7-10,000 barrels or one T-2/T-5 tanker load of fuel. Other types of storage systems are still being evaluated but cost, installation time, deployability, and other factors unique to volume POL operations quickly limit most systems.

The Army estimates that within 30 hrs.(or about D+5), it can accommodate 6,600 bbls. per day and by D+10 it will be capable of handling about 40,000 bbls. per day. The existing POL system is one-of-a-kind and is intended as an interim means for providing bulk fuel. Ultimately, the Army intends to examine the off-shore bulk fuel system (OBFS) being developed by the Navy as part of the COTS program. Subsequent Army buys may be made following the Navy tests.

Navy OBFS

A limited bulk POL capability is organic to an Amphibious Force. Amphibious ships themselves carry varying quantities of cargo bulk POL for the Landing Force. Consequently, there is a requirement to off-load this fuel and to off-load follow-on tankers. To do this, the Amphibious Force normally embarks a 4-inch floating system. It is not adequate, however, to accommodate large tankers and has less pumping capacity than the Army system. Consequently, the Navy has been developing an 8-inch system capable of standing off much farther (10,000 ft) for the deep draft vessels and of pumping a greater volume of fuel. A total of three 8-inch lines would be installed. The new system is due to be on-line about 1984.

The Navy operational scenario calls for the installation of its 4-inch floating line system first, since it is the fastest system to install and to transfer POL. The first 8-inch line is to be installed D+5 to D+7, a second line started at that time and completed on D+9, and the last line started and completed about 48 hrs later.

LIGHTERAGE

Army

The final report for the LOTS test concluded that Army and Navy lighterage (in particular, LCUs and LCM8s) were adequate for container operations, given favorable beaches such as at the LOTS test site. The Army uses amphibians for shallow beaches and the LARC-LX was found to be a competent vehicle that could handle 20- or 40-ft containers. The Army tested the air cushion vehicle LACV-30, which when fully fueled cannot

handle loads heavier than 24 STons nor was it designed to handle 35- or 40-ft containers nor deployment cargo such as heavy armored vehicles. Bascially, it was intended to haul 20-ft containers through the surf zone of a shallow beach to a crane ofshore.

The LOTS test final report found the LACV-30:

- Load limited with respect to expected ship-to-shore requirements,
- Consumed more fuel per container transported than all other lighters (by as much as 5 to 1),
- Improved productivity, theoretically possible due to its greater speed, off-set by the greater carrying capacity of the LCU (at five containers per load the LCU was more productive),
- Untested in sea state 2 (or greater) loading conditions,
- Misleading with respect to its 30-ton classification since, unlike other lighters and amphibians, weight of fuel, crew, and equipment (self-unloading crane, tie-downs, and the like) are considered part of the "pay-load" before cargo weight is considered, and
- Had difficulty on land manuevering sharp turns, cross-winds, and along slopes.

The payload difficulty was noted early in the test. Given a full load of fuel and two containers, the LACV-30 on occasion was unable to make the beach incline to the amphibian discharge crane. With regard to its maneuvering capabilities at one point a crawler tractor had to pull the LACV-30 around a sharp turn in its specially prepared path to the marshaling yard. Not thoroughly investigated due to insufficient information at the time was the effects of sand blown into the crane.

Notwithstanding these observations and other logistical burdens, the Army plans to purchase 12 of the craft. There are some areas of the world where this craft will operate better than others, i.e., underwater obstacles, extensive mud flats, shallow beaches etc. The LACV-30 (and the LCM8) can also be deployed by a conventional breakbulk ship or a SEABEE. The LCM8 can be deployed on a LASH vessel and, if special lifting devices are constructed, lifted. The LACV-30 is the only Army lighter that can be deployed by air -- although it would be unusual to fly the LACV-30 to a LOTS site to unload ships that could carry LACV-30s and LCM8s to begin with.

Navy

The Navy solution for shallow beach operations is a causeway ferry. This method has been found effective over sandbars and shallow beaches. Essentially pontoon sections 21 ft. wide by 90 ft. long and 3 ft high are linked end-to-end. Containers are deposited on all but the first section to minimize draft for beaching and facilitate crossing sandbars. The string of pontoon sections is then pushed up to the beach.

During the LOTS test the causeway ferry was paired with a light-weight amphibious container handler (LACH) for off-loading or retrograding at the waterline. This method worked well but causeway ferry maneuvering was too time-consuming. The problem was determined to be that pusher boats and tender boats were underpowered for the task.

The Navy's solution has been to adopt a self-propelled causeway section, powered by water jets and having a low profile and shallow draft. Four such units are scheduled for delivery to the Fleet this year and more will be added annually until 16 have been procured. Each unit will be linked to standard pontoon causeways for ship-to-shore operations.

Deployment of this craft and the causeway sections would follow the traditional method of side-loading on tank landing ships (LSTs). In addition, the Navy has developed a cantilevered lift frame for LASH vessels to load and stack causeway sections. During the LOTS pretest phase, the cantilevered lift frame was tested with marginal success. That is, it lifted a causeway section but failed to lift a second causeway section intended to represent a causeway warping tug. The surrogate warping tug had weights which

were incorrectly located; consequently, with the center of gravity thought to be too far aft. Thus, the lifting frame and causeway warping tug and/or the self-propelled causeway section should be re-evaluated in a test lift on a LASH vessel.

TRAINING EXERCISES WITH CONTAINERS

Subsequent to the LOTS test only one significant container supported exercise has been conducted. During SOLID SHIELD 79, a JCS directed exercise conducted by CINCLANT, approximately 180 containers were used ashore and another 100 containers were placed aboard a small coastal self-sustaining containership. (See Appendix B.) The exercise involved the discharge of containers aboard ship and retrograde of containers ashore. An elevated causeway (See Figure 4) and LACH were used. Both a Navy-Marine Corps task unit and elements of an Army terminal service battalion conducted phased type operations using the facilities.

Exercise findings are contained in Appendix B. Some of the more significant ones are:

- Small container feeder vessels--numerously found in the NATO countires--are extremely sea state sensitive, especially for retrograde operations, and productivity will be low in sea states worse than SS 1. (See Figure 5.)

- Planning factors determined for the LACH and elevated causeway were comparable to those of the LOTS test (approximately 195 containers per day for the elevated causeway and 115 for the LACH).

- Installation of the elevated causeway required approximately 65 operational hours (accomplished intermittently over a 3-week period).

