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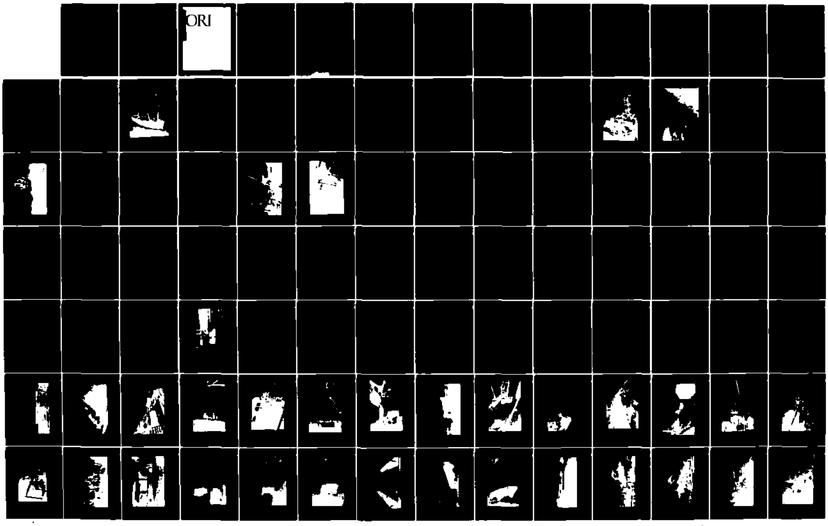

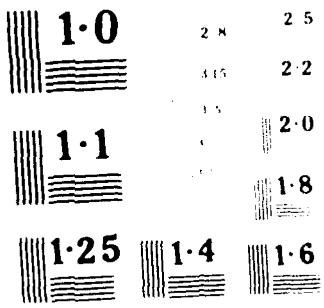

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HEAVY-LIFT BREAKBULK SHIP PRETEST RESULTS OF
THE JOINT LOGISTICS-OVER-THE-SHORE (LOTS)
TEST AND EVALUATION PROGRAM

25 JULY 1977

Prepared Under
Contract Number MDA-903-75-C-0016
For the Office of the Secretary of Defense
Deputy Director (Test and Evaluation)
Office of the Director, Defense Research and Engineering
Washington, D.C. 20310

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The major objective of the Heavy-Lift Breakbulk Ship Pretest was to determine the capabilities of the Services to use such a ship for deploying selected Logistics-Over-The-Shore (LOTS) equipment to a site where fixed port facilities do not exist. This test was the third of five planned preliminary tests of the Joint LOTS Operational Test and Evaluation Program conducted under the sponsorship of the Deputy Director (Test and Evaluation), Office of the Director, Defense Research and Engineering. The pretest was conducted from anchorages off Sewells Point, Norfolk, Virginia, and Ft. Story, Virginia.

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The pretest, conducted 1-9 November, 1976, was part of an evaluation program leading to a major LOTS exercise in August, 1977. The heavy-lift ship was needed in order to verify the capabilities for deploying newly procured LOTS equipment assembled in a near ready-to-use configuration. It was anticipated that a LOTS beach and throughput system could be established more rapidly if equipment assembly requirements were minimized. Operational response time would be significantly improved because the detailed disassembly—required for embarkation aboard conventional breakbulk ships, containerships, and most bargeships—would not be required for the heavy-lift breakbulk ship.

A secondary objective, conducting a container-oriented throughput operation, was added to the pretest by the Services. This objective was included for training purposes and for eliminating potential technical problems during the LOTS main test.

The results of the pretest indicated that equipment could be deployed with minimal disassembly and emphasized the continuing need for the heavy-lift breakbulk ship. Anticipated time savings are on the order of 53 hr in deployment of the 300-ton capacity crane with minimum disassembly. This is compared to the time needed for the more detailed disassembly required when only conventional breakbulk ships are available.

The heaviest item loaded was a 1466-class LCU that weighed 180 long tons. A 1646-class LCU was scheduled for loading but lacked an appropriate sling. A recommendation was made that such a sling be included as part of the ship's equipment. Except for the 300-ton crane, all equipment was loaded/unloaded without difficulty. Handling of the 300-ton crane was complicated by the fact that it was rigged incorrectly. Also it had to be placed in the LCU backwards so that the combined center of gravity of the LCU with the crane was far enough aft to be safe and seaworthy. Consequently, after it was backed out of the LCU, the crane had to be turned around on the beach, a move that delayed the crane's operational readiness for several hours.

During the container throughput phase a temporary containership discharge facility (TCDF), an Army 300-ton lifting capacity crane mounted on a DeLong barge, was used by military personnel to unload containers from a ship [illegible] II, proved the concept feasible [illegible] pretest provided an opportunity [illegible] on the amount of derating to [illegible] when it is operating on an unstable [illegible] are expected in a later report to be published [illegible] be utilized during the LOTS main test.

[illegible] form a pier at the beach. The DeLong, [illegible], was [illegible], jacked-up, ramps lowered, [illegible]. The pier with the 140-ton crane [illegible] containers.

[illegible] was the Army's 300-ton capacity crane [illegible] and used as a crane-on-beach container [illegible] crane-on-beach and the 140-ton crane on [illegible] inability to reach containers in lighters [illegible] —were successfully and con- [illegible] causeway ferry was employed to load con- [illegible] using the TCDF, but wave motion and con- [illegible] with the chassis made this operation too time- [illegible] was successfully used to lighter containers at [illegible] the beach where a frontloader rapidly off-loaded [illegible] chassis.

[illegible] the pretest verified the Services' capabilities for using [illegible] heavy and outsized equipment. [illegible], because of its weight and size, is the [illegible] the first opportunity in over 4 years [illegible]. This opportunity provided the ex- [illegible] which will be amplified during the main [illegible]

ABSTRACT

[illegible] the Heavy-Lift Breakbulk Ship Pretest was to [illegible] Services to use such a ship for deploying [illegible] equipment to a site where fixed port [illegible] was the third of five planned preliminary [illegible] Test and Evaluation Program conducted under [illegible] (Test and Evaluation), Office of the [illegible] Engineering. The pretest was conducted from [illegible], Virginia, and Ft. Story, Virginia.

[illegible] November, 1976, was part of an evaluation [illegible] exercise in August, 1977. The heavy-lift ship [illegible] capabilities for deploying newly procured [illegible] ready-to-use configuration. It was anti- [illegible] throughput system could be established more [illegible] requirements were minimized. Operational re- [illegible] improved because the detailed disassembly- [illegible] conventional breakbulk ships, containerships, [illegible] required for the heavy-lift breakbulk ship.

[illegible] conducting a container-oriented throughput [illegible] the Services. This objective was in- [illegible] eliminating potential technical problems [illegible]

[illegible] pretest indicated that equipment could be deployed with [illegible] and emphasized the continuing need for the heavy-lift breakbulk [illegible] time savings are on the order of 53 hr in deploy- ment [illegible] crane with minimum disassembly. This is compared [illegible] the more detailed disassembly required when only con- ventional breakbulk ships are available.

The heaviest item loaded was a 1466-class LCU that weighed 180 long tons. A 1646-class LCU was scheduled for loading but lacked an appropriate sling. A recommendation was made that such a sling be included as part of the ship's equipment. Except for the 300-ton crane, all equipment was loaded/unloaded without difficulty. Handling of the 300-ton crane was complicated by the fact that it was rigged incorrectly. Also it had to be placed in the LCU backwards so that the combined center of gravity of the LCU with the crane was far enough aft to be safe and seaworthy. Consequently, after it was backed out of the LCU, the crane had to be turned around on the beach, a move that delayed the crane's operational readiness for several hours.

During the container throughput phase a temporary containership discharge facility (TCDF), an Army [illegible]-ton lifting capacity crane mounted on a DeLong barge, was used by military personnel to unload containers from a ship for the first time. A previous exercise, OSDOC II, proved the concept feasible on a larger barge using civilian operators. This pretest provided an opportunity to instrument the crane for an evaluation on the amount of derating to the crane's lifting capacity is necessary when it is operating on an unstable (floating) platform. These findings are expected in a later report to be published by a Naval laboratory and will be utilized during the LOTS main test.

A DeLong barge was also used to form a pier at the beach. The DeLong, with ramps and a 140-ton crane aboard, was beached, jacked-up, ramps lowered, and made operational in approximately 18 hr. The pier with the 140-ton crane was then used as an unloading facility for containers.

Also tested for the first time was the Army's 300-ton capacity crane which was placed at the high water line and used as a crane-on-beach container unloading facility. Both the 300-ton crane-on-beach and the 140-ton crane on the DeLong pier were hampered by an inability to reach containers in lighters at low tide. Amphibians—LARC-LXs and LARC-XVs—were successfully and continuously used during calm seas. A causeway ferry was employed to load containers on milvan chassis at shipside using the TCDF, but wave motion and container alignment difficulties with the chassis made this operation too time-consuming. The causeway ferry was successfully used to lighter containers at low tide and over sandbars to the beach where a frontloader rapidly off-loaded the containers and placed them on milvan chassis.

In summary, the pretest verified the Services' capabilities for using a [illegible] breakbulk ship to deploy certain LOTS heavy and outsized equipment. The only item not considered feasible, because of its weight and size, is the DeLong B barge. The pretest also provided the first opportunity in over 4 years to conduct a container throughput exercise. This opportunity provided the experience required by military personnel which will be amplified during the main test.

TABLE OF CONTENTS

[illegible]

I. INTRODUCTION

BACKGROUND

The principal objective of the heavy-lift Breakbulk Ship Pretest was to determine the capabilities of the Services to use a vessel of this type to:

- Deploy heavy and outsized, mission-essential, Logistics-Over-The-Shore (LOTS) equipment to an off-shore site,
- Off-load and transport the equipment to shore in landing craft deployable aboard the ship, and
- Prepare the equipment on the beach for LOTS throughput operations.

A secondary objective, conducting a container-oriented throughput operation, was added to the pretest by the Services for training purposes and for identifying potential unforeseen technical problems during the LOTS main test. These objectives were accomplished in an exercise conducted November 1-9, 1976. The test began with the ship at anchorage in Hampton Roads, Virginia, where equipment was loaded and continued off Ft. Story, Virginia, where ship discharge and throughput operations took place.

The heavy-lift breakbulk ship pretest also offered a less obvious but important feature besides verifying the deployability of new equipment. There is rarely an opportunity for deployment of very large and heavy equipment, especially if handling by military personnel is required. The paucity of heavy-lift ships and the cost, difficulty, and infrequency of repositioning outsized, heavy equipment have diminished the familiarity and skill of military personnel in dealing with such equipment. Accordingly, it was found that some "rediscovery" of the special equipment and handling considerations was necessary for supporting this type of operation.

The [illegible] was the [illegible] conducted [illegible] [illegible] needed in the [illegible] report [illegible] the [illegible] requirements of the [illegible] tional Breakbulk Ship [illegible] conducted earlier, the heavy-lift breakbulk ship [illegible] examined the capability of the [illegible] [illegible] cranes and [illegible] handling equipment items with [illegible] [illegible] needed [illegible] of the [illegible] the capability [illegible] in a ready-to-use configuration [illegible] [illegible] and equipment reassembly time in the [illegible] tive area. In turn, [illegible] can be established [illegible].

With the [illegible] equipment, planners have [illegible] recognize that these [illegible] the largest and heaviest items in the [illegible]. For example, the [illegible], and container handling equipment [illegible] greatest [illegible] the size and weight of a tank and all have [illegible] containership [illegible]. [illegible] a key role in the [illegible] capability.

[illegible]

The ship used for the [illegible] was the [illegible] MBIA (see Figure 1), a World War II [illegible] that was rebuilt in 196[illegible] with modern, heavy-lift [illegible] and extra large [illegible]. The ship was rebuilt for long term [illegible] Military Sealift Command (MSC) [illegible] one of two (the other is the [illegible]) [illegible] operated in the [illegible] fleet. As part of the MSC charter fleet, the [illegible] MBIA and [illegible] are among the most readily [illegible] sealift assets. Except for the [illegible] barge which weighs [illegible] long tons, the heavy-lift breakbulk ship [illegible] equipment in assembled or ready-to-[illegible] configuration [illegible], the SEABEE, can equal [illegible] capability, but [illegible] limited in number (three), and [illegible] availability [illegible] the event of ship requisitioning [illegible] emergency.

[illegible] heavy-lift breakbulk [illegible] important [illegible] which have extraordinarily [illegible] permit below deck [illegible].

[illegible] Research, Inc., [illegible] Field Tests [illegible] Program, [illegible] Technical Report [illegible]

[illegible] Research, Inc., [illegible] Results of the Conventional Breakbulk [illegible] Test and Evaluation Program, [illegible] Technical Report [illegible] ber 197[illegible].

[illegible] Research, Inc., [illegible] Results of the [illegible] Program, [illegible] Technical Report [illegible]

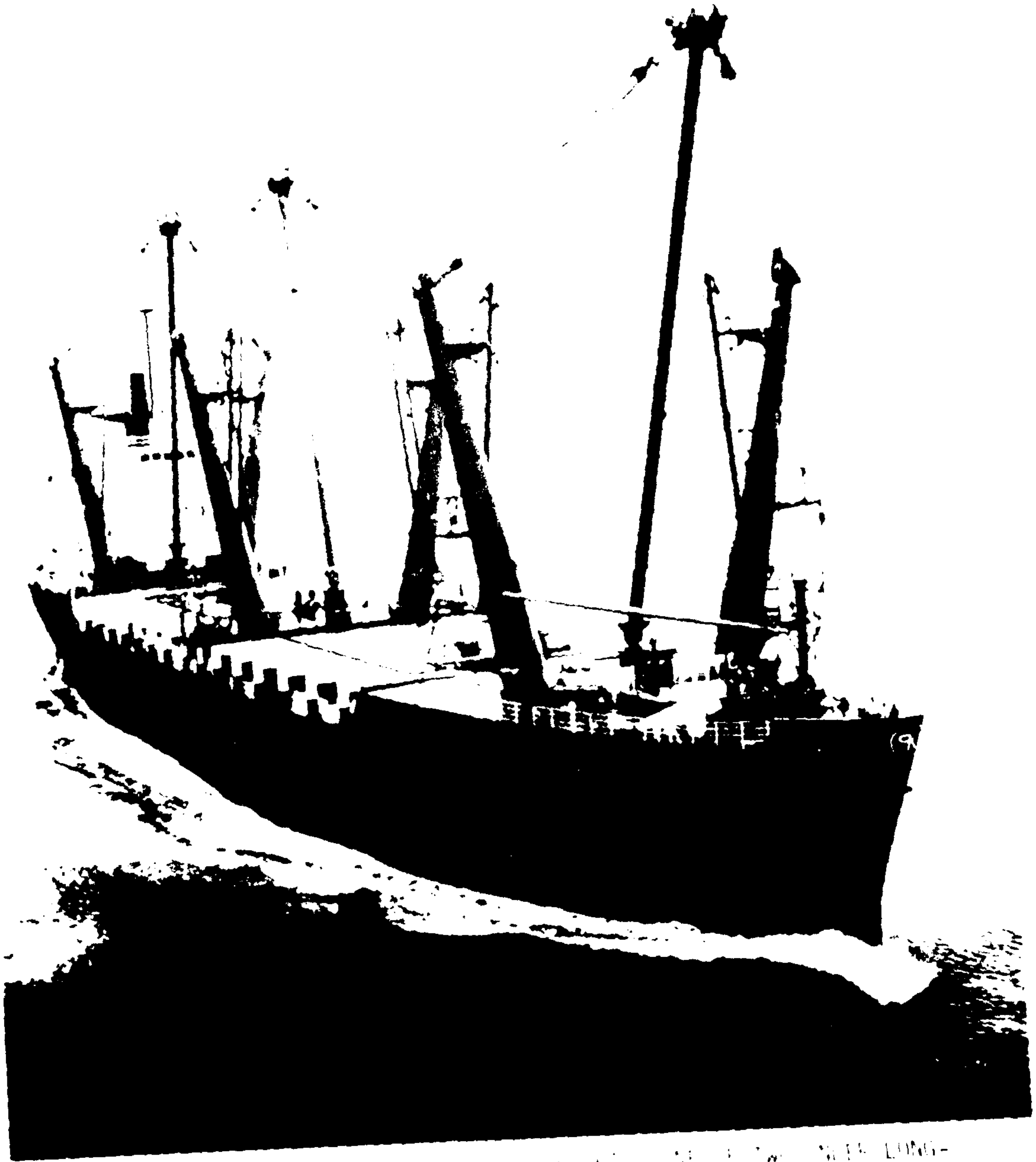


FIGURE 1. A BREA[illegible] LONG-
[illegible] COMMAND

heavy items such as [illegible], LARC-LXs, and locomotives. Second, there are three 1[illegible]-long ton Stuelcken booms, [illegible] ft in length which permit loading large heavy items in holds [illegible], 3, and 4. The 1[illegible]-ton booms can also be paired to work together giving the ship a nominal 240-ton lifting capacity,* permitting the hoisting of an [illegible]. A total of four LCUs can be stowed on the main deck. Figure [illegible] illustrates the capability for use singly or paired. The general characteristics of the two heavy-lift breakbulk ships are contained in Table 1. Appendix A contains more detailed information on ship characteristics.

TABLE 1

GENERAL CHARACTERISTICS
S.S. TRANSCOLORADO AND S.S. TRANSCOLUMBIA

<u>Type of vessel</u>: Single screw C4-[illegible] transport converted to dry cargo ship having a heavy-lift capacity of 240 tons. Vessel was originally built in 1945 and converted by Newport News Shipbuilding and Drydock Co., Newport News, Virginia in [illegible]

Length overall	[illegible] ft [illegible] in
Length between perpendiculars	[illegible] ft [illegible] in
Breadth, molded	[illegible] ft [illegible] in
Depth to main deck at side, molded	[illegible] ft [illegible] in
Draft to assigned waterline, molded	[illegible] ft [illegible] in
Displacement in salt water	[illegible] tons
Deadweight	[illegible],475 tons
Shaft horsepower, normal	9,000
Continuous sea speed	16 knots
Light ship characteristics	
Displacement	[illegible],225 tons
Vertical center of gravity, KG	[illegible] ft above keel
Longitudinal center of gravity, LCG	236.34 ft fwd of A.P.
Officers and crew	38
Number of cargo holds	[illegible]

* The TRANSCOLUMBIA's master and chief mate reported that on one occasion the ship had loaded and discharged a 300-ton tugboat.

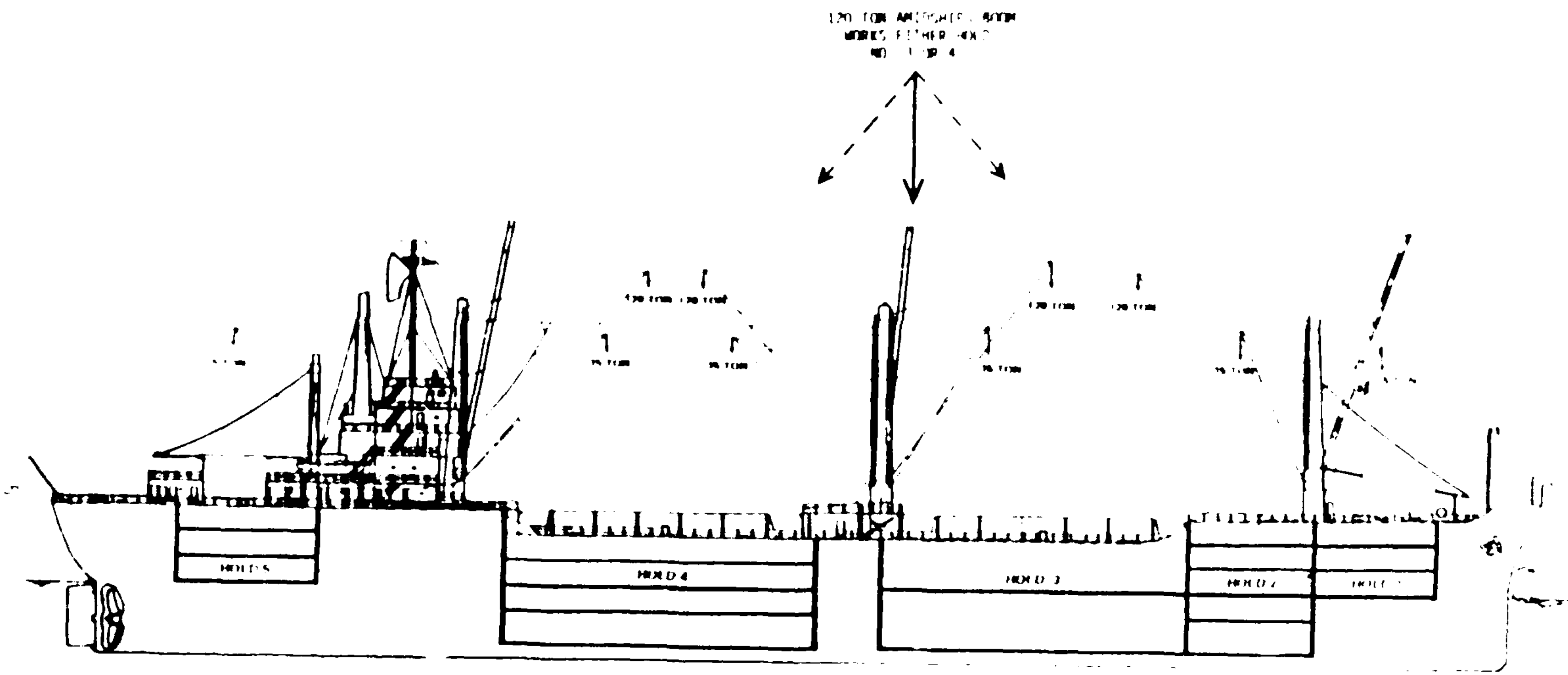


FIGURE 2. HEAVY-LIFT BREAKBULK SHIP PROFILE

[illegible]

[illegible] this pretest were the heaviest [illegible] containerized cargo at a [illegible] criteria eliminated, [illegible] characteristics of the [illegible].

[illegible] pretest design report were not test[illegible]:

- The [illegible] vehicle could not be made [illegible] developmental tests.
- The [illegible] considered a redundant [illegible] was demonstrated [illegible] capabilities.
- [illegible] yet been received [illegible].
- [illegible] which a [illegible] was not [illegible].

[illegible] is needed to transport [illegible] when embarked in a tactically disassembled configuration. [illegible] the crane is defined as the minimum disassembly [illegible]. In a tactical disassembly the crane, [illegible] had all sections of the boom [illegible] with the counterweights and out-rigger floats. [illegible] from approximately 150 long [illegible] time in the test. This is as opposed [illegible] extensive disassembly into components of less than [illegible] and requiring [illegible] days for reassembly.

The [illegible] truck crane [illegible]-ton lifting capacity) is smaller and lighter than the [illegible] crane and is a suitable load for an LCM8, which has a capacity of approximately 62 short tons and can be deployed on most commercial ships. In the [illegible] pretest the [illegible] crane was loaded into an LCM8 but loading from a [illegible] presented different problems discussed in detail later in this report.

[illegible], the [illegible], was embarked for the first time in the [illegible] pretest series. The heavy-lift breakbulk ship was the only ship tested that had the [illegible] capacity (more than [illegible] long tons) and space available to [illegible] the [illegible].

[illegible] in this instance refers to the Army [illegible] pier and [illegible] discharge facility [illegible]. The latter is a [illegible] barge with a large crane mounted on it. The [illegible] is positioned alongside [illegible] for unloading operations.

TABLE 2

HEAVY-LIFT SHIP PRETEST PLANNED LOADS

Lifts Planned	Characteristics					Remarks
	Lift Made	Length (Ft)	Width (Ft)	Height (Ft)	Weight LTons	
[illegible] Model [illegible] ton lifting capacity) crane, tactical disassembly	Yes	57.6	12	13.5	98	
[illegible] Model [illegible] ton lifting capacity) crane, tactical disassembly	Yes	48.5	11.3	9.4	42	
[illegible]	Yes	62.5	26.6	15.3	88	
[illegible]-Class LCU	Yes	119	34	17.8	180	
[illegible]-Class LCU	No	135.3	29	17	151.8	No sling available
[illegible] Model Sideloader	Yes	41	12.5	11.7	64	Top handler removed.
[illegible] Frontloader	No	30.5	13.2	16.5	69.3	Not received in the inventory. Top handler ([illegible] tons) removed.
[illegible]-30	No	76.3	33	21.5	27.7	Not available for loading
3 x 15 Causeway Section	No	90	21.3	5.1	60.3	Lift was redundant*
[illegible]-Ft Milvans	19	20	8	8	–	Weights varied by container
[illegible]-Ft Container	1	40	8	8	30	

* See [illegible] Technical Report No. 1037.

[illegible]

[illegible] the equipment deployment aspects of the test the most [illegible] [illegible] were [illegible] the physical feasibility of moving the LOTS equipment with [illegible] and, once in the objective area, making the equipment [illegible] operations. Thus, observations were concerned with matters [illegible], centers of gravity (did the item hang in an appropriate [illegible] lift slings with lift points, any pendulation problems [illegible], and the like. Times required for deployment of [illegible] items were measured to support main test planning. Crane cycles [illegible] data samples were also obtained. The throughput rates [illegible] and the factors that influence them were additional inputs to main test [illegible].

[illegible] off-loading measurements were made of the sea state and [illegible] platform. An ancillary test to measure the stresses [illegible] of the [illegible] was also conducted. These measurements, made by [illegible] the Naval Civil Engineering Laboratory at Port Hueneme, California, will be the subject of a separate Navy report. The results may assist the Joint [illegible] Test and Evaluation Program by establishing better safe working limit [illegible] the [illegible] crane working in this environment.

Finally, observations were made of the way various equipment functioned in the environment and of cargo documentation and control procedures.

II. OPERATIONS

OPERATIONAL SUMMARY

The operations began about 0700 hr November 2, 1976, with the [illegible] MEIA at anchor off Sewells Point in Hampton Roads. Weather conditions throughout the loading and discharge phases of the pretest were clear with a light-to-calm wind and calm seas at both the Sewells Point anchorage and off Blue Beach, Ft. Story.

Preparations for loading required approximately 3 hr and included the opening of hatches and the loading of dunnage, cargo rigging sets, and tools. Loading of test cargo was accomplished using the ship's 120-ton booms which are designed to move very large objects and, hence, move rather slowly. Consequently, the first day only containers and the LARC-LX were loaded before darkness halted operations. On most ships round-the-clock operations are possible but with the heavy-lift ship this is not advisable because of the extremely long booms (100 ft) and the need for the boom operator to constantly watch the line passing through the sheaves at the boom tip. This is difficult to observe at night since artificial light at the 100-ft distance is inadequate.

The first lift on the second day was the 1466-class LCU, which was lowered in the starboard side of Hold No. 4 without difficulty. The 9125 crane subsequently was loaded and stowed in the well deck of the LCU. At hold No. 3 the 6250 crane was loaded on the port side and the sideloader on the starboard side. All lifts were made in a fairly routine fashion except for the 6250 crane which was lifted with a pronounced fore and aft tilt.

Off-loading began about 0730 on 4 November after the ship had moved to an anchorage off Blue Beach, Ft. Story. The order for off-loading was the 6250 crane, sideloader, the 40-ft container, the 9125 crane, the 1466-class LCU, and the LARC-LX. Only the 6250 crane posed any difficulties and this was [illegible] the [illegible] the beam the [illegible] crane [illegible] working hours, [illegible]

[illegible] A [illegible] was used [illegible] initiate [illegible] was [illegible] at [illegible] the [illegible] exercise the [illegible] containers from the holds of the [illegible] was completed. A [illegible] the exercise as a substitute for the ship [illegible] weather conditions were experienced. November, [illegible] activity was possible [illegible] was towed [illegible]

[illegible] area inland from [illegible] were used to [illegible] containers were [illegible] the containers [illegible] were accomplished. [illegible] processing of standard [illegible] movements management.

[illegible]

[illegible] with the [illegible]-ton heavy-lift [illegible] booms were used [illegible] deck operations, such as [illegible] operation of the heavy-lift booms is normally [illegible] the heavy-lift [illegible] of special [illegible] the large hatch covers, [illegible] sections each weighing 16,560 lb [illegible] As much as an hour may be [illegible] the weather deck hatches, although hatches [illegible] loading or off-loading [illegible] time.

[illegible] the [illegible] and the [illegible] containers were [illegible] to become the through- [illegible] the operation. The [illegible]-ton booms, which are [illegible] were [illegible] for these [illegible] required an average of [illegible] minutes each. [illegible] (see Figure [illegible], page [illegible]) but, because some of the [illegible] weight and a lengthy change of booms and rigging would have been [illegible], the 120-ton booms were used.

[illegible] into hold No. [illegible], the 120-ton boom between [illegible] had the most capability to maneuver the load. [illegible] hold No. 4, it was necessary to swing it over. [illegible] over No. 4 hold and passed through a [illegible] over the other side to No. 3 hold. This

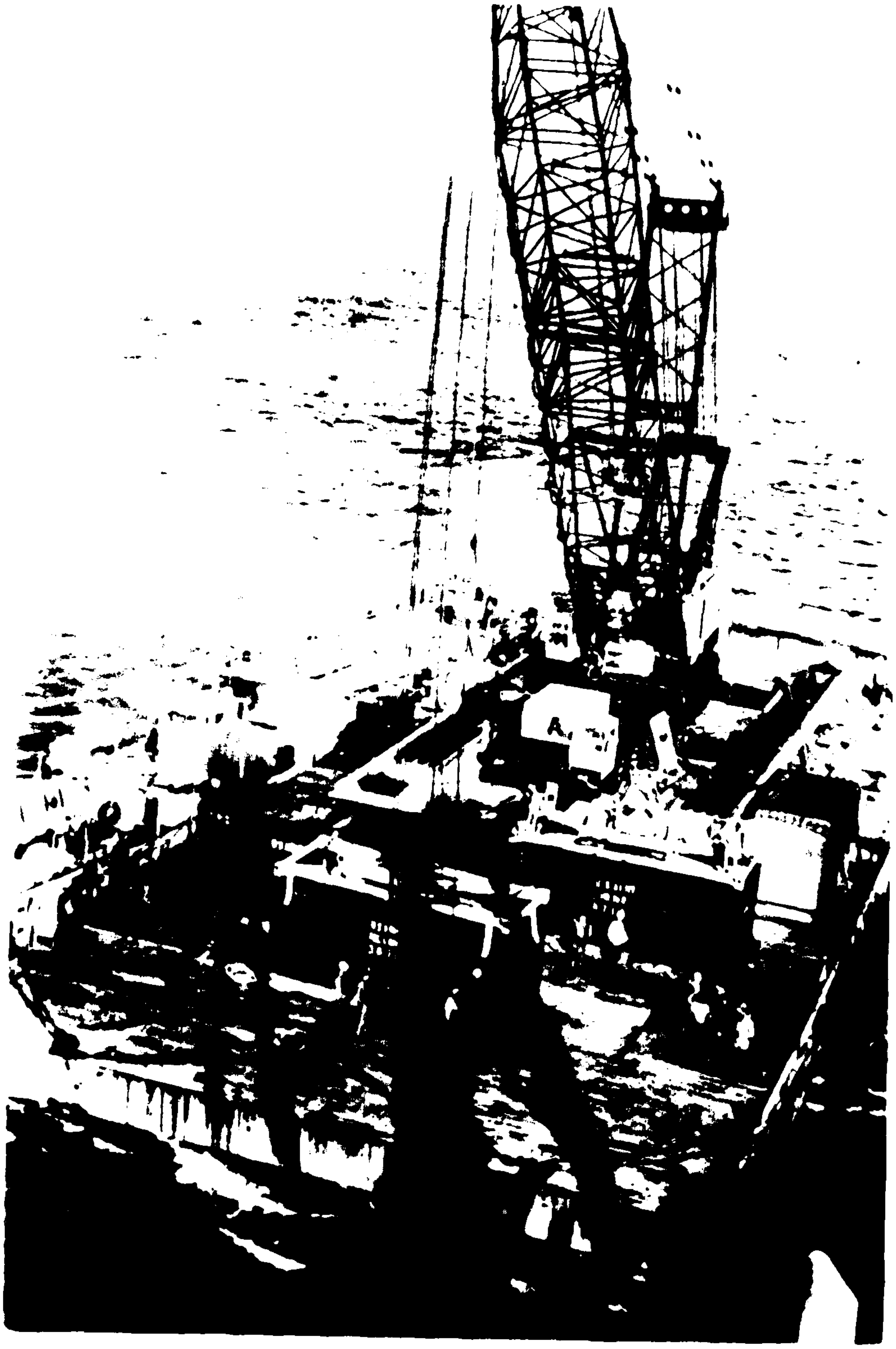


FIGURE 3. TEMPORARY CONTAINERSHIP DISCHARGE FACILITY

[illegible] required approximately [illegible] of the project.

[illegible] general summation of the [illegible]. In the table, the elapsed time [illegible] the time required to bring landing craft alongside and [illegible] the [illegible] of the next lift or until operations are secured. Because [illegible] preparation, cycle times are considerably [illegible] hoist the lift and deposit [illegible] the approximate lift-to-lower time segment [illegible] in the remarks column to illustrate the [illegible] noted. Generally, this portion of [illegible] speed is largely determined [illegible] operator; therefore, the [illegible] with other segments of the [illegible] lashing, and [illegible] times, since lashing can generally [illegible] operations.

[illegible] was [illegible] using a special [illegible] lifting point and all gathered at the [illegible] was able to shift its loading from the start [illegible] possible damage to the [illegible] deckhouse [illegible] clearance all around and was lowered [illegible].

[illegible] delays were experienced in the loading of the [illegible] wait for stevedores to debark the [illegible] and correcting a malfunction [illegible] the lift. During the lift the ship listed at [illegible] its counterballasting system [illegible] the lift. Nevertheless, no major problems [illegible].

[illegible], which at approximately [illegible] tons was the [illegible] than the containers, was also the fastest. It required [illegible] deck, including preparation time to attach the [illegible].

[illegible] two heavy lifts were the Army truck cranes. Both were [illegible] configuration. Each crane had been [illegible] it would be more nearly ready for use after [illegible] remained attached on each crane and allowance [illegible] needed additional clearances. A previously used [illegible] the [illegible] crane or the [illegible] which is larger, was used. [illegible] accommodating various center-of-gravity [illegible] a series of holes in a spreader bar at the [illegible]. Between the spreader bar and the heavy-lift [illegible] different from that previously used was tried. [illegible] was used instead of steel cable loops. This [illegible]

TABLE [illegible]

HEAVY-LIFT BREAKBULK SHIP LOADING SUMMARY

[illegible]	Stowage Location	[illegible]	[illegible]	[illegible]
[illegible]	Main Deck #[illegible]	[illegible]	[illegible]	
[illegible] and [illegible]	Between Hatches #4	[illegible]		
	Main Deck #4			
[illegible]	Between Hatches # [illegible]	[illegible]	[illegible]	[illegible] tower [illegible]
		[illegible]		
		[illegible]		
	Main deck [illegible] #[illegible]	[illegible]	[illegible] min	[illegible] tower [illegible]
		[illegible]		
[illegible]	Main deck [illegible] #	[illegible]	[illegible]	[illegible] tower [illegible]
		[illegible]		
[illegible]	Main deck [illegible] (fiesta [illegible])	[illegible]	[illegible] min	Lift [illegible] rigging time [illegible]
[illegible]	Main deck [illegible]	[illegible]	[illegible] min	Lift tool [illegible]
		[illegible]		
		[illegible]		
		[illegible]		

FIGURE 5. ATTACHMENT POINTS TO ADJUST SPREADER BAR FOR CENTERS-OF-GRAVITY ON 6250 AND 9120 TANKS

was successful, although there were minor delays in inserting the strap under the [illegible] of the lifting frame and also in manhandling the loops of the strap over the [illegible] of the ship's heavy-lift boom.

The smaller crane, the 9125, was lifted first. There was a delay while the crane upper was rotated 180 degrees. The boom base was over the crane truck cab in the final configuration. After a test lift the crane was set down again in the [illegible] and the nylon loop inspected. The lift was then made without any further delays.

The lift of the 6250 crane was the final heavy lift and was the only one that required an on-the-spot decision. The same lifting frame that was used for the smaller crane was used for the 110-ton 6250 crane lift. As the lifted started, the load nosed up. The front wheels were about 3 ft off the deck before the rear wheels began to lift clear. The crane boom, facing the rear, slanted downward toward the ramp of the LCU it was being lifted from. If the lift had continued, the boom presumably would have come in contact with the top edge of the ramp. Experience in the breakbulk ship pretest[1] had shown that even seemingly minor bumps impacting on the tubular frame of the crane boom can cause dents that seriously affect the maximum lift capability of the crane. Thus the possibility of contact had to be minimized.

One way to avoid the problem would have been to re-rig the lift so that it remained level. This would have involved shifting the lift point at the apex of the lift frame from one point to another in the series of holes available. However, such re-rigging would have been time-consuming. A decision was made to continue the lift, but to first lower the LCU ramp so as to provide increased clearance. This was done and the lift proceeded with the crane at a pronounced slant. As the crane started downward toward the deck of the ship the tilt would have caused the boom base to make contact with timbers on the hatch top before the crane wheels made contact. To avoid this possibility caused a delay of about 15 minutes. The crane was repositioned in such a way that the boom base was located over a gap between the [illegible] of hatch number 3 and the deck house. This allowed the crane wheels to touch before the tip of the boom base. With that problem solved, the lift was completed.

The total time required for [illegible], including delays, was 2 hr and 12 minutes. There were three delays: [illegible] waiting for the [illegible] to tie-up in the proper [illegible] [illegible] malfunction, and 15 minutes for the [illegible] [illegible] completion of lashing of this lift the ship [illegible]

[illegible]

General

[illegible] began at [illegible], November 4. The weather was [illegible] were [illegible] the most part the order

[1] Operations Research, Inc., [illegible] Results of the Conventional Breakbulk Ship Pretest of the [illegible] Over-the-Shore (LOTS) Test and Evaluation Program, [illegible] Technical Report [illegible], [illegible] October 1976.

the equipment. Off-loading was the reverse of that for loading. In general, off-loading proceeded at a good rate and, with the exception of the 6250 [illegible] crane, equipment preparation ashore was completed in a timely fashion so that throughput activity could begin. Table 4 provides a summary of equipment off-loading times and time required to make the equipment ready for operations.