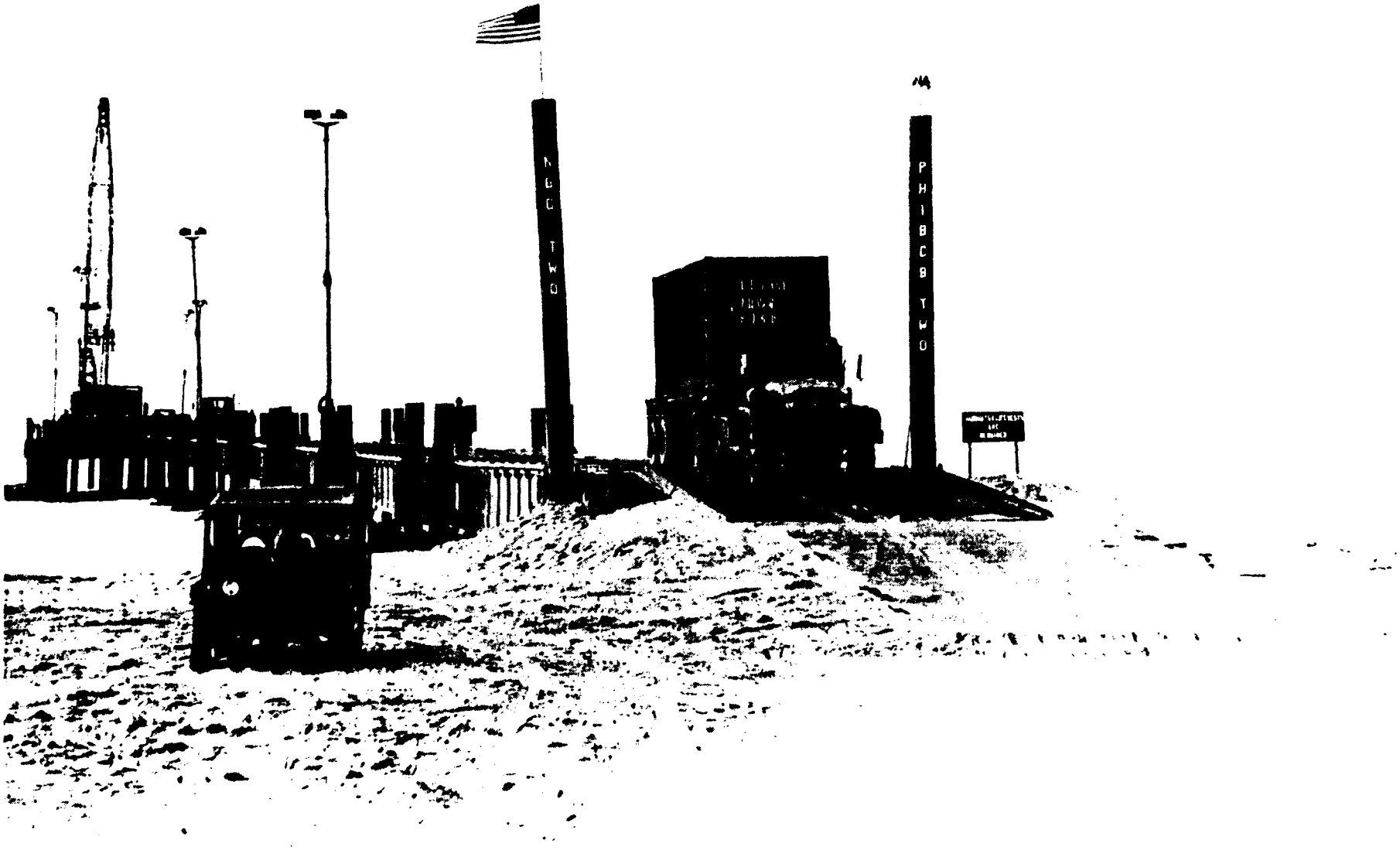

FIGURE 4. DURING SOLID SHIELD 79 THE ELEVATED CAUSEWAY WAS SUCCESSFULLY EMPLOYED. CONTAINER HANDLING RATES WERE FOUND COMPARABLE TO THE LOTS MAIN TEST. INSTALLATION REQUIRED 65 OPERATIONAL HRS ACCOMPLISHED OVER A 3-WEEK PERIOD.

- The Army's remote processing facility for import and export operations was a significant success.

- The Marine Crops still requires development of a shoreside container-supported distribution system, including broader use of the MILSTAMP system.

- The in-place turnover of facilities and equipment in a joint operation could be accomplished smoothly but there are unresolved issues on the timely replacement of this equipment for future amphibious operations.

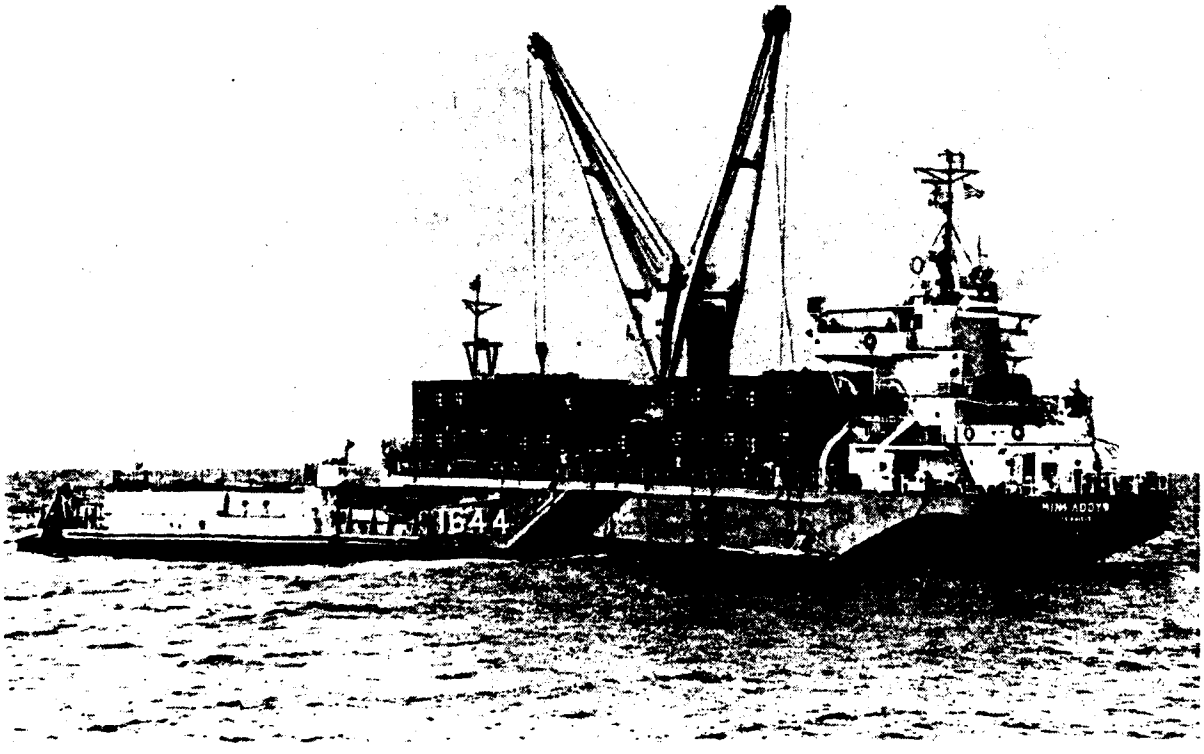

FIGURE 5. THE SMALL, FOREIGN FLAG, COASTAL CONTAINERSHIP USED DURING SOLID SHIELD 79 WAS FOUND TO BE VERY SENSITIVE TO SEA STATES, MAKING IT DIFFICULT TO WORK IN AN OFF-SHORE ENVIRONMENT.

III. FUTURE LOTS-TYPE TESTS

REQUIREMENT

For the 1977 LOTS test the Army used essentially off-the-shelf hardware with minimal modification for off-shore type operations and was burdened with severe sea state and deployment limitations. The Navy and Marine Corps participated in the test with on-hand equipment or equipment still in development (the LACH and elevated causeway) that, at best, provided an interim capability. By the 1983-84 time frame deployable system equipment for container operations by the Navy and Marine Corps suitable for support in SS 3 conditions and operations ashore will be coming into the DOD inventory. This equipment will represent an R&D and hardware investment by the Services of several billion dollars and which will be oriented toward a container-supported distribution system. Components of this system will have undergone rigorous testing but the system as a whole will not have been assembled or tested.

Consequently, the Navy requested OUSDR&E, DDT&E sponsor a second container-oriented off-shore system test for FY 84 under more rigorous environmental conditions than experienced in 1977 but similar to the LOTS test. OUSDR&E has generally agreed on the requirement and recognized a need to support the test. Table 1 compares the shortfalls from the 1977 LOTS test with developments requirements for a Navy-proposed "OSDOC III" (Offshore Discharge of Containership) test.

TABLE 1

SUMMARY OF TEST REQUIREMENTS AND OBJECTIVES

FOR A PROPOSED OSDOC III TEST AND EVALUATION PROGRAM

Summarizing the attached detailed information in terms of an overall objective of testing service capabilities to conduct over-the-beach support operations, the following is a comparison of expected OSDOC III test results with those of the LOTS Test:

	OSDOC III	LOTS Test
Ship Discharge	Discharge a containership and RO/RO ship in varying sea states employing the Navy TCDF (self deployable), the Army Barge TCDF (severely deployment limited and sea state sensitive), and the Navy RO/RO Ship Discharge Facility. Validate LOTS planning factors under most favorable conditions as they occur and determine degradation of productivity at higher sea states. Develop new planning factors for RO/RO ship discharge using the new RO/RO Ship Discharge Facility and the TCDF with RO/RO Lifting Device. These planning factors are sorely needed now for contingency planning in areas where adequate port facilities are lacking. The successful accomplishment of this objective alone would justify the effort and cost in conducting OSDOC III.	Established container transfer rates for Crane on Deck (COD) and Barge TCDF systems only under near ideal weather and sea state conditions. No RO/RO ship discharge facility was available for testing.
Lighter Operations	Conduct ship to shore operations using the Navy's new powered causeway sections and LCU's and Army lighters (LCU's, LCM8's, LARC LX's and LACV-30's) determine productivity of each based on total cycle times (loading, unloading, intransit, docking and undocking) under Sea States 0-3. Testing the ability to receive vehicles at the RO/RO Ship Discharge Facility in the stream is a critical feature of this test.	Same lighterage except for added Navy PCS and deleted Army LARC XV (units being disestablished). Lighterage productivity rates were established under mostly ideal conditions (SS 0-1). No RO/RO ship discharge system was available for testing