[illegible] Crane

The first [illegible] to be unloaded was the [illegible] crane. The rigging used for loading was again used. However, a modification was made to the [illegible] the [illegible] coupler. This meant that the crane was off-[illegible] that the lowest [illegible] the crane when [illegible] the wheels but the boom [illegible], a damage-sensitive com-ponent [illegible] the [illegible] where the ramp hinges, the [illegible] the boom [illegible]. Once the [illegible] the deck, the boom [illegible] clearance [illegible]. Figure [illegible] shows [illegible] crane was lowered with [illegible] the bar for [illegible] compensate for [illegible] center of gravity. Figure [illegible] been landed [illegible].

[illegible] been adjusted [illegible], the crane [illegible] have been [illegible], but it still would have been necessary to load the [illegible] with the [illegible] frame interferes with [illegible] with the crane [illegible] forward, the center of gravity [illegible] operation [illegible]. Therefore, at the beach the [illegible] landing craft [illegible]. Before it would [illegible] assembled. The process [illegible] the crane, [illegible].

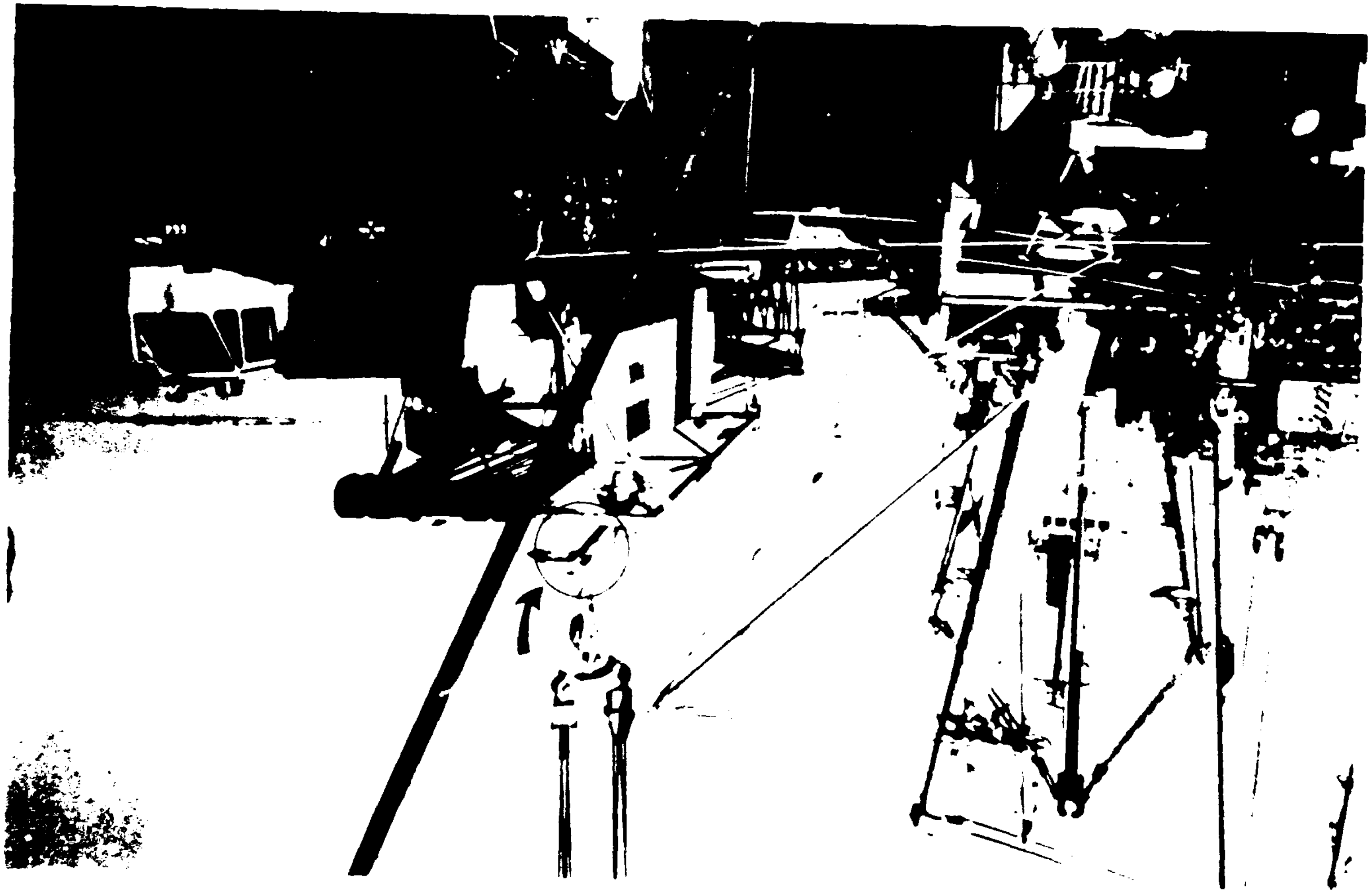
[illegible] with the crane [illegible] water [illegible] after high tide. It was [illegible] two bulldozers on the beach [illegible] with sandbags. [illegible] the [illegible] wave [illegible] with [illegible] made [illegible] the crane tires from [illegible] the sand. These [illegible], [illegible] the crane was [illegible].

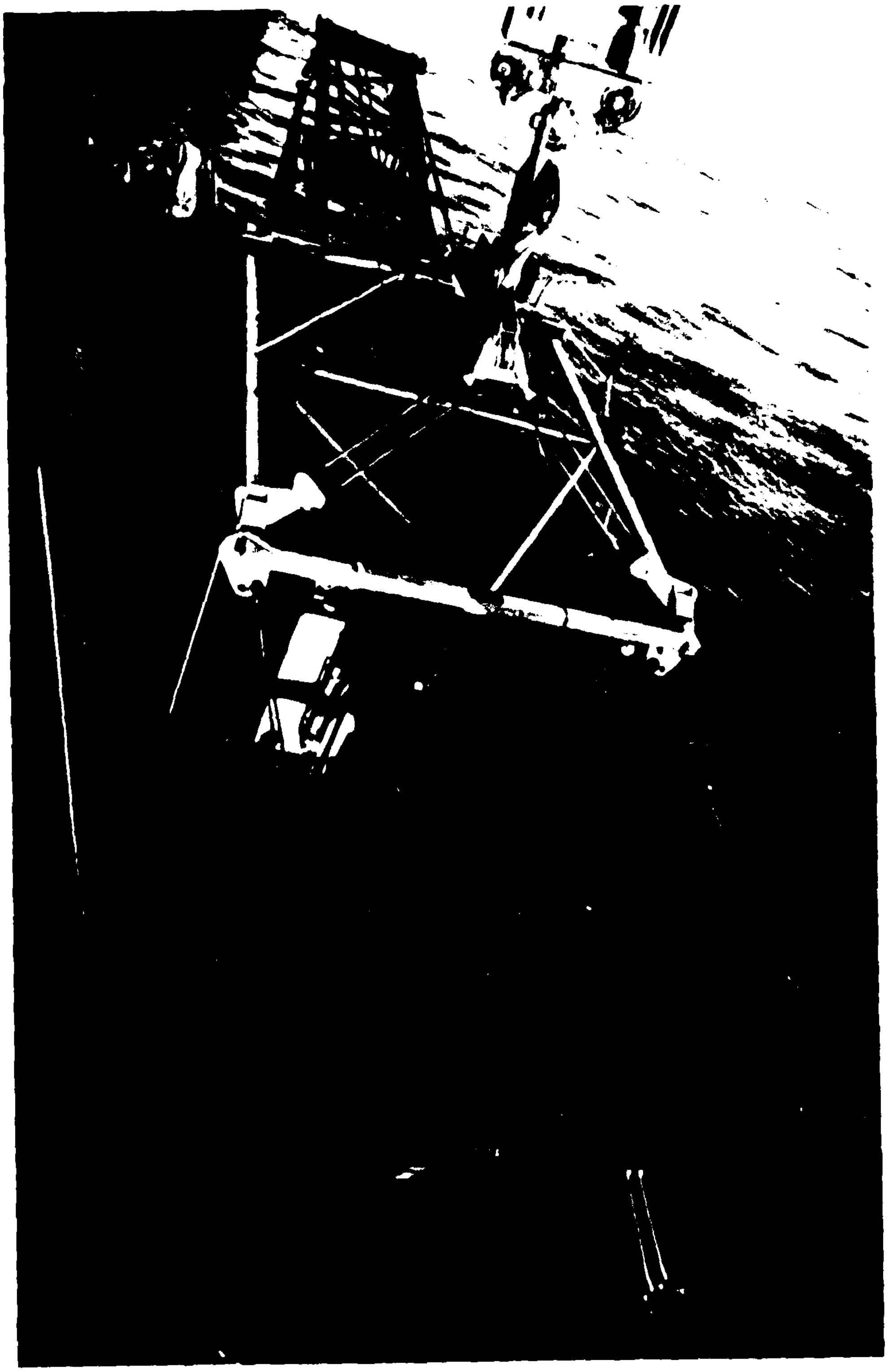
The majority of the time spent on the beach [illegible] the crane [illegible] involved reassembly of the boom, counterweights, [illegible], and out-rigger [illegible] reeving the wire, components that are normally [illegible] commercial and military [illegible]. It [illegible] the crane [illegible] that the crane [illegible] over the rear of the crane carrier where its lift capability would be greater than over the [illegible]. [illegible] breakdown of the time required to make the crane ready is contained in Table [illegible].

TABLE 4

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible] [illegible] min Total	[illegible] Tidal delay	[illegible]
[illegible]	[illegible] [illegible] [illegible] min Total	[illegible] Tidal delay	[illegible]
[illegible]	[illegible] min - offload	N/A	N/A
[illegible]	[illegible] min - rig [illegible] min - offload [illegible] min Total	N/A	N/A





[illegible] RANE BEING LANDED IN [illegible] WITH RAMP DOWN

[illegible]

[illegible] the beach is based on [illegible] with [illegible]

- [illegible]
- [illegible] stability [illegible]
- [illegible] wheels of the carrier [illegible]
- [illegible] when the carrier [illegible] while they were [illegible]

[illegible] the crane was slow work on the sand. [illegible] the 140-ton [illegible] the 140-ton crane [illegible] configuration. In this case the 140-ton crane was [illegible] operation which had been previously delayed [illegible] the vehicle aboard.

9125 Crane

The LCM8 carrying the Army 9125 crane to shore had no difficulty underway despite a pronounced list. The LCM8 grounded on an off-shore sandbar an hour before low tide. A LARC-V from the Naval Beach Group detachment assisted it in backing off. The LCM8 then waited for the tide to come in, and some 6 hr later made a second attempt. Again the LCM8 was stuck on a sandbar. This time cables were passed from bulldozers to the landing craft. With a hard strain on the lines the LCM8 was pulled over the bar and into the deeper water nearer the shore. From there it was successfully beached.

Bulldozers then graded a ramp for the crane to use in coming ashore. Momat was unrolled onto the graded ramp and, some 30 minutes after the LCM8 had been pulled across the sandbar, the crane was ready for moving ashore. In moving out of the LCM8 onto the mat, the crane got hung up on the after end of its carrier. By using an outrigger to jack itself up, the crane freed itself and moved onto the beach with no further difficulty. No difficulty was recorded in assembling the crane's counterweights, attaching the boom sections, and reeving the cables. These operations were accomplished during the night so that the crane was ready for operations before the first landing craft arrived the next day.

Sideloader

The LCU carrying the sideloader also had to be assisted by bulldozers in landing. It came ashore on the same tide as the LCM8 carrying the 9125 crane. After moving ashore out of the LCU, the sideloader overran the Momat matting and got stuck in the sand. Bulldozers assisted and got it back on the Momat. On another occation it got stuck crossing a narrow gap between Momat strips. This time it used its outriggers to elevate its tires so that beach matting could be placed under them and then it was freed.

CONTAINER THROUGHPUT OPERATIONS

General

In the second phase of the pretest, which involved container throughput operations, the TCDF was used exclusively to discharge containers from hold and deck stowage locations aboard the TRANSCOLUMBIA to various types of lighters, including LCU, LCM8, LARC-XV, LARC-LX, BC barge, and causeway ferry.

Four methods were used to unload containers from lighters:

- 140-ton crane on jacked-up B DeLong to off-load all lighters and load containers on milvan chassis.
- 300-ton crane at the high waterline primarily to off-load LCU and LCM8 craft. It was used to also off-load amphibians and to transfer loaded containers onto milvan chassis.
- 140-ton crane in the marshalling area to unload amphibians.

- Frontloader to off-load containers from a causeway ferry onto milvan chassis.

These subsystem elements were not used concurrently due to the small quantity of test cargo available (20 milvans and 1 40-ft van). Nevertheless, the pretest was the first opportunity in 4 years that a container throughput exercise had been attempted. Data and training on the new Army equipment were needed. It was also the first time in 4 years that a container marshalling area operation was conducted and, although the activities there were relatively slow and simple, the same data and training opportunities existed. Documentation and movements management also played a part in this phase with some limited use of the mobile SPS van.

To be representative of military cargo shipped in containers, the containers were weighted with dummy cargo. Figure 8 shows the weight distribution of the containers used.

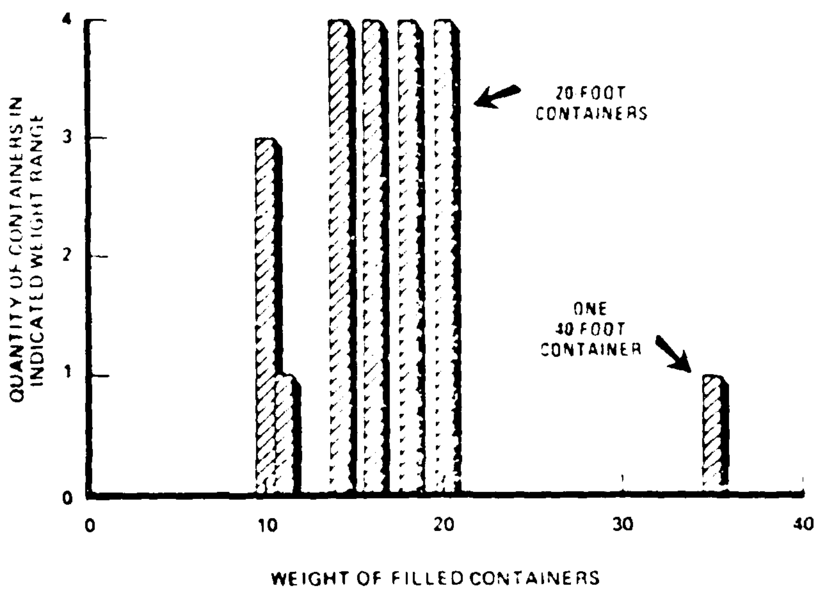


FIGURE 8. DISTRIBUTION OF CONTAINER WEIGHTS (20 and 40-FT)

Temporary Container Discharge Facility

Use of the heavy-lift breakbulk ship as a containership had two recognized drawbacks. First, there were no cell guides to assist in attachment of the container spreader bar to containers in the hold. As a result, stevedores had to wrestle the spreader bar around over the tops of containers until it could be engaged with the corner fittings. Second, the TCDF had to make allowance to clear the ship's booms and kingposts. Both of these obstacles tended to slow cycle times. However, the time data gathered provides order of magnitude information useful for main test planning.

During the pretest the containers were first completely off-loaded from the ship and retrograded. In some cases a container was backloaded and then without detaching the containers from the spreader bar the container was reloaded in the lighter. These latter iterations were disregarded since they had more training value than data validity. The TCDF working the TRANSCOLUMBIA off-loaded [illegible] and backloaded 16 containers. When the ship charter period was completed, a LASH barge was used briefly instead. No timings were made of these loading and unloading events. There were considerable periods while working the ship in which the crane was inactive or delayed. When the TCDF had cargo and was operating, a cycle required approximately 10 minutes. Similarly, backloading containers to the ship required approximately 7 minutes each. Further discussion on these times is contained in Section III. Table 6 summarizes characteristics of the TCDF.

TABLE 6

SUMMARY OF TCDF CHARACTERISTICS

TCDF length (boom assembled)	130 ft
TCDF width	60 ft
TCDF weight*	656.[illegible] LTons
Boom length	100 ft
Boom tip used	Heavy duty
Weight of hook blocks ([illegible])	1,450 lb each
Hook operation	Double drum
Wire	1 inch
[illegible]-part purchase	[illegible] parts per hook
Hr of actual operation during test	1[illegible]

* Includes barge, crane, and crane foundations.

Crane on Beach

Operations with the 6250 crane at the water's edge commenced the afternoon of [illegible] November. The first day's activities consisted of discharging only five LARCs during a period of approximately 1½ hr. Operations had commenced just 45 minutes after low tide, so it was not possible to land LCUs, LCMs, or barges close enough for the crane to reach them. Therefore, to obtain some crane use, amphibians were employed instead.

The next day, there was a morning high tide (0854) so retrograde operations were possible. One LCU was beached, backloaded with four containers, and retracted in 44 minutes. The average cycle time per container was 10 minutes 4[illegible] seconds. [illegible] weather was being experienced at the beach so the next LCU was loaded with only two containers before it was retracted after 22 minutes. After that the [illegible] crane practiced loading and unloading LARC-LXs and trucks. Gusts up to [illegible] knots were experienced which caused difficulties for tagline handlers.

On the last day of beach operations for the [illegible]-ton crane, approximately [illegible] hr after high tide, a LASH barge was grounded within the crane's reach and four containers were unloaded at an average rate of [illegible] 3/4 minutes each. [illegible] barge was subsequently brought in at low tide and one container was off-loaded.

[illegible]

The second [illegible] beach unloading system to be exercised was the [illegible]-ton crane on the DeLong pier. The DeLong with the crane aboard was [illegible] the [illegible] by tugs and positioned at the beach using [illegible]. Installation began [illegible] working schedules normally followed a [illegible] routine since the [illegible].

The DeLong was brought in approximately 1 hr before high tide and approximately 4[illegible] minutes later all its caissons (piling) had been lowered. There was no activity the next day and the third day, [illegible] November, after some [illegible] cutting, the ramps to the DeLong were lowered from the DeLong to the beach. However, by the end of that day some additional alignment was required and the fourth day was spent aligning the ramps. Then, because a [illegible] was needed shoreside of the 4-ft high DeLong ramps, an assault vehicle [illegible] bridge (AVLB) ramp was installed. By the end of the day, after approximately [illegible] of activity, spread over 4 days, the DeLong pier was ready for operations. Appendix [illegible] provides a detailed description of the installation [illegible] and subsequent crane operations.

Operationally the DeLong handled approximately [illegible] containers during the [illegible] phase. The first day of operations was mostly one of practice [illegible] onto and off landing craft and once onto a truck. The morning of the next day, [illegible] November, the hydraulic spreader was found damaged and a manual spreader had to be obtained. Consequently, the opportunity for operations during the high tide period was lost. During the low tide period initially some practice was accomplished by loading and off-loading trucks. Then two LARC-LXs were sent with containers to the DeLong and these were unloaded onto the pier. One container was later retrograded via a LARC-LX.

The next day, [illegible] November, was more active. In the morning during high tide two LCUs were loaded with three retrograde containers. Then three LCUs and a [illegible] barge were moored for off-loading a total of 1[illegible] containers. In the afternoon amphibians replaced landing craft in order that operations could continue during low tide. Two LARC-LXs were off-loaded and two others were backloaded.

[illegible] the [illegible] were [illegible] windS gusting [illegible] They were the lightest amphibians used [illegible] have been [illegible] containers. [illegible] was [illegible] with two containers and that was the extent of container activity for that day.

The last day, [illegible] November, a LASH barge was moored at high tide to the [illegible] with four containers. At some point the LASH barge was [illegible] welding a plate over the hole. The welding was done at low tide with the barge grounded and the hole exposed.

[illegible]

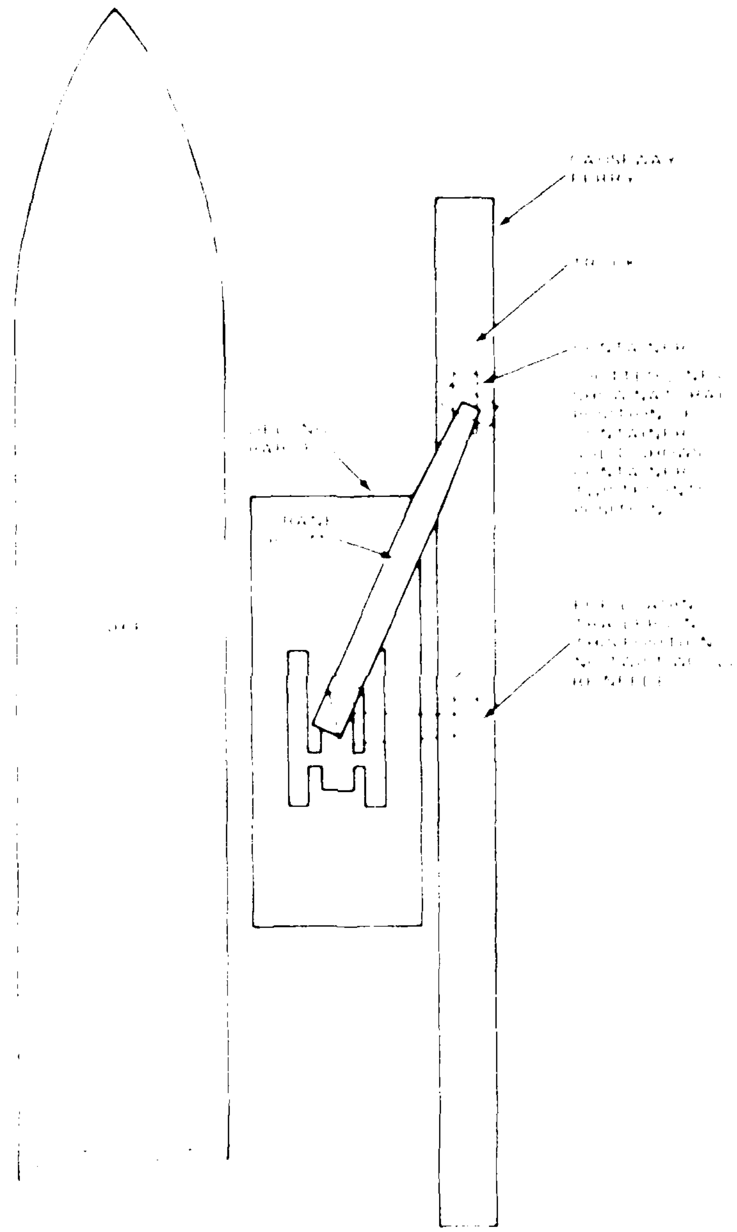
The causeway ferry was used twice during the operation. The first [illegible] loading in which containers were placed on milvan chassis [illegible] The second employment a day later called for placing [illegible] on the causeway. The four-section causeway used in both [illegible] two LCM8 causeway tender boats.

[illegible] November the first operation was begun by loading three milvan trailers at the beach east of the Delong pier. Bulldozers constructed a sand ramp to the causeway. As soon as the ramp was prepared, three M-54 trucks with the trailers individually proceeded onto the causeway. Each truck-trailer unit was positioned on a separate causeway section. The most seaward section, the one between the two tender boats, was left vacant. None of the vehicles were tied down. The causeway retracted from the beach without difficulty at 1 hr past high tide and proceeded towards the ship.

At 14[illegible] the first milvan was lifted from the deck of the [illegible]. After [illegible] minutes of trying to position the container on the platform trailer, the attempt was aborted. The problems were:

- The relative motions of the [illegible] and the causeway.
- The twist angle (approximately 45 degrees) needed to properly align the container with the trailer (see Figure 9).
- The limited deck area for line holders.
- The target is small — even when there is no relative motion, as on dry land; it is not easy to position a container directly onto the container fittings of this type of trailer without repeated tries.

The second attempt on a different trailer was successful, requiring about [illegible] minutes. The first lift attempted had been to a trailer spotted on the causeway well forward of the [illegible] crane. The second lift loaded a trailer which offered a better angle to the axis of the boom. (Dotted lines, Figure 9.) The


CAUSEWAY
FERRY

[illegible] was [illegible] minutes. Although there were [illegible] about [illegible] minutes. But loading the two containers required [illegible] attempt to load the third container was [illegible] minutes.

The causeway ferry then [illegible]. Its approach [illegible] after low tide required about [illegible] minutes. [illegible] the vehicles onto the beach required approximately [illegible] minutes.

In the [illegible] mode of causeway [illegible], five milvans were loaded from the ship directly [illegible] the causeway. All had their long axes across the causeway. The causeway [illegible] ft wide and the container [illegible] ft long. There was some [illegible] the container [illegible] degrees to position them. The first section of [illegible] causeway (the one that would beach first) was left vacant [illegible] a shallow draft appropriate for beaching. The milvan was positioned [illegible] the third section. The fourth section was [illegible]. The causeway [illegible], was loaded with five con-[illegible].

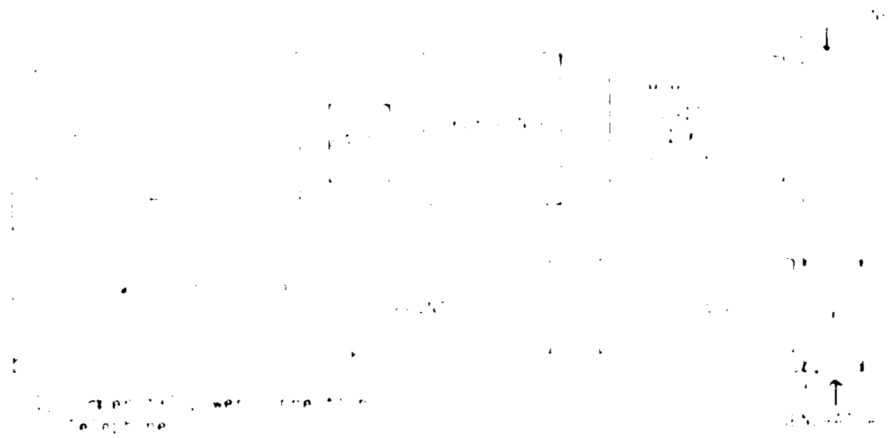
[illegible] the beach, the causeway had difficulty [illegible] a perpendicular [illegible] bulldozers went out as far as [illegible] to assist, but were initially [illegible] the tide was receding. After [illegible] the causeway [illegible] stranded at a [illegible]-degree angle to the beach, but the bulldozers were able to push the causeway clear after about [illegible] minutes. It remained clear [illegible] until within an hour of low tide [illegible], at 14[illegible] when it was [illegible] beached with the assistance of two bulldozers.

Once the causeway was secured by a bulldozer winching cable, the five milvans were rapidly off-loaded by a frontloader directly to waiting trucks. [illegible] required approximately [illegible] minutes.

[illegible]

[illegible] data processing van for interfacing with [illegible] was employed for the second time in [illegible] the [illegible] ship pretest. The mobile van inter-[illegible] timely documentation essential to the move-[illegible] transiting the beach complex but it was not [illegible] the supporting computer was still needed [illegible] manifests, its [illegible] files, and [illegible] Movement Documents [illegible] to the mobile unit. Also, [illegible] terminal equipment [illegible] was not directly tied [illegible] the van [illegible] link with the supporting computer. Nonethe-less, the pretest provided a practical try-out [illegible] the available components and helped [illegible] problems before the main test.

Mobile van equipment which had been available on the [illegible] ship pretest [illegible] memory unit [illegible], a card reader, printer, a filing cabinet, [illegible] two desks. For this pretest one desk was taken out and a keypunch, a [illegible], and another filing cabinet were added. Figure [illegible] shows the van's current [illegible] layout.



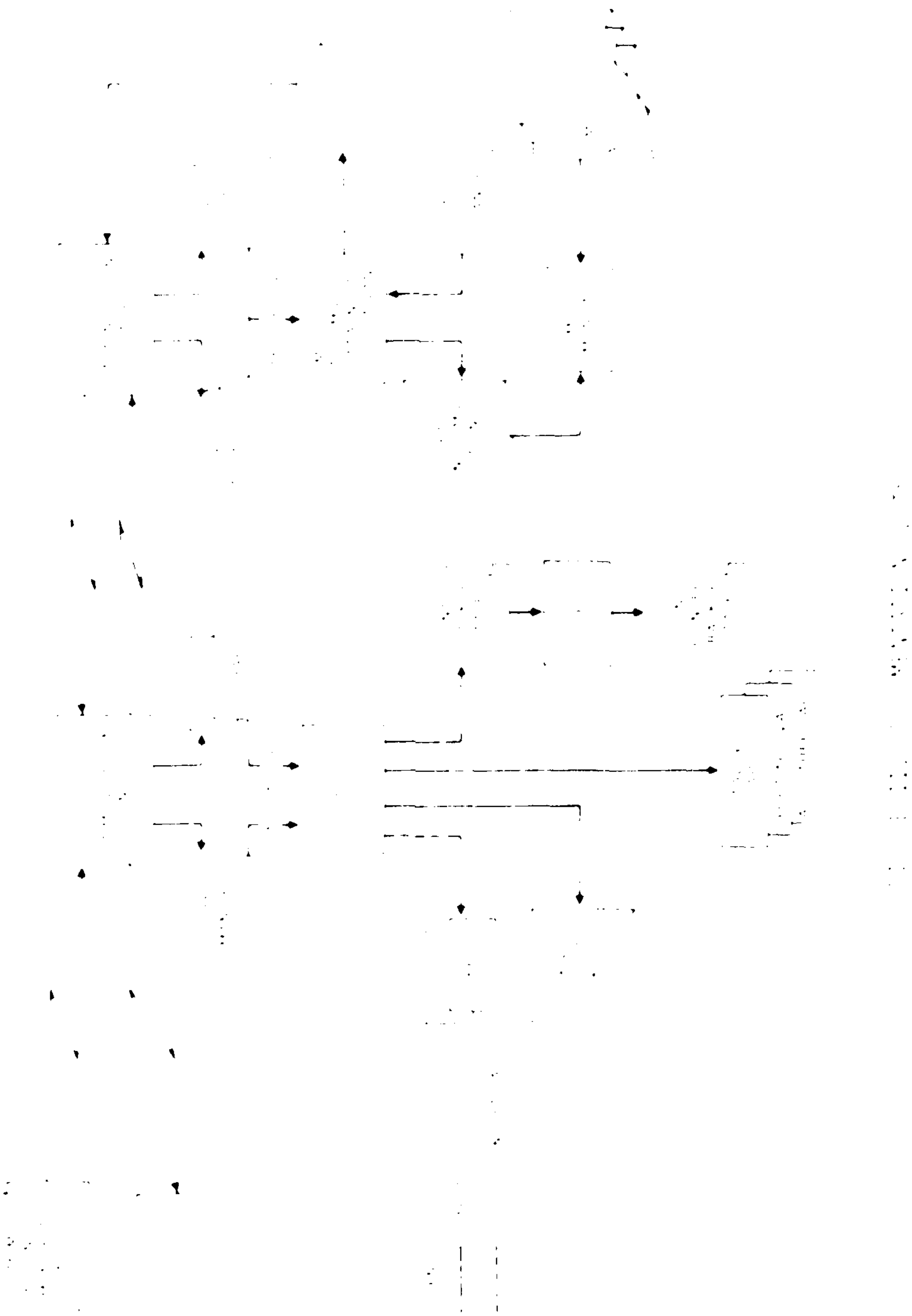
[illegible]

[illegible] and receipt [illegible] was not placed [illegible] punched cards were used to [illegible] completed the discharge tallies [illegible] for processing. With the installation [illegible] possible to prepare cards that were [illegible] provide reports on [illegible]

[illegible] implementation personnel [illegible] which included tallies from several [illegible]

[illegible]

- [illegible]
- [illegible]
- [illegible] as required.



[illegible]

[illegible] light-lift [illegible] capability, [illegible] sea [illegible] types. [illegible] suitable for lightering the heavy, [illegible] equipment [illegible] include [illegible] barges [illegible] the pretest [illegible] (Figure [illegible]). This capability [illegible] exceeded only by [illegible] and three (ABLE [illegible]) [illegible]. The pretest also verified that, [illegible] have the necessary [illegible] the equipment [illegible] be lightered.

[illegible] was accomplished [illegible] the equipment [illegible] the beach and taking it ready [illegible] because of the small beach gradient and [illegible]. Nevertheless, the pretest [illegible] necessary to establish a bare beach capability, [illegible]

[illegible] it should be noted that this type of exercise was badly [illegible]. In general, these were areas which [illegible] experience [illegible]. For example, difficulties were experienced [illegible] over the beach and [illegible], [illegible] delays [illegible] queued at the ship [illegible] without activities [illegible] and [illegible].

[illegible]

[illegible]

[illegible] will be necessary [illegible]

[illegible]

[illegible] when [illegible]

This position proved to be in error— the pins should have been at the other end. As the lift began the error became all too evident. The center of gravity of the crane assembly began to swing to a position under the suspension point, with the crane at a strong tilt. (See sketch, Figure 12.)

The tilt, however, was accommodated in the loading phase, although it did create some delay. While the ship was underway or prior to the initiation of ship unloading, the lifting frame should have been modified. The decision not to correct the location of the pins resulted in additional delays during off-loading operations.

Comparison of Crane Readiness Times for Different Assembly Configurations

The disassembly of the 300-ton capacity crane to a tactical configuration for deployment takes less time than an administrative (detailed) disassembly would for deployment on a ship with a less capable boom. This, of course, is also true for crane reassembly once the crane has been shipped to the objective area. Table 7 illustrates the differences in deployment times for the two disassembly operations. The table is based upon judgments regarding which delays are typical of real operations, which operations can be done concurrently, and the like.

In the test the 6250 crane was made ready from its minimum disassembly configuration in a shorter period than required when fully disassembled as in previous pretests. The turnaround of the crane on the beach makes a precise comparison of the times for the two get-ready operations difficult. Even after subtracting administrative delays, it is not possible to make an exact comparison.

The comparison shown in Table 7, then, should be interpreted as showing a general order of magnitude of difference in the times that could be expected between the two assembly operations, if two otherwise similar operations are compared. The table indicates what times were included and excluded in the comparison.

Looked at in total, the savings in time by moving the crane in its minimum disassembly configuration is about 2 days. This difference depends on the assumptions made. These assumptions concern such matters as:

- Whether the loading bottleneck will be the heavy crane (in effect, Table 7 does assume this);
- The order of unloading from the ship (the components for the 9125 and 6250 cranes are assumed to have priority for unloading); and
- Whether the assembly of the 9125 crane could be done concurrently with the discharge of the 6250 crane components from the ship (as assumed in Table 7).

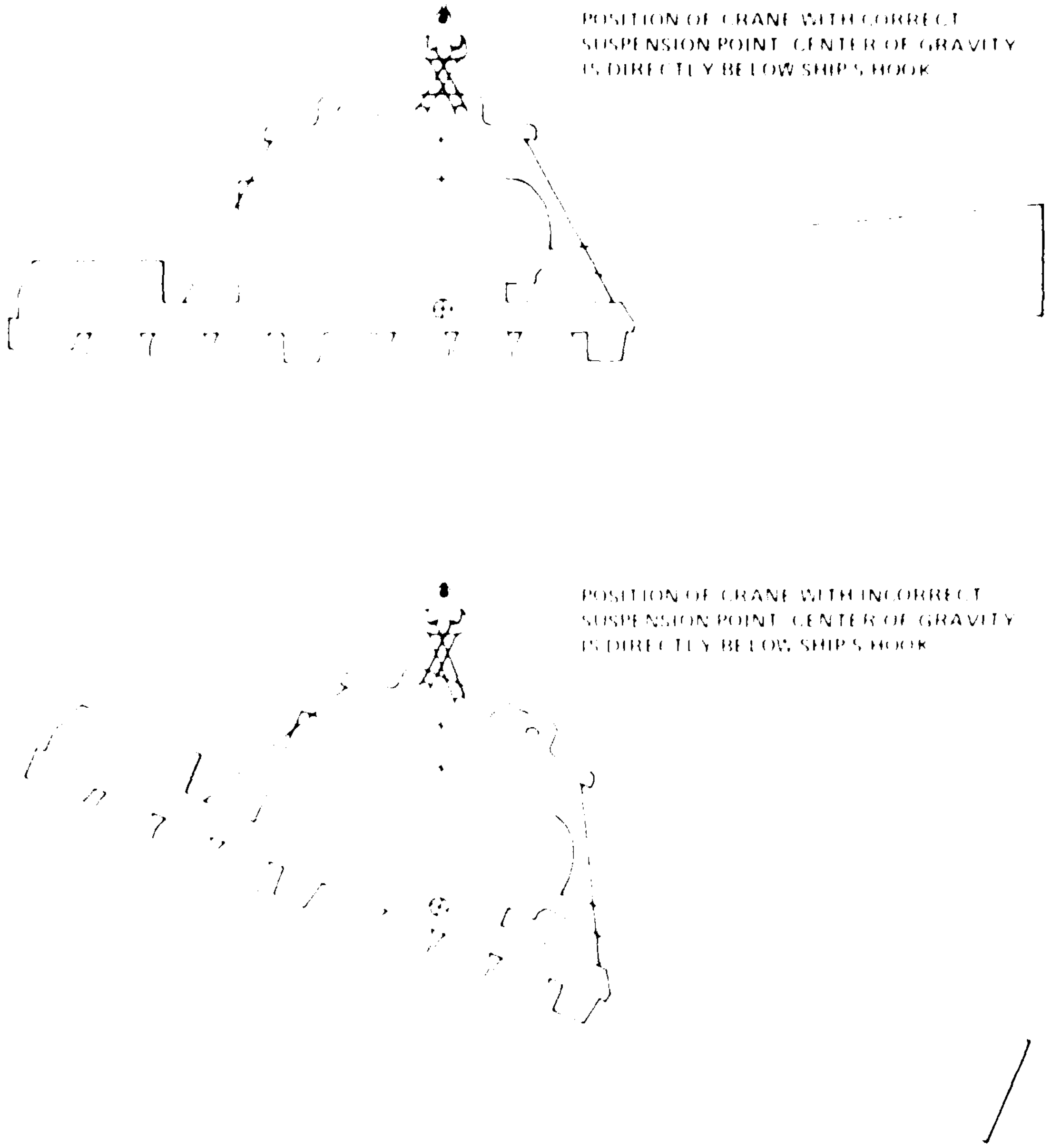


FIGURE [illegible]. SCHEMATIC SHOWING CRANE TILT

Tilt resulted from incorrect selection of holes in top member of hoist rig. (Not to scale.)

TABLE [illegible]

[illegible] TIMES FOR DEPLOYING HEAVY CRANE

Administrative', Disassembled 6250 (as in previous pretest)		Minimum Disassembly (as in Heavy-Lift Ship pretest)	
Disassembly and Loading Times			
Disassembly and mobile loading (as reported in [illegible])	[illegible] hr	Partial disassembly and mobile loading of booms and cntrwts.	11 hr
[illegible]	[illegible]	Transit time	[illegible]
Loading times [illegible] carrier, upper [illegible], [illegible] outriggers [illegible]	[illegible] hr	Single heavy lift	[illegible] hr
Loading times [illegible] counterweights [illegible]	[illegible] hr	Counterweights, booms, etc.	[illegible] hr
	[illegible].4 hr		[illegible] hr
Off-Loading Times (at objective area)			
[illegible]	1.[illegible] hr	Off-loading assembled crane	[illegible] hr
[illegible]	1.[illegible] hr		
[illegible]	1.[illegible] hr		
[illegible] total off-loading	[illegible] hr		.5 hr
Movement to Shore			
[illegible] time for last boat; [illegible] transit time would be [illegible] with off-loading	[illegible] hr	Ship-to-shore transit time	.[illegible] hr
[illegible] time at shoreline, [illegible] for last boat; [illegible] would be concurrent with off-loading	.[illegible] hr	Transfer time	.[illegible] hr
	.[illegible] hr		1.0 hr
Assembly Times (based on best estimates)			
Reassemble 9125 crane	13 hr	Install operator's module	1 hr
Reassemble 6250 crane	20 hr	Assemble booms and counter-weights	3 hr
	[illegible] hr		4 hr
TOTAL TIMES	[illegible] hr		21.7 hr
Difference attributable to degree of disassembly . . . . 52.8 hr			

Even if the assumptions listed are not realized in a contingency and the listed components of the deployment times are different from those shown in the table, it is judged that there would still be a definite advantage. This advantage would be on the order of two days if the more fully assembled crane configuration is possible for deployment. This advantage is gained by the use of a heavy-lift ship that can load and discharge the crane (tactically disassembled) and the type lighter needed to transport the 6250 crane (in its more nearly operational configuration) to shore.

The decision on which configuration to use in moving the 6250 crane will be dictated by the shipping available. Assuming that in a future emergency heavy-lift ships will have other cargo competing for sea transport, a comparison like that shown above would be of value in making a decision on shipping allocations. [illegible] shipments must be delayed until an appropriate [illegible] capability has been established in the objective area.

[illegible] allocation considerations are the lesser risks in the transfer of the heavier, fully assembled crane versus the risks of reassembling it after it has been detail-stripped. Detail stripping is necessary to permit the crane being carried on a ship that can load and off-load components weighing only [illegible] long tons or less. The detailed disassembly and reassembly includes the need for more highly skilled and experienced personnel and still includes the risk of not being able to assemble close fitting components that might have been damaged in transit.

Moving Cranes Ashore From Ship

Transit of the cranes from the ship to the vicinity of the beach aboard their respective lighters, the LCU and the LCM-8, presented no problem. [illegible] close to the beach presented real difficulties at low tide and [illegible] even at high tide. Thus, the sandbars were a considerably [illegible] in the operations at Green Beach, Ft. Story. For [illegible] amphibians are, of course, an answer to sandbars and [illegible] gradient problems. However, during the deployment phase and ship-to-shore movement, even the largest amphibious vehicle (the LARC-LX) is not capable of lightering either crane. In any case, these vehicles are in short supply and are themselves difficult to deploy. Thus, for deployment with landing craft, beach gradient and sandbar problems appear to need further study, in the light of the potential problems they present to equipment deployment, especially [illegible] equipment.

[illegible]

The use of the heavy-lift ship to deploy 1466-class LCUs was reaffirmed as a tried and proven procedure during the pretest. However, the Navy's new 1646-class LCU which had been scheduled for loading was not because neither the ship nor the Navy had the necessary sling. As part of the charter agreement the ship is required to carry other LCU slings but no requirement has been levied for carrying a sling needed for this type landing craft. Since this is the predominant LCU in the Navy and the older Army LCUs will be phased out in favor of a craft similar to the Navy's, this shortcoming should be rectified.

From the point of view of the best use of the heavy-lift ship as a resource with severe limitations on the total quantities of equipment it can carry, its LCU capability is still most important. MSC has 16 ships that can carry LCMs, causeway sections, and, potentially, BD barges, but it has only these two ships that can carry four LCUs each. An LCU is necessary for carrying a fully-assembled crane and it has a greater container lightering capacity that is relatively unhindered in improved beach operations. It also has capabilities to operate longer in heavy weather than other types of landing craft.

CAUSEWAY FERRY OPERATION

The causeway ferry was the only non-amphibian lighter in the pretest that was able to function at any desired stage of the tide and could cross sandbars that hindered other landing craft. The reason for this is the shallow draft of the causeway, particularly its shoreward end when left unloaded. The shallow draft permits a close approach to the beach and its light weight forward permits the shore end to be pushed up on the sand toward dry land. The section at the shore end is, thus, literally, a causeway leading out to the cargo-carrying sections of the ferry, which remain in deeper water. The total length of the four-section ferry used was 360 ft, although additional sections can be added increasing the length.

The operation in which the causeway was loaded with containers placed with their long axes athwartship was in the overall more efficient than the operation in which the containers were placed on milvan chassis. This was because much greater accuracy was required to land the containers on the milvan chassis, which proved to be difficult and time consuming.

For the operation without trailers the containers were placed directly on the causeway. One possible disadvantage is that loaded in this manner there is a greater chance the containers are likely to get wet in other than a calm sea. Also, the containers had to be positioned athwartship for unloading by a frontloader on the beach. This required tagline handlers to turn the suspended container 90 degrees or more. This was accomplished, however, without great difficulty. Since the containers are 20 ft long and the causeway is 21 ft wide, there is little room along the edge of the causeway for tagline handlers to maneuver the swaying containers.

For unloading the ferry on shore the frontloader was very effective. Using only one unit was slow since the same frontloader was also used to position each container on a trailer. The five containers were unloaded in just over 5 hr, or approximately 61 minutes each. If two front loaders had been available this time could have been greatly reduced. An empty loader could move onto the causeway immediately after its predecessor left with a load. Another way to reduce the causeway unloading time, at the expense of some double handling and possible truck delay, would be to have the single frontloader drop each container at a point near the causeway until it was unloaded. Then the frontloader would load trailers until another loaded causeway ferry was beached.

The causeway ferry provides a beaching capability where landing craft are not able to function. Its use should be considered by the JLOTS in its lighterage mix during periods of the main test when landing craft are unable to beach.

[illegible]

[illegible] personnel, [illegible] test. [illegible] planning the [illegible] self-reporting [illegible].

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] sometimes [illegible]

[illegible] installed position. [illegible] twist [illegible]
[illegible] the [illegible] twist [illegible]
[illegible] the failing [illegible] twist [illegible] at [illegible]
[illegible] -degree twist [illegible] container suspended [illegible] hoist lines.

[illegible] to [illegible] therefore, the [illegible]
[illegible] the crane [illegible] that the required twist [illegible]
[illegible] when loading containers [illegible]
[illegible] the barge, where a [illegible] -degree twist [illegible]
[illegible] way would be to use a swivel [illegible]
[illegible] would be where the extra weight [illegible]

[illegible]

[illegible] problem that [illegible]
[illegible] work the ship near the bow. The
[illegible] shows the barge moored parallel to the
[illegible] between the barge and the ship at the
[illegible] forward to unload containers from [illegible]
[illegible] the barge was not required to [illegible]
[illegible] presumably, interfere with the crane operation.
[illegible] depends on the crane reach available, how the barge
[illegible] containers or hatches near the bow, and [illegible]
[illegible] evaluation of the crane's rating [illegible]
[illegible] near the bow. [illegible] this evaluation [illegible] investigated [illegible]

[illegible]

[illegible] weights and vessel characteristics [illegible]
[illegible] and operation of the crane [illegible]
[illegible] As part of the preparation [illegible]
[illegible] insights may be gained [illegible]
[illegible] with the [illegible] operations, the [illegible]
[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]		
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	
[illegible]	[illegible]	
[illegible]	[illegible]	
[illegible]	[illegible]	
[illegible]	[illegible]	

[illegible]	[illegible]	[illegible]	[illegible] Moment	[illegible]	[illegible] Moment	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]						

[illegible] Degrees

[illegible] Degrees

[illegible] Degrees

[illegible] Degrees

APPENDIX B

[illegible]

[illegible]

The [illegible] the B [illegible] barge [illegible]. The barge, with [illegible] was lowered [illegible] the working [illegible] wells [illegible] position, was [illegible] (see Figure B.1). [illegible] the barge was [illegible] ashore with [illegible] from [illegible]. [illegible] the barge [illegible] with the beaching. The barge [illegible] ice breeze [illegible] with the [illegible] the high water [illegible]. Two bulldozers attempted [illegible] forward [illegible] the barge further ashore, but were unsuccessful. The [illegible] the bulldozers [illegible]. The barge was then raised [illegible] the [illegible] with [illegible] recorded.

The [illegible] equipment was [illegible] the barge [illegible]:

- [illegible] assembled [illegible] crane
- [illegible] silver
- Two trailers, one an air compressor, the other a generator
- Assorted [illegible] equipment
- Two [illegible] (... ft x ... ft x ... ft)

---

* A rough calculation shows that the average draft was [illegible] ft.

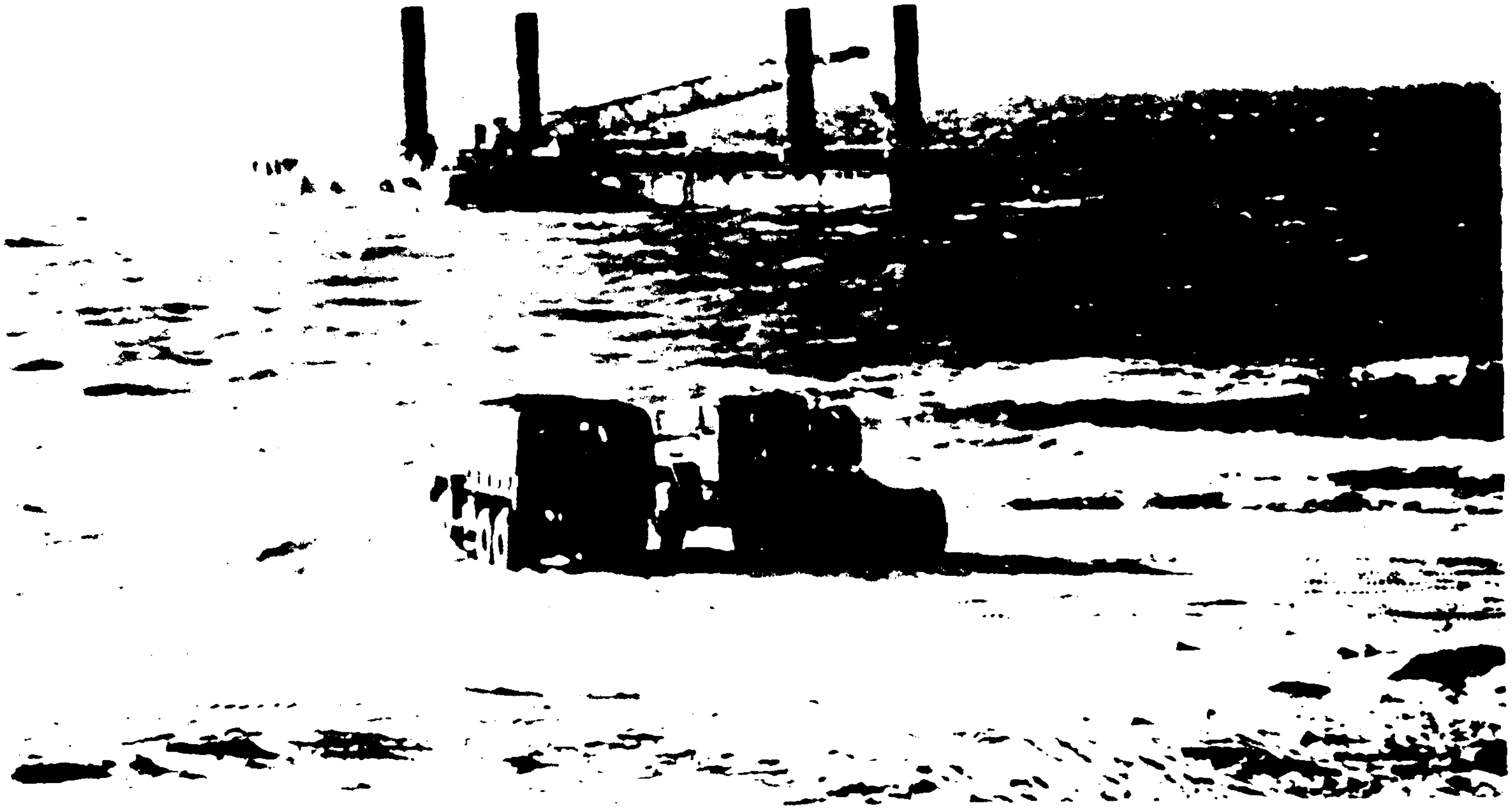


FIGURE B.1. B DELONG PIER ENROUTE TO RED BEACH

After a day with no activity (November [illegible]), work began on positioning the ramps. Half-inch steel plating, mounted on rail-ties, was positioned in front of the barge on the beach to act as a foundation for the beach end of the ramp when the ramp had been winched off the barge. Concurrently, a metal lip at the shore edge of the barge was burned off with an acetylene torch to facilitate off-loading the ramp. Holes were cut in the ramps for cable hooks so that each ramp could be winched off with two bulldozers.

During the operation one bulldozer winched a little faster than the other, causing some side motion of the first ramp. As a result, the cable hole on the right side was distorted and the line came loose. A new hook-up was made to an existing [illegible] and the ramp was winched off the barge without further incident. The ramp was pulled to a position with one end on the beach and the other still overlapping the barge platform by approximately [illegible] ft.

The beach area was again graded and the beach end foundation timbers were realigned. The second ramp was winched off the barge. Alignment with the left ramp was assisted by an additional bulldozer. The winching this time took only [illegible] minutes. (Lessons learned on the first ramp were evident during the winching operations on the second.)

Next the [illegible] was raised further on its caissons to allow a better angle for the ramps on the pier support beams. The supports, or ledges, are located on the vertical face of the barge end. They are at a sufficient distance below the barge deck so that when the ramp is in place, its top is flush with the barge deck.

The [illegible] crane then lifted the barge end of the left ramp. At the same time two bulldozers began pulling the beach end of the ramp until the barge end was clear of the barge platform. The crane then lowered the ramp onto the support ledge. The ramp was then secured. This operation took only [illegible] minutes each for both ramps. An additional bulldozer was used to push the right ramp against the left. When both ramps were in place, the right side at the beach end was approximately 1 ft higher than the left. This was the situation when activities ceased at the end of the working day.

The next morning, November 4, two [illegible]-ton cranes attempted to lift the beach end of the left ramp in order to shore it up to the height of the right one. The weight of the ramp was estimated at [illegible] tons. By lifting only one end, the total lift was only about [illegible] tons. Two attempts to lift the ramp were unsuccessful, and the [illegible]-ton cranes were secured. However, two bulldozers, working in unison, were able to lift the end of the ramp. Shoring was installed and a proper horizontal alignment achieved.

When both ramps were properly positioned and secured to the pier, a sand ramp was constructed by two bulldozers. Immediately thereafter, an Assault Vehicle Launching Bridge (AVLB) positioned its scissored landing bridge over the sand ramp to the pier ramps. No problems were encountered with the AVLB. Total time for the AVLB operation was 4 minutes.

A final beach grading was completed at 1600 and the pier was ready for operations. Total elapsed working time for the ramp emplacement was [illegible] the target at the [illegible] were used.

- [illegible]
- [illegible]
- [illegible]
- [illegible]
- [illegible]
- [illegible]
- [illegible]
- [illegible]
- [illegible]
- [illegible]
- [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] operations [illegible] during a lunch break between 114[illegible] and 1[illegible]. [illegible] was [illegible]. Two milvans were on the pier [illegible] the marshalling area. These milvans were ultimately [illegible] the pier approximately 4 hr after being [illegible].

[illegible] consisted of two loaded LA[illegible] docking and dis- [illegible]. Two additional milvans were then loaded into these [illegible] after which [illegible] were secured.

[illegible], the A[illegible] scissor ramp was removed. [illegible] were substituted, together with Momat for [illegible]. At this time seas were rough with wave heights esti- [illegible] knots.

[illegible] arrived at the pier but because of the surf conditions [illegible]. The craft would ground out wherever it [illegible] unsuccessful attempts to lift the milvan out of the LA[illegible] operations were postponed.

[illegible] the pier at 11[illegible]9 after some difficulty with the [illegible] departed. Operations were called off [illegible] high wind and seas.

[illegible] milvans were rapidly loaded into a LASH barge. [illegible] prepositioned on the pier before the barge moored at [illegible] after the barge was loaded, two LCMs arrived. [illegible] with [illegible] container and the other was empty. The container was [illegible] three times. Average cycle time was 5 minutes [illegible].

[illegible] during the lunch break. At 14[illegible] a LASH barge [illegible] welding repairs. The repairs continued throughout the [illegible] 1 ft x 1 ft plate was welded over a hole inflicted above [illegible]. This operation took up one whole side of the pier and restricted [illegible] the other side.

[illegible] of the day, four LA[illegible]s were loaded with con- [illegible]. There were [illegible] difficulties.

APPENDIX C

TEMPORARY CONTAINERSHIP DISCHARGE FACILITY (TCDF)

GENERAL

The Heavy-Lift Breakbulk Ship Pretest helped provide data on crane capabilities and limitations in the important area of Temporary Containership Discharge Facility (TCDF) operations. This pretest was the first opportunity to use the Army's own 6250 (300-ton lifting capacity) crane on a floating B DeLong barge for the discharge of containers from the holds of a ship. In addition, it was the first time military operators were used to conduct TCDF-containership operations. Although there were some artificialities due to the lack of container cell guides, the need to top the crane boom to clear the ship's booms and kingposts, and the limited opportunity for establishing a rhythm for unloading, valuable data and insights were gained.

DERATING

As of this report, it is uncertain what capacity load can be safely lifted by a mobile crane mounted on a floating platform when the crane (and platform) moves in response to waves or to the load. That is, when waves are moving the platform, different kinds of stresses occur in the crane from those experienced on solid ground. Accordingly, the crane lift capability is reduced to allow for such extra or different stresses; in other words, the crane must be derated for operations in a seaway. It is possible that the point may be reached where the crane on the barge cannot safely hoist the heaviest loads. In that case, in attempting a lift there is the possibility of a catastrophic failure to some component of the crane.

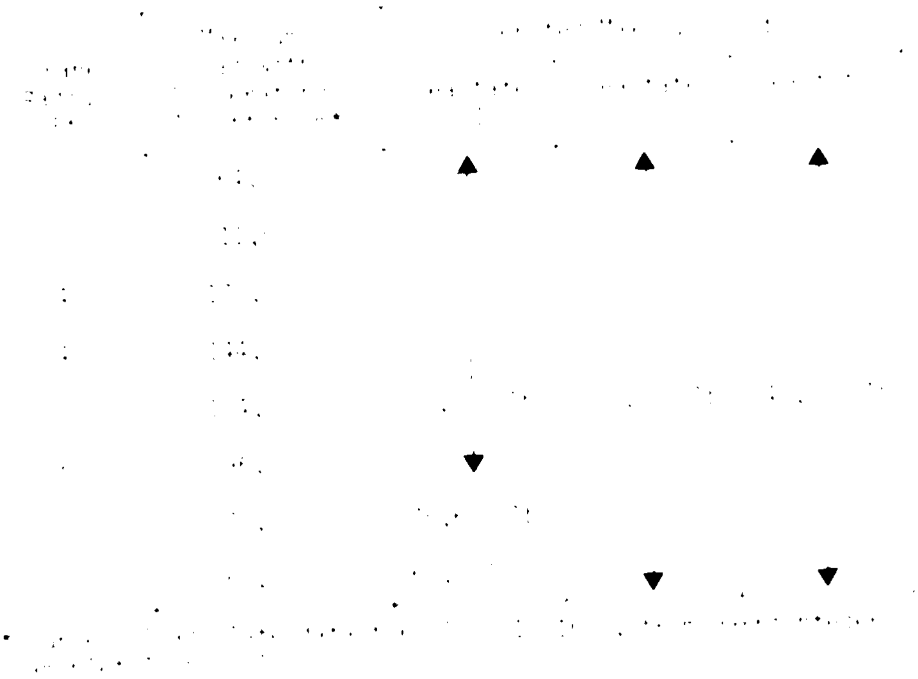
[illegible] primarily, [illegible] was designed [illegible] for land operations. [illegible] derating informa[illegible] with the maximum allowable load [illegible] expected [illegible]. However, the manufacturer's experience [illegible] the derating [illegible] continues to [illegible] recommended [illegible] the derating [illegible] conservative by some engineering personnel who [illegible]. As a result, the crane was instrumented during the [illegible] information on crane lifting capacity in [illegible] the initial trial [illegible] that appeared [illegible]

[illegible]

[illegible] in which containers were [illegible] engineering tests of the [illegible] crane [illegible] during the container unloading. The [illegible] measurements of the crane and were part of [illegible] with the effects of platform motions caused by [illegible] cranes. Results from this on-going program [illegible] capabilities of cranes in the [illegible] crane operators [illegible] the results of the measurements [illegible] have been [illegible] manufacturer's recommended derating values are [illegible] this data and its analysis will [illegible] capabilities to unload [illegible]

[illegible]

[illegible]



[illegible] illustrates the clearances and reach dimensions that [illegible] during the pretest in which the heavy-lift ship was acting as a sub- [illegible] containership. A reach to the centerline of the ship is necessary [illegible] hatch covers on many containerships. The designers of containerships, [illegible] the rule that a hatch cover can be no heavier than the [illegible] to be lifted from the holds of that ship. This limits the [illegible] requirement to a maximum of [illegible],000 lb or the equivalent weight [illegible] container and that of a spreader bar needed to lift it. [illegible] containers hatch covers weigh considerably less but a [illegible] the maximum requirement.

[illegible] ship has a beam [illegible] ft. Half of this distance [illegible] centerline [illegible] the fender between the barge and the [illegible] crane reach requirement [illegible] the heavy-lift breakbulk ship. This distance [illegible] Figure [illegible]. It may be noted from Table [illegible] that, under the [illegible] operating scale for this distance, a hatch cover [illegible] be lifted. In fact, there is a [illegible] sea state one. This is approximately the [illegible] chartered by the [illegible] there are [illegible] seas and a relatively light spreader [illegible]

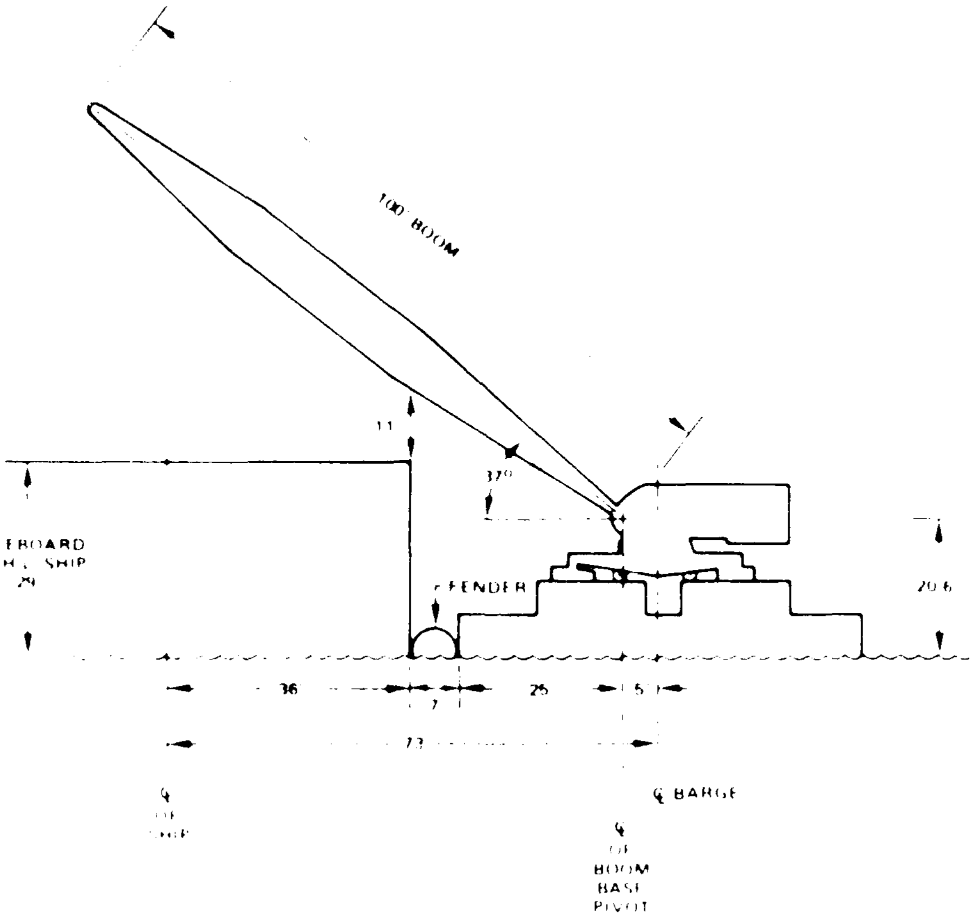
[illegible] have beams of approximately 95 ft, the [illegible] suitable for ships this wide that [illegible] centerline, the reach would have to be at least [illegible] however, under [illegible] the crane would not be able [illegible] designed for [illegible]-ft containers with [illegible] the lift would be within the limits of the derated [illegible]

[illegible]

[illegible] breakbulk ship pretest was conducted using [illegible] course, the more it weighs and [illegible] required. However, there are circumstances [illegible] the use of a longer boom. The [illegible] requirements, ship stability, and [illegible]

[illegible] crane used in the pretest will, generally, [illegible] those containers from hatches directly [illegible] with respect to those containers near the centerline [illegible] reach only to the centerline [illegible] will necessitate frequent repositioning in order [illegible] centerline within the boom's lifting radius.

[illegible] containership type chartered [illegible] beam [illegible]. The center of gravity [illegible] the ship's centerline. Therefore, the reach will [illegible] sea state one capacity.



[illegible] CLEARANCE AND REACH DIMENSIONS FOR 6250 TC CRANE [illegible] relation during heavy-lift ship pretest.

A longer reach could also be beneficial in helping ship stability. This would result when the TCDF is capable of reaching across the ship's centerline to unload containers. Thus, with only one TCDF or [illegible] working this would help the ship maintain a more even keel during the unloading process than if all the containers were first removed from one side and then the other.

Another factor to be considered is the freeboard of the ship. For a containership with a freeboard greater than the heavy-lift breakbulk ship, a longer boom would be required. This is illustrated in Figure C.1.

With the range of weights and vessel characteristics now known, more detailed planning for the configuration and operation of the [illegible] crane on the [illegible] barge type [illegible] can be done.

APPENDIX I

[illegible]

FIGURE I-1. S.S. TRANSCOLUMBIA DURING PRETEST. The S.S. TRANSCOLUMBIA, one of two heavy-lift breakbulk ships under long-term charter to the Military Sealift Command, was used November 2-7, 197[illegible], for the third LOTS pretest. The primary objective of the pretest was to load LOTS heavy and outsized equipment in a harbor, unload it from the ship at anchor in the open sea, and establish it ashore for the conduct of container throughput operations.

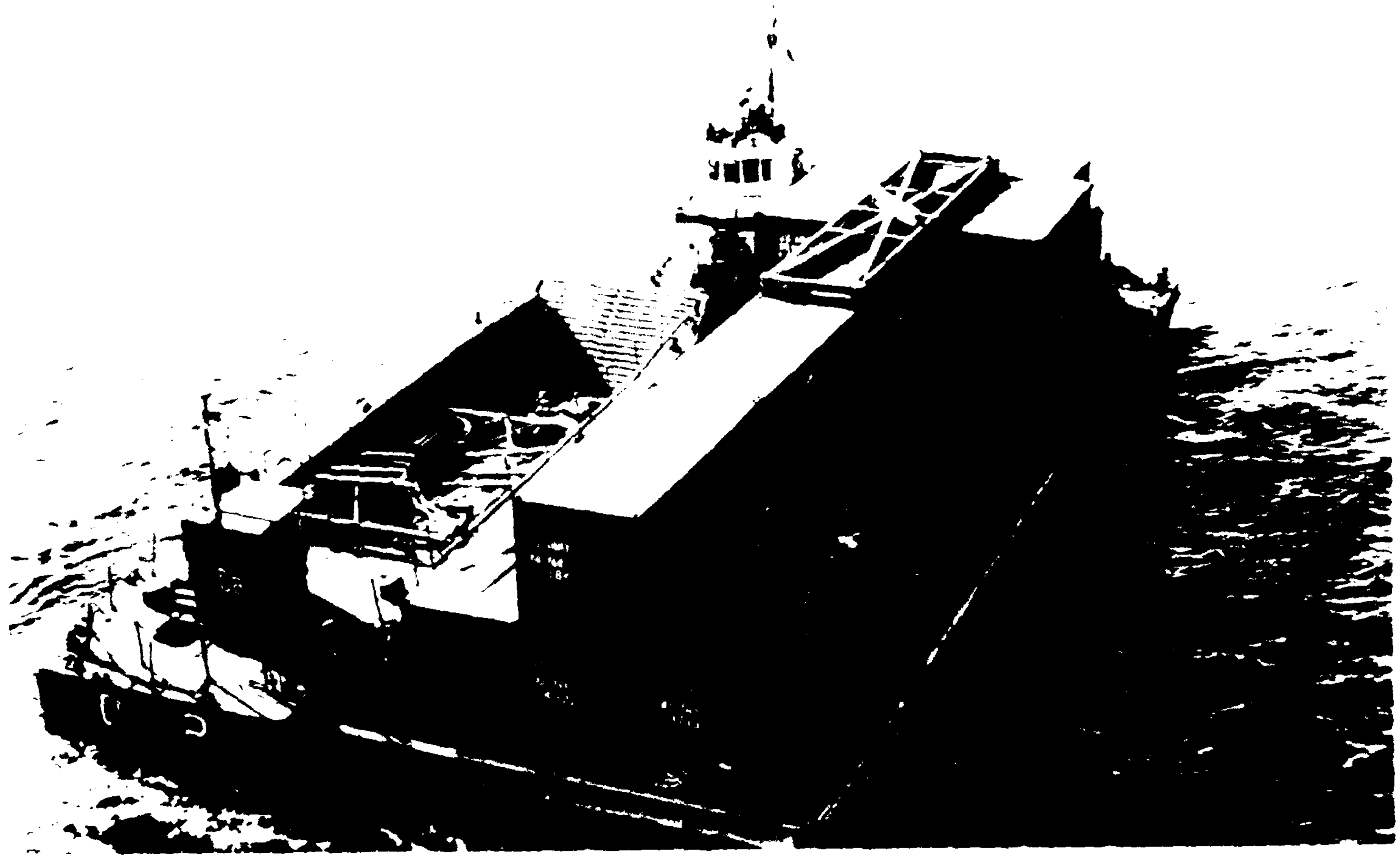


FIGURE [illegible] STRIKER CAMP [illegible] primary objective, established by the Services, was to conduct a container throughput exercise. [illegible] and 20-ft containers [illegible] Army B[illegible] barge are being [illegible] alongside the [illegible] the containers were used [illegible]

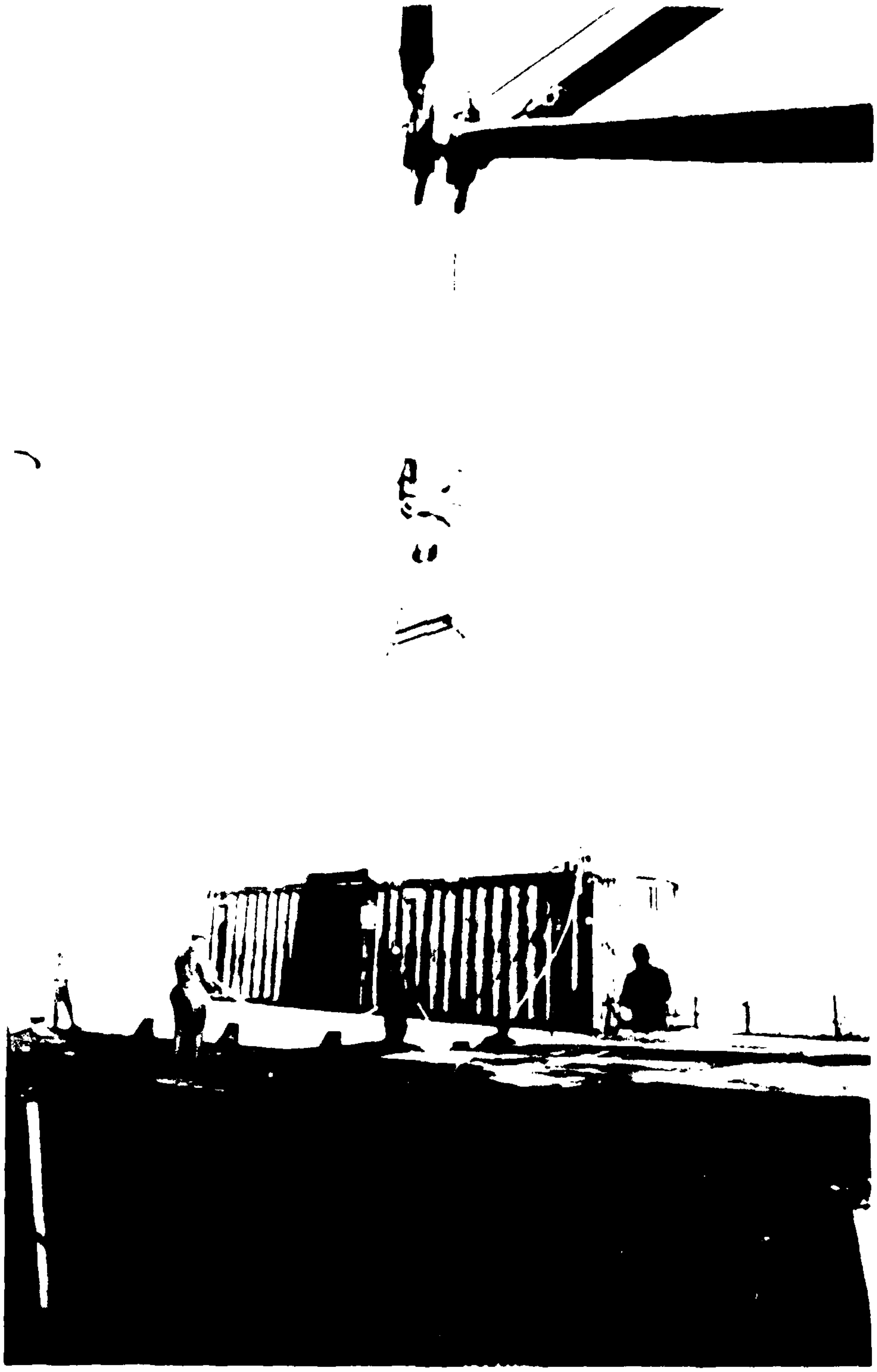


FIGURE D.4. 40-FT CONTAINER. One 40-ft container was included in the load to provide data and experience in handling a 40-ft container which weighed [illegible] short tons.

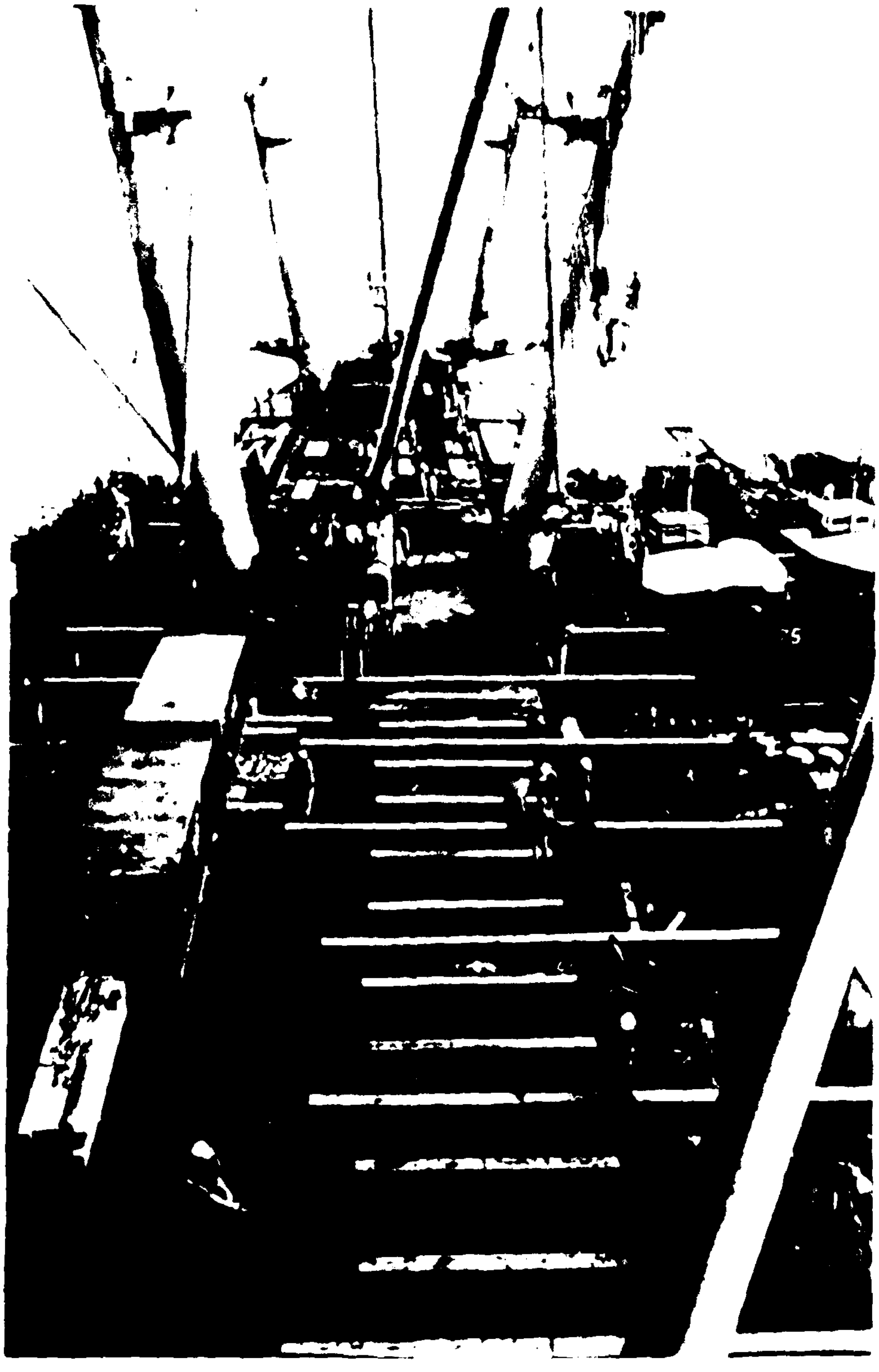


FIGURE [illegible].5. DECK PREPARE[illegible]. [illegible]unnage was laid on deck in preparation for the heaviest lift made in the L[illegible] pretest program, a 14[illegible]-class Army L[illegible]. Each of the two heavy-lift ships (the only heavy-lift ships currently in the [illegible]. flag fleet) can carry four of these large landing craft. A 16[illegible]-class [illegible] could not be lifted because neither the ship nor the Navy had the necessary sling.