(Table 1 Cont'd)

	OSDOC III	LOTS Test
Shoreside Cargo Operations	Conduct container transfers at the Navy Elevated Causeway, Army B-Delong Pier, USMC LACH and Army Amphibian Discharge Crane sites. Validate container transfer rates calculated from LOTS Test data obtained under near ideal conditions and determine degradation in higher sea states, tide and wind effects. Determine discharge rate of vehicles transiting the beach from the RO/RO ship discharge operations.	Same transfer systems, transfer rates established under ideal weather conditions only. No roll-on/roll-off vehicle traffic.
Beach Clearance Operations	Conduct USMC motor transport operations on Elevated Causeway and at LACH site; Army motor transport operations at DeLong Pier and Amphibious Crane site. Validate LOTS test results on truck-trailer cycle times (loading, unloading, queue and intransit times), test new operating and control procedures developed following LOTS Test experience.	Same fleet of vehicle types; first time experience operating with container MHE on the beach and in the marshaling yard. Lack of control in the yard, particularly at night and unsynchronized watches made more rigorous analysis of truck operations impossible.
Marshaling Yard Operations, Cargo Management and Documentation	Army frontloaders, USMC rough terrain crane and LACH, Army RPF (with remote stations on beach, receiving point, and dispatch point). Validate and/or modify receiving, stacking and back loading rates during day time and night operations. Spot check stow location, yard inventory accuracy. Evaluate ability of RPF to provide timely reports and documentation for cargo accounting and movement control. Evaluate USMC manual documentation and cargo management procedures.	Same equipment except USMC did not have sufficient container MHE to keep up with workload. Army MHE handled the bulk of container transfers. Army control of MHE operators at night was poor. Documentation support for clearing cargo was adequate after initial start up difficulties. Improvement in marshaling yard management was needed.

(Table 1 Cont'd)

LOTS TEST REPORT RECOMMENDATIONS:	ACTIONS TAKEN TO DATE:	MAJOR BENEFITS TO BE GAINED FROM AN OSDOC III T&E
1. As a priority matter the Army acquire all necessary equipment for discharging, storing, and distributing bulk POL from tankers in a LOTS operation.	1. The Army procured equipment during 1978 to achieve an interim capability pending acquisition of a system being developed by the Navy. The Army set was tested in 1979 then packed and stored for possible contingency use.	1. Realistic testing of the Services capabilities to discharge bulk POL products from tankers offshore in an expeditionary environment is needed. See Navy Offshore Bulk Fuel System (OBFS) under "New Developments Since LOTS Test" below. Issue involved: "Is it technically and operationally feasible to provide continuing OSDOC operations in AOA following departure of assault shipping?" This is a critical issue for all three Services (A, N, MC).
2. The Department of Defense carefully examine the vulnerability of the LOTS and amphibious follow-on echelon container handling subsystems to environmental factors and mechanical breakdowns; and considering the lack of system redundancy, assess the need for system maintenance requirements and the impact of probable losses of key components on sustained logistic support.	2. Current Navy COTS planning calls for the installation of multiple elevated causeway and LACH sites to support Marine Corps amphibious operations. The LACH is to serve primarily as back-up for the elevated causeways and to assist during surges in off loading. For continuity in ship discharge operations, four TCDF's are planned with two cranes on each with an average workload requiring seven cranes; thus, one crane on average would be avilable as a spare. The Army plans to procure two LACH's for each transportation container handling company to serve as back-up for the shoreside cranes and to assist during surge discharge periods. The Army has no back-up for shipside container transfer operations.	2. One of the most serious limitations of the LOTS Test results was the lack of data for evaluating the degradation of the LOTS/COTS subsystem capabilities during periods of adverse weather, (sea states above Sea State 1.). The LOTS test established the upper limits of capabilities for all systems tested during ideal weather conditions. An OSDOC III, field test would provide a basis for validating the LOTS test baseline for the systems previously tested and establish a baseline for the new systems, and obtain the data critically needed for estimating the degradation of system capabilities as sea states increase. The importance of this data to Service planners for analyzing support capabilities in certain under-developed areas in the world cannot be over stated. With regard to system redundancy, employing both the Navy and Army TCDF's at shipside and LACH's at beach discharge sites to back-up Navy and Army shoreside container transfer cranes would avoid major delays due to equipment malfunctions. All equipment failures, down time and reasons for breakdowns would be recorded for evaluating system reliability. The applicable issue in the Navy JT&E nominating memorandum is: "Is it technically and operationally feasible to provide continuing OSDOC operations in AOA following departure of assault shipping?"

(Table 1 Cont'd)

LOTS TEST REPORT RECOMMENDATIONS:	ACTIONS TAKEN TO DATE:	MAJOR BENEFITS TO BE GAINED FROM AN OSDOC III T&E:
3. The Department of Defense review the arrangements (legislative and contractual) under which essential shipping can be made available to the Department when required for military operations.	3. Department of Navy, representing the DoD, meets periodically with MARAD to review Department of Defense sealift requirements, to include desired defense features in future ship construction. Since briefings and discussions with MARAD on the LOTS test findings, MARAD has taken two important initiatives: (1) mandatory ship owner participation in the Sealift Readiness Program when receiving either ship construction or operational subsidies; (2) introduction of an "Omnibus Maritime Bill" to foster a stronger merchant marine industry in the U.S.	3. Using planning factors derived from OSDOC III test results, Navy COTS, Army LOTS and USMC FLS force requirements could be estimated to support a given contingency requirement. Shipping requirements would then be determined and compared with MSC estimated ship availability within the desired contingency response times. This was done for Army LOTS deployment requirements only following the LOTS test because major elements of Navy COTS and USMC FLS systems and organized units were not available for test and evaluation. These results would be important to JCS for consideration of priorities for sealift and MSC and MARAD to address means of alleviating shipping short falls.
4. OSD MRA&L provide positive direction in the coordination of LOTS/COTS program requirements to insure balanced system support at the earliest practicable date.	4. MRA&L monitors LOTS/COTS program progress through briefings and reports made by the Service program managers and seeks recommendations from the Container Steering Committee consisting of Senior logistics representives of the Services. Program progress direction and funding support are left entirely up to the individual Services. For example, the urgently needed Navy TCDF remained programmed at Level 4 for indefinite deferment due to internal Navy priorities while Army was procuring LOTS equipment to obtain an early container handling capability as a priority matter. Program imbalance continues.	4. In conjunction with deployment requirement determinations in 3 above, total unit and equipment requirements to meet contingencies can be compared with capabilities reflected in currently approved DoD programs, and any critical shortfalls highlighted for Service review and appropriate action.
5. OSD MRA&L support the assignment of an appropriate priority for the early acquisition of a deployable temporary container discharge facility by the Navy in order to meet planned development/operational testing in the FY 81-83 time frame.	5. Only known MRA&L action was to send a memorandum to the JCS to inquire if a LOTS capability is needed to support contingency plans. The Navy in the meantime is funding R&D work at a level to obain a prototype TCDF for testing by 1983.	5. The lack of a deployable and less sea state sensitive containership discharge system was the most critical shortfall reported in the LOTS T&E report. For benefits to be gained from an OSDOC III test in this critical area see Navy Temporary Container Discharge Facility under "New Developments Since LOTS Test" below.

(Table 1 Cont'd)

LOTS TEST RELATED RECOMMENDATIONS:	ACTIONS TAKEN TO DATE:	MAJOR BENEFITS TO BE GAINED FROM AN OSDOC III T E:
6. Until self-deployable container discharge facilities are available, OSD MRA&L consider the determination of requirements and acquisition of COD hatch bridging kits to support most likely contingency operations; and that the kits be positioned at locations to permit the rapid conversion of NSS containerships into self-sustaining ones.	6. No known action by MRA&L. The Navy is deferring the decision on acquisition of hatch bridging kits for the COD system pending the procurement and testing of the prototype self-deployable ICDF.	6. The M... COD ... need not and is not planned to be tested in OSDOC III. Data derived from the test of the system in the LOTS test would be used for comparative purposes in the post test analysis of the other ship discharge systems in OSDOC III.
7. MSC sponsor a deployment test loading of 1466- and 1610- class LCMs aboard the GIS ADM WM CALLAGHAN.	7. No action taken by MSC to date for lack of funding and strong interest by either the Army or the Navy. (MSC the DoD Single Manager for Sealift, is *industrially funded*).	7. Use of the Callaghan in OSDOC III is not planned due to high charter costs and its dedication to normal Army lift commitments (Bayonne, NJ to *Bremerhaven, Ger*). *For planned RO/RO operations* see Navy RO/RO Ship Dischage Facility under New Developments Since LOTS Test below.
8. The Army examine trade-offs in the deployment, operating effectiveness, and support cost of alternative mixes of lighters to support most likely contingency situations.	8. Formal COEA by a disinterested agency was not accomplished. The Army proceeded with the procurement of LACV-30 vehicles on the basis of "unique capabilities" rather than trade-off analyses of alterative and possibly more cost effective lighters available to the DoD.	8. OSDOC III would provide the data needed for comparative analysis of the productivity, relativ economy and efficiency of the available Navy and Army lighterage, operating simultaneously under varying degrees of sea state and other environmen conditions (tidal currents, wind, visibility, etc The applicable issue contained in the Navy JI&E nomination memorandum is: (1) "Will equipment developed in Navy COTS R&D program satisfy Army and Navy *requirements for a ship offloading* capability for container capable ships?"