FIGURE [illegible]-6. BOOM MARRIAGE. To lift the 180-long ton LCU, a boom marriage of two [illegible]-long ton capacity booms was made. This gives the ship [illegible] long ton capability, although reportedly the ship has lifted and carried [illegible] long ton tug.

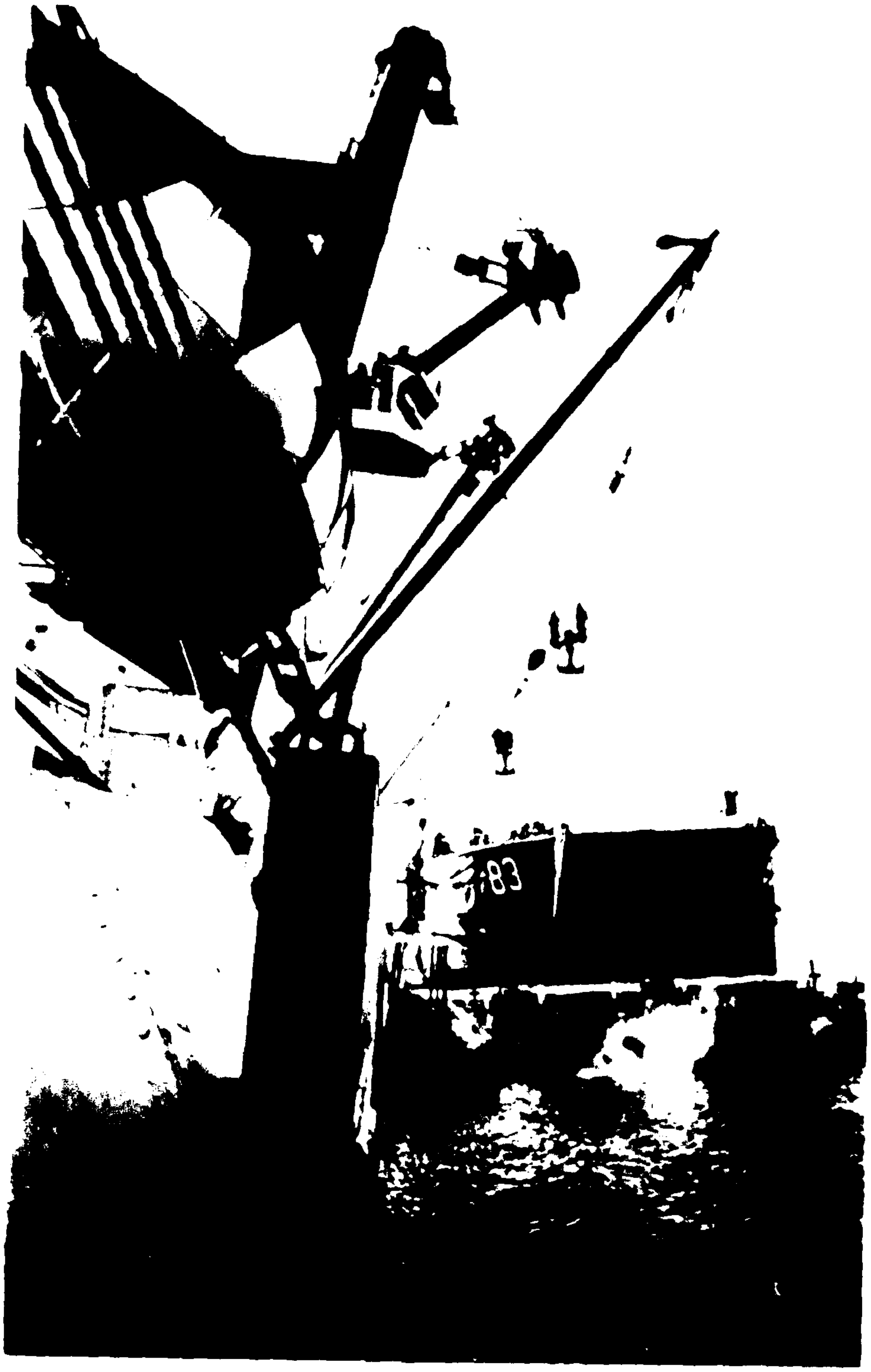


FIGURE [illegible] HOISTED WITH EASE. The LCU lift, although infrequently accomplished, was made with relative ease. Military personnel acted as stevedores but the ship's company operated all machinery and directed the technical aspects of [illegible].

FIGURE [illegible]. SMALL LIST EXPERIENCED. During the LC[illegible] lift the ship did experience nearly an [illegible]-degree list; however, the ship was designed to take a maximum of a 10-degree list during loading. A counter-ballasting system is used for heavy lifts.

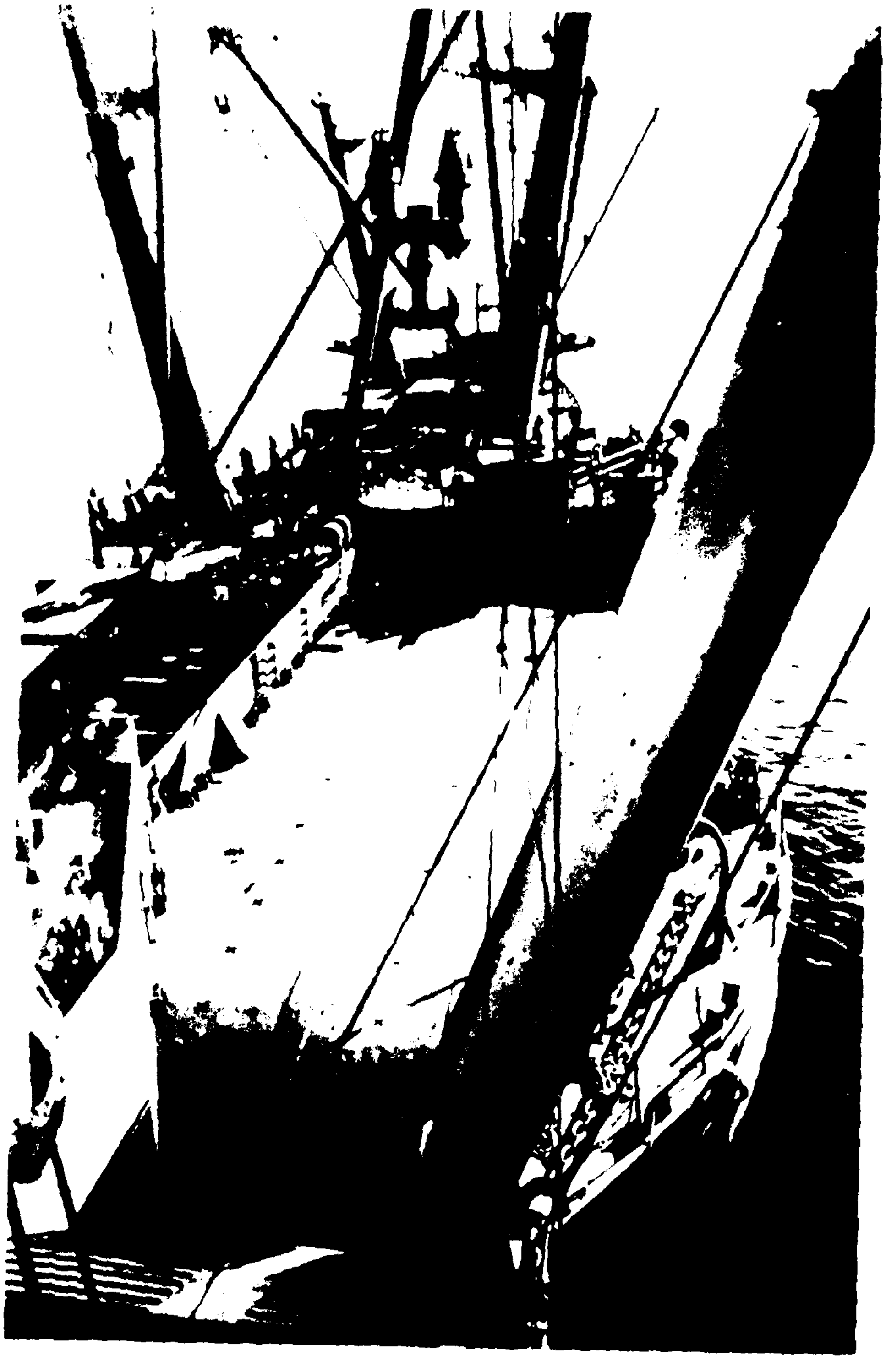
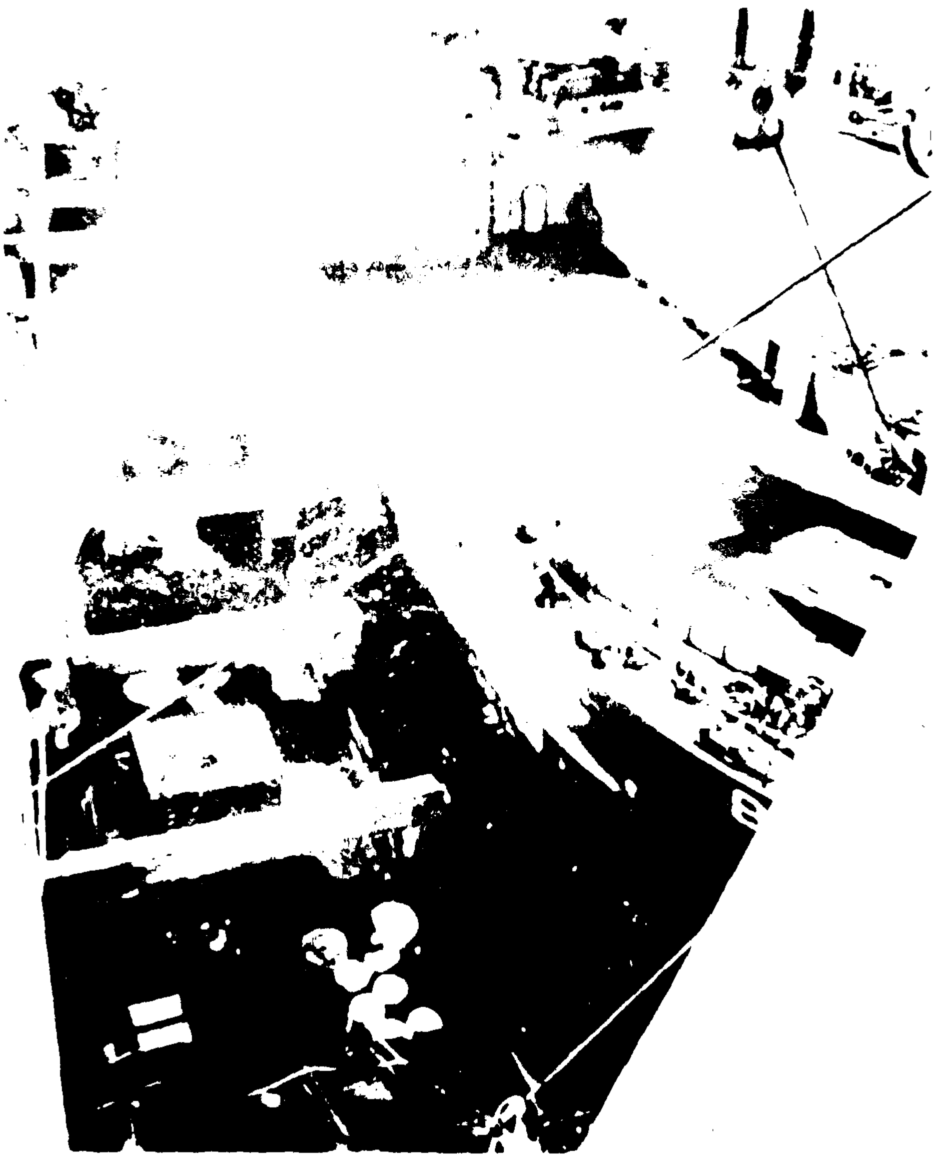
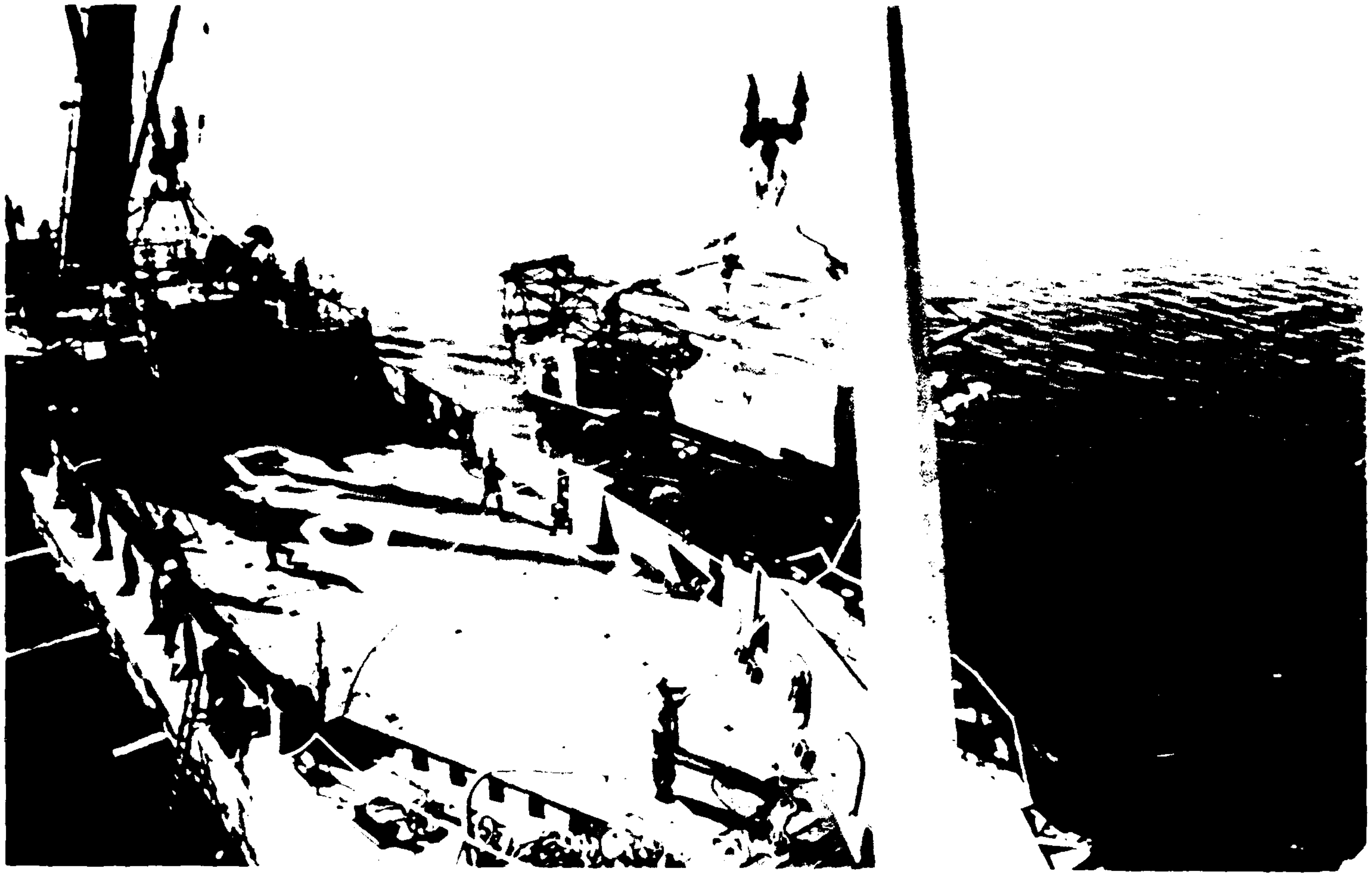
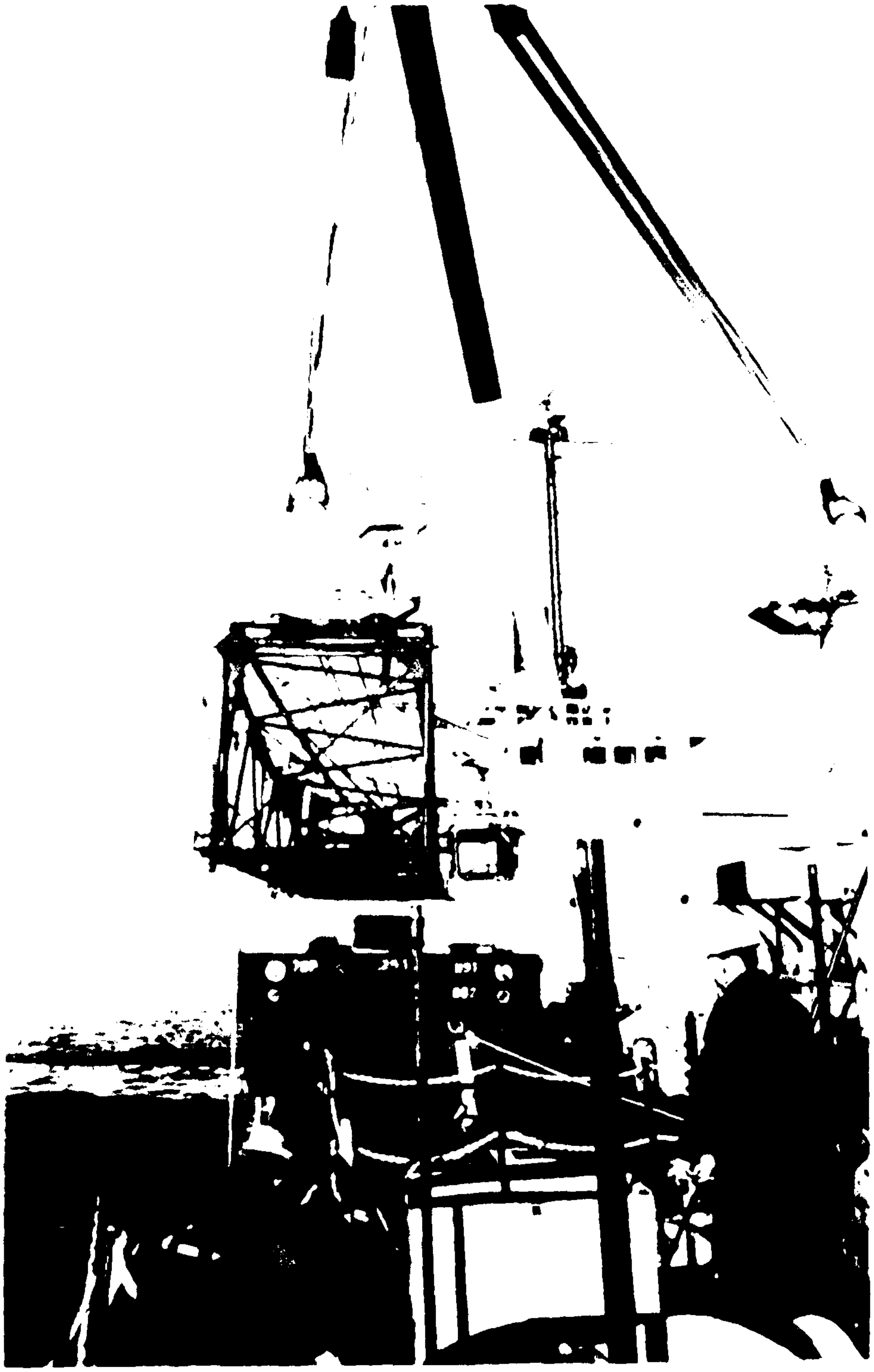


FIGURE [illegible] SPECIAL PREPARATIONS REQUIRED. No special preparations are required [illegible] for lifting. In this case the LC[illegible]'s mast was lowered [illegible] deck, but this proved to be unnecessary.

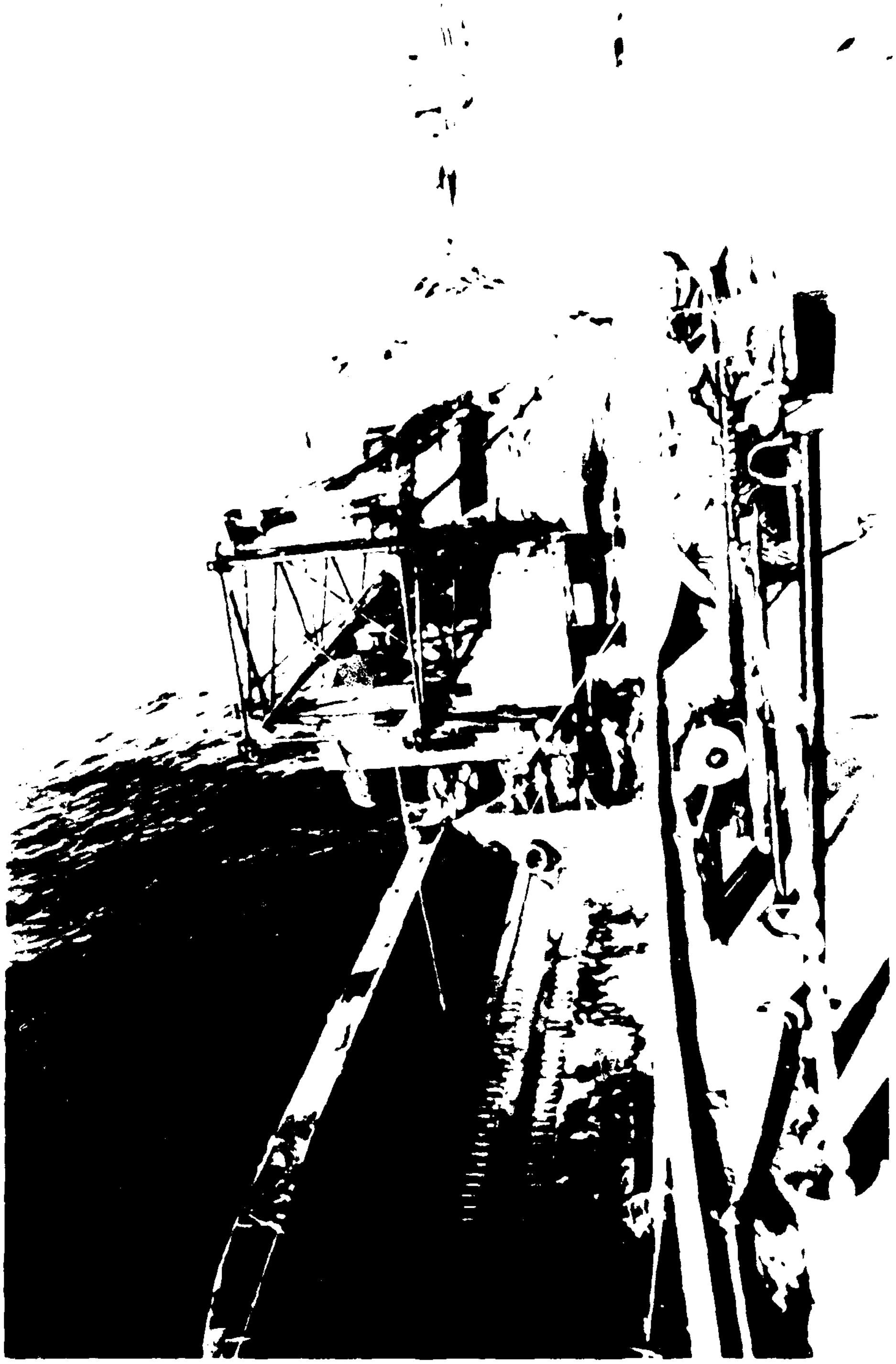


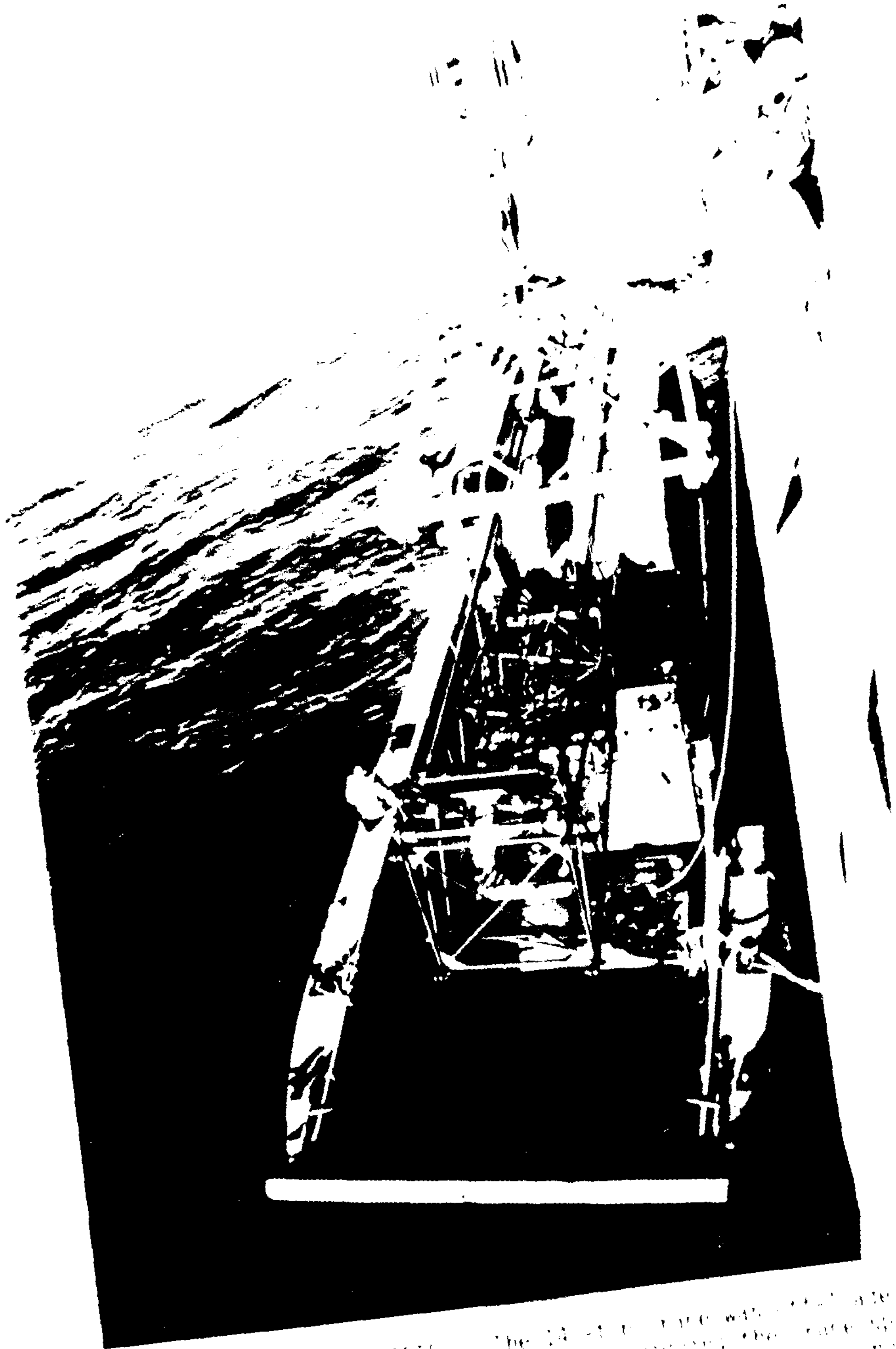


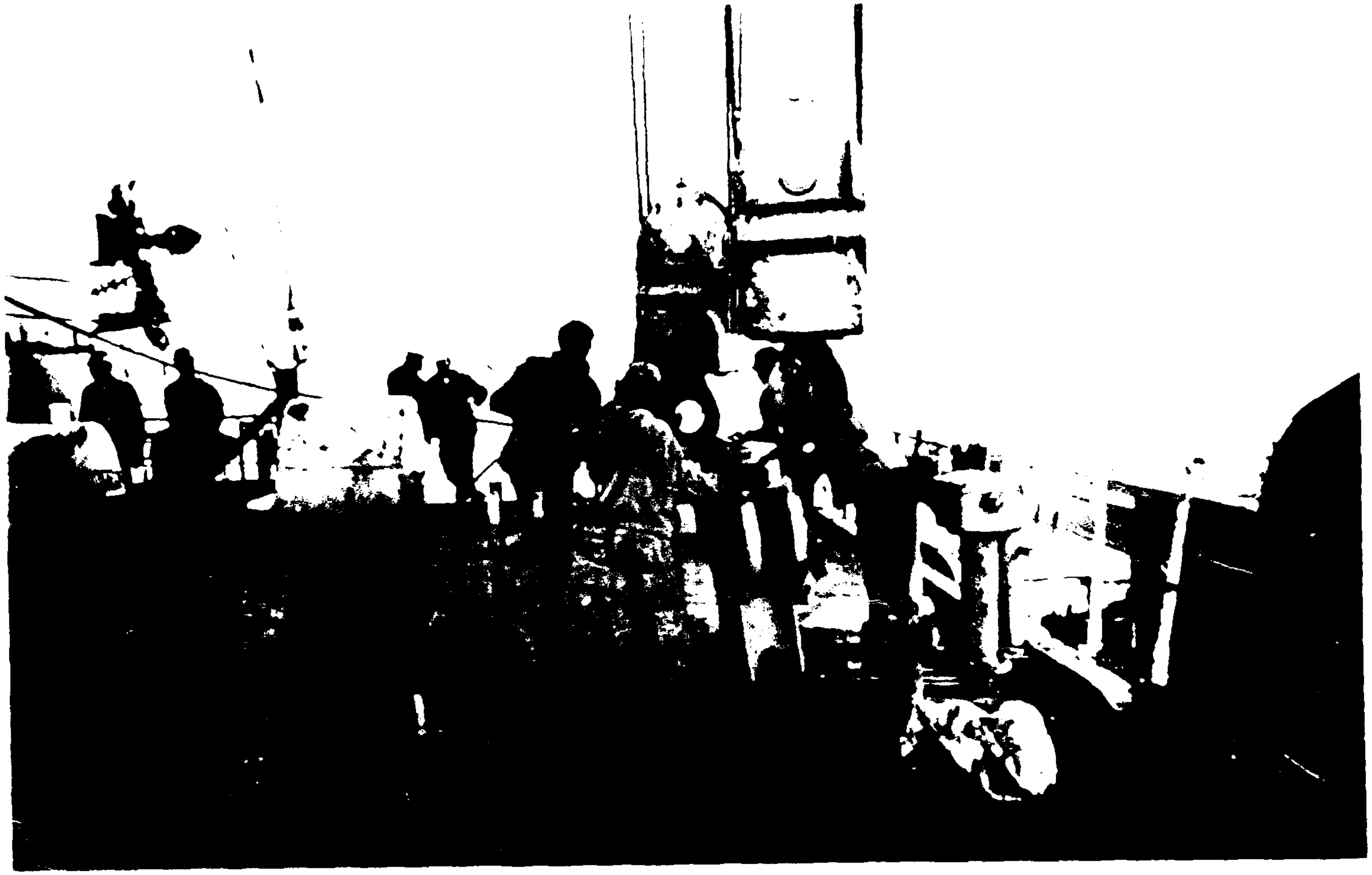
[illegible] SEA [illegible] wide space [illegible] the [illegible] crane [illegible]
The crane was lifted in [illegible] minutes, including preparation and rigging [illegible]



[illegible] In lifting the [illegible] into the [illegible], the ship's [illegible], which is 100 ft long, has more than adequate [illegible] the [illegible].







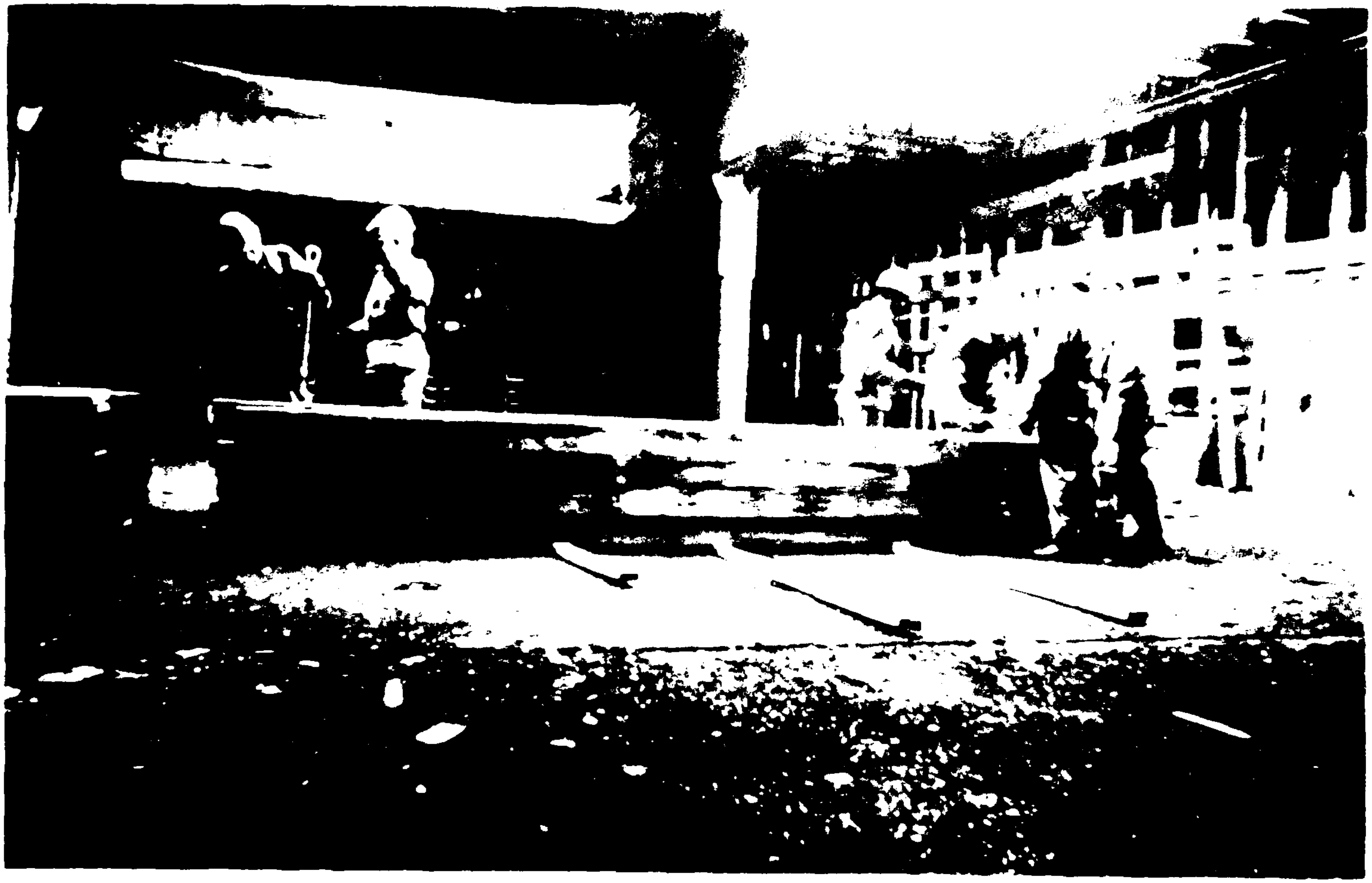
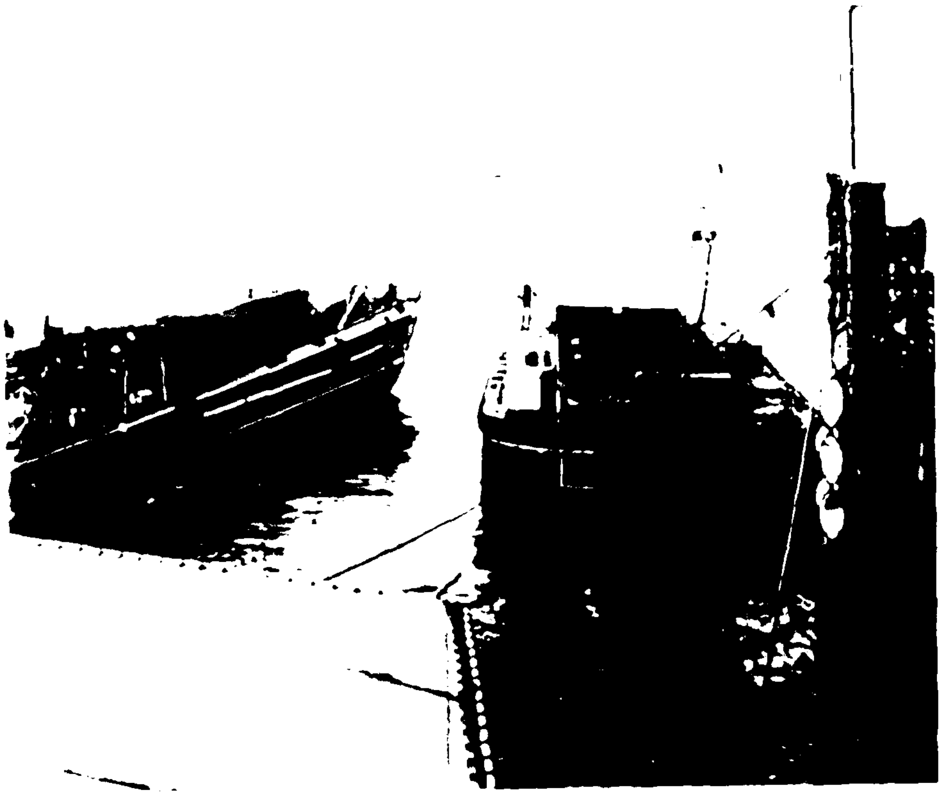
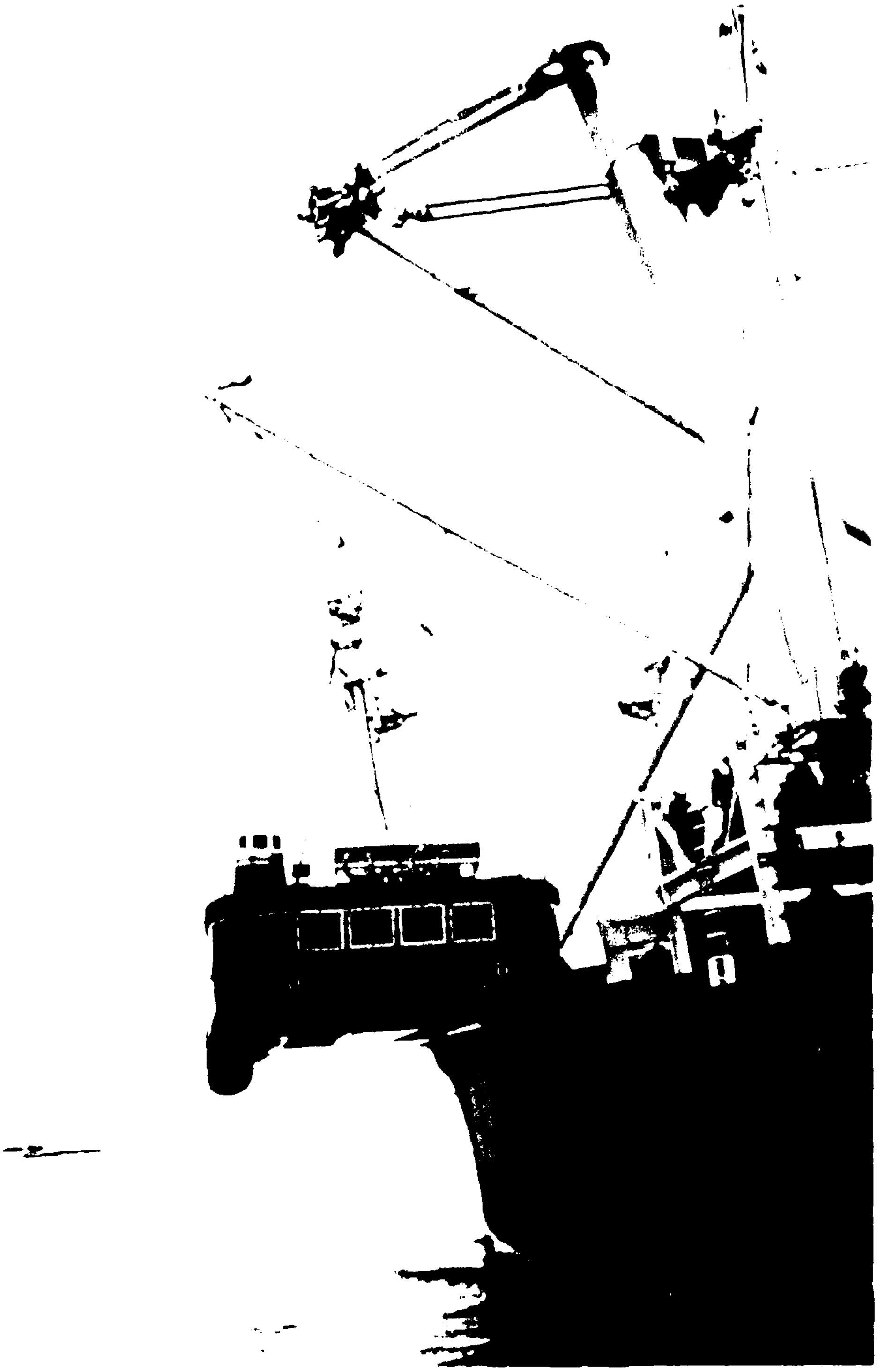


FIGURE [illegible]. [illegible] Cargo is being prepared at [illegible] hold No. [illegible]. The above view provides a perspective of the exceptional clearances within the ship's holds. This hold has a minimum clearance of [illegible] ft and a clearance to the hatch square of [illegible] ft.