(Table 1 Cont'd)

9. In conjunction with a review of lighterage requirements the Army examine the relative merit of the LACH, the elevated causeway, sand jetty, and the Delong pier in meeting contingency requirements.	9. The Army has elected to retain its current equipment and concept of Delong pier sections and amphibious beach cranes with their inherent deployment limitations. The Army has planned to add two LACHs to each terminal service company to provide back-ups for the shoreside container cranes, as noted in 2 above.	9. An OSDOC III test conducted in an area where Sea States 2 to 3 and higher can normally be expected during the planned test period would provide valuable comparative data on the Navy and Army shoreside container transfer systems. The Navy elevated causeway permits cargo transfers from lighters to piers in water beyond the surf zone whereas the Army Delong pier is well within the surf zone. Data on the impact of sea state on container transfer operations would be of great value to the Services.
10. The Navy conduct additional training and testing of the deployment, erection, and operation of the elevated causeway to include unfavorable weather conditions.	10. The Navy has conducted follow-on tests as recommended and has greatly reduced erection time. Vessel space requirements and loading/unloading time of elevated causeway components for deployment on commercial ships have not been determined by field testing.	10. OSDOC III would provide an opportunity for an evaluation of the deployment requirements of the elevated causeway system as envisioned in Navy planning (only single causeway sections have been tested the larger cube requirements for the pilings and associated gear in terms of commercial vessel requirements have not been determined).
11. The Marine Corps examine container MHE and transporter options and develop LSA operating procedures to acquire an adquate capability to handle containers in amphibious follow-on and resupply operations.	11. The USMC has been developing doctrine and programming equipment acquisitons under its container oriented Field Logistics System (FLS). Sufficient quantities of most major system elements are planned to be procured in time for a complete system test by 1983.	11. SEE MARINE CORPS FLS UNDER "NEW DEVELOPMENTS SINCE LOTS TEST" BELOW.
12. The Army improve procedures and management of the marshalling yard, particularly in maintaining accuracy of stowage location and control.	12. Army documentation and control procedures in the stacking area reportedly have been improved. Principal improvement was needed in communications with the container MHE operators during night operations.	12. In conjunction with the testing of the new ADP Remote Processing Facility (RFP), Army procedures for maintaining accurate storage location records and inventory of containers in the marshalling yard could be evaluated. It is envisioned that physical spot checks would be conducted periodically during the test, particularly during periods of heavy container flow and during hours of darkness.

(Table 1 Cont'd)

13. The Army improve the capability of the Remote Processing Facility to include a stand alone communication capability in receiving, processing, and producing terminal documentation, operational status, source data collection, and cargo accounting reports. The Army should also continue training and testing in the use of mechanized documentation for breakbulk and container cargo in planned annual exercises.	13. A totally new RPF incorporating a minicomputer with communication links with the world wide system and software for the terminal management information system has been developed and demonstrated by the Transportation Center at Ft. Eustice, Virginia. Full scale testing under a realistic LOTS environment is needed.	13. During the LOTS test the data provided by the prototype RPF was not timely enough and did not agree with manually prepared reports. In short, the commander could not use the RPF reports to meet his operational information requirements. These system deficiencies resulted in the development of the new RPF with an integral mini-computer and stand alone communications capability. See the RPF under "New Developments Since the LOTS Test" below.

(Table 1 Cont'd)

NEW DEVELOPMENTS SINCE LOTS TEST: NAVY-COTS PROGRAM:	DISCRIPTION AND CURRENT STATUS	MAJOR BENEFITS TO BE GAINED FROM AN OSDOC III T&E
1. Offshore Bulk Fuel System (OBFS)	1. The OBFS consists of a pipehead for connecting to a tanker at an offshore anchorage; secured by a multileg mooring buoy; 8" bottom line to shore and distribution to storage bladders on shore. A test set will be available for the OSDOC Test. Initial production buy is programmed for FY 83.	1. The Navy JT&E nomination memorandum does not call for the OBFS to be included in the OSDOC III Test. This remains as an option and an opportunity for the services to "piggy back" the OBFS OT on the OSDOC III T&E if the timing is right.
2. Temporary Container Discharge Facility (TCDF)	2. The TCDF is made up by mounting two motion compensated cranes and load spreading foundations on tanker hulls of opportunity in CONUS, transiting to an operations area and operating as a floating pier to offload ships. Testing of the motion compensated crane commenced in 1979 and is continuing to completion by mid-1980. IOC for a prototype system test is FY 83. (One TCDF set will be available as early as FY 82; 2 are on order for FY 83; and 1 set in FY 84; a total of 8 cranes and platforms).	2. An OSDOC III Test and Evaluation of a deployable ship TCDF would address two major deficiencies uncovered in the LOTS Test: (1) The urgent need for a rapidly deployable containership discharge facility and (2) and equally urgent requirement for such a system mounted on a more stable floating platform, i.e., able to handle containers in up to Sea State 3 conditions. The Navy TCDF should be tested under sustained, around the clock operations in conjunction with the Army barge TCDF. Both systems would be evaluated on the basis of their average productivity under like conditions and their ability to load lighters alongside in varying sea states, during daylight and night operations. Only in full scale, sustained operations with all systems interacting can the sustained throughput of the Service systems be fairly and accurately assessed. For all Three Services the additional benefit of operational experience gained is of great value in view of the heavy annual turnover in personnel and the inability of the Services to fund joint LOTS/COTS exercises of this magnitude. (SOLID SHIELD is a typical example). All four Navy issues set forth in the JT&E nomination memo would apply

(Table 1 Cont'd)

NEW DEVELOPMENT SINCE LOTS TEST: NAVY LOTS PROGRAM (cont'd):	DESCRIPTION AND CURRENT STATUS	MAJOR BENEFITS TO BE GAINED FROM AN OSDOC III T&E:
3. Roll-on/Roll-off (RO/RO) Ship Discharge Facility.	3. Concept calls for construction of an adjustable ramp mounted on a causeway section for securing to RO/RO ship stern or side ramps. Vehicles driven onto the causeway would then drive onto lighters for movement to shore. A lift-off devise for vehicle lifts using the TCDF crane is an alternative for use under higher sea states. Prototype system will be available for testing in FY82; IOC FY84.	3. This was one of the major gaps uncovered in the early planning for the LOTS Test. A major portio of the cargo arriving during the early deployment phase and in replacement of combat losses are wheeled and tracked vehicles. The most efficient way to handle this cargo is by RO/RO ship, and the number and availability in the merchant marine are increasing. A test of the Navy gear for unloading RO/RO ships offshore is of critical importance to all three services. OSDOC III would provide the means for evaluating this capability under realistic operating conditions. All four issues in the Navy JT&E nomination memo apply wholely or in part.
4. Powered Causeway Section (PCS)	4. The PCS consists of a waterjet propulsion unit attached to a causeway ferry made up from standard pontoons. With the addition of a winch and A-frame, the PCS operates as a Side Loadable Warping Tug (SLWT). Developmental testing completed and first four units will be available this year (FY80).	4. In OSDOC III the PCS/SLWT would be tested in the warping tug role positioning causeway sections during the erection of the elevated causeway, assisting in the installation of the offshore fuel systems, and in the recovery of broached landing craft. Secondarily, the SLWT can be used as a causeway ferry for cargo transfers from ship to shore. The test design should provide for thorough testing and evaluation in both roles. The analysis would include comparative performance data with other lighterage at various sea states and other environmental conditions (effect of wind, tide, surf, sand bars, etc).

(Table 1 Cont'd)

NEW DEVELOPMENTS SINCE LOTS TEST	DESCRIPTION AND CURRENT STATUS	MAJOR BENEFITS TO BE GAINED FROM AN OSBCC III TBE
MARINE CORPS - Field Logistics System (FLS)		*Comments apply to entire set of equipment.*
5. The number of different equipment line items being procured for FLS is so extensive they are summarized here in major functional groups.	5.a. Inserts and PALCONS ("pallet-sized containers") and QUADCONS (4 joinable containers = one 8' x 8' x 20' container). Purpose is to provide a durable replacement for the old Marine Corps "mount out" boxes and to improve storage and accessability enroute to the AOA. (IOC FY82-84)	5. 11. OSBCC III would provide a valuable test vehicle for the test and evaluation of the Marine Corps logistic support organization, its deployment, establishment in an objective area, its support capabilities with organic motor transport, all necessary M&E, and shelters (living, kitchen, maintenance facilities, field hospital, etc.) required for the support of a Marine Air Ground Task Force. Emphasis would be on the organization, newly developed concepts and procedures, and performance and equipment in the support of the MAGTF and the storage control and distribution of supplies to forward units. For the Marine Corps it would be their first opportunity to test the totality of units of their newly developed Field Logistics System under operating conditions of sustained operations over an extended period of time. In addition, the deployment phase would permit an evaluation of vessel space requirements and the adaptability of containers (shelters) transporting troops on board a containership enroute to an objective area.
a. Intermediate Sized Containers and Container Inserts		
b. Flat Racks	b. Standard 8'x 8'x 20' and 8'x 8'x 40' flat racks with corner posts for handling and loading on containerships. Open sides, ends and tops provide additional clearance and access in the shipment of vehicles and other equipment. (IOC 80-84).	
c. Family of Shelters	c. Based upon modular use of standard container sizes (8'x 8'x 20' and 8 x 8 x 40'), single units are equipped as ready made CP's, sleeping quarters, etc. and by complexing with a number of sections, maintenance shops, field hospitals, mess halls, etc. are formed. Individual sets have been tested and are being procured (IOC FY81-83).	
d. Family of Tactical Vehicles, Container M&E, and Rough Terrain Crane	d. New vehicles with capability of towing heavy trailer loads through a beach environment; rough terrain forklifts and crane for handling break bulk cargo, positioning and complexing shelters and other construction projects. Tractor-trailers slipped to FY84. (OSBCC will use modified M-127 trailers and M818 5-ton tractors in OSBCC III).	
e. Lightweight Amphibious Container Handler (LACH)	e. Product improved based upon IOTS and post IOTS user testing. All deficiencies corrected, 56 being procured by FY82. Unloads lighters and transfers containers to trailers.	
f. Fuel/Water Pump and Storage Modules.	f. Pump with storage bladders are packaged and configured in an 8' x 8' x 20' unit with ISO standard container fittings. Prototypes available this year (FY80), IOC FY82/83.	

(Table 1 Cont'd)

NEW DEVELOPMENTS SINCE LOTS TEST	DESCRIPTION AND CURRENT STATUS	MAJOR BENEFITS TO BE GAINED FROM AN OSDCC III TEST
Army LOTS Program		
6. Remote Processing Facility (RPF) with Dedicated Mini-computer and Communications Link.	Mounted in an 8' x 8' x 20' air conditioned container, the RPF consists of a third generation mini-computer seven remote input/output stations, high speed printer, and capability to link with worldwide transportation data communications net (MTMC in CONUS and overseas ocean terminals). System procured, operator training, and software programming completed and tested.	OSDCC III would provide an opportunity for testing the new RPF in a realistic field environment under heavy cargo movement management and documentation workloads and around the clock operating conditions. Of particular concern is the ability of the new RPF to provide real time status information for the terminal commander and operations staff for taking timely actions and planning operations for the following day; e.g. cargo remaining on board ship, cargo intransit to the marshaling yard, cargo on hand, cargo shipped forward and retrograded, etc. In addition, the system must provide documentation so as not to delay shipments, respond to changes in priority and/or destination consignees, handle tracer actions and normal cargo accountability functions.

Incident to the LOTS program was the generation of an RDF, to be at least partially supported by prepositioned ships overseas. Basically, the concept is for air deployed forces to quickly link up with the pre-positioned surface supplies which are located in proximity to the objective area. Initial RDF development calls for port availability, however, subsequent operations may not have the advantage of an adequate undamaged or politically viable port. This could limit or jeoparadize or entrap RDF units of large size in heavy combat.

LOTS program testing and development needs to be brought into alignment with RDF development objectives. In general, an RDF deployment test possibly using an SL-7 vessel is postulated for 1983. This type of test program could be incorporated into the proposed LOTS II Program.[1/] Either a prototype RO/RO platform could be evaluated for a converted SL-7 vessel, if available, or a crane-on-deck system could be made available and the Navy RBTS employed to discharge the ship if a conventional SL-7 is used. Such options need to be explored.

1/ LOTS II is the OUSDR&E name to identify the testing program to support Navy and Marine Corps efforts. It should be noted that the definition for LOTS calls for operations in a non-hostile area while Navy-Marine Corps developments are directed toward amphibious warfare support but in a relatively low threat environment for merchant ship operations.

IV CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

1.1 The requirements for container handling, LOTS-type capabilities has lost emphasis in Army and Navy program areas:

- The Army has delayed conversion of two of three breakbulk terminal units into container capable ones and may eliminate the fourth company because of funding priorities.
- The Navy has delayed funding of its crane procurement program until FY83, making availability of the first ship-TCDF approximately 1985. The second and third ship-TCDFs will be 6 years from now and the final one is 7 years away.
- The Navy has only minimally funded and supported development of a RO/RO platform. Validation of design (level 2) type tests won't be accomplished until 1982 and developmental and operational testing in terms of projected funding support are uncertain beyond that.

1.2 The capability to provide bulk POL for large size forces has been attained by the Army which has rehabilitated and reorganized a marine petroleum unit with interim equipment. A newer and larger system is being developed by the Navy for operation by 1984. Both Services may eventually adopt this system.

1.3 The Navy has made considerable progress in the development of a ship-TCDF crane component system but realistic sustained operations conducted by the operating forces are still required.

1.4 Policy on ownership, funding, maintenance, and operation of ship-TCDFs has not yet been established. In this area OSD MRA&L has not adequately supported the expeditions procurement, management guidance, nor fostered the doctrine and organization for deploying and sustaining U.S. Forces under a container-supported distribution system.

1.5 The crane-on-deck method of discharging non-self-sustaining containerships is a proven method that could be used in the interim until ship-TCDFs (5 to 7 years) are on-line or for augmentation; however, nothing has been accomplished by OSD MRA&L has been initiated to stockpile hatch bridging kits or prepare the systems for operation since the 1977 LOTS test.

1.6 The Services need to foster more extensive container handling field expercises for transportation and logistic units.

1.7 The Navy proposed joint test to be sponsored by OUSDR&E, DDT&E (LOTS II) should be aligned with Rapid Deployment Force test objectives to provide needed priorities to LOTS programs and more realistically focus LOTS type scenarios.

RECOMMENDATIONS

1.1 The Army restore its original priorities for establishing a four-company, container-handling, terminal service battalion.

1.2 The Navy upgrade its funding priorities for an earlier attainment for four ship-TCDFs and a RO/RO platform.

1.3 The Army identify and establish or procure its ship-TCDF requirements so that DOD will hold sufficient non-self-sustaining containership discharge capabilities.

1.4 OUSDR&E, DDT&E iniate action to support in conjunction with RDF requirements a joint test of an SL-7 with a crane-on-deck discharge system for FY83.

1.5 The Secretary of Defense consider placement of the LOTS program requirements and their implementation under the ASD, PA&E in order to better analyze and expedite attainment of DOD objectives; and to strongly support the operation test and evaluation of the LOTS II program under OUSDR&E, DDT&E.

APPENDIX A
NAVY SHIP - TCDF DEVELOPMENT TESTING

The Navy in its Container Off-loading and Transfer System (COTS) program, managed by the Naval Facilities Engineering Command (NAVFAC), has been exploring sea state effects on land cranes used afloat. During 1979 the Civil Engineering Laboratory (CEL) Port Hueneme, California, conducted a series of land based tests to establish a baseline on crane capabilities Subsequently the crane was loaded on a "B" section DeLong barge for afloat tests.