[illegible] The [illegible] which weighs [illegible] tons, and has a height of [illegible] can be [illegible] internally [illegible] only by a heavy [illegible]



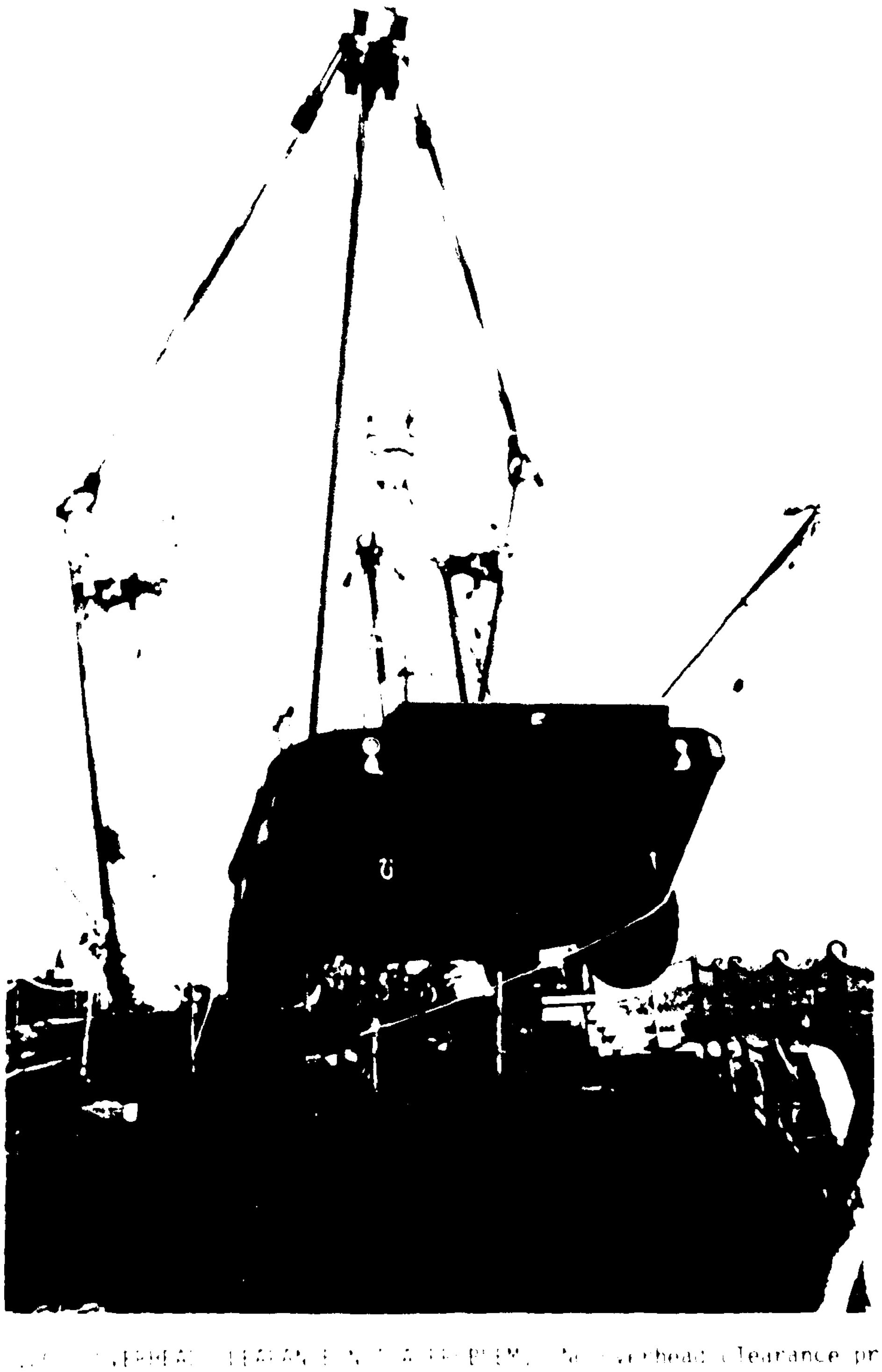
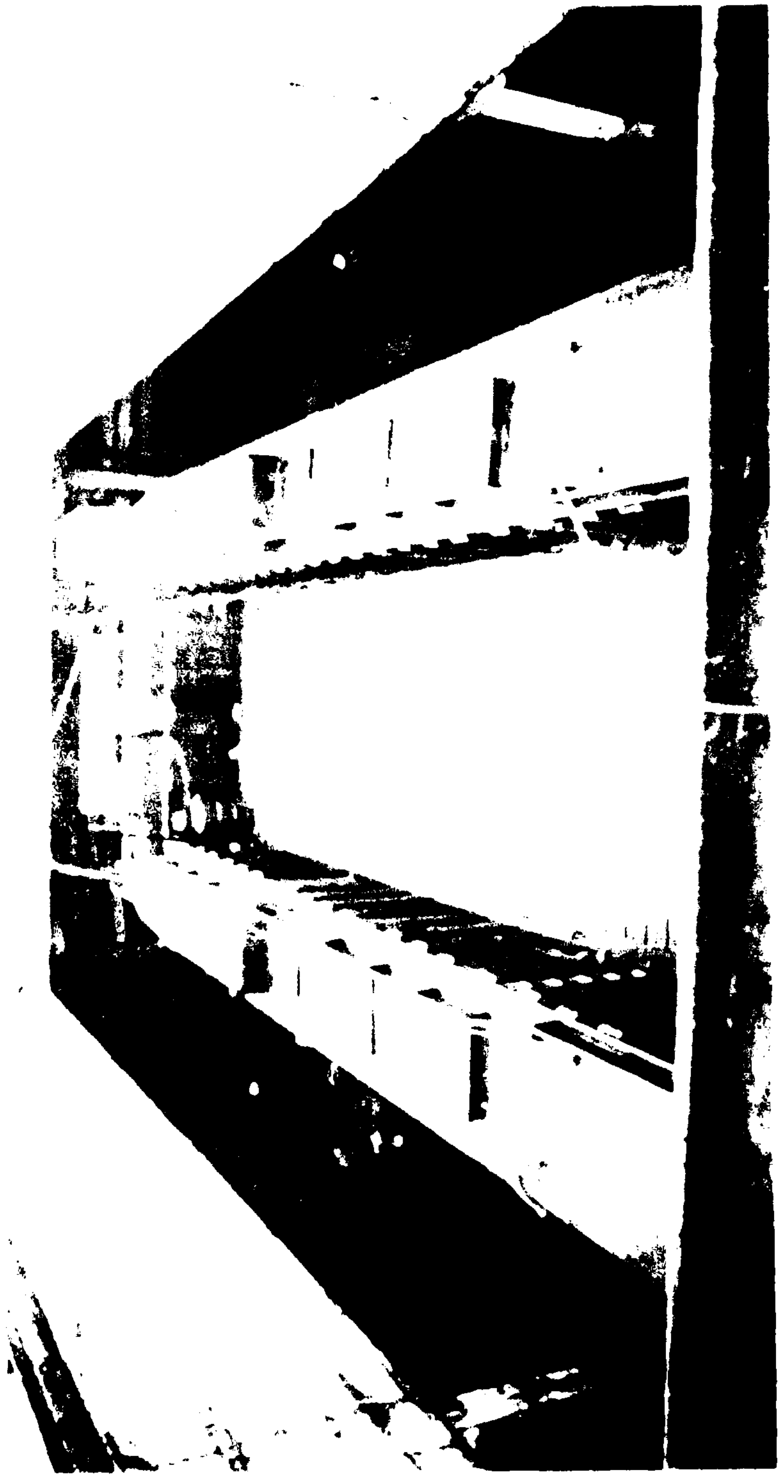


FIGURE [illegible] OVERHEAD CLEARANCE [illegible] PROBLEM. No overhead clearance problems were experienced by the [illegible]-ton boom swinging the [illegible] high LARC-LX across the deck and over the rail.



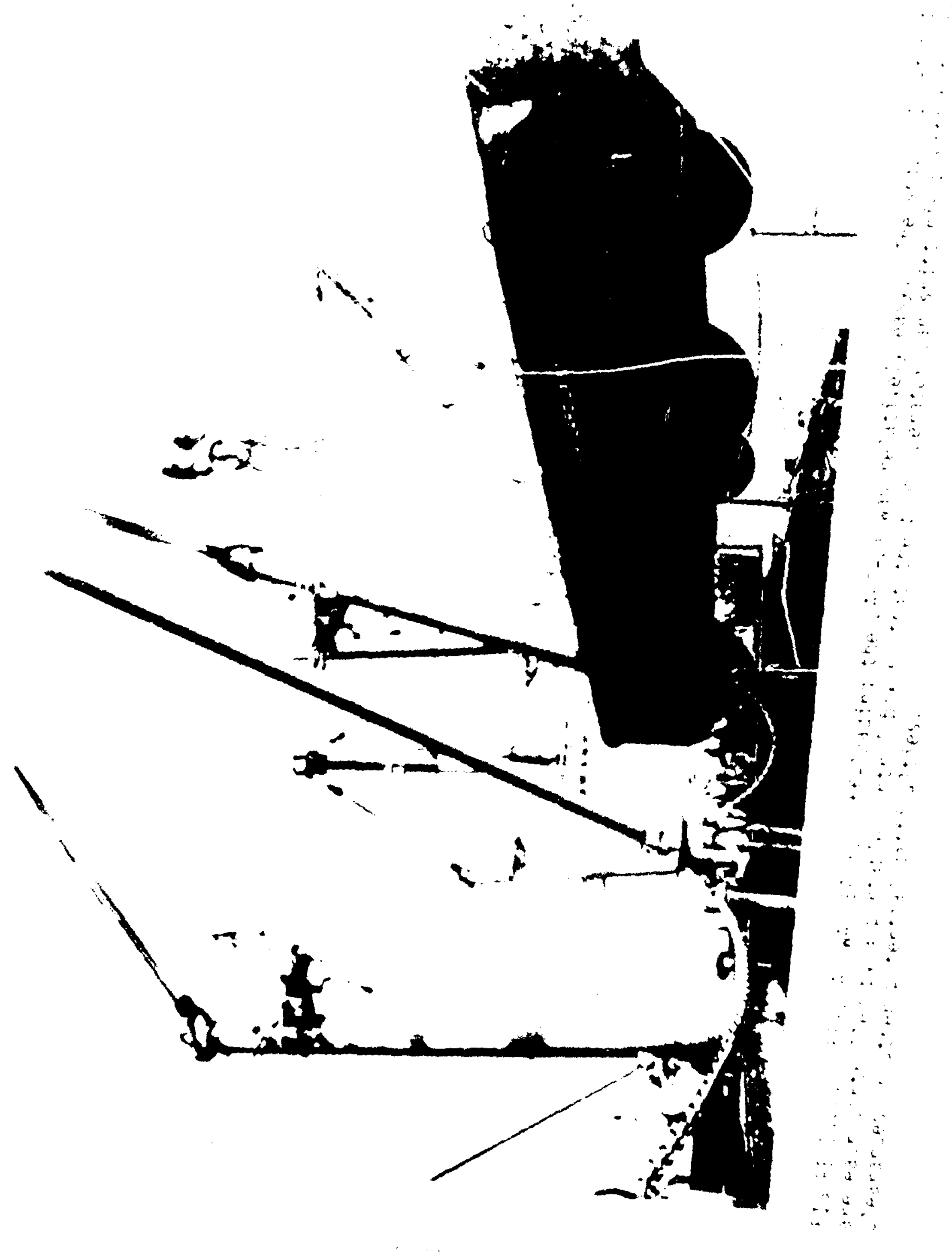
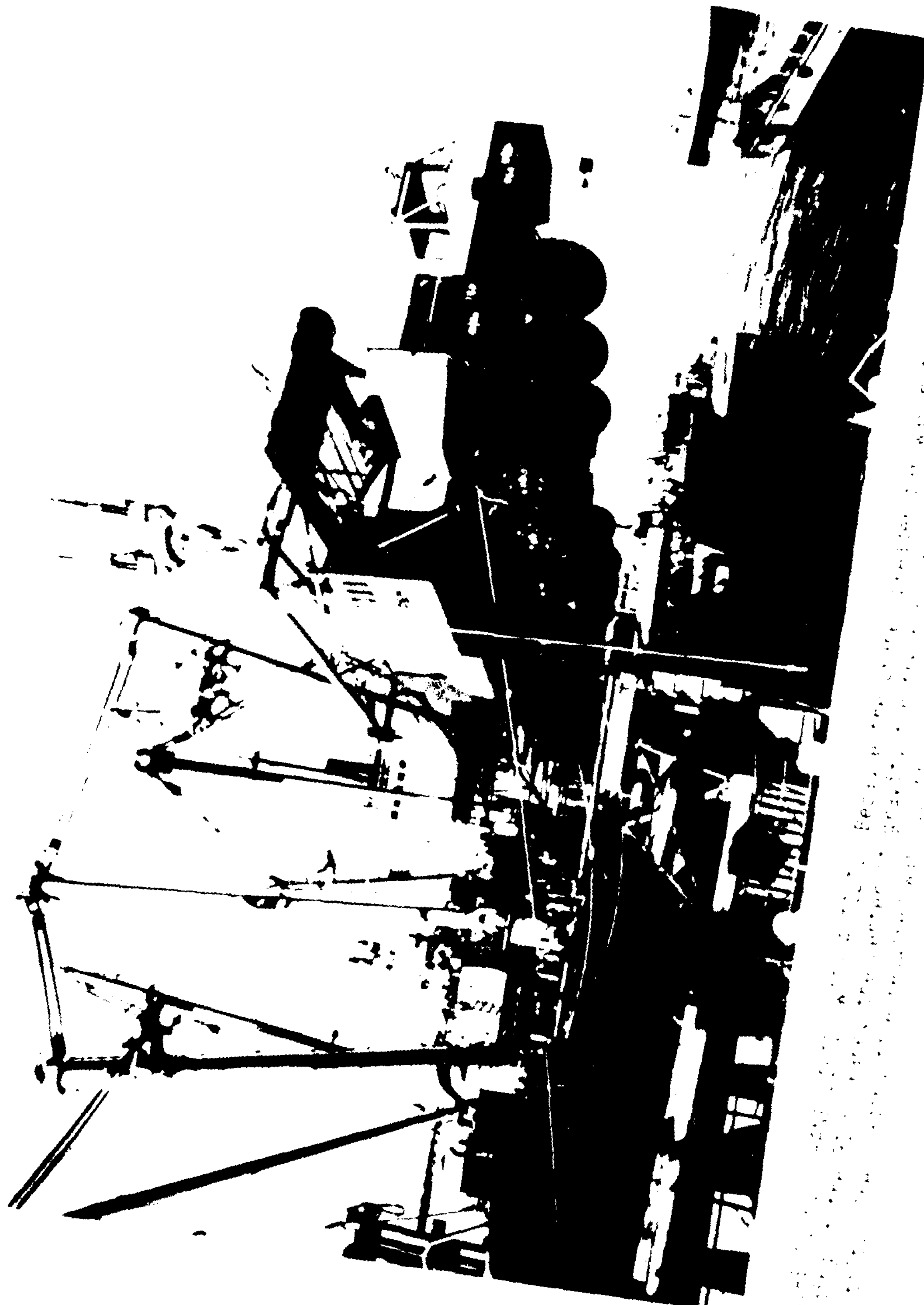
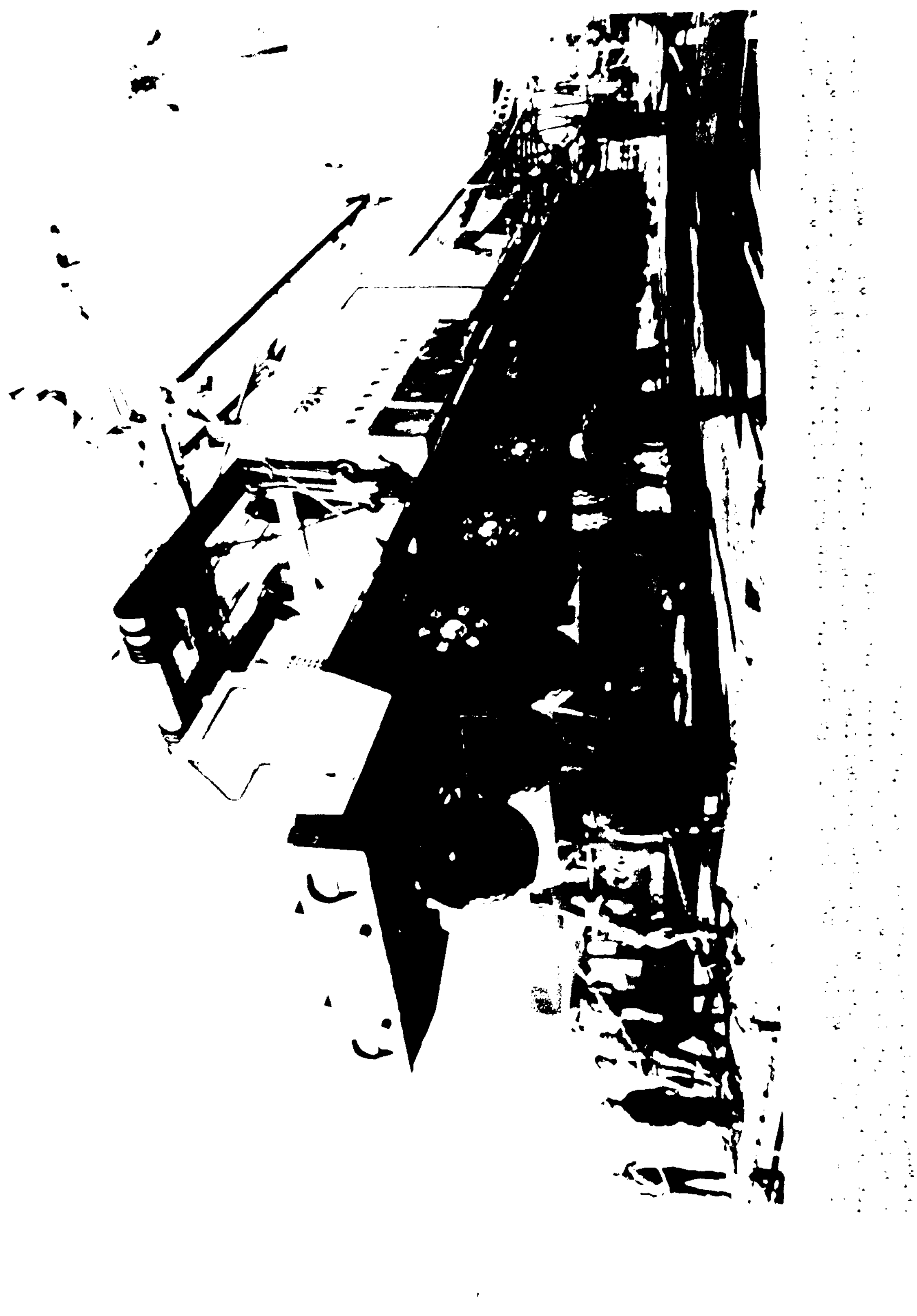
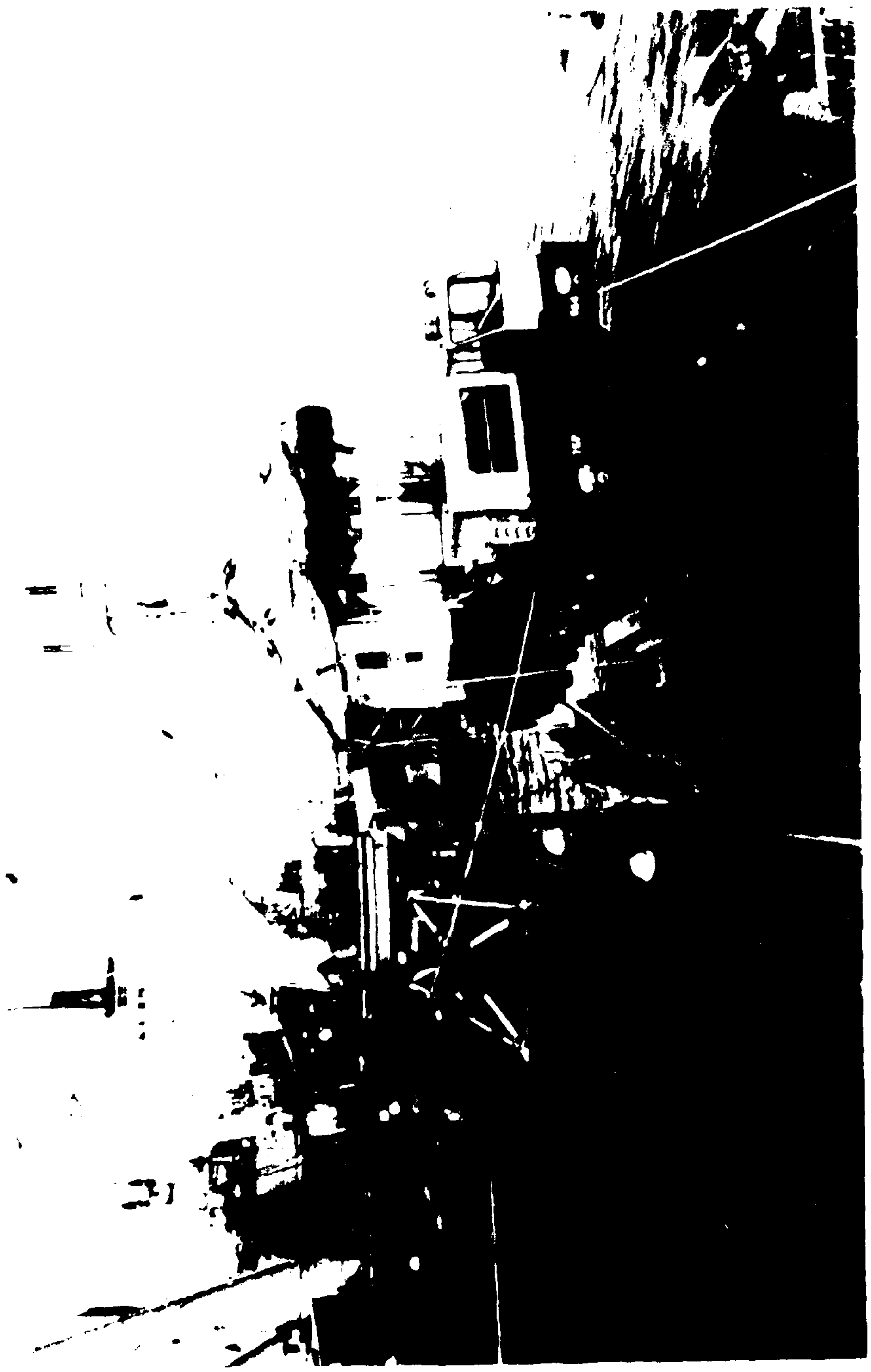


FIGURE [illegible] Approximately one-third of the 36-minute [illegible] the amphibian [illegible]







AD-A149 368 HEAVY-LIFT BREAKBULK SHIP PRETEST RESULTS OF THE JOINT LOGISTICS-OVER-THE..(U) ORI INC ROCKVILLE MD H CASEY ET AL. 25 JUL 77 ORI-TR-1168 MDA903-75-C-0016 2/2

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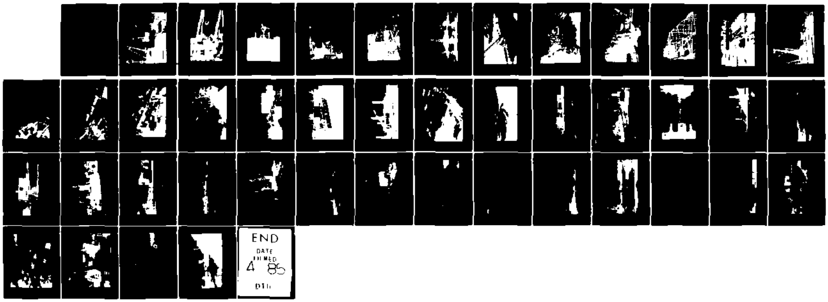

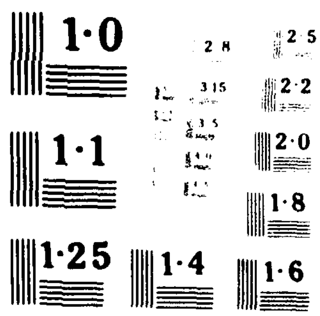
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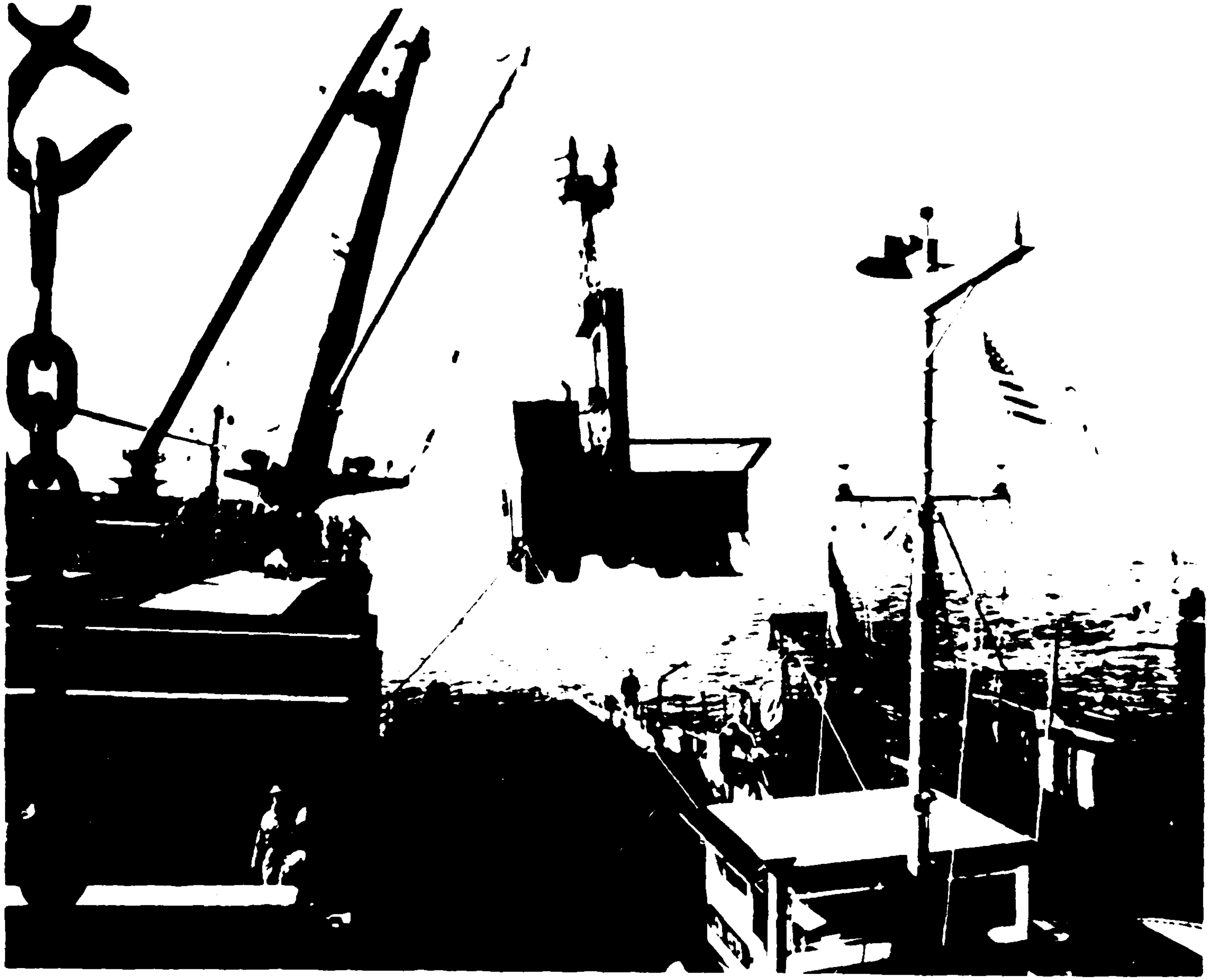


FIGURE D.29. SIDELOADER EASY LIFT. Compared to the other equipment embarked the sideloader went aboard relatively easily. It weighs 64 long tons and is 41 ft long, 12.5 ft wide, and 11.7 ft high.

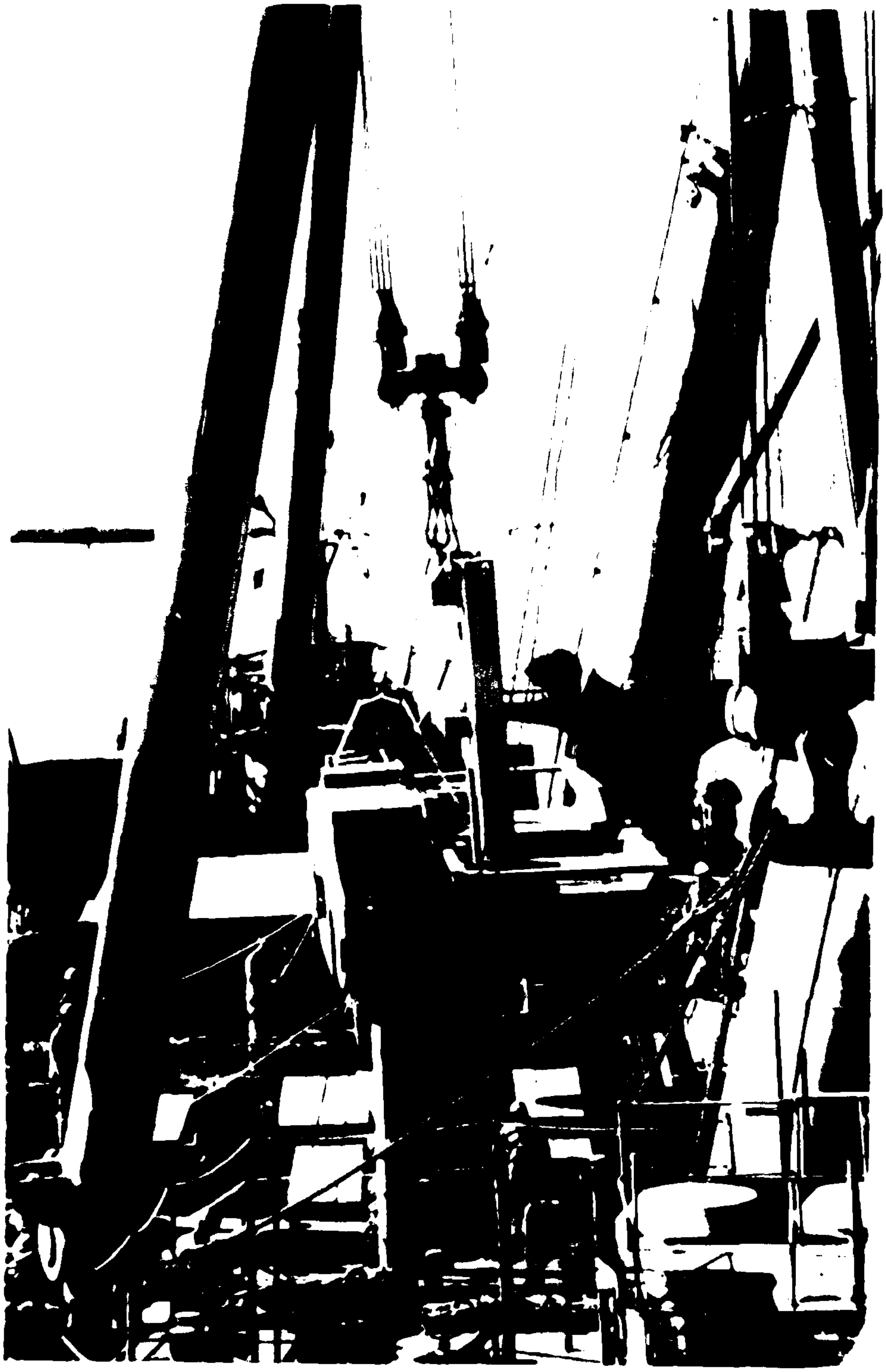


FIGURE D.30. SIDELOADER DECK-STOWED. The sideloader could have been stowed in a hold but to reduce loading time so that other events could be accomplished, it was deck-stowed. Its loading time was only 27 minutes, including rigging time.

FIGURE [illegible] sideloader for lifting it is necessary [illegible] attach and detach the chokers on the hook required [illegible] loading cycle and 9 minutes during off-loading.