The Navy used a Manitowoc 4100 W crane, the same type crane used as the crane-on-deck in the LOTS test in 1977 except that the Navy tested a ring-mounted crane instead of a crawler crane. In its ring-mounted configuration and with appropriate counterweights (69 STons), the Manitowoc crane has a maximum lift capacity of 300 STons versus 200 STons as a crawler crane. This makes the Manitowoc crane comparable in lift capacity to the Army's P&H 6250 truck-mounted crane which was used as the barge-TCDF in the LOTS test.

In the land testing phase the Navy placed the crane on a tilt of about five degrees. Near the end of this testing phase the crane experienced a major failure not related to the tilt testing. During rotation, the direction of the crane was reversed without first coming to a full stop as

would normally be done. The resultant high torque caused considerable damage to the crane's rotating mechanism. This mechanical failure, along with difficulties in loading the crane on the B section DeLong, delayed the program almost six months.

Once the crane was afloat, a series of tests were conducted to evaluate crane stresses. These were accomplished in varying sea states with the initial tests accomplished while tied to a pier for a calm water baseline. Subsequently, the barge-TCDF was moved to water where greater sea states could be experienced. The maximum wave height during testing was about 3 ft. or about sea state 3.

The purpose of the tests was to develop a concise mathematical approximation for the estimation of static side loading components for any arbitrary crane orientation. Cranes operating on floating barges induce list and trim that varies with the slew and boom angle of the crane and the load being handled. List is the angle between the plane of the barge and the horizon in the longitudinal direction. Since most barges are not built or loaded symetrically, the combined list and trim may result in a side-lead as well as an off-lead angle. The result could be an unsafe lift at certain weights and distances in particular sea states. Worsening sea state, of course, degrades both weight and distance for cycles.

To evaluate these tests the Navy recorded approximately 200 channels of data from instrumentation to include boom stress, mast stress, load tension, barge motion, brake temperature, engine and other equipment temperature on each lift. The amount of information taken was so extensive that it was necessary to record only during selected intervals because of the large volume of data reduction that was then necessary. Component failure times, types of failures, and replacement times were also recorded for reliability, maintainability, and availability data. In addition, human factors data were collected for effects of noise, lighting, vibration, and temperature on the operator and crane personnel.

The Manitowoc 4100 W ring-mounted crane itself has a 145 ft mast and a 200 ft. boom to enable it to make heavier lifts at greater distances. A 4-part hoist line was used. In addition, during the afloat container lift and land testing (as opposed to heavy lift tests) motion compensation equipment was employed. The crane was equipped with a Rider Block Tagline System (RBTS) to help control the pendulation and a sensing device to lower containers only during certain periods in a lighter's vertical motion activity (caused by sea swells). This equipment has worked so satisfactorily that reportedly crane operators prefer to use these modifications even in calm seas when they would not be required. Figure A.1 shows the crane in operation during the afloat tests.

The loads tested were of two types; containers and heavy lifts. The containers were weighted at 30 STons. Also adding to the lift weight was 7,000 lbs of block and rigging. Thus, the total crane suspension was 67,500 lbs at a distance of 150 ft. from the crane's center. The container lifts were made to or from a "ship" cell to a position near the TCDF. Both 20-ft. and 40-ft. containers were used. The "cells" were positioned at 60 ft. and 125 ft. distances from the centerline of the crane.

CONTAINER PRODUCTIVITY TEST RESULTS

Although termed "Productivity Tests" the Navy's use of a barge-mounted crane were more for learning about crane stress, afloat operations, use of the RBTS, and reliability data than for deriving productivity data. The Navy crane differs considerably from an Army crane in terms of major characteristics (see A.1 below), but the lessons learned from the Navy tests are of interest to the Army.

FIGURE A.1. NAVY RING-MOUNTED CRANE ON AN ARMY DELONG B BARGE DURING PIERSIDE TESTING.

Table A.1

MAJOR BARGE-TCDF DIFFERENCES

Army Crane	Characteristics	Navy Test-Configured Crane
P&H 6250 truck-mounted	Type	Manitowoc 4100 ring-mounted
150 ft.	BOOM length	200 ft
None	Mast height	145 ft
360,000 lbs	Weight (approx.) standalone	400,000 lbs
491,000 lbs	Weight w/foundations	544,000 lbs
300 STons	Max. lift (ashore)	300 STons

* Both cranes do have gantrys of about 29 ft height when operational.

RIDER BLOCK TAGLINE SYSTEM

The RBTS was found to remove the dangerous side load effects of motion on the crane (where boom strength and stress capabilities are less). Load pendulation, another obviously dangerous factor, is greatly limited also. These factors normally would be the primary reasons for halting barge-TCDF operations, but with the RBTS additional safety and operating time are gained.

A new area developed during the tests related to the controls system of the RBTS. First, the crane operator must learn to respond differently when using the system and, second, a new and simpler set of controls had to be engineered. Once these hurdles had been passed, operating times with and without the RBTS were found comparable. Crane operators later, reportedly, were found to prefer lifts using the RBTS, especially in any type of sea state.

Two types of container tests were conducted: pierside and at anchor near the channel entrance at the CEL facility, Port Hueneme, California. The latter tests were intended to simulate open sea conditions while the pierside tests provided a calm water/controlled environment. The Navy

intends a follow-on detailed report of these results; however, preliminary data on cyclic results were released. Table A.2 contains the results of these tests and somewhat comparable times for the LOTS test. The LOTS test results are slightly lower but events are more realistic and operationally are more inclusive. For example, in the LOTS test the spreader bar each time was seated and locked into the container but not in the Navy tests. It should be noted that the crane operators at CEL were public works crane operators as opposed to military personnel. Nevertheless, the results are relatively close.

Table A.2

COMPARISON OF NAVY BARGE-TCDF
RESULTS WITH LOTS TEST DATA

Events	Number of Interactions	Time (In Minutes)		
		With RBTS	Without RBTS	Comparable LOTS Test
Land Test (crane level); full cycle	167	3.13	Not Avail.	N/A
Land Test (crane on 2° slope); full cycle	184	2.9	2.9	N/A
Pierside; full cycle	169	3.13	3.32	N/A
At Anchor; lower spreader bar into cell over container	126	.82	1.46	1.5 (Note 1)
At Anchor; partial cycle - lift container, rotate, return (did not detach spreader bar)	56	1.38	1.46	2.6 (Note 2)

Note 1: LOTS test data provide TCDF times varying from .89 min to 4.43, which includes seating the spreader bar into the container's corner fittings. An experienced crew during daylight operations typically averaged about 1.5 min from the time the spreader bar was grossly over the cell until the spreader bar was seated and locked.

Note 2: Comparable LOTS test data for the TCDF would be the lift-to-land times. These varied from 1.87 to 4.28 min, depending upon day or night operations and crew experience. An experienced crew during daylight typically averaged 2.6 min.

Due to the large type crane for the size barge used (a B DeLong), SS 2 was not exceeded. When lifting, the large crane easily was capable of creating lists in the barge. The maximum list found acceptable was about 3^{o} for normal operations, which is equivalent to about 10.5 ft of change at the boom tip. Without the RBTS pendulation of the load at the end of the hook would be difficult and time-consuming to bring under control. With the increased frequency of waves that would cause such lists, the load becomes even more difficult to control. The RBTS does control most such pendulation, although it cannot halt all motion resulting from wave-induced activity. Upon completion of the barge-TCDF testing CEL has tentatively concluded that the upward limit is SS 2 type conditions, and perhaps certain "heavy SS 1" conditions.

Paired with the RBTS is a sensing device which was also tested. Once the container has been lowered to a position over the intended landing point, the sensing device controls lowering of the container the rest of the way with minimal impact. Since the lighter moves in an up and down plane not always relative to the barge's motion, timing between signalmen and crane operators was usually erratic with respect to optimal landing. The sensing device is programmed to take over and correctly perform this function.

FUTURE TRAINING AND TESTS

The next phase of the Navy ship-TCDF developmental program is location of the crane from the B DeLong barge to the helicopter platform of an LSD for at-sea testing. The ship to be utilized is one drawn from the National Defense Reserve Fleet (NDRF). The vessel will be modified and repaired as necessary this summer. Some preliminary ship-TCDF testing will begin in late summer or early fall. By November it is expected that the full scale development and later the operational tests will be conducted. The wrap-up is expected by January 1981.

The testing will include the use of a container vessel with a relatively small number of containers. It is not anticipated that the containers will be dispatched ashore, but rather just off-loaded to lighters. Once all the lighters have been loaded, then retrograde operations will be initiated.

As part of this program the Navy intends to train a number of operators for large type cranes in the use of the RBTS. Army personnel were invited to participate in the program but due to travel fund limitations the nominations were withdrawn. The two-month training program is planned for completion by mid-August but subsequent training may include one month at sea using the LSD-mounted TCDF. Test results indicate that at least 40 hrs training time is required for someone already proficient in operating large cranes.

MISCELLANEOUS FINDINGS

Crew Size

Based upon test operations hatch crew size is not likely to change from LOTS test requirements. Two crane operators (one could act as a signalman), the signalman, and four tagline handlers are required per shift. Two more tagline handlers are required in the lighter.

Crane Failures

Crane stress was found most noticeable in the crane's drive system, which has a standard pinion drive for the heavy tests. Consequently, a broken tooth sometimes resulted. This required about a 6-8 hr delay for repair. It is a problem that may be resolved with a heavy duty pinion drive in subsequent buys.

Crane Platform

During the barge-TCDF tests the platform used to support the crane was a box configuration. The beams used were the hatch bridging beams used by the crane-on-deck during the LOTS test. Minor modifications were made to the beams but they otherwise worked quite well.

APPENDIX B
FIELD TRAINING

GENERAL

Subsequent to the LOTS test only one field exercise, SOLID SHIELD 79, has been held; a second exercise is tentatively planned for about September, 1980. The latter will be a Navy-Marine Corps exercise to be held on the West Coast. Neither exercise approached nor will approach the size and scope of the LOTS test. Nevertheless, although infrequent, these exercises are important learning experiences.

SOLID SHIELD 79 ORGANIZATION

SOLID SHIELD 79 was a joint exercise conducted at Camp Lejeune, N.C., with Army, Navy, and Marine Corps forces participating. Container handling exercises were an add-on feature to the test since that year's scenario simply called for a command post exercise. For container operations a local scenario was developed in which an elevated causeway was erected (see Figure B.1) and a LACH was positioned on the beach for Navy-Marine Corps resupply operations. These units were subsequently replaced by Army terminal service and lighterage units. The Army then operated the elevated causeway and paired a frontloader with the LACH for beach operations.

The ship used in the exercise was a small, foreign flag (Greek), container feeder vessel, called the MINI LOAF. See Figure B.2. The vessel's characteristics are contained below in Table B.1. Essentially

FIGURE B.1. SOLID SHIELD 79 INCLUDED THE ELEVATED CAUSEWAY OPERATED BY THE NAVY AND ARMY.

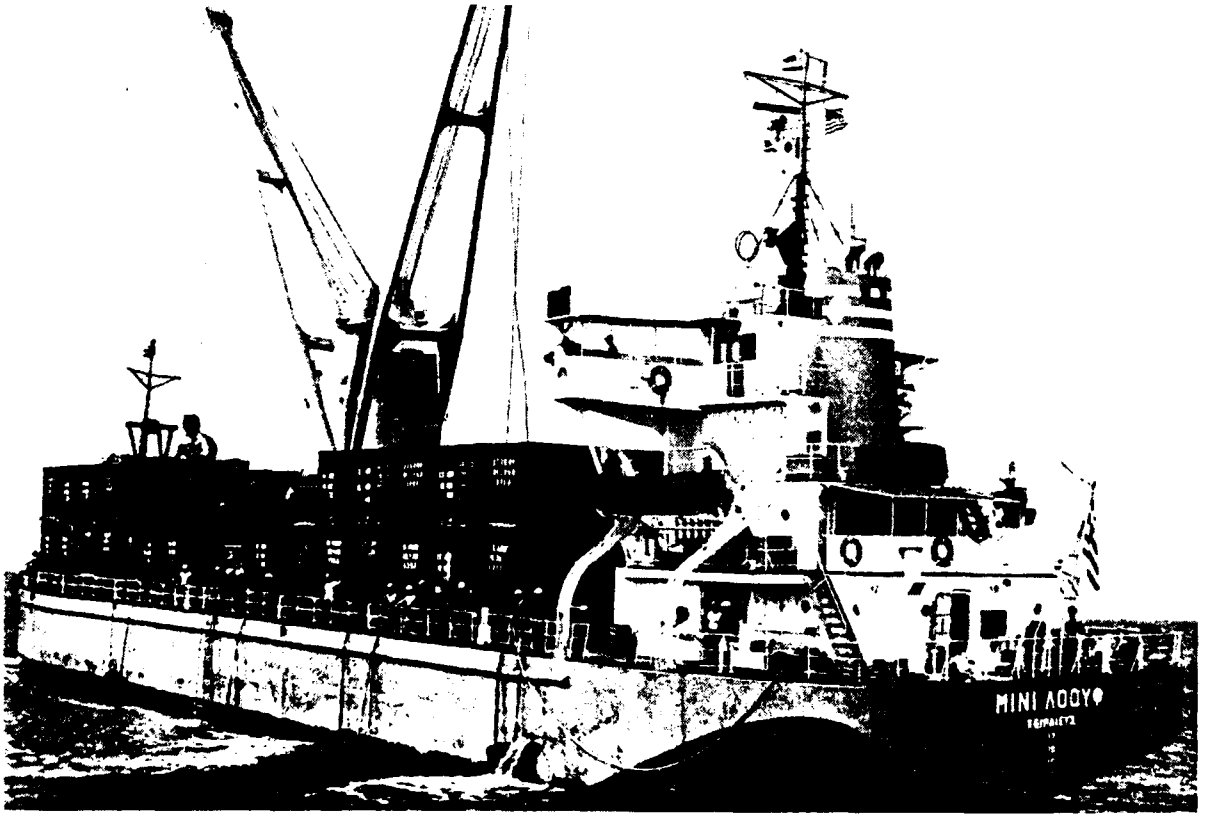

FIGURE B.2. THE MINI LOAF, A FOREIGN FLAG CONTAINERSHIP, WAS TOO SMALL FOR MODERATE SEAS.

the ship is only one-third longer than an LCU but almost twice as wide. It is characteristic of many container vessels in the NATO merchant fleets that ply the Mediterranean and European coastal waterways, as well as a number of the Third World fleets. The most apparent fact about the vessel was its sensitivity to sea states due to its small size.

TABLE B.1
MINI LOAF
PRINCIPLE CHARACTERISTICS

Length	215 ft
Beam	50 ft
Naviagtional Draft	16 ft
Displacement	2,972 LTons
Cruising Speed	8 kts
Crew Size	10
Container Capacity	100
Cranes	2
Capacity singly	15 LTons
Capacity married	30 LTons

The test cargo consisted of about 280 containers (milvans), some of which were suitable only for training purposes since they had doors missing or other defects. Of the good containers, 21 were loaded with rations and had an average weight of 12.7 STons. Since the number of exercise containers exceeded the ship capacity by 300 percent, 200 containers were staged ashore as cargo that already had been landed. This was necessary to build some volume into the management and marshaling yard requirement.

Lighterage for the Navy-Marine Corps phase consisted of four LCM8s and five LCUs. The Army in its phase used a similar mix but had more lighters to support breakbulk operations. Because the breakbulk handling phase required beaching lighters, LCM8s primarily were employed since they have less difficulty attaining a dry ramp. Similarly, LCM8s were used at the LACH site (beaching required) where containers were transferred.