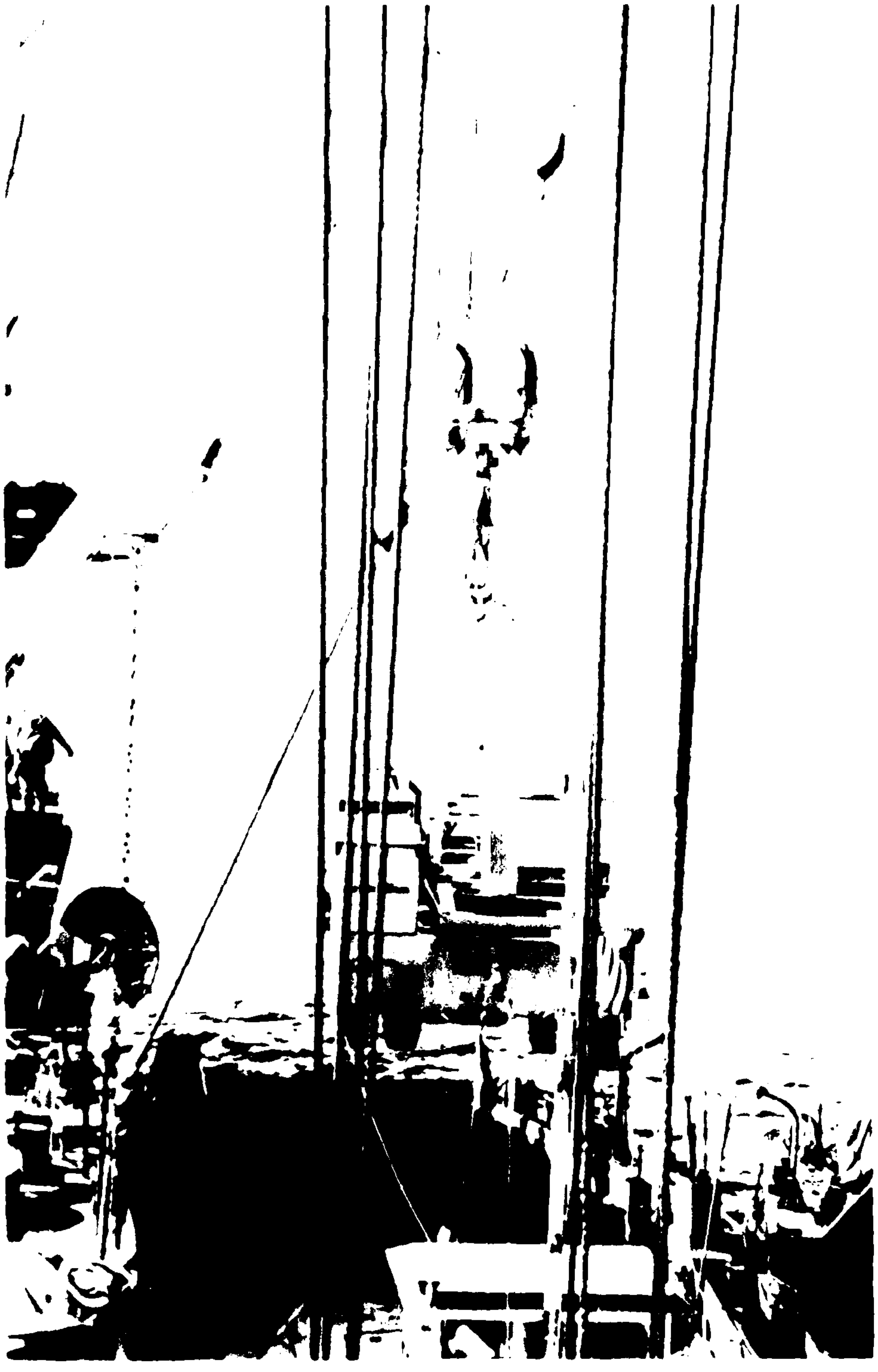


FIGURE D.32. SIDELOADER PLACED IN CLU. No difficulties were experienced off-loading the sideloader into an LCU. The sea state was relatively calm and the wind was light.

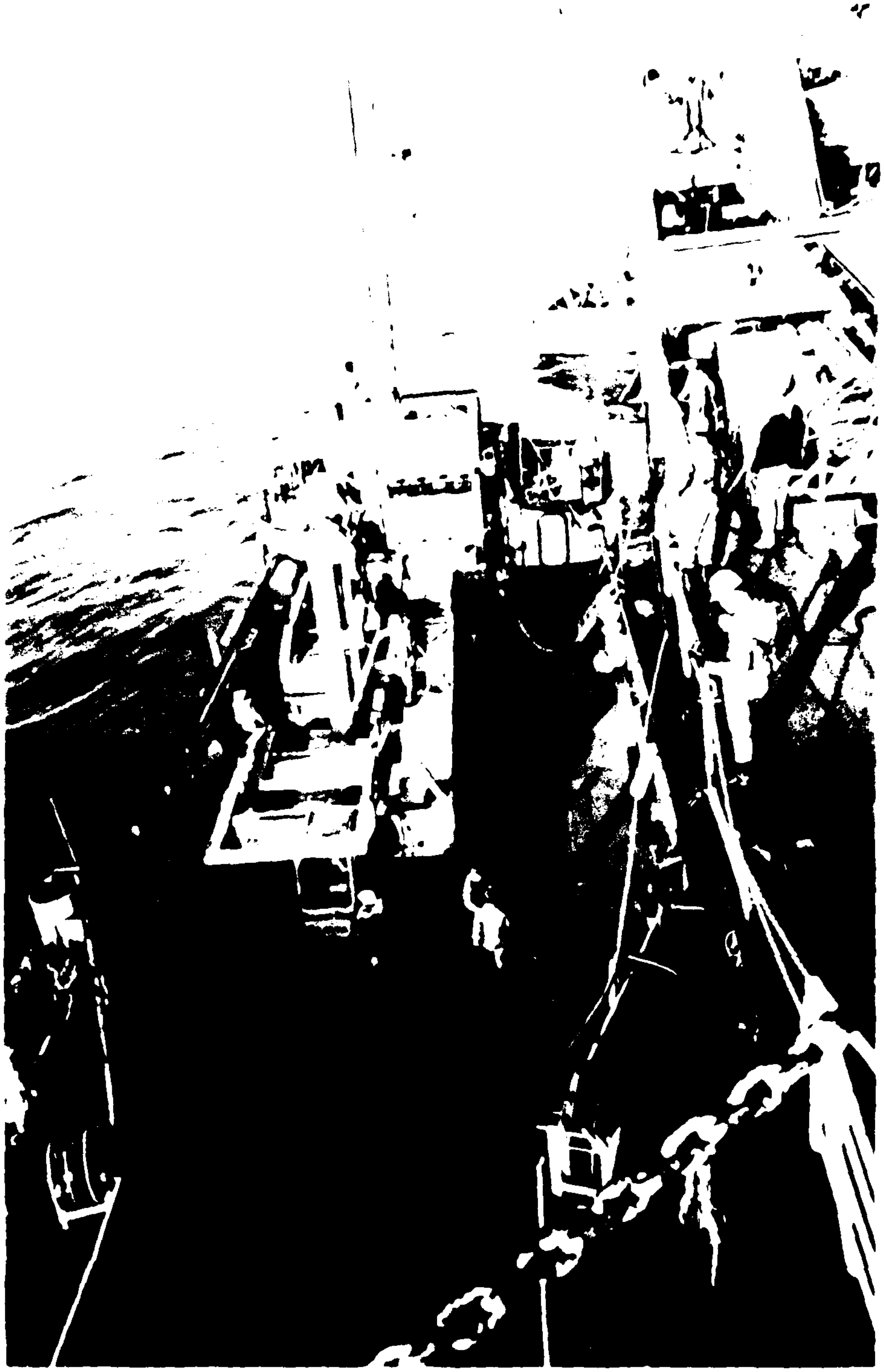


FIGURE [illegible]. OFF-LOADING TIME 34 MINUTES. The sideloader lift was the fastest one made. It took 34 minutes to off-load the sideloader, including time to moor and cast off the LCU.

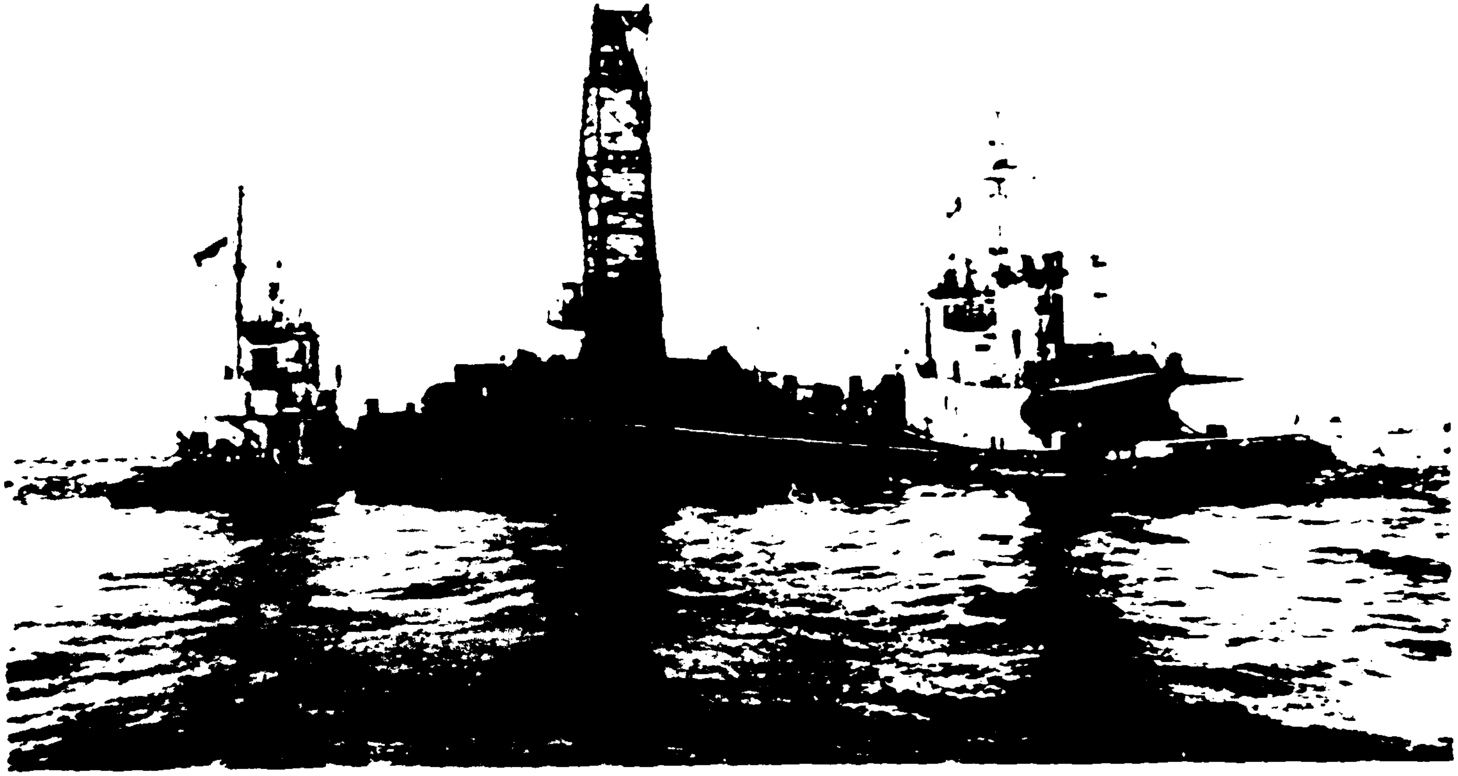


FIGURE D.34. TCDF TOWED TO PRETEST SITE. Once the deployment cargo had been off-loaded, the TCDF was positioned alongside the ship so that containers could be off-loaded and throughput events could begin.

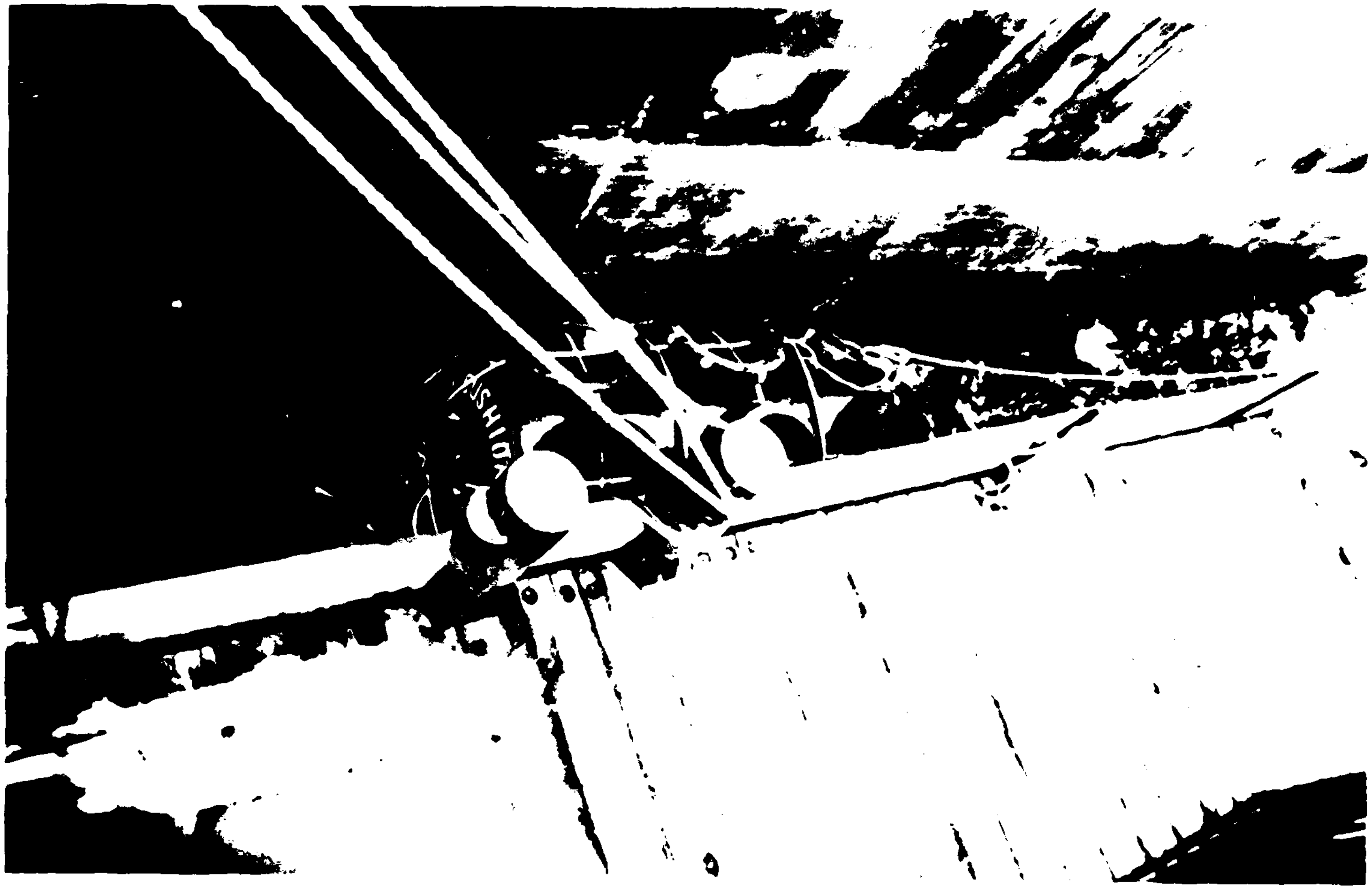


FIGURE D.35. FENDERS USED. Two special inflated fenders, one of which is shown above, were used to separate the TCDF from the ship.

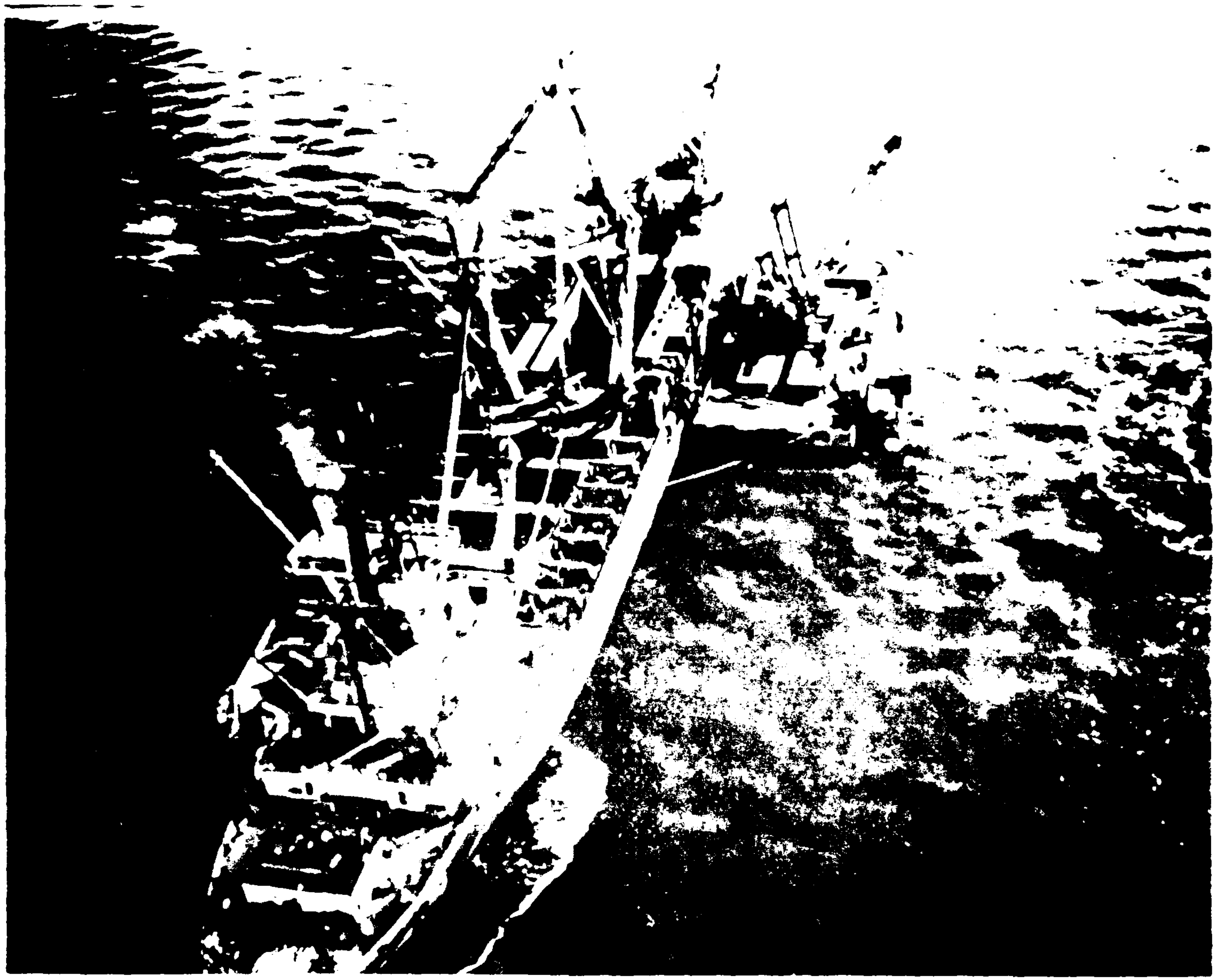


FIGURE D.36. OPERATIONS AT THE BOW. After the initial load of containers had been discharged the TCDF was moved to the bow of the ship. Later, when the TCDF had swung into the gap at the bow shown in the photo above, the container spreader bar had to be turned further to line up with the containers. This was difficult because a two-point attachment was used between the crane and the spreader bar.

FIGURE D.37. TCDF OPENS HATCH. To gain experience and crane data on hatch square opening, the TCDF was used to remove the 5-ton sections of the hatch cover.

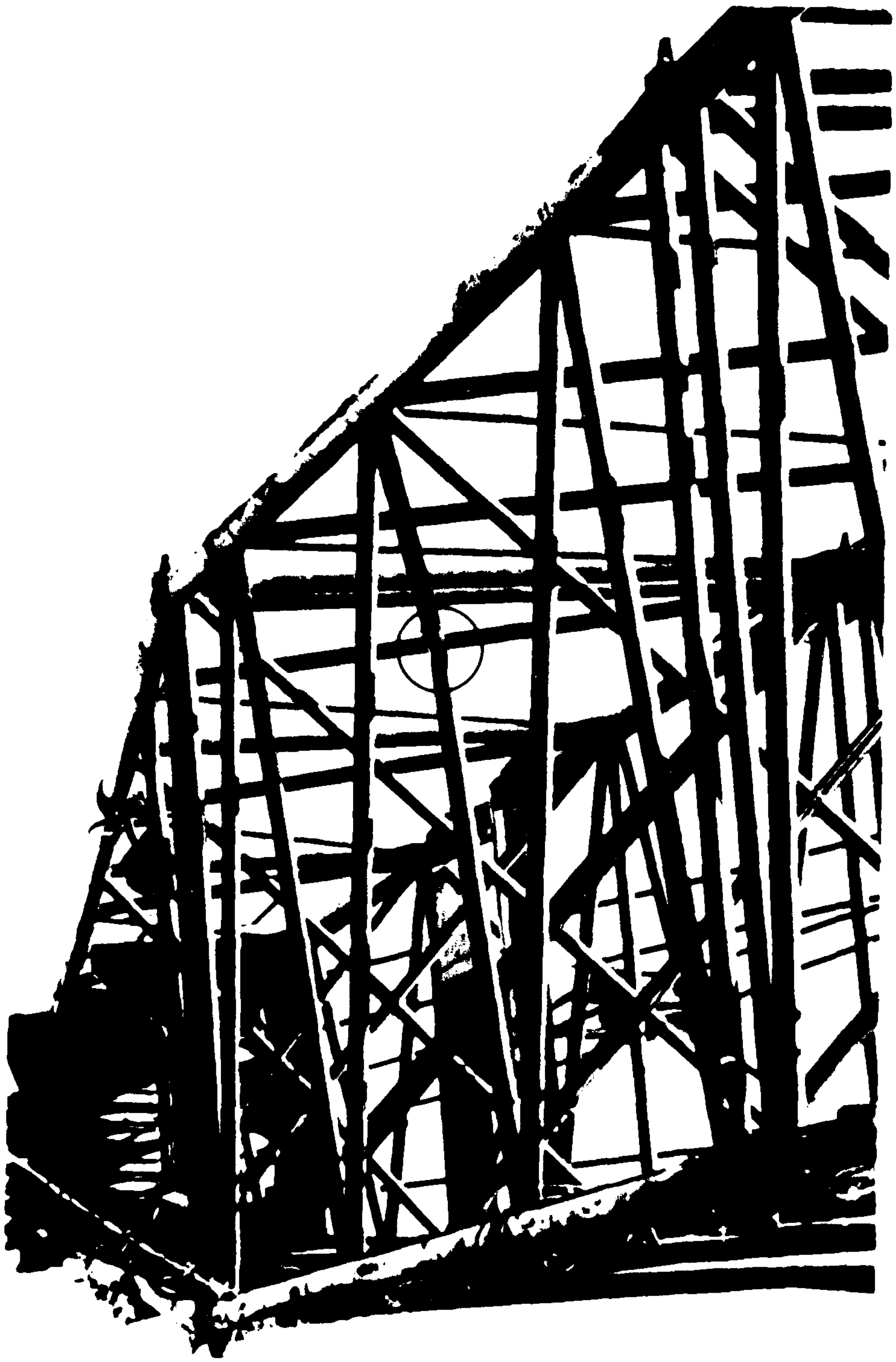


FIGURE D.38. BLOCK DENTS CRANE BOOM. On the first full day of container unloading the sea state caused the crane's block to pendulate during a break in the unloading. The heavy block struck the boom's tubing with sufficient force to seriously dent it.

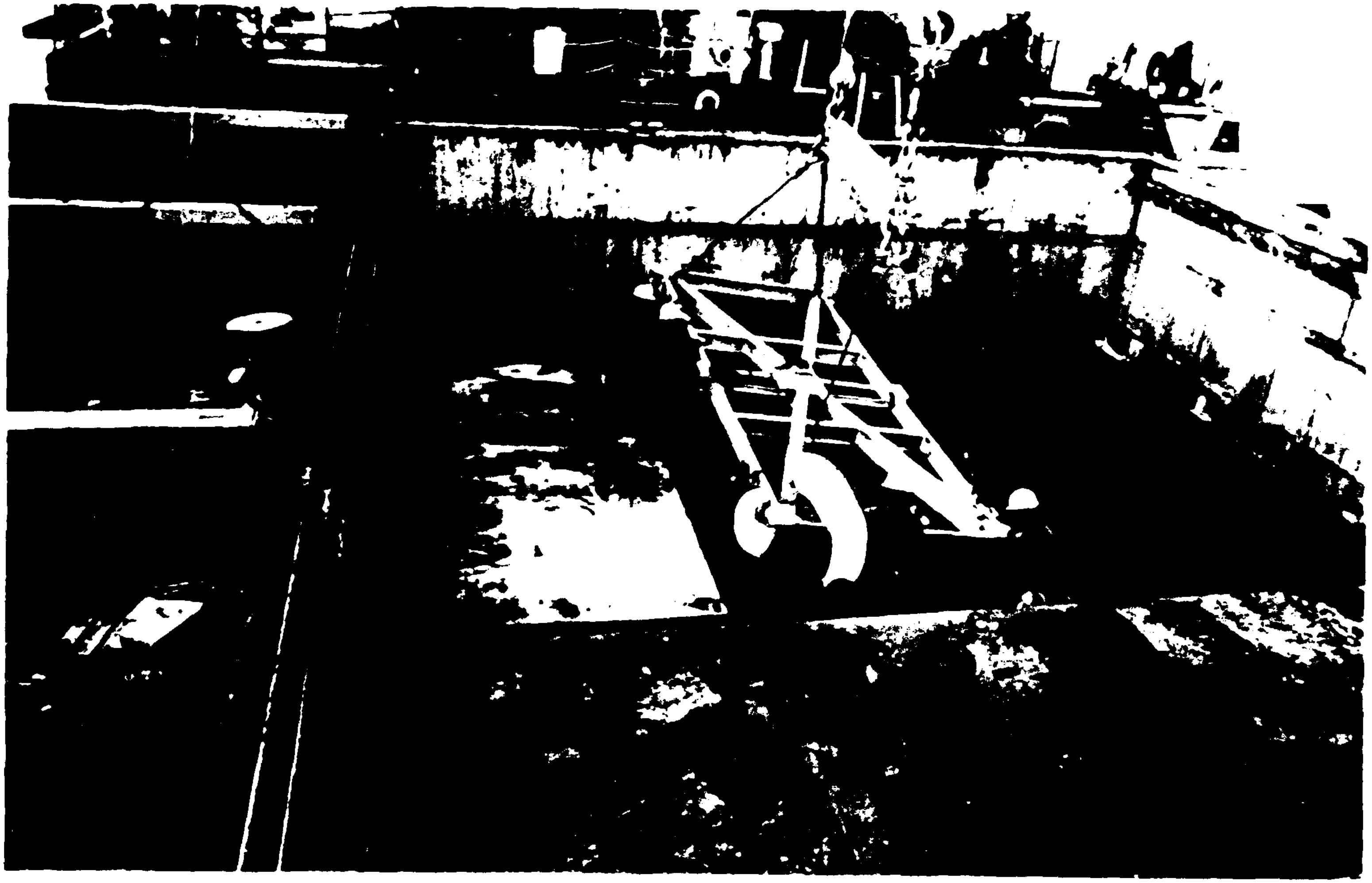


FIGURE D.39. POSITIONING SPREADER BAR. Without cell guides it was necessary to position the spreader bar manually in the hold. If the boom was not at a 90-degree angle to the container axis, delays and difficulties in attaching the spreader bar were experienced.

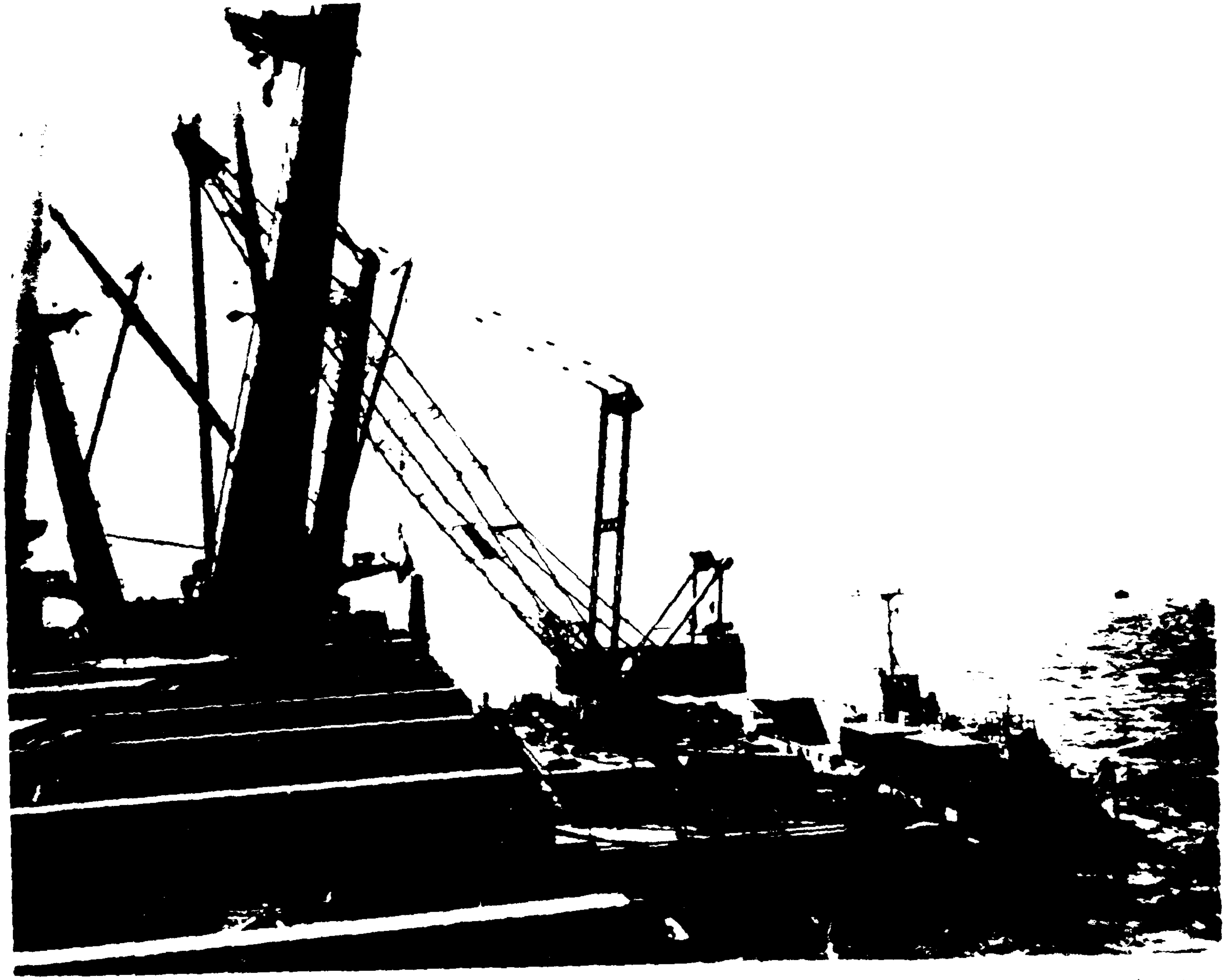


FIGURE D.40. BOOM TOPS [illegible]. Once the container was attached the crane had to top up as well as raise the hook in order to clear the ship's booms and kingposts. This added delays to cycle times that would not be typical of operations on the clear deck of a containership.

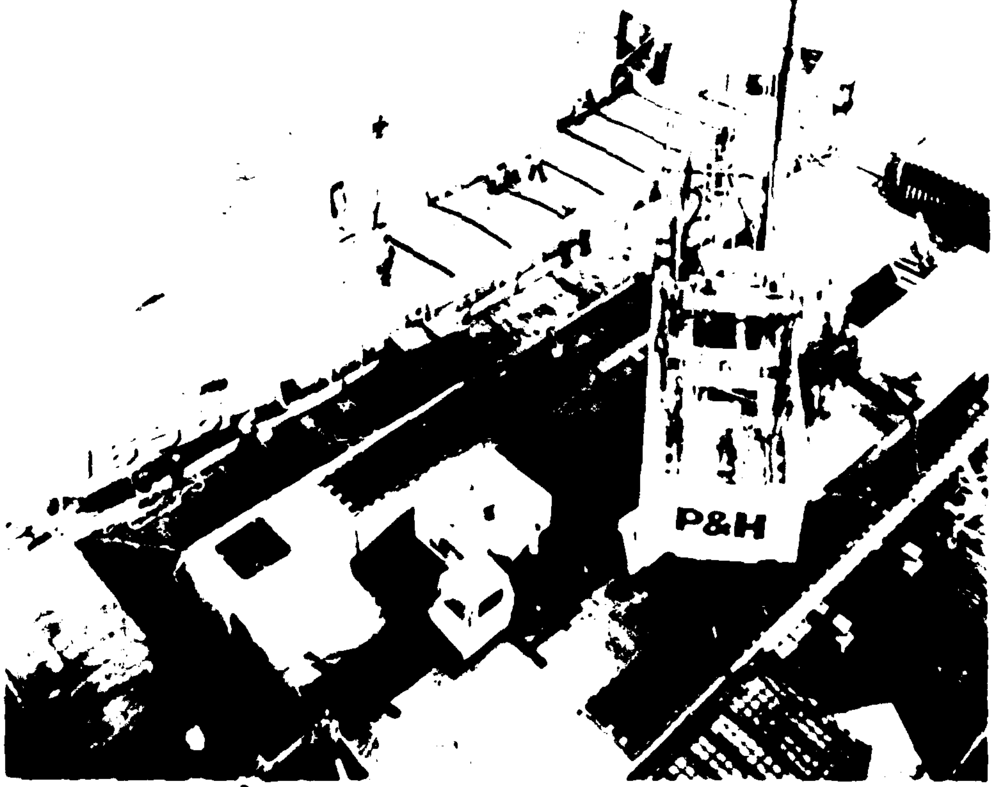


FIGURE D.41. LCU USED FIRE HOSE. To cushion the impact of containers being lowered, a problem when there is a sea state, fire hose was used on the deck of this LCU.

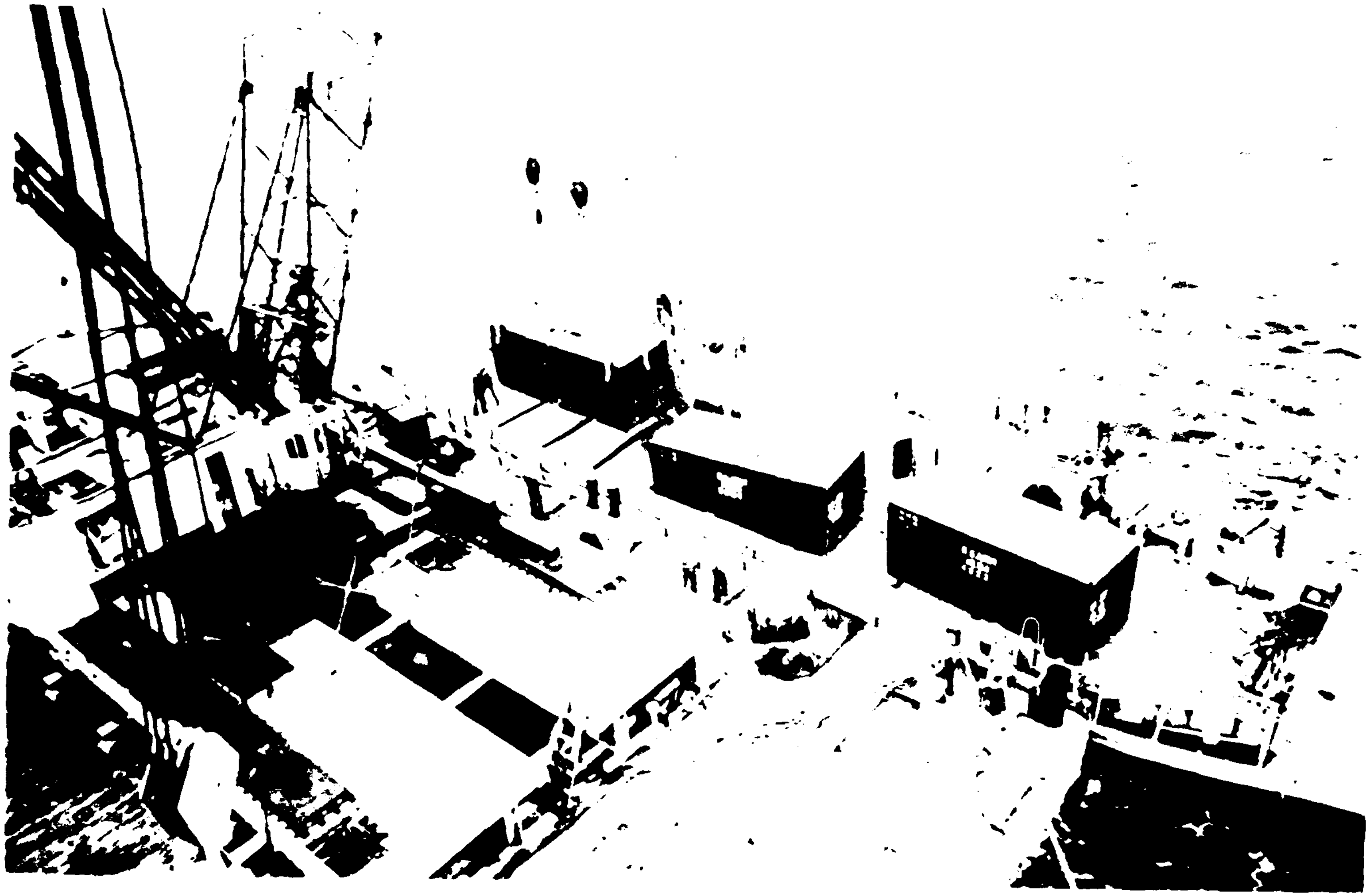


FIGURE D.42. LCU LIGHTLY LOADED. Normally an LCU would be loaded with four containers but because of the limited number of containers available, capacity loading was not practiced.

FIGURE D.43. MOBILE LOADING TIME-CONSUMING. One method of minimizing handling at the beach is to place trailers on a causeway ferry and load the trailers shipside. However, because of the motion of the seas and the need for close alignment during loading, it required approximately an hour to load just two of three trailers and it became apparent that the method was too time consuming.

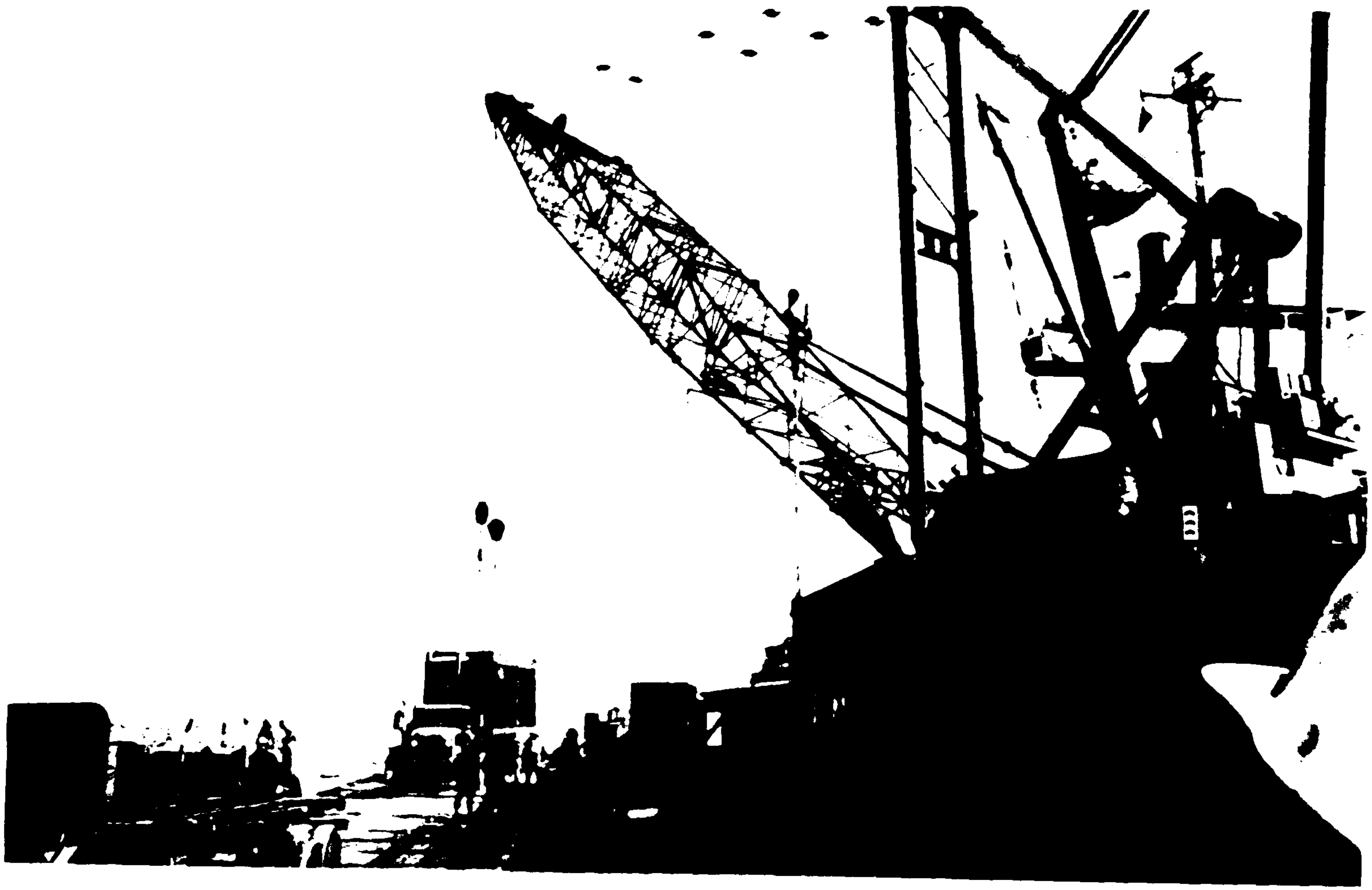


FIGURE D.44. SPREADER BAR NOT ALIGNED. With a two-point spreader bar attachment and automatic taglines, the spreader bar and container were nearly always perpendicular to the boom, while the trailer chassis was not. This necessitated man-handling the container until it was in a position that would permit lowering the trailer corner fittings.

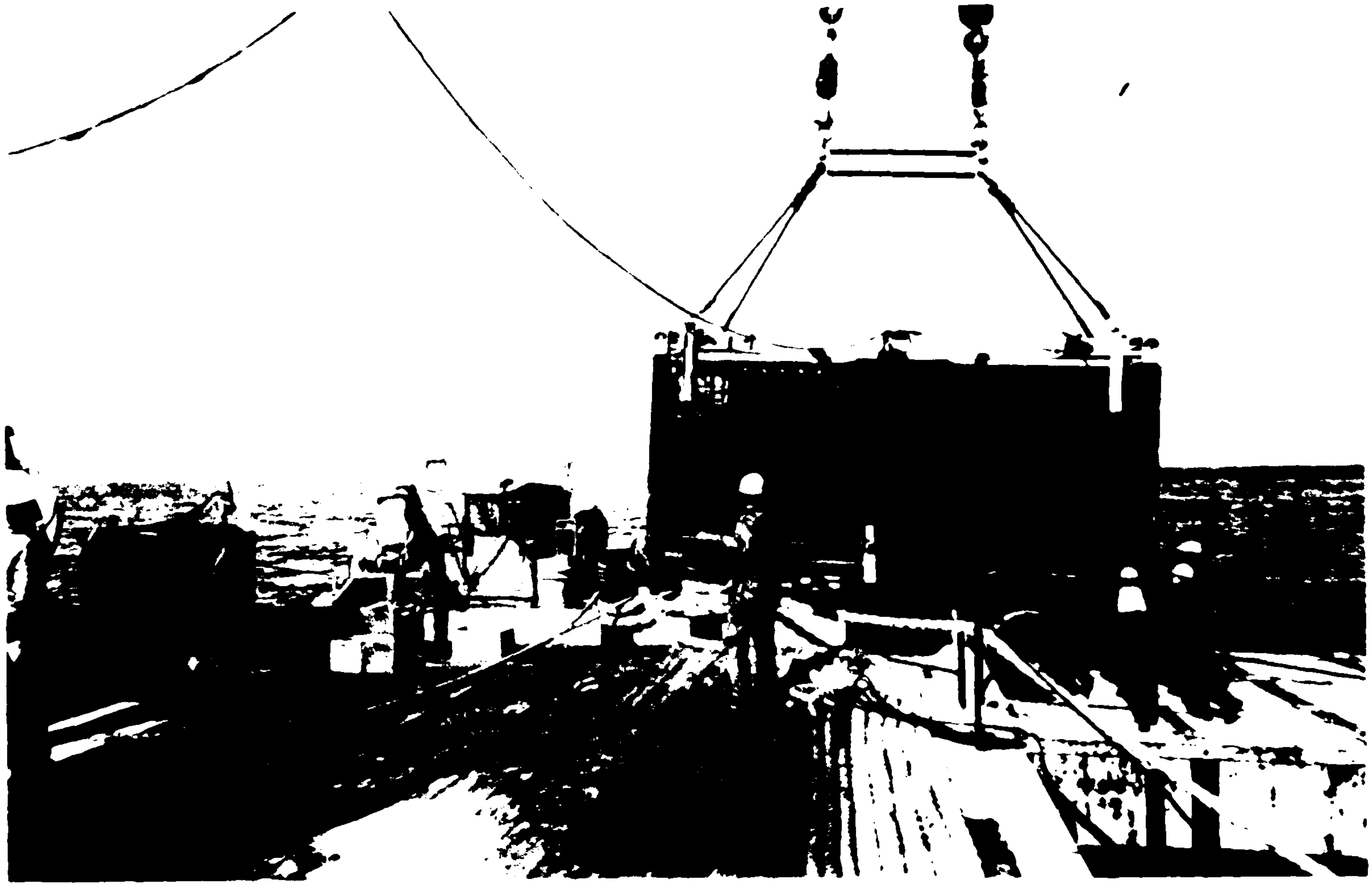


FIGURE D.45. ALIGNMENT DIFFICULT. Aligning the container with the trailer required from 4-[illegible] personnel to force the container into position so it would engage the corner fittings. Because the procedure was so time-consuming one trailer returned to the beach without being loaded.

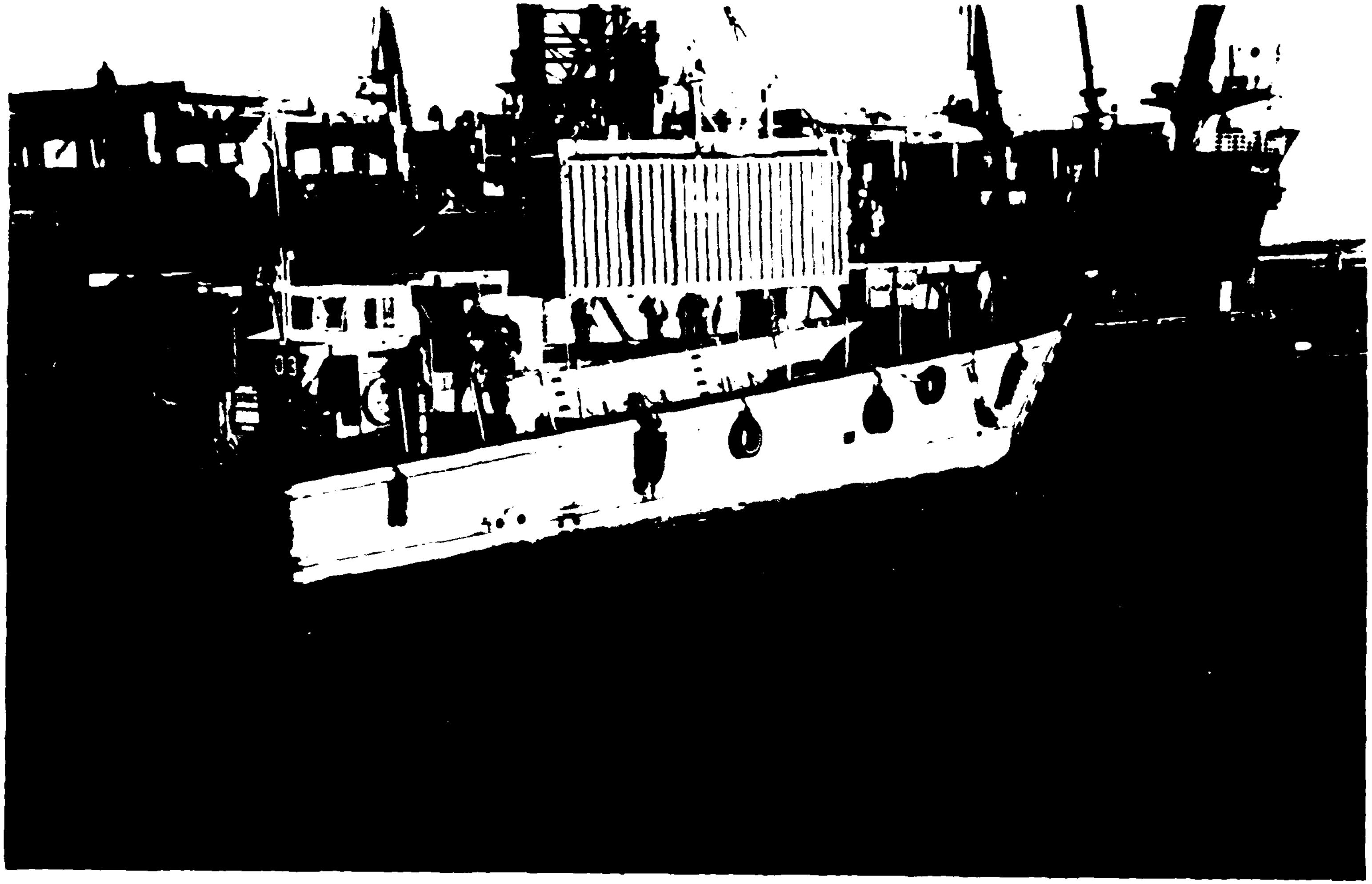


FIGURE D.46. LCM8s USED. LCM8 landing craft received extensive use in the pretest and had better beaching capabilities than LCUs, although both were unable to beach close enough to shore cranes at low tide.

FIGURE D.47. DELONG PIER POSITIONED. To improve shoreside unloading capabilities a 140-ton crane was positioned on a DeLong barge and towed to the objective area. The DeLong was beached using two LCM8s. Later the DeLong was jacked-up out of the water on its pilings and ramps were added so that trucks could drive from the beach onto the pier.

FIGURE D.48. LCU RETRACTS. An LCU is shown above retracting from the DeLong pier after unloading at high tide.

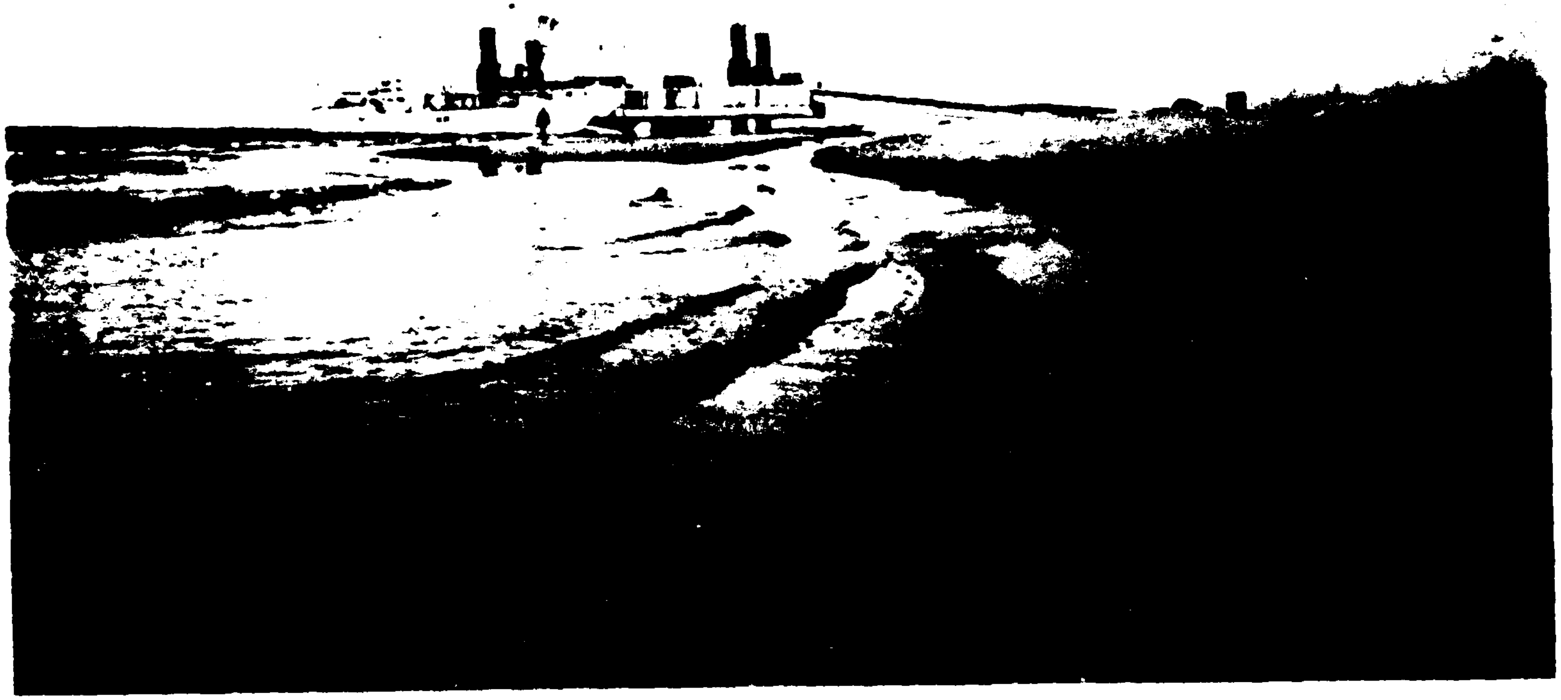


FIGURE D.49. LOW TIDE PROBLEMS. Because of the gentle beach gradient and the fact that a single DeLong does not extend far enough seaward, landing craft were stranded at low tide. At low tide only amphibians could be unloaded.

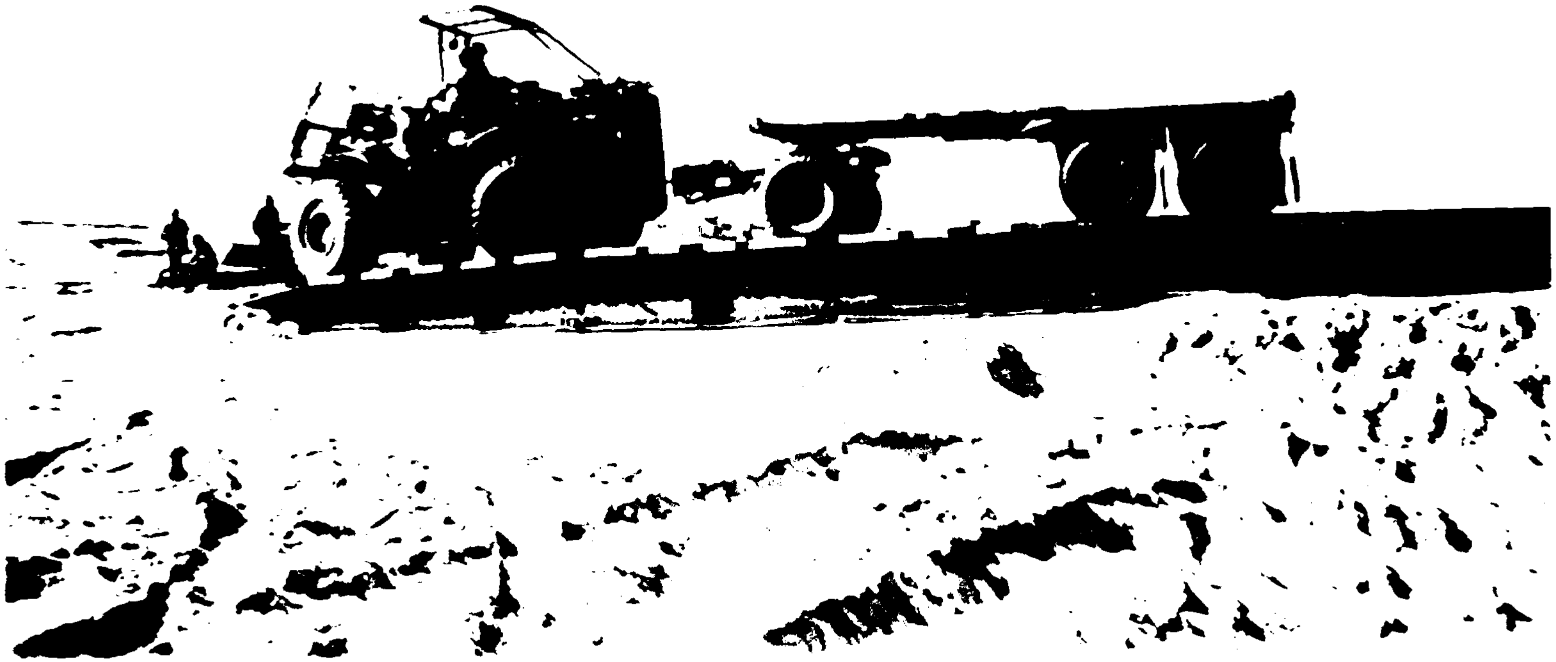


FIGURE D.50. RAMP PROBLEMS. Truck drivers experienced difficulty backing their trailers up the ramp so a rough terrain forklift, which has articulated steering, was tried. The above ALWB ramp connects onto the DeLong ramps. The ALWB ramp was subsequently replaced by a sand ramp.

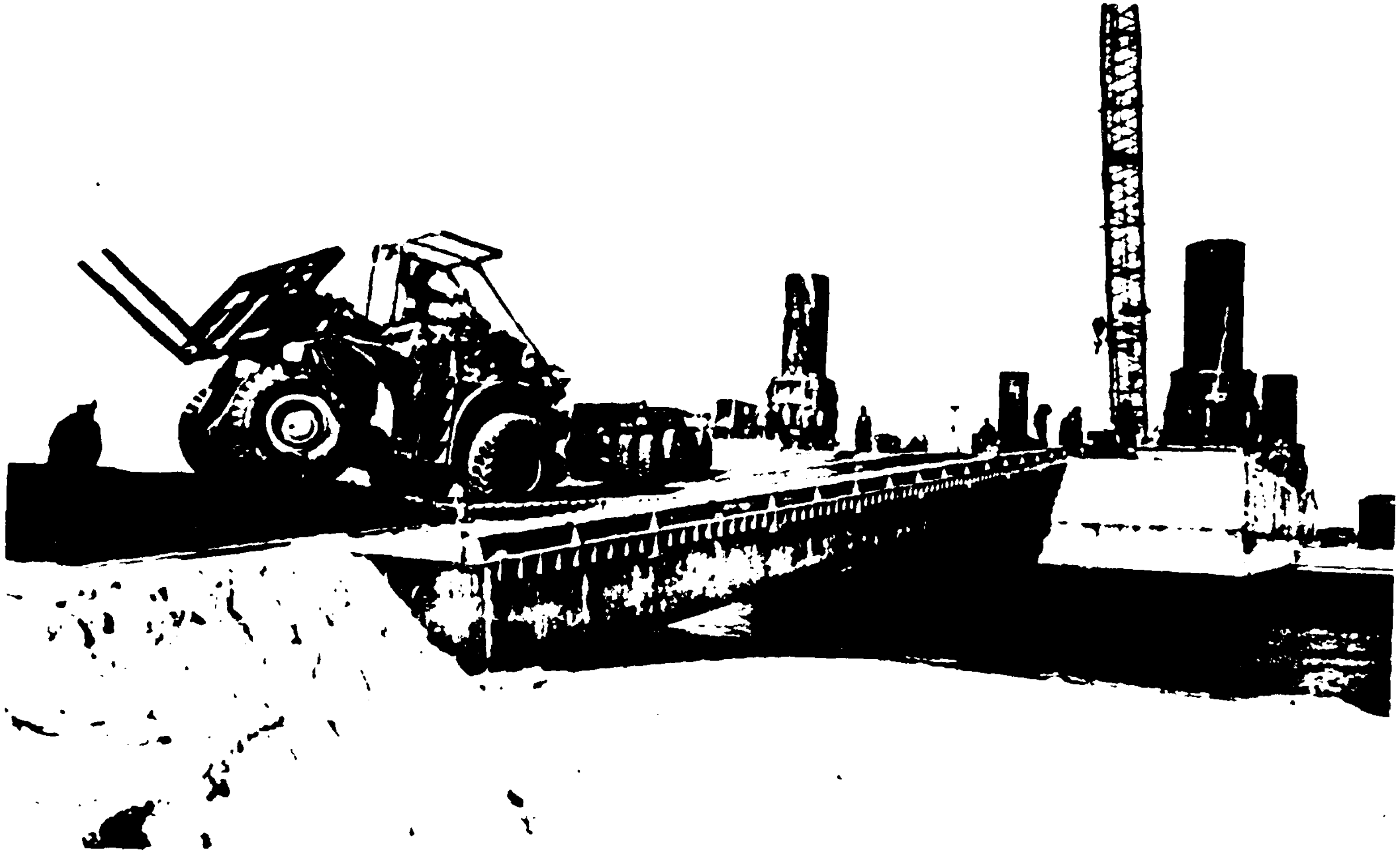


FIGURE D.51. CRANE DELAYED. Until the trailer was positioned under the crane, operations were choked. With experience drivers were able to more rapidly back their trailers up the ramp.

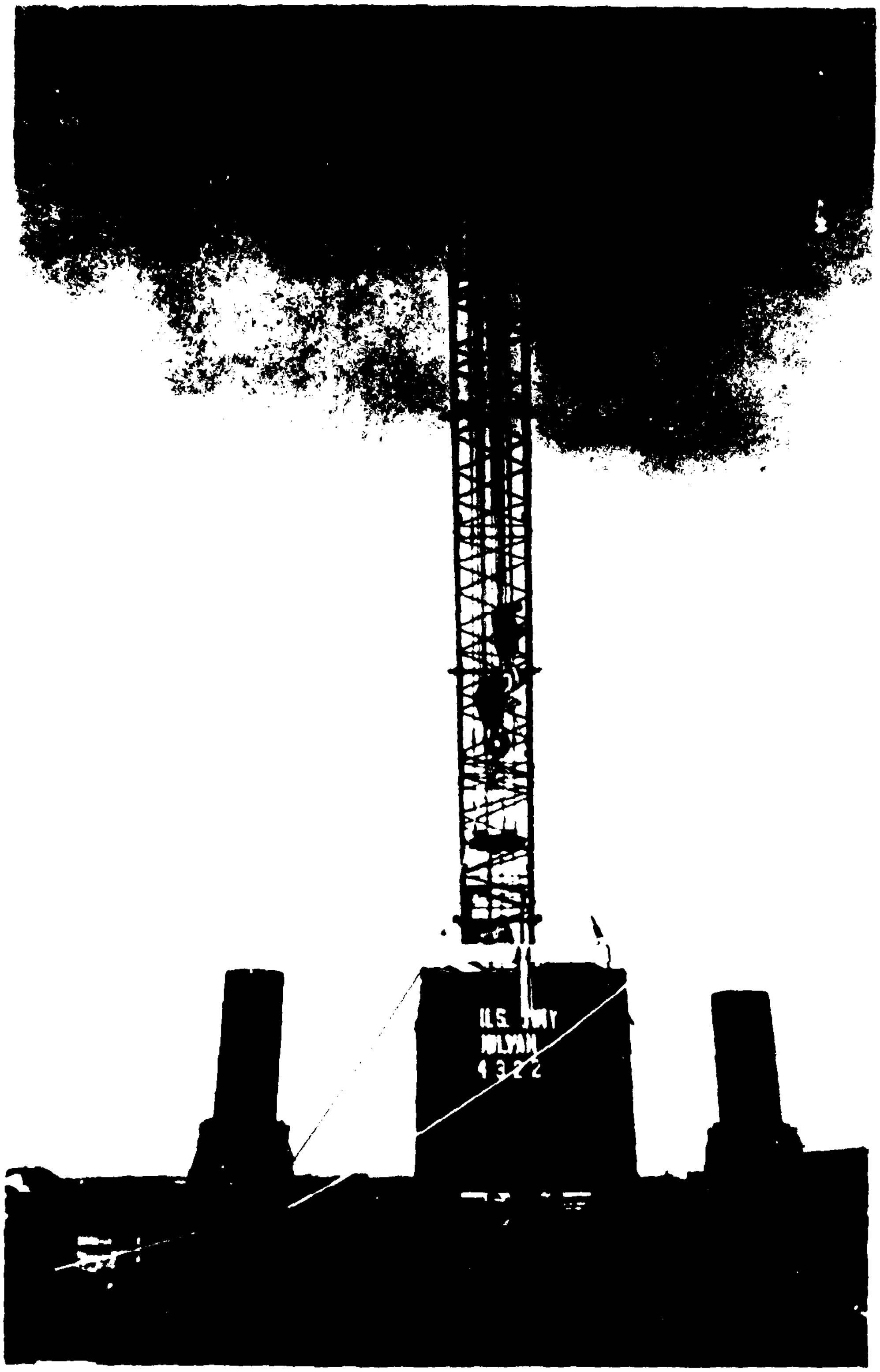
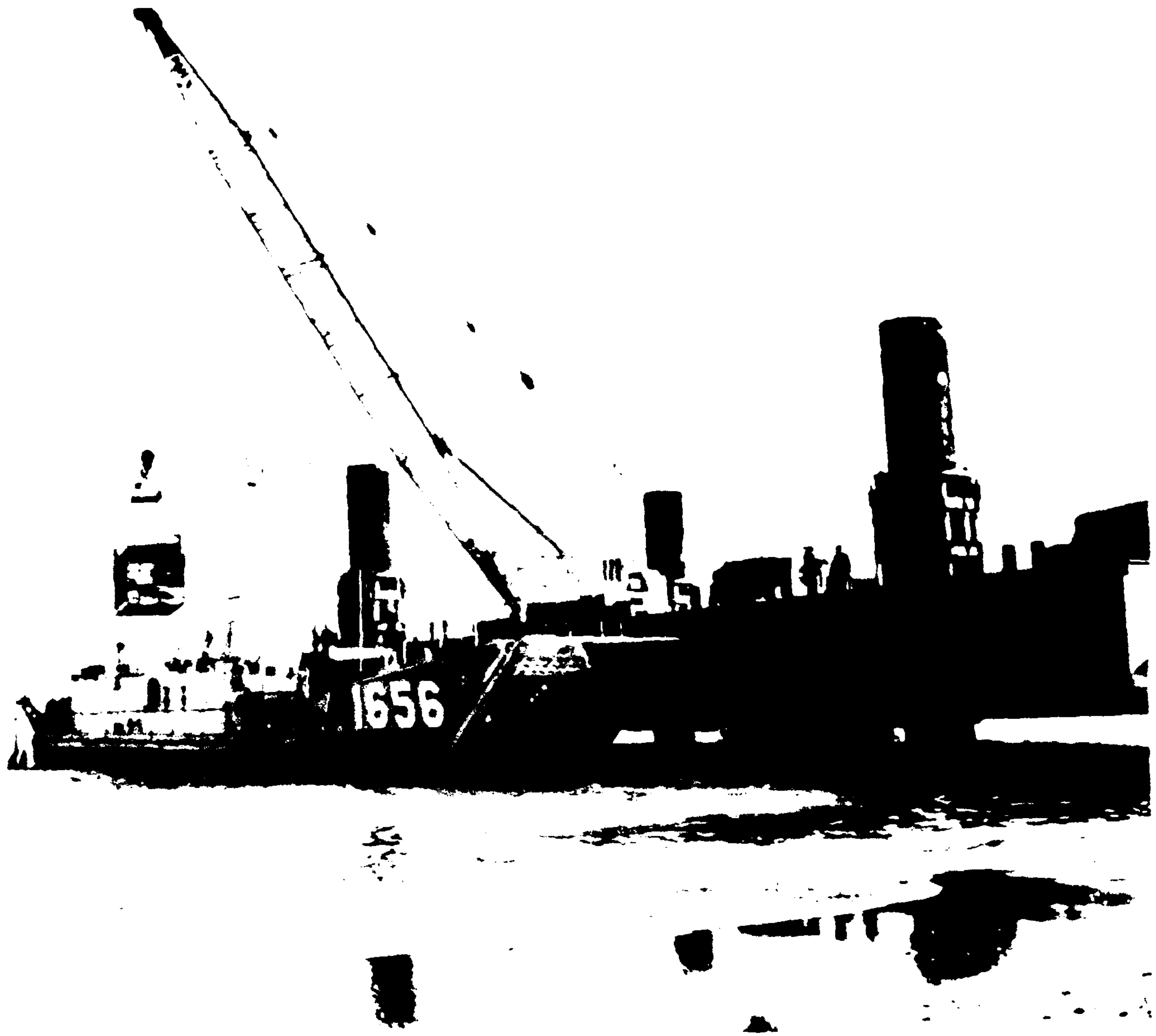
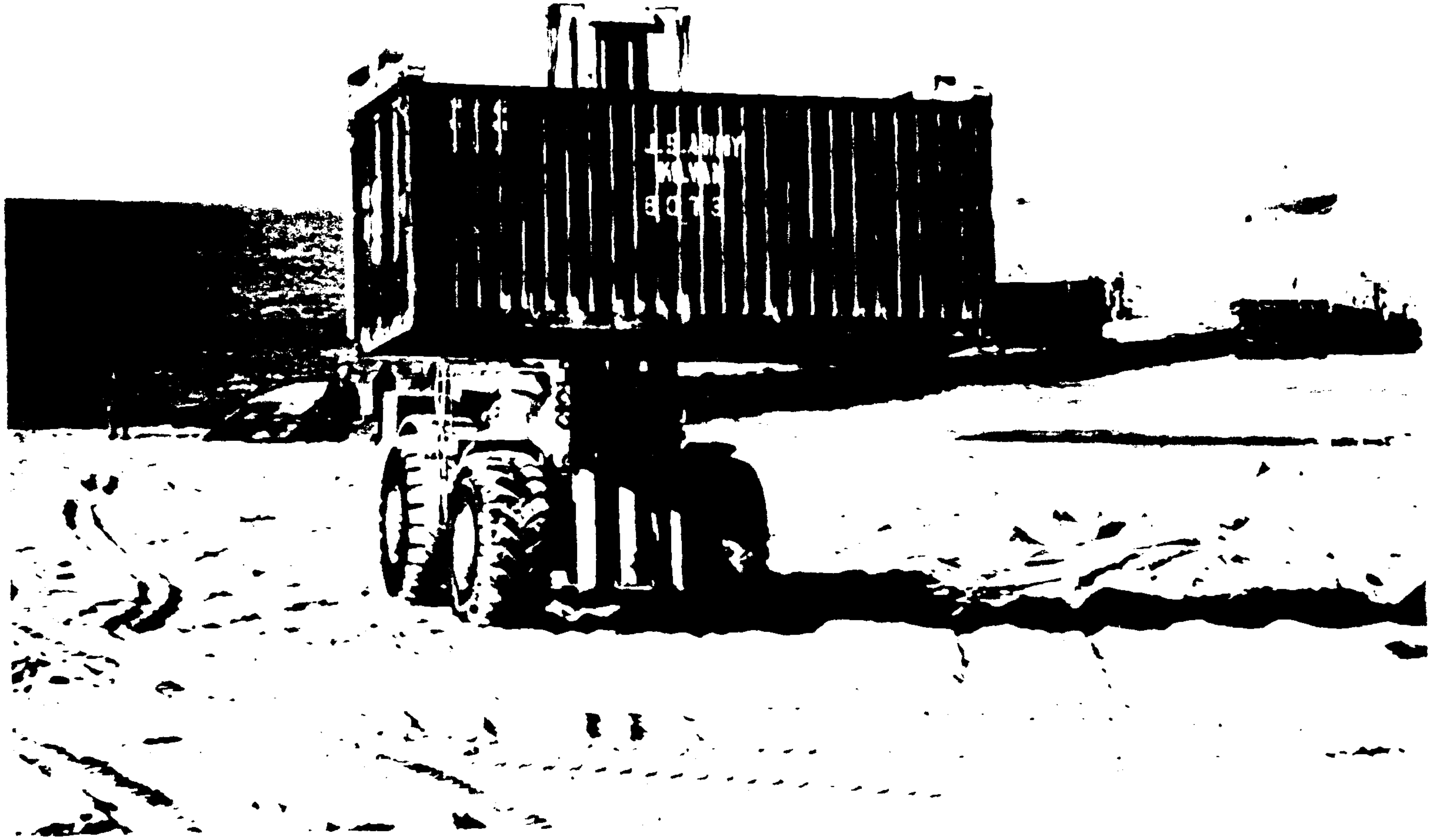


FIG. [illegible] IN POSITION. Once the milvan chassis was on the [illegible] loaded.



[illegible] At high tide all landing craft could easily moor to the [illegible] pier.

FIGURE D.64. CAUSEWAY FERRY. [illegible] the best [illegible] was the Navy causeway ferry. [illegible]



[illegible] The Army frontloader carrying a 14-ton container from the causeway [illegible] beach preparation was necessary.

FIGURE D.56. [illegible] A [illegible] chassis on a hard surface is [illegible] above by the frontloader. From the time the container was [illegible] on the causeway [illegible] the time it was loaded onto the chassis required approximately 4 minutes.

[illegible] Before a driver could depart the beach, corner fittings had to be engaged. The driver [illegible] was operating on beach matting.

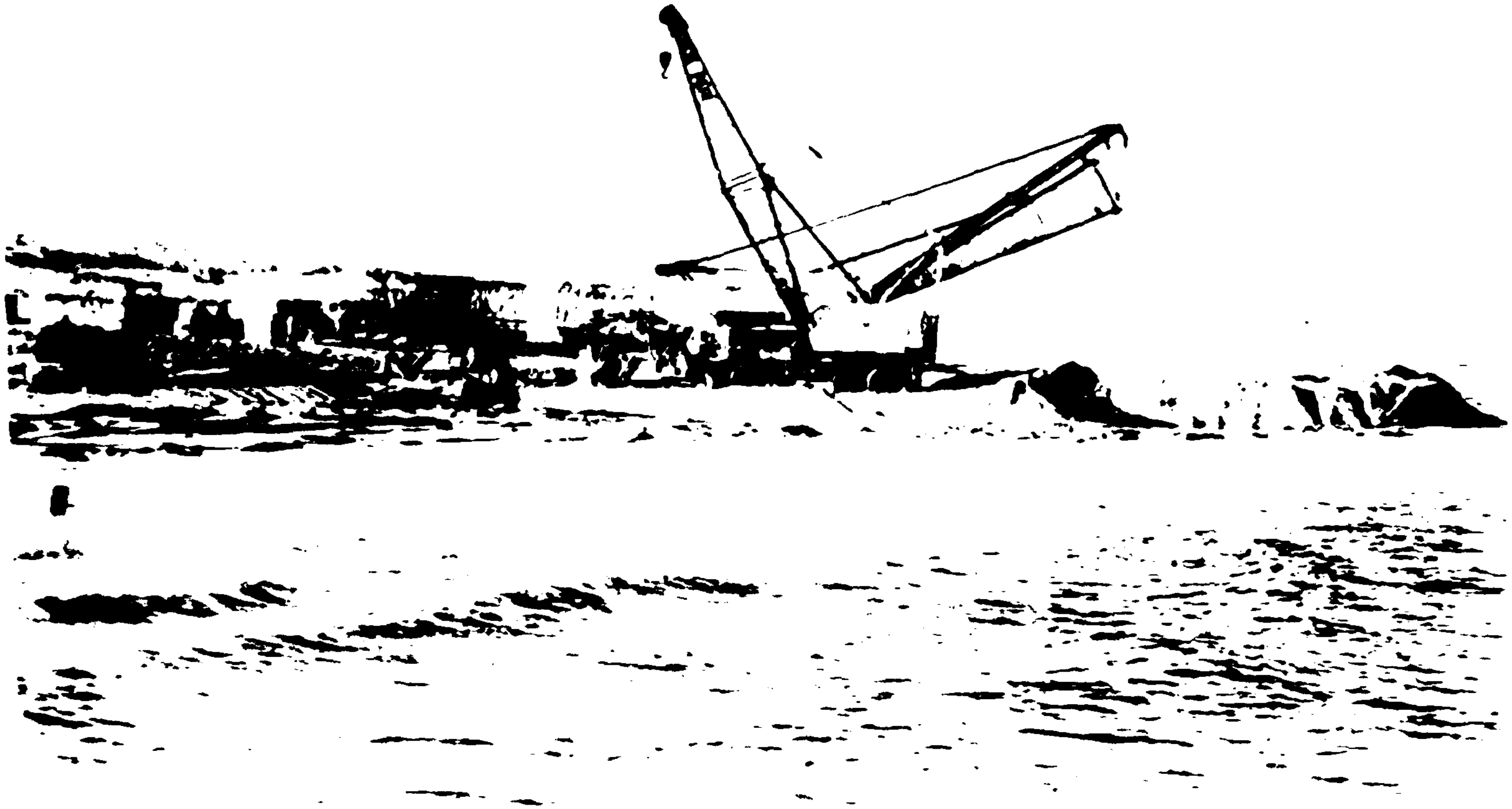


FIGURE [illegible]. BEACH CRANE ASSEMBLY BEGINS. Once the 300-ton crane was landed and turned around, its assembly could be completed. It required [illegible] days before being operational, although no night operations were conducted and [illegible] that time were spent reversing the crane due to the necessity of [illegible] the crane [illegible] (see Figure [illegible]).