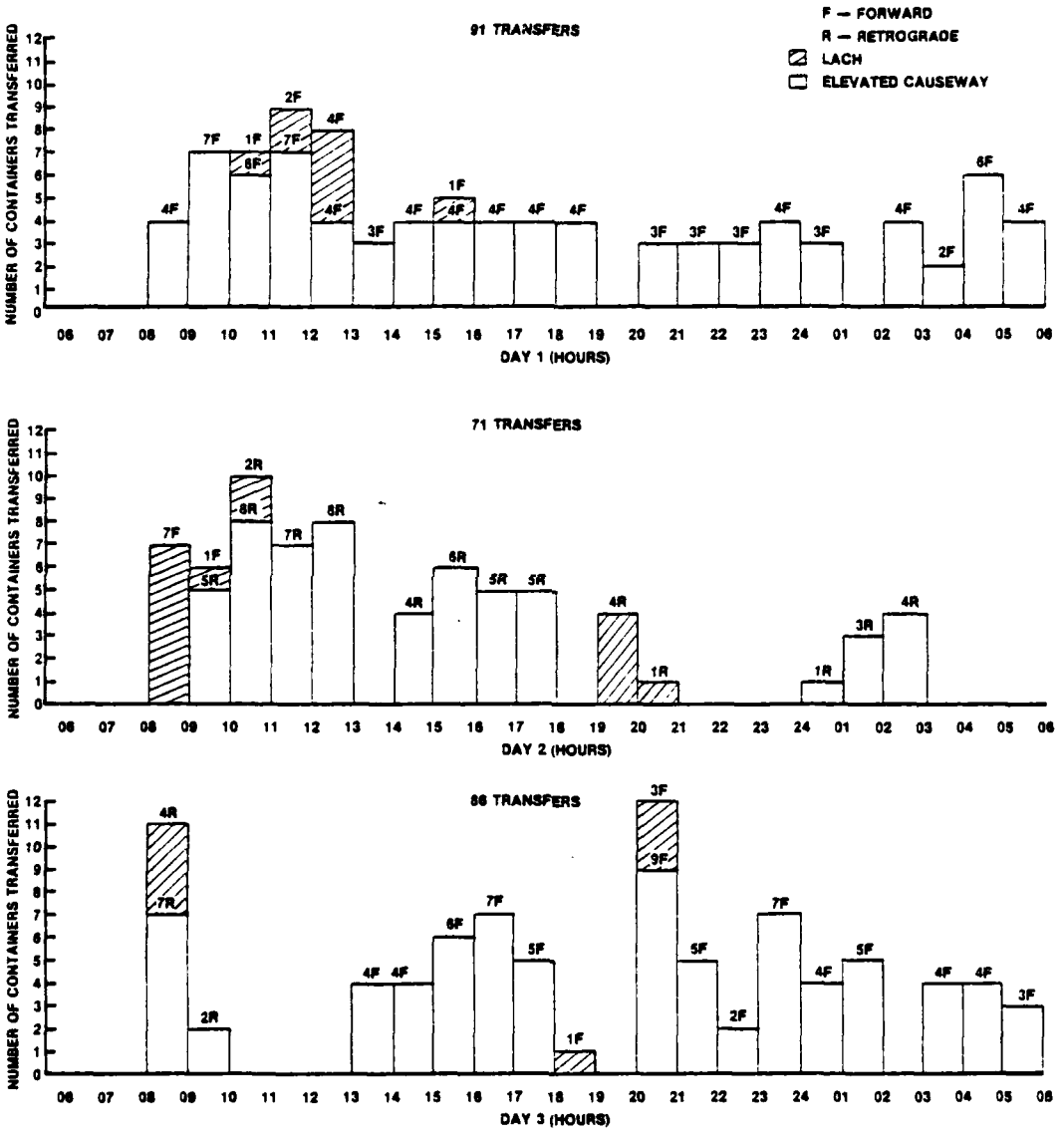

FIGURE B.3. SUMMARY OF MARINE CORPS-NAVY BEACH TRANSFER OPERATIONS

SUMMARY OF OPERATIONS, MARINE CORPS-NAVY

Marine Corps-Navy throughput results are summarized in Figure B.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 lighers 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 only 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.

In the second day of activity 71 transfers were made; eight of these were LACH off-loads and seven retrogrades. 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 tranfers (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 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 transferred, 13 were retrograded and 73 were off-loaded on the final day.

Overall, in the Marine Corps-Navy segment of the exercise 248 container transists between the ship and marshaling yard were made. Of these 30 percent were retrograded 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.

SUMMARY OF ARMY OPERATIONS

Transition

During the Army phase of the exercise, both container and breakbulk operations were conducted. The operational transition from Navy-Marine Corps to Army was conducted like a tactical relief of a combat position. Army personnel replaced Navy personnel on the elevated causeway and in the beach command post. Army lighters and trucks incrementally began replacing Navy lighters and Marine Corps trucks. Gradually, communications equipment was replaced and eventually only the Navy elevated causeway (with crane) and the Marine Corps LACH (operated by Marines) were still supporting the Army. Theoretically, these items would have been replaced by an Army DeLong pier and an amphibian discharge system. The Army's breakbulk training vessel, MV FRANK SUTTON, was introduced with several hundred tons of breadbulk cargo. Container

operations were plagued by rough weather which made retrograde at the MINI LOAF slow and difficult for two days.

Breakbulk Operations

The Army bladed some loose top sand and then used 5-ton trucks on the beach without other improvements. LCM8s brought palletized cargo to the beach and forklifts were used to off-load the landing craft and load the trucks. Normally about 3 to 4 pallets were loaded per truck. The trucks then hauled the pallets to the marshaling yard where forklifts off-loaded them. The pallet transfer time at the beach from a lighter to a truck averaged 7.64 min per pallet, including the time a pallet sat on the beach while its documentation was recorded. By comparison, in the 1977 LOTS test the same type of transfer time required 8.84 min per pallet on average, or about 16 percent slower.

LACH Operations

The LACH was paired with a frontloader belonging to the Army to decrease beach transfer times. The LACH can enter a lighter and retrieve a container, which the frontloader cannot. On the other hand, the frontloader can load containers on tractor-trailers about three times faster than the LACH. Thus, the concept was to merge the best characteristics of both equipment items into a single operation. The result was a time savings of about 20 percent for container transfer cycles. One frontloader could have supported three LACHs and saved the same proportional amount of time for each.

Elevated Causeway Operations

SOLID SHIELD 79 was the first opportunity for the Army to operate on the elevated causeway. Consequently, without prior training the first few cycles were somewhat rough but operations settled into a routine pattern generally similar to the Navy's.

Army operations were not as extensive as the Navy-Marine Corps'. The Army had to first retrograde containers to the ship, which was empty, then off-load them. In addition, operations were plagued for the most part by bad weather which also made training sporadic and difficult at the ship. Nearly two days were spent retrograding and on the third day with good

weather, the ship was off-loaded very quickly.

At the elevated causeway the Army's container company accomplished some of the faster crane cycles of the test. Several of these were under 2 min, the fastest being 1.7 min. Overall, Army crane cycles during retrograde averaged 4 min and for off-loading containers from lighters to trucks (and boom returns to start point) averaged 4.3 min each.

Tractor-trailers on the elevated causeway were in the loading position about 7.1 min, slightly longer than for Marine Corps vehicles. This was a consequence of the Army's loading two containers per trailer (versus one for the Marines).

EXERCISE RESULTS

SOLID SHIELD 79 provided some helpful insights to container operations in an off-shore and field environment and verified some of the findings of the LOTS test. One of the most beneficial results was the more realistic appreciation of container operational requirements and benefits gained which heretofore were skeptically accepted. Given new equipment and the background of the LOTS test, step-by-step procedures are slowly being developed to smoothly accommodate and manage cargo handling and flow in the Marine Corps Field Logistic System. Further steps are being planned to include field warehousing procedures and ammo distribution.

Using the same methodology for calculating composite cycle times, the two exercises demonstrated similar results for the LACH and elevated causeway. The LACH required 12 min per container in SOLID SHIELD 79 and 10.5 min in the LOTS test. The elevated causeway averaged 6.4 min per container in SOLID SHIELD 79 and 6.2 min in the LOTS test. The following summarize some of the findings of SOLID SHIELD 79:

- Small container feeder vessels such as the MINI LOAF and numerous others employed by NATO countries are extremely sea state sensitive, especially for retrograde operations, and productivity will be low in conditions worse than sea state 1. Sheltered water will be required.

- Planning factors determined for the LACH and elevated causeway based upon SOLID SHIELD 79 exercise activities were found comparable to those of the LOTS test. Those were:
  - Elevated causeway in LOTS, 195; in SOLID SHIELD, 190;
  - LACH in LOTS, 115; in SOLID SHIELD, 100.
- Installation of the elevated causeway required approximately 65 operational hours, accomplished intermittently through the period 19 April to 8 May (about 3 wks). During the LOTS test about 110 hrs were required for installing a causeway that was three sections shorter.
- Management over the shoreside elements of both Marine Corps and Army operations showed considerable improvement from the LOTS test. Control of containers and trucks was better accomplished and documentation procedures were better observed.

- The Marine Corps still requires development of a shoreside container-supported distribution system.
- A revised container loading procedure (positioning further forward on the trailer) used by the Marine Corps for its M127A1 trailer proved a safer and more satisfactory method than the LOTS test procedure (all the way to the rear of the trailer bed).
- Modifications to the LACH's ISO locking pins were recommended, including the substitution of a regular spreader bar for the two-bar system now used.

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