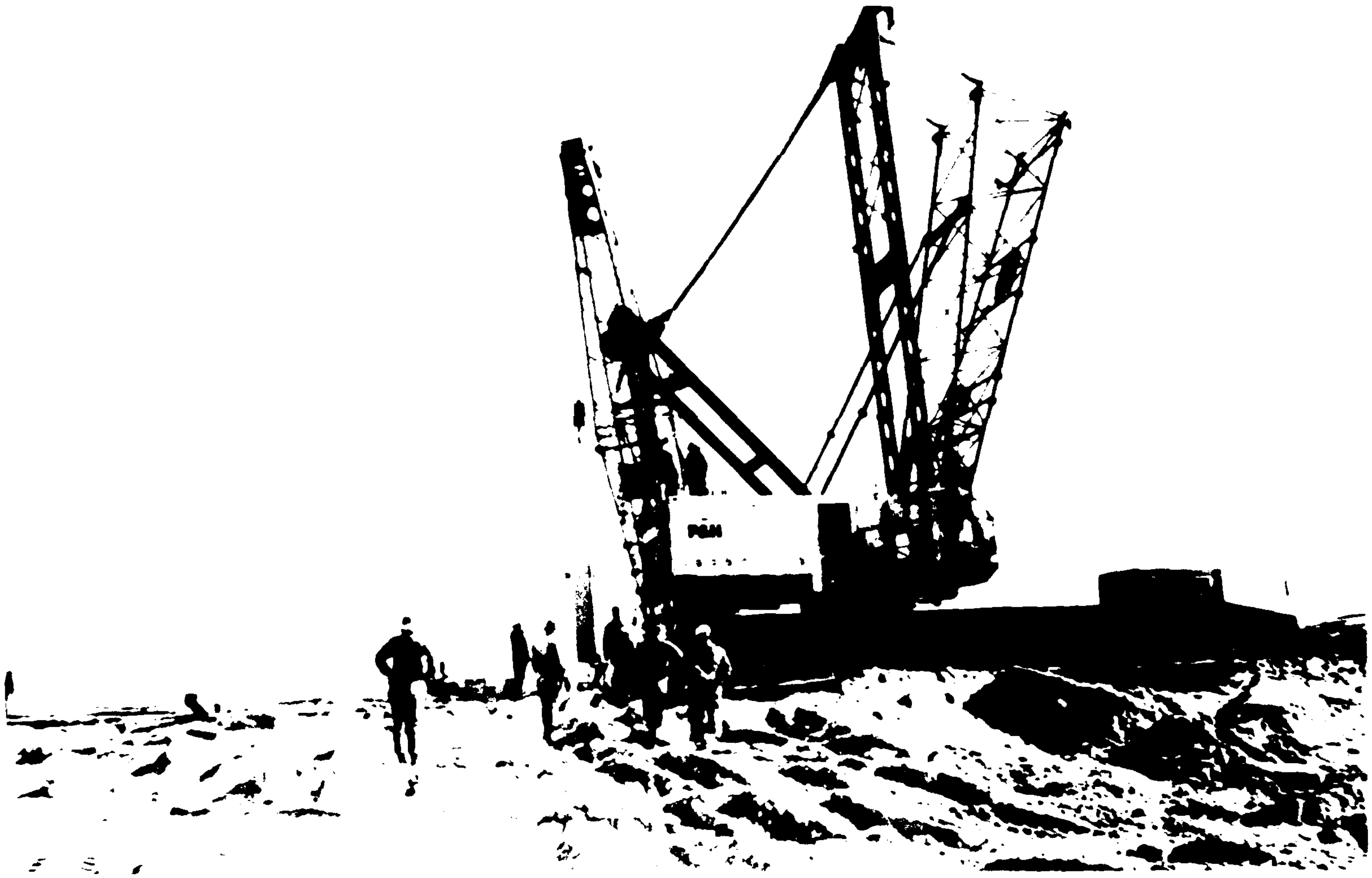


FIGURE D.59. 140-TON CRANE ASSISTS. To recover time lost in turning the 300-ton crane, a 140-ton crane assisted in reassembly. Normally, the 300-ton crane can make itself operational without assistance.

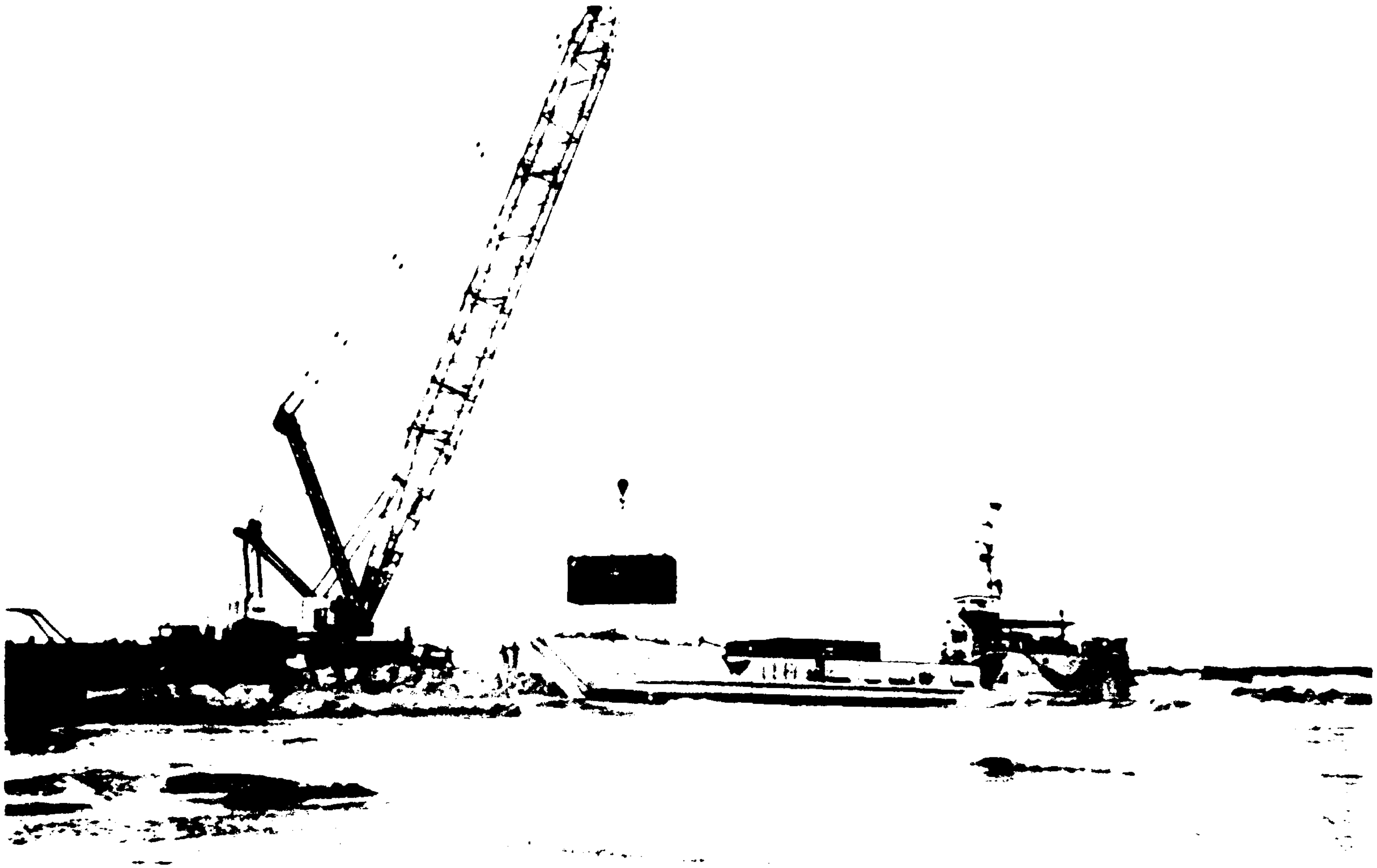


FIGURE D.60. HIGH TIDE OPERATIONS. At high tide landing craft were able to beach within reaching distance of the beach crane and were unloaded without difficulty.

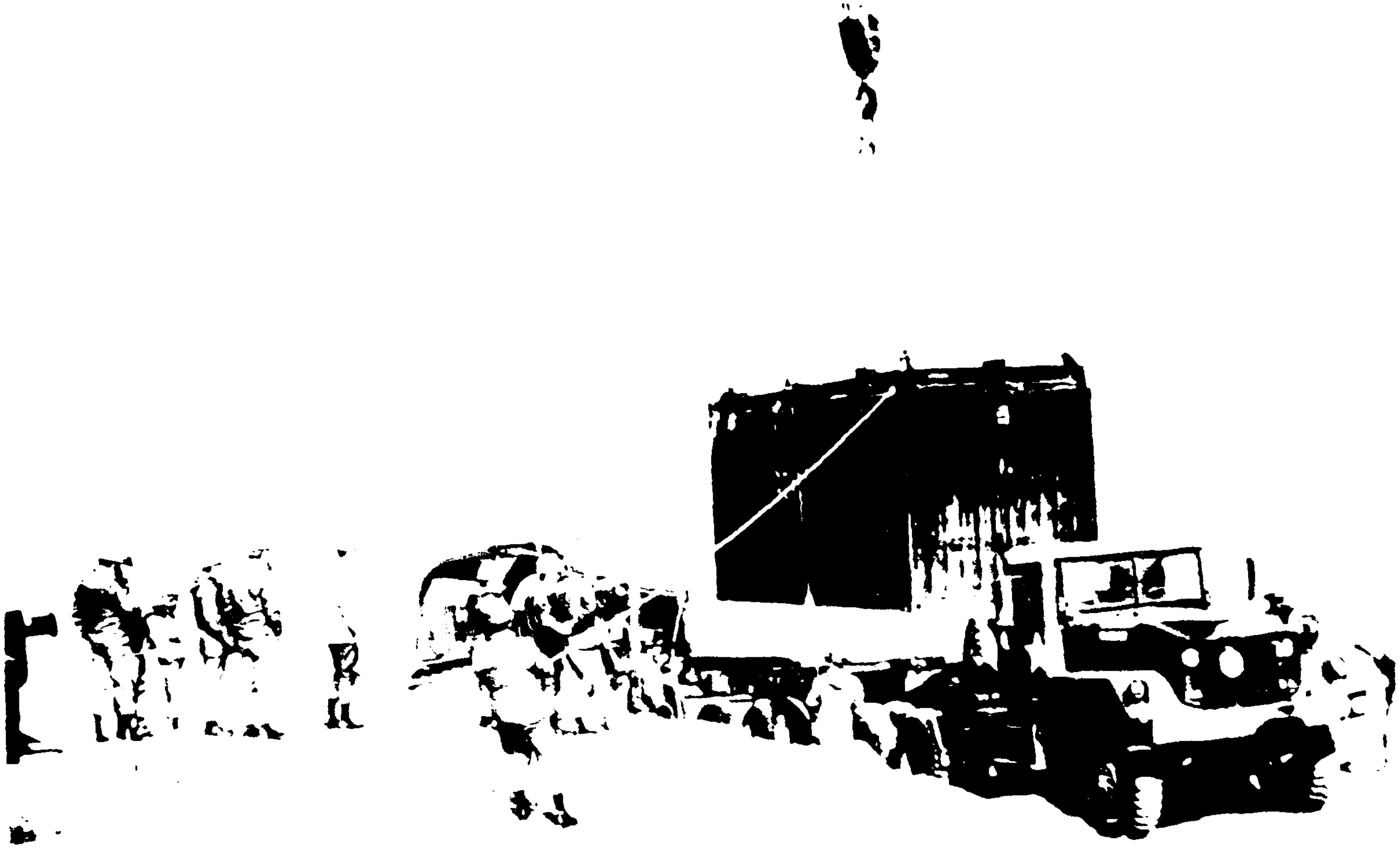


FIGURE [illegible] TRAILER BEING [illegible] CONTAINERS [illegible] once lifted off the [illegible] containers were [illegible] chassis for dispatch to the marshalling site.

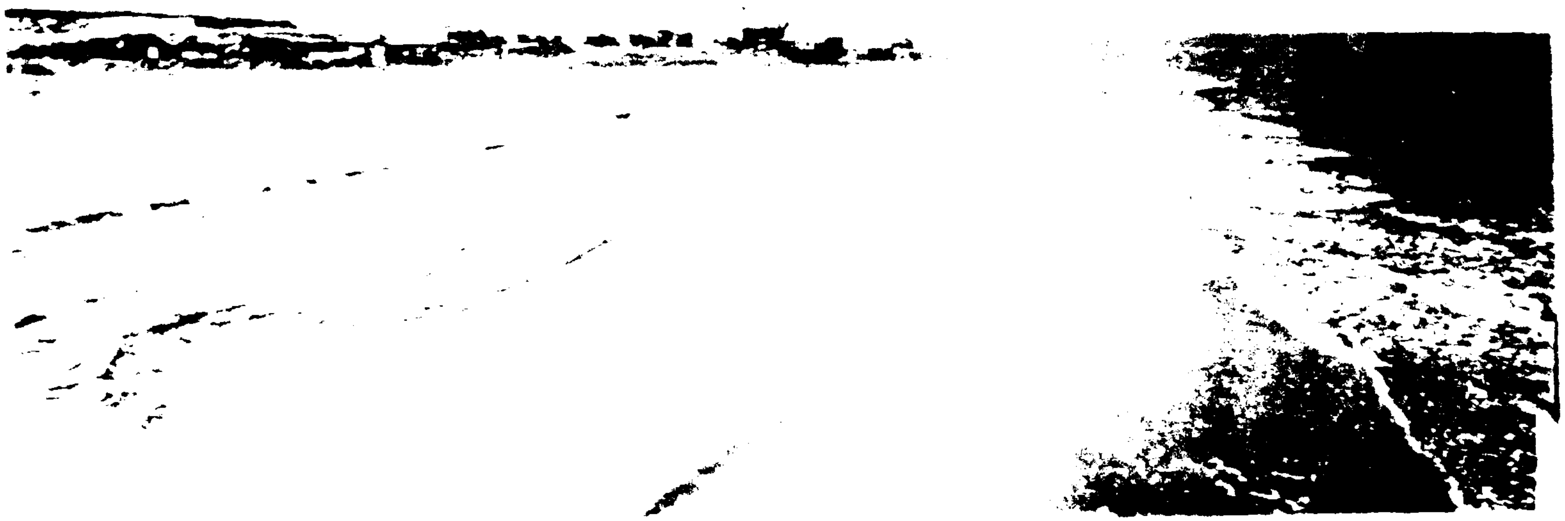


FIGURE [illegible]. As the tide went out, [illegible] no longer could reach within the crane's boom radius. The [illegible], which weighs approximately [illegible] when operational, is unable to readily move across the sand and follow the tide out.

FIGURE D.63. CHANNEL DREDGED. In an effort to keep the beach crane operational a channel was dredged seaward of the crane by bulldozers.

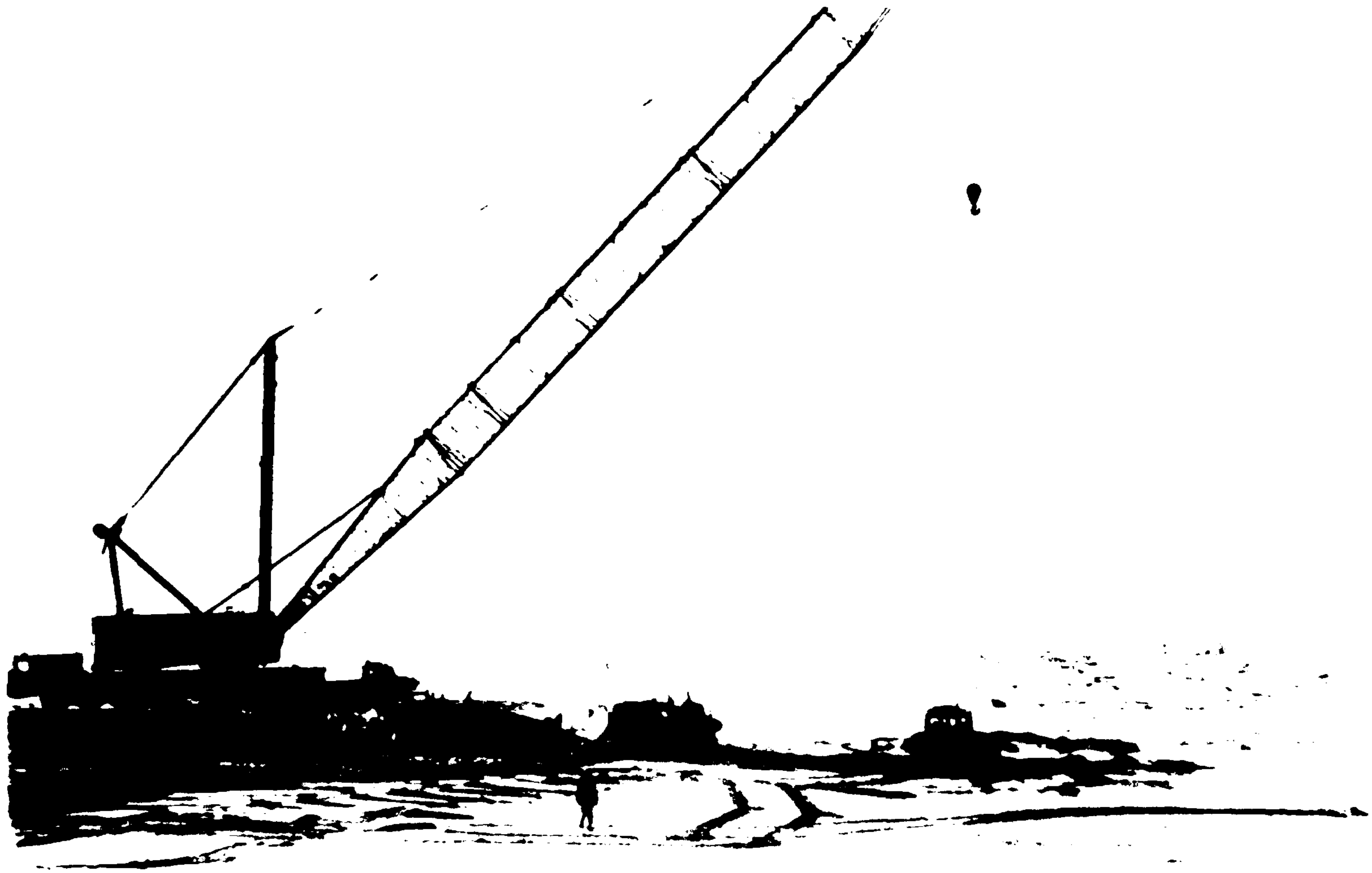


FIGURE D.64. CHANNEL N [illegible] After approximately 1[illegible] hr of dredging, it was apparent that a channel deep enough could not be excavated. The above photo was taken about 30 minutes before low tide.

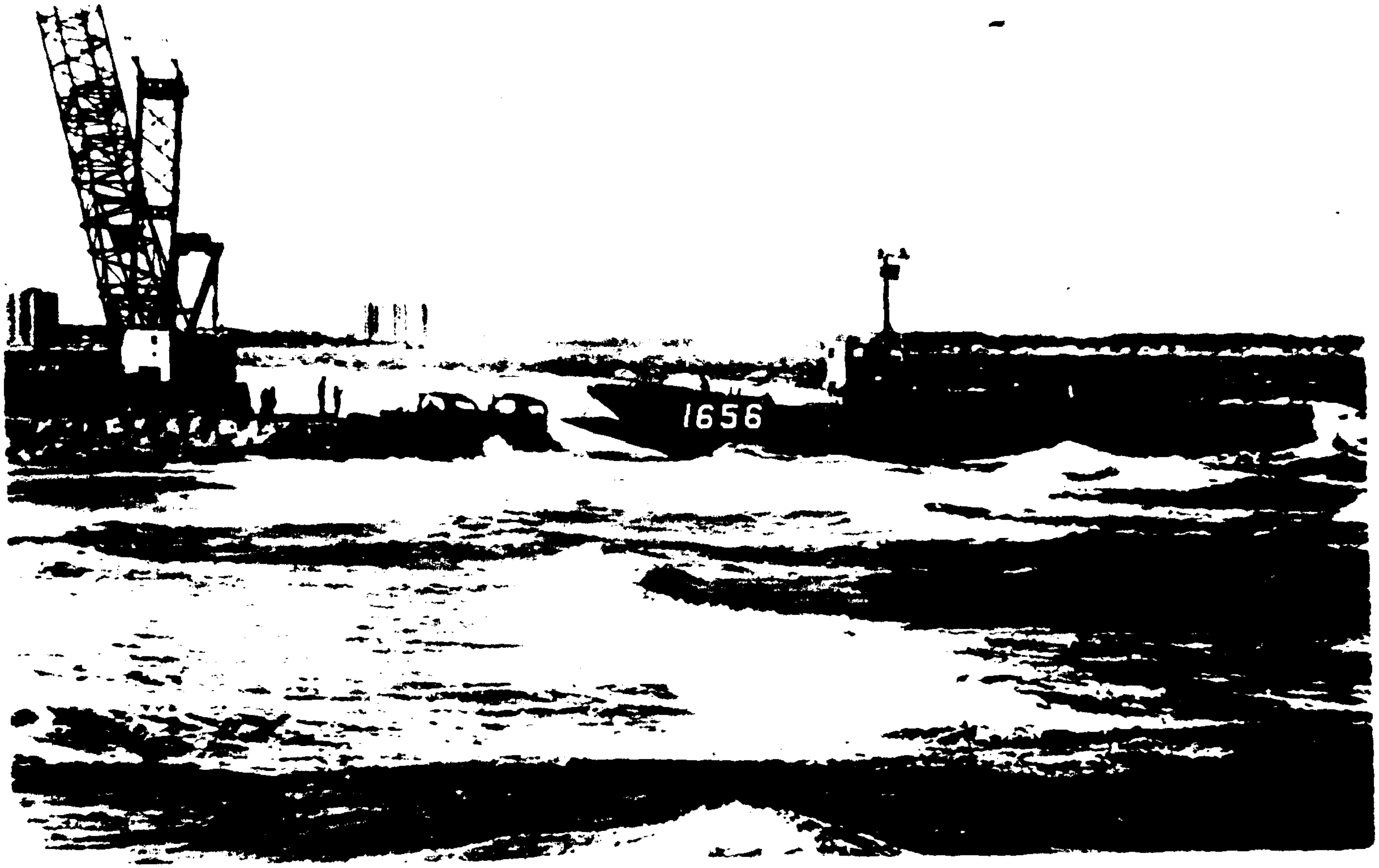


FIGURE D.65. ROUGH WEATHER EXPERIENCED. Another problem was encountered when the surf and winds increased. The sand ramp upon which the crane had been placed began to erode and had to be repaired at high tide by dozers.

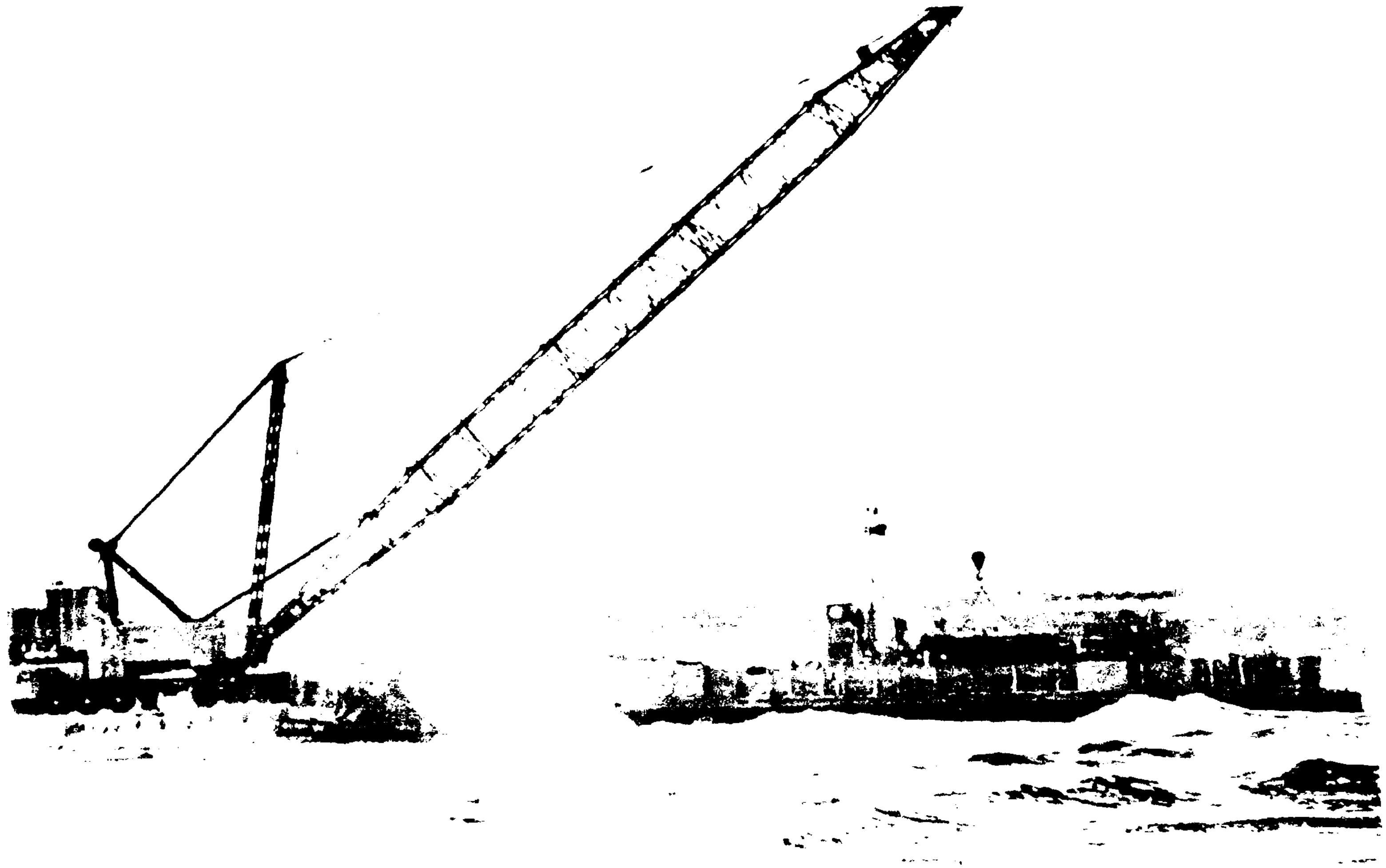


FIGURE [illegible].66. SOME CONTAINERS OFFLOADED. Some container unloading was possible before the heavy weather required cessation of operations.

FIGURE [illegible] approximately [illegible] containers [illegible] and the [illegible]

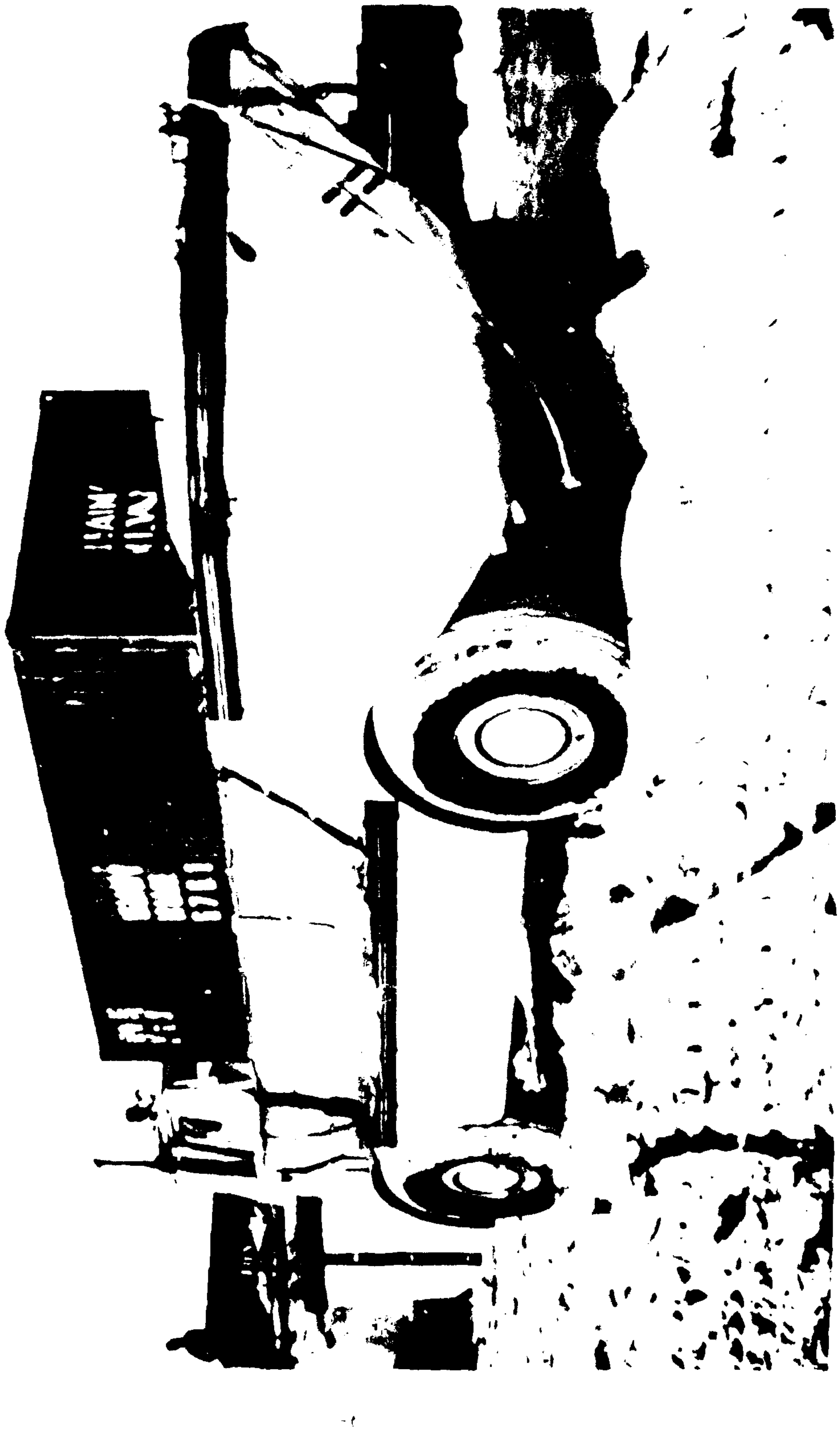


FIGURE [illegible]. MARSHALLING AREA [illegible] [illegible] At the marshalling [illegible] were used. A sideloader and a frontloader off-loaded trucks, while the [illegible] milvar chassis, was more often used to off-load amphibians.

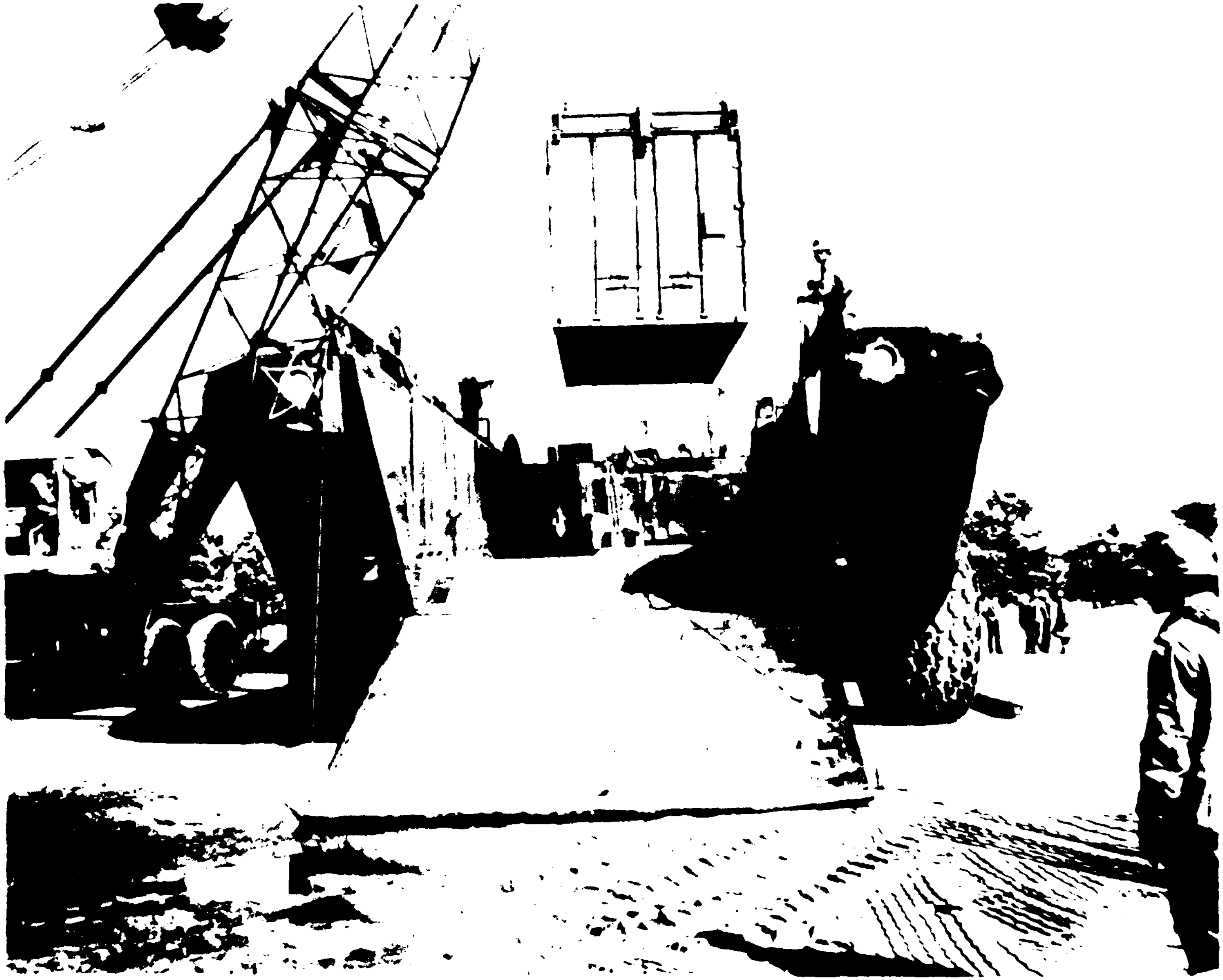


FIGURE D.79. LARC-LX UNLOADED. A LARC-LX is unloaded at the marshalling site by a 140-ton crane.

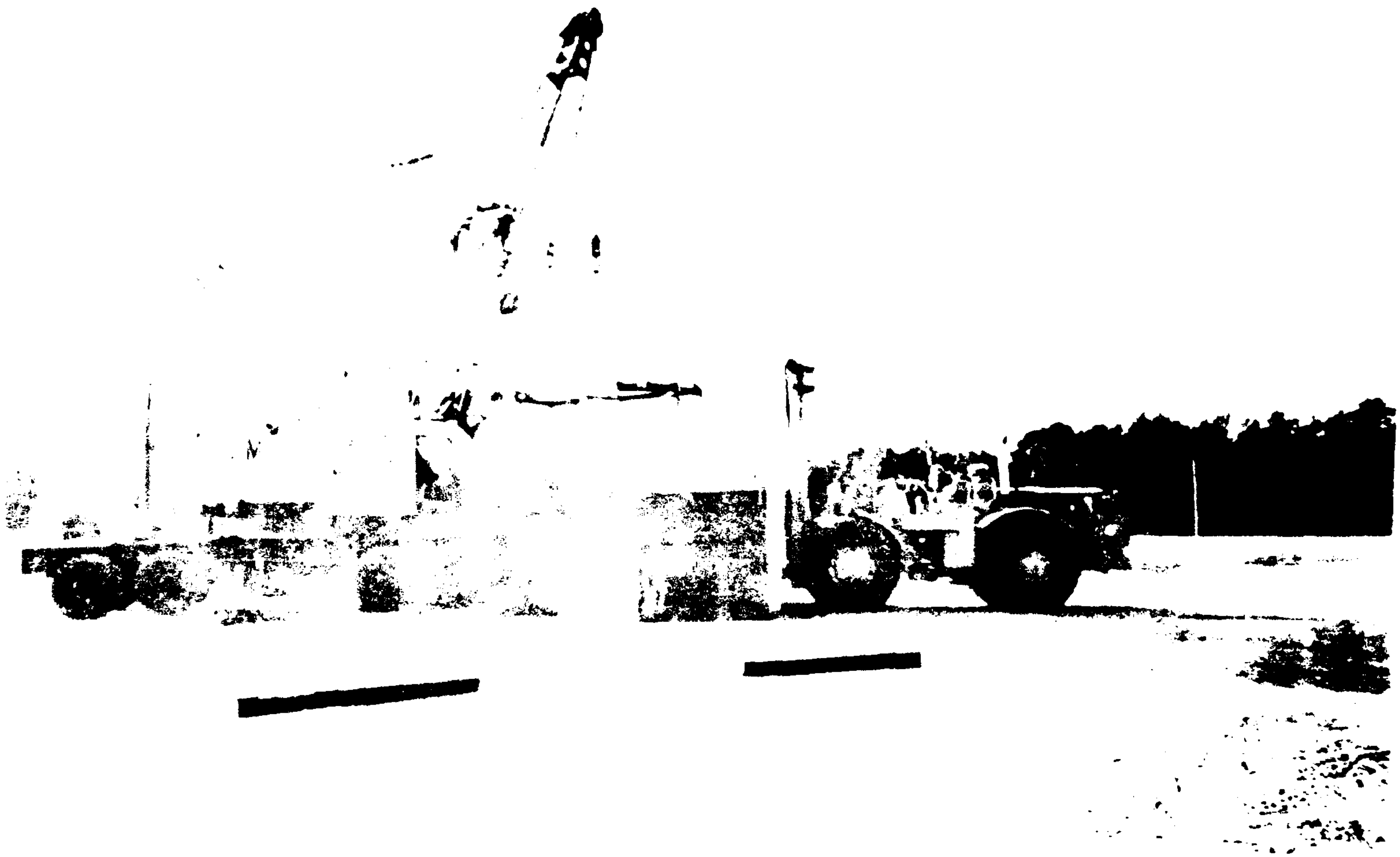


FIGURE D.71. FRONTLOADER CLEARS CONTAINER. Once a vehicle was unloaded a frontloader (above) or sideloader was used to clear the discharge point.

FIGURE D.72. SIDELOADER SAVES SPACE. A sideloader (above) is used in the marshalling area to stack a fully-loaded container. Two and three high stacking saves marshalling area stowage space. The sideloader operates only on hard surfaces.

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